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Abstract

The study of the rise of syntactic complexity, in particular of clause subordination and recursive language structures has more recently become the topic of intense discussion. The present paper builds on the reconstruction of grammatical evolution as proposed in Heine and Kuteva (2007) to present a scenario of how new forms of clause subordination may arise.

Taking examples from attested cases of grammatical development as well as using evidence that has become available on grammaticalization in African languages, it is argued that there are two major pathways leading to the emergence of clause subordination: either via the integration of coordinate clauses or via the expansion of existing clauses. The concern of this paper is exclusively with the latter pathway.

1 Introduction

As argued for in Heine and Kuteva (2007, chapter 5), there are crosslinguistically two main ways in which clause subordination arises: Either via the integration of two independent sentences within one sentence or via expansion, that is, the reinterpretation of a thing-like (nominal) participant as a propositional (clausal) participant.¹ This is a strong claim, namely that clause subordination is historically derived from non-subordinate sentences. The same claim has been made independently, and more competently, by Givón (2006; see also 2002, 2005): Analyzing a wide range of languages of worldwide distribution, he concludes that there are two main diachronic sources or channels leading to complex sentences (or clause union), namely via embedded verb phrase complements (type A) and clause chaining (type B). His type A relates to clause expansion, while type B corresponds to clause integration.² In a similar way as Heine and

² The reader is referred to this study by Givón (2006), which discusses a much wider range of processes than we are able to cover here and provides a coherent syntactic account of these processes.

¹ This terminology is taking from Diessel (2005), who uses them for two distinct kinds of strategies used in first language acquisition to develop complex sentences. Observing that in first language acquisition complex sentences appear later than simple sentence, he proposes the following generalization: "Thus, while complement and relative clauses evolve via *clause expansion*, adverbial and co-ordinate clauses develop through a process of *clause integration*" (Diesel 2005: 4).

Kuteva (2007), Givón (2007: 4) proposes the following two main pathways leading to clause union:

- (a) the nominalized V-COMP pathway
- (b) the clause-chaining pathway.

Historical information on grammatical change in the languages of the world is unfortunately scanty, and many of the reconstructions proposed are based on applying the methodology of grammaticalization theory to synchronic linguistic data, even if a number of the reconstructions are also supported by attested historical evidence (see Heine and Kuteva 2007, chapter 5).

The concern of this paper is exclusively with the process of clause expansion, which so far has received little attention in morphosyntactic reconstruction. For example, Hopper and Traugott (2003: 176) propose a cline of clause combining leading from parataxis to subordination; but their concern is only with clause integration; as we will see in this paper, this is not the only way in which clause subordination arises.

The purpose of this paper is to show how devices that first served to structure independent sentences come to assume functions of subordination. This, however, does not necessarily mean that there was no previous form of subordination; as Harris and Campbell (1995: 282ff.) rightly emphasize, the rise of a new form of subordination may simply mean that an existing form was either modified or replaced. In some language families, no subordinate structures can be reconstructed though; for example, no specific relative clause marking can be reconstructed for the Germanic languages. But this does not mean that in the relevant families there previously were no corresponding subordination structures.

The present paper is based on a small survey of "nominal" complement clause constructions in languages across the world. What I have to say about complement clauses presumably applies as well to relative and adverbial clauses, but more research is required on this issue (see Givón 2007 for a detailed treatment of relative clauses). The term "construction" has received a wide range of applications in the recent literature. I will use the term for linguistic phenomena (a) that combine a specific form with a specific meaning, (b) that combine more than one linguistic unit with one or more other units, and (c) whose meaning is non-compositional (i.e., is not identical to the sum of its parts).

There are three main methods for reconstructing earlier morphosyntactic situations, namely (a) studying historical records of contiguous developmental stages, (b) analyzing synchronic variation of co-existing related constructions, and (c) internal reconstruction (Givón 2007). Our concern here will be with (c), to some extent also with (b).

2 Patterns of clause expansion

Take the following example. In the Nigerian language Kanuri, the dative case enclitic $-r\dot{o}$ (DAT), clearly an exponent of noun phrase syntax, can be attached to finite clauses like (1a) to form complement clauses (1b).

(1) Kanuri (Saharan, Nilo-Saharan; Noonan 1985: 47; Heine 1990)

a Sávā- nyī íshìn. friend- my come(3.SG) 'My friend is coming.'

b Sávā- nyī íshìn- rò tèmǎŋénà.

friend- my come(3.SG)- DAT thought.1.SG.PERF 'I thought my friend would come.'

I will say that (1b) is an instance of clause expansion, that is, of a conceptual strategy whereby clausal (propositional) participants are treated like nominal participants, and that this strategy has the effect that – over time – nominal structures acquire the properties of subordinate clauses (Givón 2007; Heine and Kuteva 2007). Even when this process has reached a more advanced stage, there tend to be some nominal properties that survive as relics, such as the following (but see also below):

(2) Structural properties commonly found on subordinate clauses arising via expansion

- a The marker of subordination resembles a grammatical form associated with noun phrase structure, such as a marker of case, gender, definiteness, or an adposition.
- b The verb of the subordinate clause is non-finite, coded like an infinitival, gerundival, participial, or a nominalized constituent and takes the case marking of a corresponding nominal participant.
- c The arguments of the subordinate clause are coded in a form that tends to differ from that of the main clause.
- d The agent or notional subject takes a genitive/possessive or other case form, typically having the appearance of a genitival modifier of the subordinate verb.
- e The patient or notional object may also take a genitive/possessive or other case form.
- f There are severe restrictions on distinctions such as tense, aspect, modality, negation, etc. that can be expressed -- in fact, such distinctions tend to be absent altogether.

The properties in (2) are not definitional ones; rather they are taken to be diagnostic for identifying instances of expansion and, as we will see below, not all of the properties are necessarily present in a given case. To be sure, nominal encodings such as the ones listed in (2) are in no way restricted to specific languages; rather, they are found in some way in quite a number of languages. For example, English *He witnessed the enemy's destruction of the city* largely corresponds to (2), being a nominal version of the largely equivalent sentence *He witnessed that/how the enemy destroyed the city*.

With reference to the four parameters of grammaticalization proposed by Heine and Kuteva (2007, 1.2), clause expansion tends to have the following effects in particular: *Extension* means that an existing morphological device is extended from nominal to clausal structures, with the result that a new function, that of presenting subordinate clauses, emerges. This has the effect that the nominal function associated with this device is lost in the relevant contexts (*desemanticization*), and also that the ability associated with nominal structures to take determiners and modifiers is lost (*decategorialization*). Finally, erosion, which may but need not be involved, means that the marker of subordination tends to lose in phonetic substance, becoming shorter or phonetically simplified vis-à-vis the corresponding nominal marker.

Which kinds of constructions undergo expansion is determined, first, by the kind of subordination that is the target of expansion. For example, as an overview of the relevant literature suggests, clause expansion is more likely to be observed in the development of complement clauses than in relative or adverbial clauses. Second, it is also lexically determined, in that it tends to affect some verbs more than others, most of all speech-act, cognition, volitional, and phase verbs, which typically take both nominal and propositional complements, such verbs being e.g. 'see', 'hear', 'feel', 'want', 'finish', 'start', 'know', 'tell', 'remember', 'say', etc.

Frajzyngier (1996: 234) distinguishes in Chadic languages between 'like'-verbs and 'want'-verbs and concludes that the former tend to be associated with nominal complements while the latter imply a subsequent action or event and are more likely to take propositional complements. And, third, it is also determined by the structure of the language involved (see Givón 2007).

3 A five-stage scenario

In order to reconstruct how new forms of clause subordination may arise via clause expansion, I carried out a crosslinguistic survey. The goal of the survey was to reconstruct the mechanism that can be hypothesized to be at work in the development from nominal to clausal complement morphosyntax. The sample employed was dictated by the availability of data; while it contains languages from a range of genetically and areally unrelated languages, no claim is made on whether it is in any way representative of the world's languages at large. Complement clauses arising via expansion tend to be restricted to a limited spectrum of main clause (matrix) verbs (see section 2).

Nominal vs. verbal properties

As a basis of reconstruction, a distinction between noun phrase and clausal morphosyntax is made. The former is said to manifest itself in the presence of what will be called "nominal properties" such as the ones listed in (3).

- (3) Nominal properties
- Na non-finite marking (nominalizing, infinitival, gerundival, participial, etc. morphology)
- Nb possessive modifiers
- Nc case affixes or adpositions
- Nd noun phrase word order
- Ne raising
- Nf other means (markers of definiteness or indefiniteness, nominal number markings, etc.)

Clausal morphosyntax is described in terms of what I loosely refer to as "verbal properties", in particular the ones listed in (4).

(4) Verbal properties

- Va personal verbal affixes or pronouns
- Vb tense-aspect markers
- Vc agreement between verb and subject
- Vd clausal word order
- Ve clausal participant marking
- Vf other properties (verbal derivation, negation, etc.)

A few notes on some of these properties and the way they are treated in this paper seem in order. Non-finite forms (Na) on verbs typically consist of a "nominalizing" morpheme, and/or a case affix or adposition, but they do not normally take any other morphological elements. Nevertheless, there are languages where they also mark categories such as transitivity, tense, aspect, cf. the tense-aspect distinctions used with infinitives in English, Russian, Classical Greek, etc. (Noonan 1985: 58-9); for a particularly complex kind of nominalization marker, see Clendon (1988) on the Manjiljarra dialect of the Australian Western Desert language. Nevertheless, if there are grammatical categories on the non-finite verb that are typically

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associated with verbal morphosyntax then these are likely to show severe restrictions in number compared to the verbal morphosyntax of the main clause.

Property Nb means that the complement subject and/or object is coded typically, though not necessarily, as a possessive modifier of the complement verb. In one language, the West African Niger-Congo language Koromfe, we found a compounding construction instead of a possessive construction; thus, in the following example, the complement object appears as the first component of an endocentric compound ('knife giving'):

(5) Koromfe (Gur, Niger-Congo; Rennison 1996: 44)

gabrɛ a pãữ а kĩĩ a kεku joro kaŋənaa. ART knife give.NOMIN ART woman ART field in be.hard.PROG 'It's hard to give a woman a knife in a field.' (Lit.: 'Knife giving a woman in the field is hard')

While nominalization is a paradigm property of noun phrase morphosyntax, there are a number of languages that have no nominalizing morphology and in such cases I relied on other structural features to establish the presence of a noun clause structure, in particular word order (Nd). For example, that the Northern Khoisan language !Xun has a nominal structure in complement clauses after certain verbs, such as kale 'want', can be concluded in particular on account of the word order employed: This language has invariably verb-medial (SVO) order, cf. (6a), but in such complement clauses the order is OV, that is, the word order is that of attributive possession (6b). Thus, the sentence in (6b) can be translated literally as 'I want the woman's giving of water', where the complement recipient 'woman' is coded as a possessive modifier of the complement verb, acting like a head noun in a possessive construction, while the complement theme (or patient) is presented by means of the transitive preposition $k\bar{e}$ (TR) via clausal participant marking.

(6) !Xun (Northern Khoisan, W2 dialect; own field notes)

a mí má là^lā dàhmà kē g∥ú. 1.SG TOP give woman TR water 'I give the woman water.'

b mí má kàlè dầhmà $|a|a k\bar{e} g||u$. 1.SG TOP want woman give TR water 'I want to give the woman water.'

A scenario

On the basis of differences in the treatment of these properties, a five-stage scenario is proposed for the process leading to the rise of one specific type of subordinate clauses – a process that is described by Givón (2007: 12) as one where "the complement-clause event is treated analogically as a nominal object of the main clause."

0 The noun stage

I hypothesize that at the beginning of the process leading to the type of complement clause subordination looked at in this paper there is a nominal complement or adjunct as, e.g., in English *I want candies, I know that person.*

I The extended noun stage

As observed above, our concern is with verbs that may have either a nominal or a propositional complement, and stage I relates exclusively to the latter. This stage concerns predications of what Noonan (1985: 60) calls nominalized complements with the internal structure of noun phrases. This is crosslinguistically a fairly common construction; in Haspelmath's (2005: 502) sample of 'want' complement clauses of 283 languages, more than half (144) belong to this type. The main properties of this stage are:

(7) Properties of stage I

- a The complement or adjunct (C) is a non-finite verb (NFV), typically in a nominalized, an infinitival, or an participial form.
- b The subject is, to use Haspelmath's (2005: 502) phrasing, "left implicit" in object complement clauses; it is coreferential with the matrix subject.
- c The complement can be interpreted alternatively as a nominal or a subordinate clause.
- d Arguments of the NFV are encoded as oblique participants, typically as genitival modifiers, occasionally also as a peripheral participant of the NFV.
- e The complement subject or object of C may be coded as the object of the matrix clause ("raising").
- f The complement lacks most or all tense-aspect markings and other trappings characteristic of matrix clause verbs.
- g Linear ordering is that of nominal rather than of verbal constituents.

A paradigm instance of stage I is provided by the following example from English, where both the complement subject and object are presented as possessive modifiers: *Algernon's shooting of the aardvark drew international attention* (Noonan 1985: 60).

The following example from Estonian illustrates one of the two ways in which complement clauses having speech-act or mental-state verbs as main verbs are expressed in this language: The verb is non-finite, constructed in the present tense of the active participle, and the subject/agent appears in the genitive case (GEN):

(8) Estonian (Finno-Ugric; Harris & Campbell 1995: 99)

sai kuul- da seal ühe mehe ela- **vat**. got hear- INF there one.GEN man.GEN live- PRES.ACTIVE.PTCPL 'S/he came to hear that a man lives there.'

In a number of languages there is no special morphology on the complement verb, that is, there is no morphological distinction between finite and non-finite verb forms; nevertheless, there may be other means which provide clues that we are dealing with nominal clauses. Such clues may consist of markers of attributive possession (Nb). For example, in the Chadic language Angas, nominalization is not marked, but the fact that the object is coded as a possessive modifier of the verb shows that there is nominalization (Frajzyngier 1996: 243):

(9) Angas (Chadic, Afroasiatic; Frajzyngier 1996: 243)

Musa	rot	dyip	kð-	shwe.
Musa	want	harvest	POSS-	corn

'Musa wants to harvest corn.' (lit.: 'Musa wants harvesting of the corn.')

Alternatively, it can be word order characteristics (Nd) that suggest that we are dealing with a nominal structure, as in our !Xun example of (6).

In the West African language Hausa, the case-marking morphology appears on the complement verb rather than its nominal complement: It consists of the enclitic genitive linker (LINKER) -n, diachronically the masculine genitive marker (cf. (11a)), which connects the preceding complement verb, behaving like a head noun, with the following complement noun, being a possessive modifier. This possessive structure is used for both complement objects (11b) and complement subjectss (11c):

(1	0) Hausa	(Chadic, Afro	oasiatic; No	ewman 2000	: 310, 311)		
a	bāya-	n	gàrī	'the back of	the town (or	behind the	town)
	back-	M.LINKER	town				
b	sun dai	inà shâ-	n	giyā.			
	they qui 'They qu	it drinkin 11t drinking be	g- LINK eer.'	ER beer			
c	harbì-	n	wàzirì	yā	burge	ni.	
	shooting	- LINKER	vizier	3.SG.M	impress	me	
	'The vizi	ier's shooting	impressed	l me.'			

Raising is considered here a nominal property even if it has the status of an affix in the matrix clause, as in the following example:

(11) Bole (Chadic, Afroasiatic; Frajzyngier 1996: 263)
ita ndol- na te- yyi.
3.F want- 1.SG eat- NOMIN
'She wants me to eat.'

The following examples from Ancient Greek and Latin are also taken to be instances of stage I since the dative case (DAT) of the complement clause is governed by the matrix verbs *éksestin* 'it is possible' of Greek and *licet* 'it is permitted' of Latin, respectively:

(12)	а	Ancien	t Greek (Comrie 1997	: 43)	
		Nûn	soi	éksestin	andrí	genésthai.
		now	you.DA	AT it.is.poss	ible man.E	DAT to.become
		'Now is	s it possil	ble for you to	be a man?'	

b Latin (Comrie 1997: 43)
Mihi neglegenti esse non licet.
I.DAT negligent.DAT to.be not it.is.permitted 'It is not permitted for me to be negligent.'

Being an argument of the matrix clause, the NFV may have a case affix or adposition on it. But depending on the language, it may as well be marked for other categories. Thus, there may be tense-aspect distinctions used with the NFV (see above). I am ignoring here adverbial adjuncts, which generally appear to be coded as clausal participants.

Evidence for transfer from nominal to verbal structure. That there is in fact an extension from nominal to clausal morphosyntax may be illustrated with the following example from the Nilo-Saharan language Ik of Uganda. In the case system of this language there is one peculiarity: The main clause object appears in the accusative case (ACC) whenever the subject has third person reference, cf. (13a) but in the nominative (NOM) when the subject has first or second person reference (13b). The same case marking is found in object complement clauses, cf. (13c) and (13d).

(13) Ik (Kuliak, Nilo-Saharan; König 2002)

a	bed-	Ia	mes-	•
	want-	1.SG	beer-	NOM
	'I want	beer.'		

- b bɛd- a mes- ík^{a.} want- 3.SG beer- ACC 'He wants beer.'
- c bεd- ía ats¹- ésa ŋkáká- é. want- 1.SG eat- INF.NOM food- GEN 'I want to eat food (or meat).' (Lit.: 'I want the eating of food'.)

d	bed-	a	ats'-	és-	íka	ŋƙáƙá-	é.
	want-	3.SG	eat-	INF-	ACC	food/meat-	GEN
	'He war	nts to eat	meat. ²	,			

The structure of the Ik complement clause is a canonical instance of stage I: The (non-finite) complement verb 'to eat' in (13a) appears in a non-finite form and is case-marked, and the object of the complement clause is treated like a possessive modifier in the genitive case (GEN). Thus, complement clauses are structured on the model of nouns.

Stage II: Mixed morphosyntax

The nominal structure is gradually intruded by a clausal syntax. At this stage, the complement clause is still determined by nominal structures but there are now elements of a clausal morphosyntax that are also found in finite clauses, such as the ones listed in (14).

(14) Properties of stage II

- a One or more arguments are presented as clausal participants. This applies in particular to the complement object.
- b Parts of the complement syntax are determined by the word order of finite clauses.
- c The complement verb may have elements of finite verb morphology on it.

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(15) Swahili (Bantu, Niger-Congo)
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a Ali a- li- m- saidia Hadija.
Ali N1.S-PAST- N1.O- help Hadija.
'Ali (had) intended to help Hadija.'
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b Ali a- li- kusudia ku- **m- saidia Hadija**. Ali N1.S-PAST- intend INF- N1.O- help Hadija. 'Ali (had) intended to help Hadija.'

The structure of the complement clause presents a mixture of nominal and clausal structures. Thus, in the English subject complement clause construction illustrated below, the subject (*Cartier*) has a nominal structure while the object (*Dugué*) is coded like a main clause object.

(16) English

Cartier's defeating Dugué is significant. (Noonan 1985: 43)

In a similar fashion, in the following example from Uzbek, the complement subject is coded in the genitive like a possessive modifier while the object shows clausal syntax, taking the object case marking. Note that there is an inflected complement verb, but the suffix -i- is not one of main clause syntax but rather it "reinforces the associative relationship" (Noonan 1985: 61).

(17) Uzbek (Noonan 1985: 60)

Xotin bu odam- niŋ joja- ni oğirla- š- i- ni istadi. woman this man- GEN chicken-OBJ steal- NOMIN- 3.SG- OBJ wanted.3.SG 'The woman wanted the man to steal the chicken.'

In the following example from the Tungusic language Evenki, the complementizer is an accusative case marker (ACC), that is, the complement clause is introduced by a case suffix, in accordance with Nc in (3), the verb $\partial m \partial$ - 'come' of the complement clause is presented in the resultative participle (PART), cf. Na in (3), and the agent of the complement clause appears as a possessor suffix (-s 'your') on the participle form of the verb. But in addition to these nominal structures there are also clausal ones, such as the subject pronoun *si*:

(18) Evenki (Tungusic; Comrie 1981: 83)

ənii-	m	əə-	ćəə-	n	saa-	rə	si	tənəwə
mother-	my	NEG-	PAST-	3.SG	know-	$?^{3}$	you	yesterday
əmə-	nəə-	wəə	- s.					
come-	PAR	T- ACC	C- 2.SC	ί				

³ No glosses are provided by the author.

'My mother doesn't know that you arrived yesterday.'

Another typical mixed situation can be illustrated with the following example from the Krongo language of the Kordofan Hills of Sudan. There are both nominal and verbal properties on the verb of the object complement clause: The nominalization and the second person possessive markers are suggestive of the former, and the verbal derivation (BEN) and transitivity markers (TR) of the latter. Furthermore, the direct object (*pàamà*) and the beneficiary (*à 2àŋ*) also appear to be coded as clausal participants, cf. (19a). The same kind of mixed situation is found in the second type of object complement clause of Krongo, which involves subject-to-object raising (*à 2àŋ*), cf. (19b).

(19) Krongo (Kordofanian; Reh 1985: 333-7)

a	n-	átàasà	à?àŋ	t-	óshó-	ókò-	n-	tú	nàamà	à?àŋ.
	1/2-	want	Ι	NOMIN-	IMPFV.cook-	BEN-	TR-	2.SG	things	DAT.I
	ʻI wa	nt you to	cook for	me.' (Lit.:	'I want your co	oking fo	r me.')		

b nátàasà à?àŋ ù?ùn kúúmúnó à?àŋ. t-1/2- want LOC-NOMIN-IMPFV.help me Ι you 'I want you to help me.'

(19b) illustrates a common stage II situation where the complement verb shows nominal properties whereas its participants are all characterized by verbal (clausal) codings. Similarly, the following complement clause type of the Ethiopian language Maale marks the complement verb in the infinitive (plus appropriate case suffix) while all of its participants (except the complement subject) are presented like main clause participants:

(20) Maale (Omotic, Afroasiatic; Amha 2001: 177) 2ála ?úſkitsí nayík'ára tuwám se. beer.ABS drink-INF.NOM child.ABS-DAT good be-**IPFV.NEG-**NEG 'Drinking beer is not good for a child.'

Stage III: Clausal syntax with nominal relics

The complement is now a full-fledged subordinate clause. Still, there are relics of nominal morphosyntax that bear witness to its nominal origin.

The clearest case is provided by languages where the morphosyntax of the subordinate clause is largely or entirely identical to that of main clauses and the only relic is a case marker or other element of nominal morphology. Thus, we saw in section 2 that in Kanuri, the dative case enclitic -ro is found on complement clauses, which otherwise have the structure of finite main clauses, and it appears to be the only relic of the erstwhile nominal structure, otherwise complement and adverbial clauses behave like other finite clauses (Noonan 1985: 47; Heine 1990). And in Imbabura Quechua it is the accusative case marker (ACC) in particular that bears witness to the nominal origin of the complement clause, which is finite:

(21) Imbabura Quechua (Cole 1982: 43)

Pedro [ñuka Agatu- pi kawsani] yan -ta. Pedro 3 I 1--ACC think-Agato- in live-'Pedro thinks that I live in Agato.'

In the Caucasian language Laz of Turkey it is possible to have a dative marker cliticized to a finite verb form, thereby turning a main clause, as in (23a), into a subordinate one (22b):

(22) Laz (South Caucasian; Nino Amiridze; Funknet, April 2005)
a ali oxori- sha mo- xt- u. Ali house- in PREVERB- come- S3.SG.AOR 'Ali came home.'

b ali oxori- sha mo- xt- u- **shi** [...]. Ali house- in PREVERB- come- S.3.SG.AOR- DAT 'When Ali came home [...].'

Similarly, in the Ethiopian language Maale, a nominalized complement clause (24b) can be distinguished from a main clause (23a) only by the fact that it takes the nominalization marker – tsi instead of a declarative marker (DCL):

(23) Maale (Omotic, Afroasiatic; Amha 2001: 177)
a nu ?á∫ínna- á jink- ó ?áád- á- ne.
1.PL.GEN neighbors- NOM Jinka- ABS go- IPFV- DCL
'Our neighbours are going to Jinka.'

b nu ?áſínna- á jink- ó ?áád- á- **tsí** goné- ke. 1.PL.GEN neighbors- NOM Jinka- ABS go- IPFV- NOMIN true- be.DCL 'It is true that our neighbors are going to Jinka.'

In the Squamish language of British Columbia, all nominals are accompanied by an article (ART), and so are nominalized complements, as the description by Noonan (1985: 61) suggests. Complement clauses such as the following have all of the verbal inflections, clitics, and sentence particles to be found in main clauses; still, the presence of an article in the complement clause bears witness to the nominal origin of the structure.

(24) Squamish (Noonan 1985: 61) k^wi č-٩čn iws wa n-Sna DECL- 1.SG ART 1.SG.POSS- NOMtiredbody fact PROG c'aq'anumi. hit-TRANS-2.SG.OBJ 'I'm tired of hitting you.'

Stage IV: The full-fledged complement clause

Finally, there are complement clauses that are indistinguishable in their morphosyntax from finite main clauses, as in the following example, where the object complement clause (25a) is

structurally identical with the main clause (25b) except for the topic marker $m\dot{a}$ (TOP), which is mandatory in declarative main clauses:

- (25) !Xun (North Khoisan, Khoisan; own field notes)
 a mí m- é bhàlì mí dàbà ||'àn.
 1.SG TOP- PAST dream 1.SG child be.sick
 'I was dreaming that my child is sick.'
- b mí dàbà má ∥'àn. 1.SG child TOP be.sick 'My child is sick.'

The stage IV situation may be due to two different processes: (a) Either there was an evolution such as the one sketched above, with the result that all nominal properties have disappeared, or (b) there never was a nominal construction; rather, the structure of the main clause is copied into the subordinate clause. While (a) is suggestive of clause expansion, (b) is an instance of clause integration, where two distinct clauses are combined into one complex sentence (cf. Givón's clause-chaining pathway; see section 1). Which of the two, (a) or (b), is involved is hard to determine in many cases.

4 Some generalizations

The extent to which nominal and verbal properties contribute to structuring complement clauses is shown in table 1 on the basis of the fairly small sample that is used in this study (see Appendix 1, 2). As the figures in table 1 suggest, it is the complement predicate that stands out as showing the highest amount of nominal properties (78.9 %), followed by the subject (69.9 %) and the object (21.4 %). An extreme situation is found with "other participants", which almost invariably are adjuncts: They are associated exclusively with verbal properties.

Table 1. Relative contribution of nominal vs. verbal properties in structuring complement clauses showing nominal properties (in percentages. N = nominal properties, V = verbal properties; O.Com = object complement clause, S.Com = subject complement clause).

Type of	Predi	cate	Subjec	rt s	Object	ţ	Other	participants
clause	Ν	V	Ν	V	N	V	Ν	V
O.Com (18)	81.0	19.0	58.3	41.7	30.0	70.0	0	100
S.Com (13)	76.5	23.5	81.1	18.9	0	100.0	0	100
Total (31)	78.9	21.1	69.9	30.1	21.4	78.6	0	100

Assuming that these figures are suggestive of a diachronic process from nominal to clausal morphosyntax, one may hypothesize that the process starts out with peripheral participants (adjuncts), subsequently affecting complement objects, subjects, and finally the complement predicate, as sketched in the following scale:

(26) adjunct > object > subject > predicate

Note that this scale is probabilistic in nature: It predicts what is likely to happen rather than what must happen. What the scale captures is the following: Adjuncts (peripheral participants) of complement clauses are the first to be coded by means of verbal morphosyntax; in fact, they are

likely to appear already at stage I as clausal participants indistinguishable from main clause adjuncts.

The next to acquire the properties of clausal syntax are (direct) objects. This observation also surfaces in Noonan's (1985: 61) analysis: He observes that cases such as Irish, where only the notional object shows a possessive syntax (an "associative relation"), that is, a nominal property, are rare. Compared to other complement participants, complement subjects appear to be the most resistant to change; but clearly the most conservative of all is the predicate structure, which tends to retain nominal (or nominalising) properties when other constituents of the clause have lost them.

The scale in (26) can be read on the one hand as a synchronic implicational structure of the kind "If any of the categories of the scale is characterized by a nominal property then all categories to its right are also likely to be". On the other hand, I hypothesize that the scale can also be interpreted as a diachronic scenario, describing the growth of complement clauses out of nominal complements via clause expansion or, in more general terms, a grammaticalization process leading from nominal to clausal morphosyntax.

5 Evidence for the development from nominal to propositional structures

That there is a fairly common grammaticalization process leading from nominal to clausal morphosyntax can be shown by looking at other kinds of grammaticalization; the development proposed in the preceding sections is but one manifestation of this strategy. In fact, there is some evidence to suggest that conceptualizing and describing propositional contents, typically expressed by clauses, in terms of concrete objects, coded linguistically as nouns, is a salient human strategy.

First, nominalization of subordinate clauses is not restricted to complement clauses; it also concerns relative and adverbial clauses, as aptly demonstrated by Givón (1994; 2007), who observes for example:

In many language families--Turkic, Carribean, Bodic (Tibeto-Burman), No. Uto-Aztecan, Sumerian, to cite only a few--all subordinate clauses are nominalized, at least historically. Such structures may re-acquire finite properties over time (Givón 1994; Watters 1998), but the morphology retains, for a long time, the telltale marks--clear fossil evidence-of the earlier nominalized status. (Givón 2007)

Second, there are some well documented grammaticalization processes whose main effect is that noun phrase morphology is extended to introduce clauses. Thus, demonstrative attributes on nouns commonly grammaticalize to relative clause markers, and nominal case markers turn into markers of clause subordination. Third, in the rise of new tense and aspect morphologies it may happen that participant roles reserved for nominal constituents are extended to take clausal/propositional constituents; thus, structures such as (27a) commonly develop diachronically into structures like (27b) (Heine and Kuteva 2007, section 2.2.6; see Heine and Kuteva 2002 for more examples):

(27) English

- a He used all the money.
- b He used to visit her once a month.

Fourth, there is also a well documented lexical process whereby negative existential verbs

taking a nominal participant ('there is no X') may be extended to take clausal participants ('there is no doing of X'), thereby giving rise to clausal negation markers. For example, in Mandarin, the negative existential *méi* [$y \delta u$] takes nominal complements, as in (28a), but its use appears to have been extended to verbal complements, as in (28b), with the result that there now is a new negation marker of completed actions (for more examples and details of this process, see Croft 1991):

(28) Mandarin (Croft 1991: 11; cited from Li & Thompson 1981)

a **méi [yŏu]** rén zài wìmian. NEG.EXIST person at outside 'There's no one outside.'

b tā méi [yǒu] sǐ.
3.SG NEG.EXIST die 'S/he hasn't died', or 'She didn't die.'

Finally, that there is a unidirectional development whereby the use of nominal structures is extended to verbal structures can also be demonstrated with the following example. A typological survey of question pronouns suggests that there is a widespread process whereby interrogative pronouns referring to inanimate objects ('what?') are extended to also refer to actions and events (Heine, Claudi & Hünnemeyer 1991: 56ff.). Evidence for this directionality comes in particular from languages where the interrogative pronoun is etymologically transparent: In such languages the pronoun is not infrequently derived from a phrase 'which thing?' For example, in the Ewe language of Togo and Ghana, the pronoun $n\hat{u}$ -ka 'what?' means historically 'thing-which?', but is used in the same way for nominal as for verbal referents, as in (29), and the interrogative pronoun $n\bar{n}tc\hat{i}$ 'what?' of the !Xun language of southwestern Africa, which is historically composed of the interrogative element $*m^4$ and the noun $tc\hat{i}$ 'thing', is not restricted to nominal referents but is used in much the same way also to refer to actions and events, cf. (30).

(29) Standard Ewe (Kwa; Niger-Congo; own data)

nú- kawo-míne-le?thing-whichoPROG2.SG-PROG'What are you doing?'

(30) !Xun (W2 dialect, North Khoisan; own field notes)
mtcí á hà- è ồ?
Q.thing Q N1 REL do
'What does he do?'

Further data are found in pidgins and creoles, where not uncommonly the question word referring to actions ('what?') is transparently derived from the phrase 'which thing?', as in the following example from the Spanish-based creole Papiamentu:

⁴ * $m\bar{n}$ is no longer a productive morpheme in !Xun.

(31) Papiamentu (Holm 1988: 180)

Ta **kiko** Wan ta hasi? is what.thing John TAM do) 'What is John doing?'

6 Conclusions

The hypothesis proposed in the present paper is far from new. That new forms of complex sentences arise via clause integration has been shown by a number of authors (see especially Hopper and Traugott 2003; Givón 2005; 2006; 2007; Heine and Kuteva 2007). The objective of this paper was a narrow one. First, we were restricted to complement clauses and, second, our concern was exclusively with clause expansion. But even the rise of complex sentences via the expansion of simple sentences has already been dealt with in earlier works (see especially Givón 1994; 2002; 2005; 2006; 2007; Heine and Kuteva 2007). The question that we were concerned with here was with the nature of the process leading from nominal to clausal structures.

As I argued in section 3, there are a number of stages of development leading from fully nominal complements at stage 0 to fully clausal constructions at stage IV, with each new stage characterized by a decrease in the amount nominal properties and an increase in verbal and clausal properties. In section 4 we saw that that this gradual process appears to have an internal structure of the following kind: It affects first adjuncts, which are coded as clausal participants from stage I on, followed by clausal objects, which again tend to be followed by subjects, and it is the verbal morphosyntax that turns out to be the most conservative component of the complement construction, surviving as a rule until stage III. At the final stage IV there are no more traces of nominal morphosyntax – the complement clause is now largely or entirely identical with the main clause.

One may speculate that the similarity shared by the implicational scale presented in (26) and other scales that have been devised ever since Keenan and Comrie (1977) proposed their accessibility hierarchy⁵ is not coincidental; but this is an issue that would require a separate analysis.

What the present survey shows is that neither the scenario of section 3 nor the scale in (26) correlates significantly with languages as a whole but rather with specific constructions of a given language. Quite commonly there are two or more complement clause constructions within one and the same language, where each of the constructions represents a different stage of development or, even more commonly, where one construction is suggestive of clause integration and the other of clause expansion, as in the following Finnish example: Whereas (32a) can be assumed to be an instance of integration, (32b) appears to represent clause expansion of stage II, where there are both nominal properties (cf. the coding of the complement subject as a genitival modifier) and clausal properties (the locative argument *Helsingissä* is coded like a main clause participant).

(32) Finnish (Comrie 1997: 45)

a	Tiedän, I.know	että that	sinä you.NOM	olet are	Helsingissä. in.Helsinki	or
b	Tiedän I.know	sinun you.GEl	olevan N being	Helsingiss in.Helsinki	ä. i	

⁵ Cf., e.g., Langacker's (1997: 262) reference-point chain subject > object > other.

'I know that you are in Helsinki.'

The hypotheses presented were based on findings made in studies on grammaticalization. For example, case affixes and adpositions have been shown to commonly develop into markers of clause subordination while a development in the opposite direction is unlikely to happen; hence the conclusion drawn in this paper is that if there is a morphological element in a given language that serves both as a case marker or adposition and as an element introducing complement clauses then the former is the older function.

Grammaticalization thus rests on generalizations on grammatical change, that is, it is diachronic in nature and, accordingly, relies on and can be falsified by means of historical evidence. But so far not much historical evidence has become available on the reconstructions proposed in this paper; accordingly, the conclusions reached here have to be taken with care until such evidence is found.

Abbreviations

ABS absolutive = ART = article; ASSOC = associative; C = complement; CAUS = causative; COMP = complementizer; COP = copula; DAT = dative; DCL, DECL = declarative; GEN = genitive; INF = infinitive; IPFV, IMPFV = imperfective; LOC = locative; N = nominal property; NEG = negative; NFV = non-finite verb; NOM = nominative; NOMIN = nominalizer; OBJ = object; PERF = perfect; PL = plural; POSS = possessive; PROG = progressive; SG = singular; TOP = topic marker; TR = transitivity marker; V = verbal property; VN = verbal noun; 1, 2, 3 = first, second, third person

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Appendix 1. Data on nominal properties in subordinate clauses
Musa rot dvin kà- shwe
Musa want harvest POSS- corn
'Musa wants to harvest corn.' (lit.: 'Musa wants harvesting of the corn.')
Bole (Chadic, Afroasiatic; Frajzyngier 1996: 263) ita ndol- na te- yyi. 3.F want- 1.SG eat- NOMIN 'She wants me to eat.'
 English a Burt's being a chicken farmer worries Max. (Noonan 1985: 49) Cartier's defeating Dugué is significant. (Noonan 1985: 43) b For Cartier to defeat Dugué would be significant. (Noonan 1985: 43) c I want her to come.
Estonian (Finno-Ugric; Harris & Campbell 1995: 99) sai kuul- da seal ühe mehe ela- vat . got hear- INF there one.GEN man.GEN live- PRES.ACTIVE.PTCPL 'S/he came to hear that a man lives there.'
Evenki (Tungusic; Comrie 1981: 83) ənii- m əə- ćəə- n saa- rə si tənəwə mother- my NEG- PAST- 3.SG know- ? ⁶ you yesterday
əmə- nəə- wəə - s. come- PART- ACC- 2.SG 'My mother doesn't know that you arrived yesterday.'
Finnish (Comrie 1997: 45) Tiedän sinun olevan Helsingissä. I.know you.GEN being in.Helsinki 'I know that you are in Helsinki.'
Ancient Greek (Comrie 1997: 43) Nûn soi éksestin andrí genésthai. now you.DAT it.is.possible man.DAT to.become 'Now is it possible for you to be a man?'
Hausa (Chadic, Afroasiatic; Newman 2000: 311-2) a sun dainà shâ- n giyã. they quit drinking- LINKER beer

⁶ No gloss is provided by the author.

'They quit drinking beer.'

b harbìn wàzirì yā burge ni. shooting- LINKER vizier 3.SG.M impress me 'The vizier's shooting impressed me.' Ik (Nilo-Saharan; König 2002) bedía ats'- ésa nkáká- é. foodwant-1.SG eat- INF.NOM **GEN** 'I want to eat food (or meat).' (Lit.: 'I want the eating of food'.) Irish (Noonan 1985: 61) Is ionadh liom Seán bhualadh Thomáis. а COMP hit.NOMIN COP surprise with.me John Thomas.GEN 'I'm surprised that John hit Thomas.' Kanuri (Saharan, Nilo-Saharan; Noonan 1985: 47) Sávānyī íshìntèmǎnénà. rò friend- my come(3.SG)- DAT thought.1.SG.PERF 'I thought my friend would come.' Khwe (Central Khoisan, Khoisan) xàcí tcàátè 'à | x'ân qāámà- àtí tè. be.sick- JUNC- PRES she ACC Ι very regret- JUNC- PRES 'I am a lot sorry that she is sick.' Koromfe (Gur, Niger-Congo; Rennison 1996: 44) kĩĩ kεku a gabre pãữ a a joro kaŋənaa. ART give.NOMIN ART woman ART field be.hard.PROG knife in 'It's hard to give a woman a knife in a field.' (Lit.: 'Knife giving a woman in the field is hard') Krongo (Kordofanian; Reh 1985: 333-337) ókòa nátàasà à?àŋ tóshóntú pàamà à?àŋ. 1/2- want Ι NOMIN- IMPFV.cook- BEN-TR- 2.SG things DAT.I 'I want you to cook for me.' (Lit.: 'I want your cooking for me.') b nátàasà à?àŋ ù?ùŋ kútúmúnó à?àŋ. 1/2- want Ι you LOC-NOMIN-IMPFV.help me 'I want you to help me.' Latin (Comrie 1997: 43) Mihi neglegenti esse non licet. I.DAT negligent.DAT to.be not it.is.permitted 'It is not permitted for me to be negligent.'

Maale (Omotic, Afroasiatic; Amha 2001: 173, 177) a ?ála ?úſkk'ára itsí nayíuwáse. m tbeer.ABS drink-**INF.NOM** child.ABS-DAT good be-**IPFV.NEG-**NEG 'Drinking beer is not good for a child.' b ?ízóis'- á ko timirto máári ?áád-3.F.SG.ABS- GEN school house.ABS INF- NOM goko?isáyake. CAUS- IPFV-NOMINwantbe.DCL 'Her going to school is necessary.' ?á∫ínnaá ?áádgonéc nu jinkó átsí ke. 1.PL.GEN neighbor- NOM Jinka-IPFV-ABS go-NOMIN truebe.DCL 'It is true that our neighbours are going to Jinka.' Imbabura Quechua (Cole 1982: 43) Pedro yan [ñuka Agatu- pi kawsa- ni] -ta. Pedro think-3 I Agato- in live-1--ACC 'Pedro thinks that I live in Agato.' Laz (South Caucasian; Nino Amiridze; Funknet, April 2005) a ali oxorisha moxtu. Ali house- in PREVERB-S3.SG.AOR come-'Ali came home.' b ali oxorisha moxtshi. u-S.3.SG.AOR- DAT PREVERB-Ali house- in come-'When Ali came home (...).' Mandarin (Li & Thompson 1981: 575-81) a zhòng shuiguŏ de hěn nán guòhuó. grow NOMIN fruit very difficult make.living 'It is difficult for fruit growers to make a living.' wŏ xĭhuān b mĭ méi yǒu de. exist Ι you not like NOMIN 'You don't have what I like.' Manjiljarra (Clendon 1988: 195) Mama- partarnunga nyangu mitu ngarrinjan. father- KIN-TOP lie-NOMIN-CONT saw dead 'He saw his father dead.'

Persian (Noonan 1985: 85) Mæn adæd-Babækfærman dadæm. æne ra Ι NOMIN-ASSOC Babakcome-OBJ order gave.2.SG 'I ordered Babak to come.' Imbabura Quechua (Cole 1982: 43) Pedro yan [ñuka Agatu- pi kawsa- ni] -ta. Agato- in Pedro think-3 I live-1--ACC 'Pedro thinks that I live in Agato.' Squamish (Noonan 1985: 61) k^wi ₹ččn iws n-Sna wa DECL- 1.SG ART 1.SG.POSStiredbody NOMfact PROG c'aq'anumi. TRANShit-2.SG.OBJ 'I'm tired of hitting you.' Swahili Ali likusudia saidia Hadija. aku- m-Ali N1.S-PAST- intend INF- N1.O-Hadija. help 'Ali (had) intended to help Hadija.' Turkish (Kerslake 2007: 236-7) a [Bura- ya kadar gelme- miz] zor ol-uyor. here-DAT as.far.as come-VN- 1.PL.POSS difficult be-IMPF 'It's difficult for us to come all this way.' b Ali [bu arabakullan- ma-] ya başladı. уI ACC Ali this car-VN- DAT beginuse-PF 'Ali has begun to use this car.' Uzbek (Noonan 1985: 60) odam- niŋ Xotin oğirla- šbu jojani ini istadi. woman this man-**GEN** chicken-OBJ steal-NOMIN- 3.SG- OBJ wanted.3.SG 'The woman wanted the man to steal the chicken.' !Xun (Northern Khoisan, W2 dialect; field notes) mí má kàlè dàhmà là'ā kē g∥ú. 1.SG TOP want woman give TR water 'I want to give the woman water.'

Appendix 2. Nominal vs. verbal properties of complement clauses. (The symbols "Na", "Vd", etc. refer to the categories distinguished in (1) and (2). Verbal properties are printed in bold).

Construction	Type of	Predicate	Subjec	Objec	Other
	clause		t	t	participant
					S
Angas	O.Com	Na	-	Nb	
Bole	O.Com	Na	Va, Ve		
English a	S.Com	Na	Nb	Ve	Ve
English b	S.Com	Na	Nc	Ve	Ve
English c	O.Com	Na	Ne	Ve	Ve
Estonian	S.Com	Na	Nb		
Evenki	O.Com	Na	Nb, Va		
Finnish	O.Com	Na	Nc		Ve
Ancient Greek	S.Com	Na	Nc		
Hausa a	O.Com	Na	-	Nb	
Hausa b	S.Com	Na	Nb		
Ik	O.Com	Na	Nb		
Irish	S.Com	Na	Nb		
Khwe	S.Com	Nc, Va, Vb, Vd	Ve	Ve	
Kanuri	O.Com	Nc, Va, Vb	Ve	Ve	
Krongo a	O.Com	Na, Vb, Vf	Nb	Ve	Ve
Krongo b	O.Com	Na, Vb, Vf	Ne	Ve	
Latin	S.Com	Na	Nc		
Laz	O.Com	Nc	Ve		Ve
Maale a	S.Com	Na, Vb		Ve	Ve
Maale b	S.Com	Na, Nc	Nc		Ve
Maale c	S.Com	Na, Vb	Ve		Ve
Mandarin a	S.Com	Na, Vd			
Mandarin b	O.Com	Na, Va, Vd			
Persian	O.Com	Na, Nb			
I. Quechua	O.Com	Nc	Ve		Ve
Swahili	O.Com	Na	-	Va	Ve
Turkish a	S.Com	Na	Nc		Ve
Turkish b	O.Com	Na	-	Ve	
Uzbek	O.Com	Na	Nb	Ve	
!Xun	O.Com	-	-	Nd	Ve

Re(e)volving Complexity: Adding Intonation

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A fruitful methodology for tracing the development of grammatical complexity has been the close examination of centuries of written texts. Unfortunately, such records exist for only a small proportion of languages. Fortunately, an additional methodology is available: the comparison of synchronic structures at various stages of development, either in related languages or within a single language. Such comparisons can do more than compensate for gaps in the philological record. Written documents necessarily remain silent about a crucial feature of the evolving constructions: their prosody. Modern documentation allows us to examine prosodic patterns in spontaneous connected speech, the speech that serves as the basis for language change.

The focus here will be on early stages in the development of complexity. The first section will explore the initial phase. It has on occasion been proposed that some languages have not yet developed syntactic complexity at all. It will be shown that in at least one such case, prosodic patterns reveal complex structures even when segmental markers are absent. The second and third sections will examine some young complex constructions, first complementation then relativization. It will be seen that prosodic patterns can suggest possible pathways of development that might otherwise not come to mind.

1. Pre-complexity?

Over the past several years there has been an ongoing discussion about whether recursion is an essential feature of language (Hauser, Chomsky, and Fitch 2002, Everett 2005, 2007, Parker 2006, Mithun 2007, Nevsky, Pesetsky and Rodrigues 2007, and others). The kind of recursion under discussion is hierarchical syntactic structure, in which clauses are embedded in other clauses. The central constructions of this type are complement constructions, in which one clause is embedded inside of another as an argument, and relative constructions, in which one clause is embedded inside of a noun phrase in another as a modifier.

1.1. Complementation

Examples of complementation in English abound. Examples (1)a and (1)b both have clausal arguments. The first contains a clausal subject (*you two converse*) and the second a clausal object (*he cried*).

- (1) English complementation
- a. It will be possible for you to converse.
- b. And then he started to cry.

Complement clauses typically have special forms that distinguish them from independent sentences, such as a complementizer like English *that* or *for* (*It will be possible <u>for</u> you to converse*), omission of a coreferential subject (*He started* <u>to cry</u>), or a special non-finite verb form (*to converse, to cry*).

Such special structures are not as easy to find in some other languages. One such language is Mohawk, an Iroquoian language indigenous to northeastern North America. All of the Mohawk clauses in the examples below can stand alone as complete, grammatical sentences. The examples are all from spontaneous, speech, generally conversation, unless otherwise specified. The free English translations were provided by the speakers themselves or by others involved in the conversations.

(2) Mohawk complementation?

Enwá:ton'	ensenikaratónnion'.
en-w-aton-'	en-seni-kar-aton-nion-'
FUTURE-NEUTER.AGENT-be.possible-PRF	FUTURE-2.DU.AGENT-story-tell-DISTRIBUTIVE-PRF
it will be possible	you two will converse

b. Sentential object: Cecelia Peters, speaker p.c.

Sok	nè:'e	tahatáhsawen'	wa'thahséntho'.			
sok	nè:'e	ta-ha-at-ahsawen-'	wa'-t-ha-ahsentho-'			
so	it.is	CISLOCATIVE.FACTUAL-M.SG.AGENT-MIDDLE-begin-PRF	FACTUAL-DV-M.SG.AGENT-cry-PRF			
so	it is	he started (it)	he cried			
'And then he started to cry.'						

Mohawk is polysynthetic: words, particularly verbs, can contain a potentially large number of meaningful parts. All Mohawk verbs contain pronominal prefixes referring to their core arguments. Intransitive pronominals refer to one argument, such as w- 'it' in 'it will be impossible' and seni- 'you two' in 'you two will converse'. Transitive pronominals refer to two arguments, such as -honwa- 'they/him' in wahonwahón:karon' 'they invited him'. The transitive pronouns are fused forms: it is not usually possible to untangle the agent and patient markers in a transitive prefix. Transitive pronominals with a neuter patient have the same form as intransitives. The prefix -ha- means both 'he' and 'he/it': wa-ha-hní:non' 'he bought it', wa't-ha-hséntho' 'he cried', For this reason, verbs like tahatáhsawen' in (2)b above could be translated either 'he started it' or 'he started'.

The only obvious relation between the two clauses in each sentence above is semantic. In each, a core argument of the first clause is coreferential with the entire second clause. In (2)a, the 'it' of 'It will be possible' is coreferential with 'you two will converse'. In (2)b 'He started to cry', the 'it' of 'He started it' is coreferential with 'he cried'. Noonan (2007) provides a list of semantic types of predicates that appear in the matrix clauses of complement constructions cross-linguistically.

(3) Semantic types of matrix predicates: Noonan 2007

Utterance predicates	say, tell, report, promise, ask
Propositional attitude	believe, think, suppose, assume, doubt, deny
Pretence	imagine, pretend, make believe, fool, trick into
Commentative/factive	regret, be sorry, sad, odd, significant, important
Knowledge and its acquisition	know, discover, realize, forget, see, hear
Fear	fear, worry, be afraid, be anxious
Desideratives	want, wish, desire, hope
Manipulatives	force, make, persuade, tell, threaten, let, permit, command, order, request, ask, cause, allow
Modals	be able, be obliged, can, ought, should, may
Achievements	<i>manage, chance, dare, remember to, happen to, get, try, forget to, fail, avoid</i>
Phasals	start, begin, continue, keep on, finish, stop, cease
Immediate perception	see, hear, watch, feel

Verbs with all of these meanings appear in Mohawk constructions like those in (2) above, sequences of fully finite clauses. Additional examples of constructions of these types are in Mithun in press (a) and in press (b). The fact that the counterparts of English complement clauses show no special dependent forms is not altogether surprising, given the overall structure of the language. As noted, all clauses contain obligatory reference to their core arguments, in the pronominal prefixes on verbs, so subordinate clauses could not be distinguished by ellipsis of coreferential arguments. All verbs are finite, capable of standing alone, so subordinate clauses could not be distinguished by dependent inflectional forms.

1.2. Relativization

Examples of relative clauses are also not difficult to find in English. These are clausal modifiers of an argument of a higher matrix clause. In (3), *the children* is modified by the clause (*they*) *came here*.

(3) English relativization

Maybe the bus brought the children [that came here].

This English relative clause has a distinctive form. It is introduced by the relative pronoun *that* and is missing a regular pronominal or lexical subject. The sentence in (3) was actually the free translation of the Mohawk sentence in (4), which was part of a conversation. The Mohawk shows none of the structural characteristics of the English: no relative pronoun and no omission of the coreferential argument.

(4) Mohawk relativization? Charlotte Bush and Josephine Horne, speakers p.c.

Tóka'	ki'	nè:' ne	ki:	iakoia'ta	akarénie's	
toka'	ki'	nè:'ne	ki:	iako-ia't-	a-kareni-e's	
maybe	just	it is	this	INDEFINIT	TE.PATIENT-body-JR-transport-DISTRIBUTIVE	
maybe	just	it is	this	it bodily	transports one here and there	
'Maybe	the bus					
thotija's	tónha'			wáhi'		
t-hoti-ia'	t-enha'			wahi'		
CISLOCA'	t Unna TIVE-M P	L PATIENT-bod	v-carry	TAG		
it bodily	z carried	them here	y curry	didn't it		
brought	thom (lidn't it		uluii t it		
biougin	uiciii, t	iiuii t ii,				
1.:.		a'akànı'a				[JII <i>MIM</i> .]
	ranksa noti lear	i okon: a,				
KI:	rau-ksa	a = okon a				
these	M.PL-D	e.a.ciiiid=Disik	GBUIIVE			
tnese	childre	en				
the child	dren					
. .						[JH <i>Mm</i>]
thoné:n	on				kèn:'en.	
t-hon-e-1	n-on				kèn:'en	
CISLOCA	TIVE-M.P	L.PATIENT-go-I	DIRECTIONAL	L-STATIVE	here	
they have come					here	
that can	ne here.	,				

The construction does share some characteristics of relative clauses in other languages. The two clauses 'Maybe the bus brought the children' and 'they came here' share an argument, the children. It is often maintained that subordinate clauses, including relative clauses, represent presuppositions rather than assertions. The last clause 'they came here' represents a presupposition. These two speakers had been standing on the front porch the day before, watching the children.

1.3. The prosodic dimension

Sequences like those in (2)a, (2)b, and (4) above are pervasive in Mohawk. One could take them as evidence that the language lacks syntactic complexity. They appear to consist of strings of independent sentences with no special relationship apart from a semantic one, perhaps one that is only inferred. If, however, we move beyond the printed word to a consideration of sound, additional structure emerges. Prosody is generally understood as some combination of pitch, intensity, and timing. In the investigation of complex structures, the most significant of these is pitch movement or intonation.

A pitch trace of the complement-like construction 'It will be possible for you two to converse' is below.

(2)a. 'It will be possible for you two to converse.'



The intonation in (2)a reflects integration of the two clauses into a higher-level structure in several ways. The first is the overall pitch contour. The first clause did not end with the full terminal fall in pitch characteristic of an independent sentence in isolation. The second clause did not begin with the pitch reset characteristic of the beginning of an independent sentence in isolation.

The first clause actually ended with a special continuing intonation contour. Mohawk stress is basically penultimate: it falls on the next-to-the last syllable of the word. (Certain epenthetic vowels, which came into the language after the penultimate stress pattern had become established, do not affect stress placement.) The primary marker of stress is pitch. Stress is accompanied by distinctive tone, basically high or low. (The actual high tone contour is rising on a long syllable. The low tone contour, which occurs only on long syllables, shows a high rise then steep plunge to a point below the baseline.) Open stressed syllables are long. The high pitch of the stress on *enwá:ton*' 'it will be possible can be seen in the first peak in the pitch trace. There is, however, an additional external sandhi phenomenon in Mohawk. When a word with penultimate stress on an open syllable (enwá:ton'), is followed by another word in the same prosodic phrase, the final syllable of that word is given extra-high pitch (enwá:ton'). The special extra-high pitch of continuing intonation is easy to see on the pitch trace above near the end of the first clause.

The pitch trace of 'And then he started to cry' shows an even clearer picture.

(2)b. 'And then he started to cry.'



The two clauses were integrated under one overall intonation contour, with no full terminal fall until the end of the last word. (The final syllable *-tho'* of 'he cried' does not come through well on the pitch trace, due to devoicing, but it is audible.) There was a regular decrease in pitch (declination) from one stressed syllable to the next, that is, from the stressed syllable of $S\delta k$ 'then', to the stressed syllable *-táh-* of 'he started it' then finally to the stressed syllable *-sént-* of 'he cried'. (There was no special extra-high pitch at the end of the first verb because stress here was not on an open penultimate syllable.)

The prosody of sentence (4) 'Maybe the bus brought the children that came here' also shows an integrated intonation structure, with no final terminal fall until the end. There was some internal structure, represented by the vertical lines on the pitch trace. The second prosodic phrase showed a partial pitch reset. The following prosodic phrases were separated by brief pauses and slight pitch falls, perceived by the other speaker as appropriate places for responses.



(4) 'Maybe the bus brought the children that came here.'

1.4. Syntactic and prosodic structures

The prosodic integration of constructions like these reflects a kind of cognitive organization similar to that reflected in syntactic integration. The fact that we see prosodic structure without substantive syntactic structure suggests that prosodic structuring may, at least in some cases, precede syntactic structuring. But as Bolinger (1984, 1989) reminded us early on, prosodic and syntactic structure are not necessarily isomorphic.

I start with a claim and a disavowal. The claim is that intonation is autonomous and one can speak of intonational subordination without reference to the segmental side of language. The disavowal is that intonation has any direct connection with subordination in syntax, however this is to be defined. Syntax nevertheless benefits handsomely from the games that intonation plays with it.

I see anything that is tributary to something else as subordinate to it. In syntax this means not only the classical dependent clauses in relation to main clauses, but also their reduced counterparts ... In Gestalt terms, what is superordinate is the figure; what is subordinate is all or part of the ground. (Bolinger 1984:401)

Prosodic and syntactic structure often go hand in hand, but they can also convey different structuring and different aspects of the message. In the complex Mohawk structures seen so far, what is interpreted as the matrix clause always occurs first, followed by what is interpreted as the subordinate clause. This is indeed the normal pattern. Each of these structures has shown a steady fall in pitch as well: each stressed syllable is lower than the preceding one. The matrix clause shows higher pitch than the complement or relative clause.

The highest pitch is not always on the matrix clause, however. Consider the subject complement construction in (5).

(5) Subject complement: Joe Awenhráthen Deer, speaker

'(If I'm still in good health,) it should be possible for me to make my garden a little bigger.'

ó:nen ki' enwá:tón', then just it will be possible then I might be able

kwah ostòn:ha enkathehtó:wanahte' nòn:wa. quite a little will I field enlarge for myself this time to make my garden a little bigger.'



What would normally be identified as the syntactic matrix clause 'then it will be possible' was spoken with significantly lower pitch than the following clause 'I'll enlarge my garden', which would normally be identified as the syntactic complement.

This is not an isolated example. The sentential object construction in (6) shows a similar pattern. The speaker was describing what she had just seen in a film.

(6) Object complement: Kaia'titáhkhe' Jacobs, speaker p.c.

['I believe it was early in the morning, because]

wakathón:té'... I heard (it) 'I heard

ит ...

kítkit rá:tsin wa'thohén:reh'te'. chicken male he yelled a rooster crow.'



Despite the pause following the first clause, the prosodic integration of this construction is still clear. The initial clause 'I heard it' did not end with a full terminal fall. The complement clause 'a rooster crowed' was significantly higher in pitch than the matrix 'I heard it', however.

In both of these examples, the main information is carried by the syntactically embedded clause. The matrix verb 'it will be possible' in (5) is serving a modal function, 'I <u>might</u> enlarge my garden'. The complement clause did not convey presupposed information: the news here was about enlarging the garden, not about possibilities. The matrix verb 'I heard it' in (6) is serving an evidential function. Again the complement clause was not presupposed: the news was not the act of hearing but the rooster crowing. Other authors have noted the mismatch between the syntax of complement constructions and information in other languages. Describing English, Thompson (2002) writes:

The standard view of complements as subordinate clauses in a grammatical relation with a complement-taking predicate is not supported by the data ... Rather, what has been described under the heading of complementation can be under-stood in terms of epistemic/evidential/ evaluative formulaic fragments expressing speaker stance toward the content of a clause. (Thompson 2002:125)

Verhagen (2005) comes to a similar conclusion about written Dutch.

Complementation constructions have the primary function of instructing the addressee of an utterance to coordinate cognitively—in a way specified by the matrix clause—with another subject of conceptualization in construing the object of conceptualization (the latter being represented by the complement clause) and not that of representing an object of conceptualization.

Effects of the prosodic structure of examples like those in (5) and (6) can be seen in the further development of grammatical structures in the language. Verbs like 'it is possible' and 'I heard' are just the kinds of words that tend to be reduced over time into auxiliary verbs, evidential particles, clitics, and affixes. A number of such developments can be seen within Mohawk itself. Mohawk contains, for example, a regular verb *iá:ken*'.

(7) Verb -en- 'say' iá:ken' iak-en-' INDEFINITE-say-STATIVE 'one says, they say, people say'

This verb can still be used as the matrix clause in a complement construction, but it is used much more often used as a hearsay evidential. In this use it is typically reduced in form and often shows some freedom of movement. Its status as an emerging particle can be seen in (8). It was pronounced with little stress or length. As a matrix verb it would be pronounced *iá:ken*', but as an evidential, it is more often *iaken*'. In this example it is embedded inside of the clause 'They just took him up there', occurring after both 'there' and 'just'. This sentence does not report that 'one just said it there', but rather that 'they just took him there'.

(8)) Hearsay evidential: Josephine Horne, speaker p.c.					
	Thó	ki'	iaken'	iahonwaia'ténhawe',		
	tho	ki'	iak-en-'	i-a-honwa-ia't-enhaw-e'		
	there	just	INDEFINITE-say-STATIVE	TRANSLOCATIVE-FACTUAL-3.M.PL/3.M.SG-body-carry-PRF		
	there	just	HEARSAY	they bodily took him		
'They apparently just took him up there'						



2. Young marked complement constructions

Givón (2002, 2005, 2006), and Heine and Kuteva (2007) identify two principal paths by which subordination develops. One is referred to as 'clause chaining' by Givón and as 'integration' by Heine and Kuteva. The other is referred to as 'embedded verb phrase complementation' or 'nominalized V-COMP' by Givón and as 'expansion' by Heine and Kuteva. Heine characterizes the two as follows.

There are cross-linguistically two main ways in which clause subordination arises: either via the integration of two independent sentences within one sentence or via expansion, that is, the reinterpretation of a thing-like (nominal) participant as a propositional (clausal) participant. (Heine 2008ms:1)

He attributes the terms 'integration' and 'expansion' to Diessel.

Observing that in first language acquisition complex sentences appear later than simple sentences, he [Diessel] proposes the following generalization: 'Thus, while complement and relative clauses evolve via *clause expansion*, adverbial and co-ordinate clauses develop through a process of *clause integration*'. (Diessel 2005:4, cited in Heine 2008ms:1)

A consideration of prosody allows us to examine the roles of these two processes and their interaction more closely. The examples of Mohawk complementation seen so far appear to reflect simple integration. In example (2)b we saw two adjacent finite clauses combined under a single overall prosodic contour: 'he started he cried' = 'he started to cry'. Two-sentence sequences involving the same verb 'start', without this prosodic integration, still exist in the language as well: 'It started. The water started swirling around.'

 (9) Separate sentences: Sonny Edwards, speaker p.c. Sok iaken' tahontáhsawen.
 so HEARSAY it started
 'So then, it seems, it started.

Wa'tkanón:wáhkwe'ki:awèn:ke.it started swirlingthiswaterThe water started swirling around.'



The first sentence 'So then it started.' ended with a terminal fall. The second sentence 'The water started swirling' began with a full pitch reset then a final fall of its own, comparable to that of the first sentence.

There are, however, indications that there may be more to these constructions than simple integration. Mohawk contains two demonstratives, a proximal ki:ken 'this, this one, these' and a distal *thi:ken* 'that, that one, those'. They are often shortened: to *ki:* and *thi:* respectively. They serve to locate a referent in space or time, in the linguistic or extralinguistic context.

(10) Proximal demonstrative: Margaret Lazore, speaker *Kthontaiawénhstsi*, all of a sudden'On the spur of the moment,

wahonterihwahserón:ni' ahatiiá:ken'ne' <u>ki</u>: entákta'. they made an agreement they should go out <u>this</u> Saturday. they decided to go out <u>this</u> Saturday.'

(11) Distal demonstrative: Margaret Edwards, speaker
 <u>Thí:ken</u> orokwáhsa' entehsié:na.
 <u>that</u> chain you will grab it
 'You'll grab <u>that</u> chain.'

(12) Demonstratives: Lazarus Jacob, speaker *É*: *ì:reht thí:ken*; away may he move **that**

'Get <u>that guy</u> out of the way; enhahétkenhte' <u>kí:ken</u> ne case.

he will make it bad $\frac{\text{this}}{\text{the case.}}$ the case.

<u>Kí:ken</u> sò:tsi this too much This guy

rahnekakà:stha'. he habitually liquid overdoes drinks too much.'

The demonstratives may occur on their own, as in (12) 'that (guy)' and 'this (guy)', or in combination with a coreferential nominal, as in (10) 'this Saturday', (11) 'that chain', and (12) 'this case'. They can appear with possessed nouns and proper names. Interestingly, they can also precede clauses.

(13) Complement with kí:ken 'this': Lazarus Jacobs, speaker *Rérha'* enhoió'ten' <u>kí:ken</u> enhshakoia'totáhsi' ratitshihénhstatsi he intends he will work <u>this</u> he will expose them priests 'He intended [to work [to expose the priests]].'

(14) Complement with *thí:ken* 'that': Joe Tiorhakwén:te' Dove, speaker

	Tóka'	ken	enhsehià:rake'	<u>thi:</u>	wahshakonahskwawíhon	wahi'.	
	maybe	Q	you will remember it	<u>that</u>	he gave away livestock to various people	you know	
'Maybe you remember [that he gave away livestock], right?'							

The appearance of demonstratives before complement clauses indicates that these clauses are conceived of as referring expressions rather than predications. One could conceive of the processes by which these constructions might have developed in different ways. They could be viewed as the result of expansion: argument slots which were originally filled by lexical nominals with demonstratives were expanded to allow clauses to fill these slots as well. Alternatively, they could be viewed as the result of the integration of two clauses followed by the later reinterpretation of the second as a referring expression.

The structure in (13) was packaged prosodically as a single sentence with internal structure, the essence of recursion. The second and third clauses each began with a partial pitch reset, but they were not as high as the initial pitch on the matrix verb 'he intends'. There was no full terminal fall until the end of the third and final clause.



(13) 'He intended [to work [to expose the priests]].': Lazarus Jacob, speaker

Though the entire construction was integrated under a single overall prosodic contour, a break can be heard between the second and third clauses. Interestingly, the break follows the demonstrative ki:ken 'this'. In this example it took the form of lengthening on the final syllable of the demonstrative, lengthening that does not normally occur between a demonstrative and following noun. As can be seen, it is not a terminal contour: the rise in pitch on the final syllable of ki:ken: indicates that more is to follow.

The break between matrix and complement clauses is often even more pronounced, as in (14). The pause can be seen in both the pitch trace and the waveform above it. Again, it is interesting that the demonstrative was grouped prosodically with the matrix rather than the complement.

(14) 'Maybe you remember [that he gave away livestock], right?'



(These breaks are not pauses for word searches; such structures show different prosodic patterns.)

As has been pointed out by Pawley and Syder (1975), Pawley (2000), and Chafe (1979, 1982, 1987, 1994), spontaneous speech is typically not produced in a continuous stream. Speakers regulate the flow of information such that, in essence, they introduce just one new idea at a time per intonation unit or prosodic phrase. The new idea might be the introduction of a new participant, a new action, a significant time, place, or something else. Chafe describes this structure as follows.

The fact that in the end we are left with few if any cases in which there are two or more separately activated new ideas within the same intonation unit suggests the hypothesis that an intonation unit can express no more than one new idea. In other words thought, or at least language, proceeds in terms of one such activation at a time, and each activation applies to a single referent, event, or state, but not to more than one. (Chafe 1994:109)

Pawley similarly observes that there is a

fundamental limit on cognitive processing, which concerns the number of units of new information that can be manipulated in a single focus of consciousness . . . Two factors place time constraints on speakers' strategies for formulating speech in meetings (face-to-face encounters): first, the social context, which usually places a premium on packaging talk for a fast ride; and second, biological limits on what the mind can do at speed' (Pawley 2000:164, 165).

There is of course variation in the magnitude of prosodic breaks between intonation units, both across speakers and within the speech of single speakers.

The management of information flow can be seen in the passage in (15) below. The passage could be translated 'The late Kahonwinéhtha' always used to go visit her daughter Konwaièn:'a in New York City in the wintertime.' The Mohawk is arranged by intonation unit: each line represents a prosodic phrase.

(15) One new idea at a time: Joe Awenhráthen Deer, speaker

<i>Ne: ki'</i> it is anyway	<u>thi:ken</u> <u>that</u>					
<i>akokstenhkénha</i> late old lady	<i>Kahonwinéhtha'</i> name (she goes with the boats)					
<u>thó</u> ienienat there she used	<i>ahré:nawe'</i> to visit way over there					
(Én:. yes)						
<i>tiótkon's thi n-akohserà:ke</i> always that the wintertime						
enienatà:ra'. she'll visit.						
Konwaièn: 'a <u>thí:ken</u> her daughter <u>that</u>						
<i>Konwahsé:ti</i> name (they count for her)						
<u>tho</u> ses <u>there</u> formerly	<i>nonkwa(ti) tienákere'</i> over there there she resides					
<i>Kanón:no.</i> New York City.						

'The late Kahonwinéhtha' always used to go visit her daughter Konwaièn:'a in New York City in the wintertime.'

Each prosodic phrase introduced a new idea. The first shifted the topic of conversation. The second identified the new main character by name, old Kahonwinéhtha'. The third introduced her activity 'she used to visit'. (The fourth was the response of another speaker.) The fifth specified the time of the visits. The sixth introduced another character, the daughter. The seventh identified the daughter by name. The eighth brought up her residence. The ninth identified the location by name.

This example also illustrates a common Mohawk rhetorical pattern. Demonstratives are often used as place holders, indicating in one line that further details about that referent are to follow in another. In the first line of (15) the demonstrative *thí:ken* 'that' establishes a referent that is further identified in the following prosodic phrase as Kahonwinéhtha'. In the sixth line the same demonstrative promises further information about the daughter. The construction in (14), 'Maybe you remember that ... he gave away livestock', was of this type.

Sequences of separate sentences following this pattern are still common in Mohawk. The sentences are grammatically and prosodically independent. Neither presents presupposed information.

(16) Two sentence sequence with demonstrative: Watshenní:ne' Sawyer, speaker p.c.

Eniakwaterohrókha' <u>kí:ken;</u> we will go to watch 'We would go watch;

tewa'á:raton tahonhthénno'ke'. it is net attached they (males) would play ball the men would play lacrosse.'



As can be seen from the waveform and the pitch trace, the two clauses were separated by a long pause. The first clause ended with a partial fall, but the second showed a complete pitch reset. Such structures are certainly likely sources for complementation-like constructions such as 'He intended to work to expose the priests'. Examples like (16) suggest that a discourse pattern of elaboration can precede prosodic integration.

Mohawk also contains another construction that appears to be an overtly marked complement. Lexical nominals are not obligatorily marked for definiteness, but there is a particle *ne* which can be used to indicate that the speaker believes that a referent is identifiable to the listener, much like a definite article. One speaker was describing the time a man had been caught inadvertently doing something illegal. One of his relatives urged the action in (17). There was no *ne* before the nominal 'lawyer'.

(17) No ne: Watshenní:ne' Sawyer, speaker p.c.

Ó:nenktsi tehari'wakénhahs right now he argues matters

entshitewaia'tatshén:ri'. we will look for him

'We have to find a lawyer right away.'

The family did locate a lawyer, and the case went to trial. The next mention of the lawyer in this account was the sentence in (18). This time the nominal 'lawyer' was preceded by ne. The lawyer was identifiable from the previous discussion. The nominal 'judge' was also preceded by ne, though this was the first mention of him. He was assumed to be identifiable from the general courtroom scenario.

(18) Ne: Watshenní:ne' Sawyer, speaker p.c.

Ah khare' ó:nen ki: ia'káhewe' tekari'wakénhahs <u>ne</u> this it arrived there he argues matters ah so then <u>the</u> 'So then this time the lawyer ne shakorihwénhtha' tanon' and the he decides people's matters and the judge wa'thonwaia'tò:rehte' they judged him brought him to trial, *ki:* X. this NAME this Mr. X.'

The particle *ne* can co-occur with demonstratives, as in *kí:ken ne case* 'this case' in (12) above and with proper names. It is not, however, obligatory, even when the referent is identifiable. The sentence in (19) occurred sometime after the sentence seen in (11) earlier: 'You'll grab that chain.'

- (19) No particles: Margaret Edwards, speaker, p.c. *Tahaié:na' orokwáhsa'*.
 he grabbed it chain
 'He grabbed the chain.'
- Unlike the demonstratives, the particle *ne* never appears as a referring expression on its own. Interestingly, *ne* can appear before clauses in complement constructions.

(20) Complement with <i>ne</i>	'the': Ce	celia Peters, s	peaker p.c.	
Iakwate'niénhtha'	<u>ne</u>	akwé:kon	onkwehón:we	a:iakwatewennón:tahkwe'.
we habitually try it	the	all	real person	we would our word stand with it
'We try [to speak only Indian].'				

The sentence in (20) was uttered with the same prosodic integration seen in other complement constructions. The complement 'to speak only Indian' was embedded prosodically inside of the larger sentence 'We try to speak only Indian'. There was no full fall in pitch until the end of the second clause. The first matrix clause 'we try' ended in only a partial fall, and the second clause, translated as the complement, began with only a partial pitch reset.

(20) 'We try [to speak only Indian].': Cecelia Peters, speaker. p.c.



The prosody of complement constructions with *ne* 'the' like that in (20) differs from those with demonstratives. The demonstratives are grouped prosodically with the preceding matrix clause. The particle *ne* is grouped with the following complement clause. This particle cannot introduce independent sentences. The sequence <u>ne</u> akwé:kon onkwehón:we a:iakwatewennón:tahkwe' 'the we all speak Indian' is not a sentence. While it could be argued that the complement constructions with demonstratives could have been formed from a discourse structure of elaboration followed by prosodic integration, complement constructions with *ne* 'the' could not have been formed in the same sequence of stages. The development of the *ne* constructions could be conceptualized as simple elaboration, by a scenario in which speakers began inserting clauses into the subject and object slots earlier occupied only by lexical nouns. An alternative scenario might originate in a discourse structure in which an element of one sentence was elaborated on, or expanded on, in the next. Such sequences of sentences then were integrated prosodically. This could be the scenario underlying the clause-clause constructions like 'It will be possible. We will speak Indian' \rightarrow 'It will be possible for us to speak Indian' and 'He started it. He cried' \rightarrow 'He started to cry.' At some point after the prosodic integration, speakers might have reinterpreted the second clause as a syntactic argument. The reanalysis would become evident only when they then began to precede it with the article *ne* 'the'.

It might be tempting to assume that the Mohawk demonstratives and definite article have now attained the status of complementizers, much like English *that*. In fact they are not yet at that point. All three still mark the same semantic distinctions with clauses that they mark with lexical nominals. The demonstratives distinguish proximal from distal situations: events or states that are near or remote in space, time, or discourse. In 'Maybe you remember *thí:ken* ('that') he gave away livestock', the speaker was talking about a remote time, during the Depression in the 1930's. In 'He intended *ki:ken* ('this') to work to expose the priests', the speaker was referring to the central topic of the conversation, a lawsuit over land ownership. The particle *ne* 'the' still marks exactly the same distinction before clauses that it marks before lexical nominals: identifiability of events and states.

Furthermore, a demonstrative and the article *ne* can co-occur before clauses. As expected, the demonstrative is grouped prosodically with the matrix clause, while the article is grouped prosodically with the complement.

(21) Coccurrence of demonstrative and article: Cecelia Peters, speaker p.c.

Kè:iahre'	<u>thi:</u>
I remember	<u>that</u>
'I remember	that

<u>ne</u> s ne: wakon'éskwani' <u>the</u> PAST it is I like it I used to like it

tsi náhe' eh niiohtòn:ne'. long ago there so it was remotely the way it was long ago.'


3. Young marked relativization

Heine and Kuteva (2007) propose that there are only two diachronic sources of relative pronouns crosslinguistically: demonstratives (*the man [that I met]*) and question words (*the man [who came]*). We saw earlier that Mohawk contains constructions that appear on some grounds to be relative clauses but with no overt marking beyond prosodic integration. There are also constructions with markers of exactly the two types predicted by Heine and Kuteva: demonstratives and questions words.

- (22) Demonstrative: Joe Tiorhakwén:te' Deer, speaker Nahò:ten' na' <u>thí:ken</u> wà:kehre' enkehià:rake'? what now <u>that</u> I wanted I will remember 'What was it now that I meant to remember?'
- (23) Question word: Charlotte Bush, speaker

Iakherihonnién:ni	<u>ónhka'</u>	í:ienhre'	aontá:ien	wahi.			
we teach them	who	one wants	one would come	TAG			
'We teach whoever wants to come, don't we.'							

It would appear that Mohawk contains prototypical relative clause structures after all.

3.1. Relativization with demonstratives

The sentence 'What was it now that I meant to remember?' appears to contain a standard relative clause. The clause 'I meant to remember something' is a presupposition, not an assertion. The full sentence was uttered under a single overall intonational contour. There was no full terminal fall in pitch until the very end. (The slight rise in pitch on the stressed syllable of the final verb 'remember' is due to the tone, written with a grave accent, which consists of a higher rise then very steep fall.)

(22) What was it now that I meant to remember?



Time (s)

The sentence did contain internal prosodic structure. A slight break can be perceived between the two clauses. Interestingly, the demonstrative *thí:ken* 'that' was grouped with the first clause.



Similar prosodic structure can be heard in larger constructions, such as that containing ki:ken 'this' in (23). Again the transcription is arranged so that each line represents a separate prosodic phrase.

(23) Larger demonstrative construction. Joe Awenhráthen Deer, speaker

<i>Nòn:wa</i> now	<u>kí:k</u> this	<u>en,</u> ,					
<i>òn:wa'k wahonwaia'táta'</i> just now they buried him			t <i>áta'</i> m	<i>thetèn:re'</i> , yesterday			
Eddie,							
Eddie De	laro	nde,					
<i>ne s</i> it is forme	rly	<i>ne:</i> the					
<i>rake'ního</i> my father	a	<i>akwas</i> really					
<i>akì:ron</i> I'd say	<i>tsi</i> that	<i>ki'</i> in fact	<i>ní:</i> myself	<i>ne:</i> it is	<i>tehiatatshnié:nenhskwe'</i> they two used to help each other	<i>wáhi</i> . _{TAG}	

'This guy [they just buried yesterday], Eddie, Eddie Delaronde, he and my father used to just help each other out, you know.'



The relative clause construction consists of the first two intonation units. A consistent drop in pitch on each successive stressed syllable can be seen over these first two phrases.

The diachronic pathway generally assumed to underlie relative clauses in languages like English is the following.

There is the car; <u>that</u> (one) I like > There is the car [that I like].

The prosodic structure of the Mohawk counterparts indicates that this is an unlikely source. There is often a significant prosodic break before the modifying clause in Mohawk, but it comes after the demonstrative. The pause in (23) can be seen both in the break in the pitch trace above and in the waveform below. The demonstrative appears to be in the head position prosodically.

(23) 'This guy they just buried yesterday ... '



The Mohawk constructions differ from standard relative clauses in another way. Ordinary lexical nouns do not usually occur in this head position.

A different path of development is suggested by the demonstrative structures seen in the previous section, as in example (15) 'The late Kahonwinéhtha' always used to go visit her daughter Konwaièn:'a in New York City in the wintertime.' It is likely that complex constructions like that in (23) sprang from a similar source, in which a demonstrative is used in one intonation unit as place holder promising further elaboration in the next.

The demonstratives here have apparently not developed into full-fledged relative pronouns. Heine and Kuteva note that as demonstratives develop into relative pronouns, 'desemanticization leads to a loss of the spatial deixis of the demonstrative'. (2007:225) The Mohawk demonstratives here retain their spatial deixis. They distinguish distance in space, time, or discourse. In 'this guy they just buried yesterday', the proximal ki:ken 'this' emphasized the proximity in time, 'just yesterday'. In 'What was it that I meant to remember', the distal thi:ken 'that' referred to a moment the speaker could no longer remember well. The difference is of course relative, not absolute. The burial had taken place the day before, while the thought of something to remember could have occurred to the speaker earlier the same day.

3.2. Relatives with question words

The second path by which relative pronouns can develop is termed by Heine and Kuteva the 'interrogative channel' (2007:229). At first glance, Mohawk appears to fall in line with languages like English.

Ónhka' 'who'

The pronoun *ónhka*' 'who' is used in questions asking about human beings or referents classified as human.

(24) 'Who' question <u>Ónhka'</u> ronáhskwaien akohsá:tens? <u>who</u> he domestic animal has it carries one '<u>Who</u> had horses?'

The same form appears in relative-like constructions.

(25)'Who': Joe Tiorhakwén:te' Dove, speaker

<i>Ó:nen</i> now	<i>ki'</i> in fact	<i>kè:iahre'</i> I remember	<i>ni:'</i> myself	<i>thí:</i> that	<i>ótia'ke</i> other
<i>kwah</i> just	uh				
<u>ónhka'</u> <u>who</u>	<i>ronáhs</i> he dom	<i>kwaien</i> estic animal has	<i>aka</i> it c	o <i>hsá:ten</i> arries one	S e
(<i>Hén:</i>). (Yes.)					
thihatah	snié:nen				

he helps here and there

'I myself remember that anyone who had horses just helped out without pay.'

The prosodic structure of (25) is different from those of the demonstrative constructions. Here the pronoun is grouped prosodically with the relative clause rather than the matrix. The prosodic phrase 'who had horses' is the third in the pitch trace below.



The clause 'who had horses' also differs pragmatically from demonstrative constructions like 'this guy they buried yesterday'. It is not presupposed: the listener knew nothing about anyone having a horse, but he did know about the burial.

18

The form *nahò:ten*' 'what' appears in questions about non-humans.

(26) Nahò:ten' question <u>Nahò:ten'</u> iakón:ni? <u>what</u> she is making (it) 'What is she making?

The same form appears in relative-like constructions.

(27) Nahò:ten' 'what': Watshenní:ne Sawyer, speaker Onkwa II 9 WS

Nia'té:ka	on	<i>enhonwà:nonte'</i> ,			
all sorts of	f things	she will feed him			
<i>nia'té:ko</i>	<i>n</i>	<i>toka'</i>	<i>nòn:wa</i>	<i>kiken:</i>	
all sorts of	f things	maybe	perhaps	this	
<i>tka'wà:ra</i> meat pie	a tand	on'			
<i>toka'</i>	<i>nòn:wa</i>	<i>tew</i>	<i>à:ia</i>	<i>wahi'</i>	
maybe	perhaps	frui	t pie	TAG	
<i>tanon'</i> and	<u>nahò:ter</u> what	<u>n'</u>			
<i>khónhte</i> and it is p	ossible	<u>nahò:te</u> <u>what</u>	<u>n'</u> iak she	ón:ni is making	•••

'She feeds him all sorts of things, maybe meat pie, maybe fruit pie, whatever she's cooking.'

As in the previous example, the pronoun *nahò:ten*' 'what' is grouped prosodically with the following clause, visible in the last prosodic phrase on the pitch trace below 'possibly what she is making'.



The construction occurs in negative clauses as well.

(28) With negation: Watshenní:nen Sawyer, Border WS 5 rec *Thetehotshénrion* <u>nahò:ten'</u> niiótteron did he find what so it is dangerous 'He didn't find anything dangerous *na'taionkwahá:wi.* so we are carrying it that we were carrying.'

= 'He didn't find that we were carrying anything dangerous.'

Again, the pronoun 'what' was grouped prosodically with the following clause.



The constructions 'those who had horses, whoever had horses', and 'the things she was making, whatever she was making' can function as free relatives. The free relative meaning can be made more explicit with the addition of an enclitic =k 'just, only'.

(29) Explicit free relatives

ónĥka'	'who, someone, anyone'
ónhka' <u>k</u>	'anyone <u>at all</u> , who <u>ever'</u>
nahò:ten'	'what, something, anything, whatever'
nahò:ten' <u>k</u>	'anything <u>at all</u> , what <u>ever</u> '
tsi <u>k</u> nahò:ten'	'anything <u>at all</u> , what <u>ever</u> '
tsi niká:ien'	'which'
tsi <u>k</u> nika:ien	which <u>ever</u>

(30) Free relative: Watshenní:ne Sawyer, speaker

<u>**Tsik nahò:ten'**</u> ká:ien' ne: eniákwake'. as <u>only</u> what it lies that we will eat 'What<u>ever</u> was there we would eat.'



Because there is no written record of Mohawk comparable to those of many European languages, we cannot know for certain how this construction evolved. In 1981, Comrie made an interesting observation.

Especially in the less widely spoken Altaic languages of the USSR, and in particular the Tungusic languages, which have developed as written languages under strong Russian influence, there has been a marked tendency to calque subordinate clause types on Russian models, for instance by using interrogative pronouns to introduce relative clauses. (Comrie 1981:85)

More recently, Heine and Kuteva (2006) have discussed the recurring polysemy between interrogative and relative pronouns among a large number of languages in Europe. They propose a process of development along the following lines.

(31) Development of relative pronouns: Heine and Kuteva 2006:209

Stage 1	Questions	Who came?
Stage 2	Indefinite complement clauses	I don't know <u>who</u> came.
Stage 3	Definite complement clauses	You also know <u>who</u> came.
Stage 4	Relative pronouns	<i>Do you know the woman</i> <u><i>who</i></u> <i>came?</i>

What begin as question words (1) come to be used in embedded questions (2), then are extended to use in definite complements (3) and finally occur juxtaposed to lexical heads as relative pronouns (4).

Heine and Kuteva point out that the distribution across languages of the interrogative-relative pronoun polysemy does not follow strict geneological lines. Some of the languages which show it are Indo-European (Romance, Slavic, Modern Greek) but others are not (Hungarian, Georgian). They attribute the distribution to language contact, in particular what they term 'replica grammaticalization'. The scenario they propose is as follows. After a series of changes like those outlined above resulted in polysemy between interrogative and relative pronouns in one of their languages, bilingual speakers, noticing the polysemy, might have extend question words in their second language to uses as relative pronouns, on the model of the first. On the basis of historical documents and other studies of them, Heine and Kuteva hypothesize that a development like that outlined in (31) may have occurred in Latin and Slavic, then later spread by contact throughout Europe, developing in Basque on the model of Spanish, and Balkan Turkish on the model of Macedonian. As European languages were spread to the New World with colonization, so too was the polysemy, for example from Brazilian Portuguese into the Amazonian language Tariana, and from Mexican Spanish into the Uto-Aztecan language Pipil.

It is possible that these Mohawk relative-like constructions could have developed under similar conditions of contact. Mohawk is still spoken extremely well, but there has also been extensive bilingualism, first in French then more recently in English. The match between the European and Mohawk structures is not perfect. In many cases, Mohawk interrogative pronouns match indefinite pronouns: *ónhka*' 'who, someone, anyone'. Where the interrogative and indefinite forms do not match, the relative-clause-like constructions are built on the indefinite forms.

(32) Mohawk question words and indefinite pronouns

a. Same *ónhka*' 'who?', 'someone, anyone, whoever' *nahò:ten*' 'what?', 'something, anything, whatever'

b. Different oh nahò:ten' 'what?'
ka' nón:we? 'where?' tsi nón:we 'the place where'
ka' niká:ien'? 'which one?' tsi niká:ien' 'the one which' Examples of the distribution of *ka' niká:ien'* 'which one' and *tsi niká:ien'* 'the one which' are in (33), (34), and (35). The first appears in direct questions and embedded questions.

(33) Question

Ka' niká:ien'wahshní:non'?Qso it liesyou bought (it)'Which onedid you buy?'

(34) Embedded question: Charlotte Kaherakwahs Bush, speaker

('She was showing pictures of her niece's wedding.')

Iahtewakaterièn:tare'ónhka'notdo I knowwhoka' niká:ien'
which onewhone:wa'kóniake'wáhi'.that oneshe got marriedTAG

'I don't know which one got married.'

The second is rare in relative clauses, but it does occur. The construction below is also unusual because it contains a lexical head. It was uttered by an excellent Mohawk speaker, but she was engaged in a somewhat unusual task at the time, describing a film she had seen. It could reflect effects of contact.

(35) Rare extension as restrictive relative: Kaia'titáhkhe' Jacobs, speaker

Raonòn:warore' nen'nè:'e his hat this it is rononhwaro'tsheróntion kí:ken um he hat lost this raksà:'a <u>tsi niká:ien'</u> ne: boy **as it lies** the

rohianenhskwenhátie'. he is fruit having stolen going along

'The boy who was going along with the stolen fruit lost his hat.'



The use of indefinite pronouns for free relatives seems well motivated semantically. It is easy to imagine that these constructions could have arisen on their own. The fact that where there is a difference between interrogatives and indefinites, the Mohawk constructions show indefinites, does not of course constitute proof that language contact played no role in their development. Bilingual speakers could, for example, have perceived a parallelism between question words and relative pronouns in French or English, developed $\delta nhka'$ 'who' and perhaps $nah\partial:ten'$ 'what' constructions by replica grammaticalization, and then later reinterpreted the pattern as one based on indefinites and extending it to other indefinites. The exact sequence of events remains a mystery for now.

In any case, the resulting constructions cover functions well. The relative-like constructions with demonstratives characterize realis referents: they presuppose the existence of a referent ('This buy they buried yesterday'). Those with indefinite pronouns characterize potentially irrealis referents ('We ate whatever was there', 'He didn't find anything that we were carrying').

4. Overall complexity

In the preceding sections, the consideration of the prosodic dimension has allowed us glimpses into possible early stages in the development of two complex constructions: complementation and relativization. It is important to note that this incipient complexity is not characteristic of the language as a whole. There is ample evidence still apparent within the grammar of an old history of syntactic complexity.

One example is provided by traces of what were most likely earlier complex syntactic constructions. Among the verbal suffixes of Mohawk are several instrumental applicatives which derive transitive verbs whose second argument is an instrument. Among them are the suffix *-st* and *-hkw*.

(36) Instrumental applicatives 'with it'

a.	-o'tsirek	'sip'
	-hnek-o'tsirek	'sip liquid'
	-hnek-o'tsirek- <u>st</u>	'sip liquid with'
	iehneko'tsirékha'	'she/one sips liquid'
	iehneko'tsirék <u>st</u> ha'	'she/one sips liquid with it' = 'straw'
b.	-na'ton	'say, call something/someone by name'
	-na'ton- <u>hkw</u> -	'name someone/something with it, name someone X'
	wa'khenà:ton'	'I mentioned/called her by name'
	X wa'khenà:tónhkwe'	'I named her with it, named her X'

The diachronic sources of both suffixes still persist in the language as verb roots. The first is clearly descended from the root *-st* 'use' (*i:sats* 'Use it!'), and the second from the verb root *-hkw-* 'pick up' (*té:sekhw* 'Pick it up!'). A verb meaning 'use' is not a surprising source for an instrumental applicative. A verb meaning 'pick up' is not so surprising either: prototypically, one picks up an instrument to use it. With grammaticalization the meaning has become more abstract. instrumental applicative verbs no longer necessarily involve a physical act of picking up a concrete object. It is likely that the modern applicative constructions are descended from earlier complex constructions whose constituents became ever more tightly bound over time.

5. Conclusion

Adding the dimension of prosody, particularly that characteristic of spontaneous conversation, can enrich our understanding of certain stages in the development of complexity. The prosody of the Mohawk constructions examined here suggests possible pathways of development not obvious from written texts.

Mohawk is a language which might, at first glance, appear to lack syntactic complexity. Counterparts of English complement and relative clause constructions are often expressed in simple strings of syntactically independent sentences. Typical indications of subordination, such as omission of coreferential arguments, and non-finite verbs, do not occur in Mohawk. The core arguments of every clause are overtly identified by pronominal prefixes on the verb, and all verbs are finite. But a look at the prosody of these sequences of clauses reveals integration of another kind and hierarchical structures. The existence of complex prosodic structures in the absence of morphosyntactic markers of subordination suggests that at least in some cases the first might precede the second.

But prosodic structure is not a simple precursor to syntactic structure. Each can show distinctions the other does not. It has sometimes been assumed, for example, that matrix clauses in complex constructions are always asserted, while subordinate clauses are presupposed. Examination of spontaneous speech indicates that subordinate clauses are in fact often not presupposed, though their syntax is identical to those that are. Prosody can mark the difference. Complement clauses conveying new information can be more prominent prosodically, spoken with a wider range of pitches.

Mohawk also contains a construction that at first appears to be equivalent to the English complement construction marked by the complementizer 'that', descended from a demonstrative. The Mohawk construction can indeed contain a demonstrative. Its prosodic pattern suggests an origin in a discourse pattern used to manipulate the flow of information through speech. This development raises interesting issues about the relative contributions of processes of integration and elaboration.

Finally, Mohawk contains some complex constructions that appear at first glance to be prototypical relative clauses. They contain demonstratives and question words, the two kinds of words hypothesized to be the sources of relative pronouns cross-linguistically. A closer look at the prosody of these constructions reveals that differ in internal structure. Further examination reveals additional ways in which they differ from their English counterparts.

We have much to gain by the inclusion of the prosodic dimension in investigations into the development of complex structures in language.

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The emergence of relative clauses in early child language

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Introduction

This paper examines the development of relative clauses in early child language. It is argued that relative clauses constitute a network of related constructions that children acquire in a piecemeal bottom-up way, starting with relative clauses that are only little different from simple sentences which are gradually extended into more complex grammatical patterns. The acquisition process is driven by pragmatic and cognitive factors that are involved in the process of language use.

The analysis draws on previous research with Michael Tomasello supplemented by a new corpus investigation of children's spontaneous relative clauses in English (cf. Diessel and Tomasello 2000, 2005; Diessel 2004, 2008; Brandt, Diessel, and Tomasello 2007). The paper reports the results of three studies. The first study is a corpus investigation of the external properties of children's early relative clauses; the second study is an experimental study investigating the way children process the internal structure of English and German relative clauses; and the third study is another corpus study examining the meaning of children's subject and object relative clauses.

Study 1

Relative clauses are subordinate clauses that are embedded in complex sentences. The first study investigates the structure and meaning of the sentence in which children's early relative clauses are embedded. In the experimental literature on the acquisition of relative clauses, children are commonly confronted with complex sentences in which the relative clause modifies the subject or object of a transitive main clause including a prototypical agent and an activity verb as in examples (1) and (2) (adopted from Tavakolian 1977).

- (1) The pig jumped over the horse <u>that pumped into the lion</u>.
- (2) The horse <u>that kicked the cow</u> pushed the donkey.

The relative clauses of spontaneous child language are different. As shown in Diessel (2004) and Diessel and Tomasello (2000), the vast majority of the children's spontaneous relative clauses are attached to the predicate nominal of a copular clause or an isolated noun phrase. Extending this analysis, the current study examines the external properties of children's spontaneous relative clauses in the transcripts of four English-speaking children from the CHILDES database (MacWhinney 2000): Adam (Brown 1973), Sarah (Brown 1973), Nina (Suppes 1974), and Abe (Kuczaj 1976). The data include 460 files of one hour recordings that occurred at regular intervals between the ages of 2;0 and 5;0.¹ Using a similar coding schema

¹ Diessel and Tomasello (2000) investigated the relative clauses of five children: Adam, Sarah, Nina, Naomi, and Peter. Since Naomi's and Peter's transcripts include only few relative clauses, they were excluded from the current analysis, which was supplemented by new data from Abe.

as Diessel and Tomasello (2000), I divided the children's relative clauses into four categories: (1) SUBJ-relatives, i.e. relative clauses that are attached to the main clause subject; (2) OBJ-relatives, i.e. relative clauses that are attached to an object (or adverbial) in the main clause; (3) PN-relatives, i.e. relative clauses that are attached to the predicate nominal of a copular clause; and (4) NP-relatives, i.e. relative clauses that are attached to an isolated noun (phrase).

(3)	People who have spears hit people in the nose	SUBJ	Abe 3;11
(4)	I can do everything <u>I want to do</u> .	OBJ	Adam 3;5
(5)	This is the sugar that goes in there.	PN	Nina 3;0
(6)	The thing that's over there.	NP	Sarah 4;5

Overall there are 583 finite relative clauses in the data, but only a minority of them are attached to the main clause subject or object. Figure 1 shows the mean proportions of the four types of relative clauses.



As can be seen, an average of only 2.1 percent of all relative clauses are attached to the main clause subject. Note that these are center-embedded relative clauses that interrupt the associated main clause. Relative clauses that are attached to an object (or adverbial) are more frequent; overall a mean proportion of 29.3 percent of all relative clauses are of this type. However, the vast majority of the children's relative clauses do not occur with the main clause subject or object, but are attached either to the predicate nominal of a copular clause or to an isolated noun phrase: an average of 44.3 percent are PN-relatives, i.e. relative clauses that are embedded into a copular clause, and an average of 21.8 percent are NP-relatives, i.e. relative clauses that occur with an isolated noun phrase. Two of the four children, Nina and Sarah, began to use PN- and NP-relatives before they used SUBJ- and OBJ-relatives; the two other children, Adam and Abe, began to use all relative clauses except for SUBJ-relatives at around the same age.

How do we account for the early and frequent use of PN- and NP-relatives in child language? One of the reasons why children begin to use them so early is that these relative clauses are very frequent in the ambient language. Like children, adults make common use of PN- and NP-relatives when they talk to the young children (cf. Diessel 2004: 144-6). However, in addition to input frequency there are two other factors that are relevant for the early and frequent use of PN- and NP-relatives: First, these relative clauses suit the particular communicative needs of young children, and second, they are less complex than other types of relative clauses. I will discuss the two points in turn.

PN-relatives and NP-relatives are grammatical constructions with particular communicative functions. PN-relatives function to focus the hearer's attention on a referent in the speech situation or in the universe of discourse, providing a reference point for the information expressed in the relative clause (examples 7-9), or they occur in questions, drawing the hearer's attention onto a referent that is characterized by the information in the relative clause (cf. examples 10-11).

(7)	*MOT:	What's the baby patting?	Nina 3;0
	*CHI:	A cat.	
	*CHI:	And here's a rabbit that I'm patting.	
(8)	*MOT:	We'll have to go to the San Francisco Zoo then and	Nina 3;2
		see all the animals.	
	*CHI:	And there's the penguins that we saw.	
(9)	*MOT:	That's gonna be very funny tea.	Nina 3;3
	*CHI:	That's the kind of tea that I'm making for them.	
(10)	*MOT:	To the fire house or to a house that's on fire?	Nina 3;0
	*CHI:	To a firehouse.	
	*CHI:	Is that house <u>that's on fire</u> ?	
(11)	*MOT:	You don't mean razor blades, you mean a razor?	Adam 3;9
	*CHI:	Yeah.	
	*CHI:	Mommy, what is dat thing <u>dat shaves</u> ?	

NP-relatives are commonly used to answer to a previous question. An average of almost 90 percent of the children's NP-relatives are produced in response to a content question (cf. examples 10-12), but occasionally they also occur in other contexts resuming a referent from the previous discourse (cf. examples 16).

(12)	*FAT:	No what did you eat?	Abe 3;6
	*CHI:	Some apples that were sweet.	
(13)	*MOT:	What are those?	Nina 3;2
	*CHI:	Animals that are chasing that .	
(14)	*FAT:	What lion face?	Abe 3;11
	*CHI:	The lion face you were gonna draw.	
(15)	*MOT:	What are those?	Nina 3;2
	*CHI:	Animals that are chasing that.	
(16)	*MOT:	What do we make in our factory?	Adam 3;8
	*CHI:	We don't make nothing.	
	*CHI:	I a cowboy maker.	
	*CHI:	A cowboy who shoot makers.	

In accordance with Givon's (2008) hypothesis that the development of relative clauses is determined by their communicative function, these data suggest that children learn the use of relative clauses in the communicative interaction with their parents. PN-relatives occur in copular constructions focusing the hearer's attention on a referent that is defined or characterized by the relative clause, and NP-relatives occur in constructions answering a content question. In both constructions, the relative clause serves to establish or to retrieve a referent in the interactive discourse between parent and child.

The early and frequent use of PN- and NP-relatives is facilitated by the fact that these constructions are less complex than other types of relative clauses. SUBJ- and OBJ-relatives are embedded in bi-clausal constructions that express a relationship between two propositions, but PN- and NP-relatives occur in complex sentences that denote only a single state of affairs.

NP-relatives occur in topicalization constructions consisting of a single clause, and PNrelatives occur in copular constructions that are 'propositionally empty' (cf. Lambrecht 1988); that is, copular clauses do not denote an independent situation but function to establish a referent in focus position, which is subsequently integrated into the relative clause. Thus, both constructions contain only a single proposition expressed by the relative clause.

What is more, many of the OBJ-relative clauses are embedded in complex sentences in which the matrix verb has little semantic content. Very often, children's OBJ-relatives include a stative verb expressing possession (cf. example 17) or a (mental) state (cf. examples 18), or they consist of a perception verb in the imperative drawing the hearer's attention to a referent in the surrounding situation (cf. examples 19). While OBJ-relatives are semantically more complex than PN- and NP-relatives, only 25 percent of the children's OBJ-relatives occur in prototypical transitive constructions including a goal-directed activity verb and an object functioning as patient in the main clause (cf. examples 20).

(17)	You have tow things that turn around.	Adam 3;8
(18)	I like everything you fix for me.	Abe 3;5
(19)	Look at this dog wags his tail.	Nina 3;2
(20)	I punched someone that had white hair like me.	Abe 3;6

In general, children's early relative clauses occur in constructions that are low on the transitivity scale (cf. Hopper and Thompson 1980; Thompson and Hopper 2001). This is reflected in the semantic role of the noun modified by the relative clause. Distinguishing the following semantic roles—agent, patient, experiencer, location, recipient, instrument, and theme—I found that an average of 83.2 percent of all relative clauses are attached to a theme;² all other thematic roles are infrequent (see Figure 2), supporting the hypothesis that the main clauses of children's early relative clauses are low in transitivity.

Figure 2. Thematic role of head



 $^{^{2}}$ A referent was classified as a theme if it is expressed by an isolated NP, by the subject or predicate nominal of a copular clause, by the object of a mental state verb or perception verb, or by the object of a verb of saying or verb of possession.

Note that the children's relative clauses are semantically more substantial than the main clauses. As can be seen in Figure 3, an average of 50 percent of the verbs in the relative clause denote a physical activity and only 29.1 percent denote a state (expressed by a copular or some other stative verb). This is in sharp contrast to the main clause in which stative verbs are dominant (mean of 52.7 percent) and activity verbs are relatively rare (mean of 10.6 percent).



In sum, the development of relative clauses originates from particular constructions that are similar to simple sentences in that they denote a single state of affairs. Two types of constructions are dominant: copular constructions that focus the hearer's attention on a particular referent, and topicalization constructions that are commonly used to answer to a previous question. There are only very few relative clauses that modify an agent or patient of a transitive activity. The vast majority of the children's relative clauses occur in constructions in which the main clause is either propositionally empty or low in transitivity.

Interestingly, similar types of relative clauses have been found in other languages. For instance, Dasinger and Toupin (1994) noticed the predominance of presentational relative constructions in the speech of Spanish- and Hebrew-speaking children, which they collected in a picture book task, and Hudelot (1980) reports that the vast majority of children's relative clauses in French are attached to the predicate nominal of a copular clause. Moreover, Hermon (2004) argued that there are some striking parallels in the development of relative clauses in English and Indonesian: like English-speaking children, Indonesian-speaking children begin to produce relative clauses in structures that denote only a single state of affairs. Finally, Brandt, Diessel, and Tomasello (2007) investigated a large corpus of relative clauses in the speech of a German-speaking boy who began to use relative clauses in topicalization constructions consisting of the relative clause and an isolated head noun.³

³ Ozeki and Shirai (2005) have shown that relative clauses in Japanese occur in different types of constructions; they are more often attached to the main clause subject and main clause object than children's relative clauses in English. Interestingly, Ozeki and Shirai note that early relative clauses in Japanese are only little different from adjectives: they usually include a stative verb and involve the same morphology as adjectives (Kim 1987 found similar types of relative-clause constructions, Diessel (2007) suggests that children's early relative clauses in Japanese (and other East Asian languages) are similar to children's relative clauses in English (and other European languages) in that they denote only a single state of affairs, although the source constructions are rather different. In English, relative clauses originate from structures in which the main clause is propositionally empty, whereas in Japanese, relative clauses originate from attributive constructions in which the relative clause specifies a semantic feature of the head noun. In both types of languages children begin to produce relative clauses in constructions that contain only a single proposition.

Study 2

The second study is concerned with the internal syntactic properties of relative clauses that influence the acquisition process. The internal structure of relative clauses is defined by the syntactic function of the relativized element, which can be expressed by a pronoun or gap in the argument structure. The developmental literature has concentrated on two basic types of relative clauses: subject relatives, i.e. relative clauses in which the subject is gaped or relativized (e.g. Sheldon 1974; Tavakolian 1977; Hamburger and Crain 1982; Corrêa 1995; Kidd and Bavin 2002). However, subject and object are not the only syntactic roles that can be relativized. As can be seen in examples (21) to (25), the relativized syntactic role can be the subject, the direct or indirect object, an adverbial, or a genitive attribute.

(21)	The man who met the woman.	Subject
(22)	The man who the woman met.	Direct object
(23)	The man who the woman gave the book to.	Indirect object
(24)	The man who the woman went to.	Adjunct
(25)	The man whose dog bit the woman.	Genitive attribute

The earliest relative clauses that English-speaking children produce are subject relatives, but direct object relatives are also quite early. In fact, two of the four children examined in Study 1, Adam and Abe, began to use subject and direct object relatives at around the same age; only Nina and Sarah produced subject relatives before object relatives. Apart from subject and direct object relatives, the children produced adverbial relatives, which are often used to modify a location, but indirect object relatives and genitive relatives did not occur in the data.

Brandt, Diessel, and Tomasello (2007) observed a similar developmental pattern in German. Examining a corpus of 783 finite relative clauses produced by a German-speaking boy aged 2;0 to 5;0, they found that subject relatives are dominant among the earliest relative clauses; but with age the proportion of direct object relatives and adverbial relatives increased. Indirect object relatives and genitive relatives did not occur in the data.

In what follows I present the result of an experimental study that sheds some light on the acquisition of the internal properties of relative clauses. The study compares the development of relative clauses in English and German, in which the formation of relative clauses involve two different strategies (cf. Diessel and Tomasello 2005). Disregarding *who*relatives, English uses the gap strategy in which the relativized syntactic role is indicated by a missing element in the argument structure, whereas German uses the relative-pronoun strategy in which the relativized syntactic role is indicated by a case-marked relative pronoun at the beginning of the relative clause. Since the relativization strategies involve different processing procedures (see Diessel and Tomasello 2005 for a detailed discussion), it is a plausible hypothesis that the development of relative clauses proceeds differently in English and German.

In order to test this hypothesis, Diessel and Tomasello (2005) conducted a sentence repetition task (cf. Slobin and Welsh 1973) in which 21 English-speaking children and 24 German-speaking children repeated six different types of relative clauses: (1) transitive subject relatives, (2) intransitive subject relatives, (3) direct object relatives, (4) indirect object relatives, (5) adverbial relatives, and (6) genitive relatives. We distinguished between transitive and intransitive subject relatives because previous studies hypothesized that transitivity plays an important role in the formation and processing of relative clauses (cf. Fox 1987; see also Fox and Thompson 1990). Table 1 provides an example of each of the six test items that were used in the English and German study.

English	
This is the girl who played in the garden yesterday.	Intransitive subject (=S)
This is the girl who saw Peter on the bus this morning.	Transitive subject (=A)
This is the girl who the boy teased at school yesterday.	Direct object (=P)
This is the girl who Peter borrowed a football from.	Indirect object (=IO)
This is the girl who Peter played with in the garden.	Adverbial (=ADV)
This is the girl whose horse Peter heard on the farm.	Genitive (=GEN)
German	
Das ist der Mann, der gestern hier gearbeitet hat.	Intransitive subject (=S)
Das ist der Mann, der mich gestern gesehen hat.	Transitive subject (=A)
Das ist der Mann, den ich gestern gesehen habe.	Direct object (=P)
Das ist der Mann, <u>dem ich das Buch gegeben habe</u> .	Indirect object (=IO)
Das ist der Mann, mit dem ich gesprochen habe.	Adverbial (=ADV)
Das ist der Mann, dessen Hund mich gebissen hat.	Genitive (=GEN)

Table 1. Experimental stimuli (Diessel and Tomasello 2005)

As can be seen, the relative clauses were attached to the predicate nominal of a copular clause. We also used test sentences with transitive main clauses, but since we were especially interested in relative clauses that children commonly use in spontaneous speech, the focus was on PN-relatives. All test items were of the same length and were controlled for various semantic and pragmatic factors. Figure 4 shows the percentages of the children's correct responses to the six types of relative clauses.



Figure 4. Correct responses (Diessel and Tomasello 2005)

As can be seen, in both studies subject relatives (S- and A-relatives) caused fewer errors than direct object relatives (P-relatives), which in turn caused fewer errors than indirect object relatives (IO-relatives) and adverbial relatives (ADV-relatives); genitive relatives (GEN-relatives) were almost always incorrect. The overall results are similar for English and German. Where the two studies differ is in the domain of object and adverbial relatives. The English-speaking children basically produced the same number of errors in response to these relative clauses (i.e. the differences were not significance); but the German-speaking children had significantly fewer problems with direct object relatives than with indirect object relatives and adverbial relatives.⁴ In particular, the adverbial relatives caused many more problems in the German study than in the English study.

How do we interpret these data? Let me begin with the subject relative clauses. Why did subject relatives cause little problems? What makes them so easy? In order to answer this question, we have to look at the errors in the children's responses.

One of the most striking outcomes of this study was that both English- and Germanspeaking children made one very common type of mistake: they often converted object and adverbial relatives to subject relatives. The English-speaking children converted them by changing the word order (cf. example 26), and the German-speaking children converted them by changing the case role of the relative pronoun (and other case markers in the relative clause) (cf. example 27).

(26)	TEST ITEM:	This is the girl who the boy teased at school this morning.
	CHILD:	This is the girl that teased the boy at school this morning.
(27)	TEST ITEM:	Da ist der Mann, den das Mädchen im Stall gesehen hat.
	CHILD:	Da ist der Mann, der das Mädchen im Stall gesehen hat.

But interestingly, children were not consistent in making this type of error. Sometimes they converted a given relative clause, and sometimes they repeated the clause correctly. What is more, the children often noticed that they had made a mistake and repaired the conversion error before the end of the sentence (cf. examples 28-29), suggesting that at least some of the children were able to produce object and adverbial relative clauses correctly despite the fact that they often changed them to subject relatives.

- (28) This is the girl who bor/ Peter borrowed a football from.
- (29) Da ist der Junge, <u>der/ dem Paul ... die Mütze weggenommen hat</u>.

These data suggest that the bulk of the conversion errors did not result from a lack of grammatical knowledge. But how then do we account for the errors? I suggest that the conversion errors are primarily due to the fact that subject relatives are more easily activated than other types of relative clauses.

One of the factors determining the ease of activation is frequency of occurrence: the more frequently a grammatical construction occurs, the more deeply entrenched it is in mental grammar, and the easier it is to active in language use (cf. Bybee 2006; Bybee and Hopper 2001). Thus, one might hypothesize that subject relatives are more easily activated than other types of relative clauses because they are more frequent.

However, if we look at children's spontaneous relative clauses we find that while some children begin to use subject relatives before object relatives, older children make common uses of both types of relative clauses. In fact, two of the English-speaking children examined in Study 1, Adam and Abe, used object and adverbial relatives eventually more frequently than subject relatives. What is more, there is no evidence that subject relatives are more frequent in

⁴ The difference between direct and indirect object relatives is only marginally significant (see Figure 4).

the ambient language than object relatives. Diessel (2004) examined the relative clauses of four English-speaking mothers from the CHILDES database. In his data, more than 50 percent of the mothers' relative clauses are direct object relatives and only 35.6 percent are subject relatives (the rest are adverbial relatives), suggesting that input frequency alone does not explain why subject relatives are so easily activated. But what then accounts for the ease of activation?

I suggest that children tend to activate subject relatives more easily than other types of relative clauses because subject relatives denote the actor (or agent) prior to any other thematic role. In fact, when subject relatives are attached to the predicate nominal of a copular clause, they are only little different from simple sentences: they involve the same order of grammatical relations than simple main clauses, whereas all other relative clauses express the object before the subject (cf. Bever 1970). This does not explain why intransitive subject relatives caused fewer errors than transitive subject relatives, but it provides an explanation for children's good performance on subject relatives, which has also been observed in many other studies (cf. de Villiers et al. 1979; Tavakolian 1977; Clancy et al. 1986; Hamburger and Crain 1982; Corrêa 1995; Kidd and Bavin 2002). I will come back to the difference between transitive and intransitive subject relatives in Study 3 and will now concentrate on the four other types of relative clauses.

I begin with the English study. Why did the English-speaking children basically produce the same amount of errors in response to direct object relatives, indirect object relatives, and adverbial relatives? Given that direct object relatives are more frequent than adverbial relatives and that indirect object relatives are basically absent from the ambient language, one would expect that direct object relatives cause fewer errors than indirect object relatives and adverbial relatives, but the differences between these three types of relative clauses is insignificant (see Figure 4). I suggest that these three types of relative clauses basically caused the same amount of errors in the English study because they involve the same word order, which is essential for the formation of relative clauses in English. As can be seen in (30), direct object relatives, indirect object relatives, and adverbial relatives include the same sequence of constituents (i.e. ... NP NP V ...), which contrasts with constituent order in subject and genitive relatives.

NP [V] _{REL}	subject
NP [NP V] _{REL}	direct object
NP [NP V] _{REL}	indirect object
NP [NP V] _{REL}	adverbial
NP [[GEN N] V] _{rel}	genitive
	NP [V] _{REL} NP [NP V] _{REL} NP [NP V] _{REL} NP [NP V] _{REL} NP [[GEN N] V] _{REL}

Note that in German object and adverbial relatives do not form a natural class. Each relative clause is marked by a different case form of the relative pronoun, so that structural similarities between object and adverbial relatives cannot affect the children's performance. Since direct object relatives are more frequent than indirect object relatives and adverbial relatives, the German-speaking children had significantly fewer problems with direct object relatives than with the two other types of relative clauses.

Note, however, that adverbial relatives caused more problems than indirect object relatives although the latter are basically absent from the ambient language. I suggest that the German-speaking children had particular difficulties with adverbial relatives because these relative clauses are structurally very different from all other types of relative clauses in German: they include a preposition before the relative pronoun whereas all other relative clauses, including indirect object relatives, begin with the relative pronoun.

(31)	der Mann, der	subject
	der Mann, den	direct object

der Mann, dem	indirect object
der Mann, mit/von dem	adverbial
der Mann, dessen N	genitive

Finally, we have to ask why genitive relative clauses were almost always incorrect. One of the reasons why children had great difficulties with genitive relatives may be that genitive relatives do not occur in the ambient language; but input frequency alone cannot account for children's poor performance on genitive relatives because indirect object relatives caused significantly fewer problems than genitive relatives despite the fact that both types of relative clauses are basically absent from the ambient language. Both genitive and indirect object relatives are extremely infrequent in the input, but children had fewer problems with indirect object relatives than with genitive relatives because genitive relatives are very different from all other types of relative clauses: they involve a different semantic link between the head and the relativized element and their constituent structure is completely different.

To summarize, there are various factors influencing the acquisition of the internal properties of relative clauses. One important factor is the frequency of the various types of relative clauses in the ambient language. As we have seen, certain types of relative clause, notably subject and object relatives, are very frequent, whereas other types such as genitive and indirect object relatives are extremely rare. This is part of the reason why children had fewer difficulties with subject and object relatives than with other types of relative clauses. However, input frequency alone does not account for the data. In addition to frequency, there is another general factor that plays a key role in this study, namely the similarity (or relationship) between the various types of constructions:

- Subject relatives caused the fewest problems because they are similar to simple sentences, which children learn before they begin to produce relative clauses.
- English object and adverbial relatives caused basically the same amount of problems because they have the same word order.
- Indirect object relatives caused fewer problems than genitive relatives despite the fact that both types of relative clauses are basically absent from the input to preschool children because indirect object relatives are similar to other types of relative clauses.
- And genitive relatives and German adverbial relatives caused tremendous problems because they are very different from all other types of relative clauses.

Why is similarity so important? It is important because relative clauses are grammatical constructions, i.e. form-function pairings, that are related to each other in an associative network like lexical expressions (cf. Goldberg 1995, 2006; see also Diessel 2004: chap 2). Children acquire this network in a piecemeal, bottom-up fashion by relating new relative clause construction to constructions they already know. The development begins with subject relatives, which are only little different from simple sentences—they contain a single proposition and involve the same word order as simple main clauses (if they are embedded in copular constructions)—and it ends with genitive relatives that are most distinct from all other types of relative clauses.

Inspired by this research, Fitz and Chang (to appear) conducted a connectionist study in which a recurrent localist network (cf. Elman 1990) had to learn the various types of relative clauses from a training sample of simple and complex sentences. Interestingly, the model learned the various types of relative clauses in an order that reflects the children's difficulty in the above experiment; that is, S-relatives were mastered before A-relatives, which in turn were learned before P-, IO-, and OBL-relatives (GEN-relatives were not included in the study). One of the factors determining the network's performance was input frequency; but in accordance with the Diessel and Tomasello study, the network's performance was also affected by the similarity between constructions. Manipulating the constructions in the training sample, Fitz

and Chang observed that the network's performance on relative clauses varied with the types of simple (and complex) sentences to which the model was exposed during training, suggesting that the emergence of a particular type of relative clause is determined by its similarity to simple sentences and other types of relative clauses. Specifically, Fitz and Chang argued that it is the frequent occurrence of the fragment 'THAT VERB' as opposed to 'THAT ARTICLE NOUN' that facilitated the emergence of subject relative clauses.

Study 3

In accordance with much previous research, Study 2 showed that children have fewer difficulties with subject relatives than with object relatives. The same asymmetry between subject and object relative clauses has been found in numerous experimental studies in adult psycholinguistic (e.g. Wanner and Maratsos 1978; Frauenfelder, Segue, Mehler 1980; Holmes and O'Regan 1981; Ford 1983; MacWhinney and Pleh 1988; King and Just 1991; Just and Carpenter 1992; Cohen and Mehler 1996; Waters and Caplan 1996). What all of these studies suggest is that adult speakers find object relative clauses more difficult to process than subject relative clauses. However, recent research has shown that the processing difficulty of object relatives is crucially affected by semantic and pragmatic factors that have been ignored in older studies (Trueswell et al. 1994; Traxler et al. 2002, 2005; Warren and Gibson 2002, 2005; Mak et al. 2002, 2006; Reali and Christiansen 2007; Gennari and MacDonald in press).

Two factors are important. First, a number of studies have demonstrated that the semantic feature of animacy is an important determinant of the processing of relative clauses in adult language (cf. Trueswell et al. 1994; Traxler et al. 2002; Mak et al. 2002, 2006; Gennari and MacDonald in press). For instance, Mak et al. (2002) conducted a reading time experiment with Dutch-speaking adults in which animacy had a differential effect on the processing of subject and object relatives. Using four different stimuli (see Table 2), they found no significant different in reading times between subject and object relatives if the subject of the relative clause is animate and the object relatives cause longer reading times than subject relatives (cf. stimuli 3 and 4).

	TEST ITEMS	SUBJECT	OBJECT	TYPE OF RC
1	The burglars who stole the computer	animate	inanimate	subject
2	The computer that the burglars robbed	animate	inanimate	object
3	The burglars who robbed the occupant	animate	animate	subject
4	The occupant who the burglars robbed	animate	animate	object ***

Table 2. Experimental items (Mak et al. 2002)

Second, several experimental studies have shown that the processing difficulty of an object relative clause is affected by the type of subject it includes. For instance, Warren and Gibson (2002) found that object relative clauses including a first or second person pronoun as subject (i.e. *I, you,* or *we*) have shorter reading times than object relative clauses including a proper name, which in turn have shorter reading times than object relatives including a lexical subject, especially when the subject is indefinite (see also Warren and Gibson 2005). Warren and Gibson argue that the NP type of the subject influences the processing of object relative clauses because it correlates with the accessibility of the referent (cf. Ariel 1990; see also Givón 1983). Other things being equal, the higher the subject on the accessibility scale, the lower the processing load of the relative clause (see Gordon et al. 2001, 2004 and Reali and Christiansen 2007 for alternative explanations).

Building on this research, Kidd et al. (2007) conducted a sentence repetition experiment with 4-year-old English- and German-speaking children in which they manipulated the

animacy of the head and the NP-type of the subject. In accordance with the literature in adult psycholinguistics, they found that an inanimate head and a pronominal subject reduce the children's difficulties with object relative clauses.

In what follows I report the results of a corpus investigation examining the semantic features of subject and object relative clauses in the speech of two English-speaking children from the CHILDES database, Adam and Abe (see above). Adam's corpus includes a total of 178 finite relative clauses, and Abe's corpus consists of 305 finite relative clauses. The study is limited to these two children because the transcripts of the two other children, Nina and Sarah, did not include enough relative clauses to investigate the correlations between semantic and syntactic features in their data.

In a first step, I examined the relationship between the relativized syntactic role and the animacy of the noun that is modified by the relative clause. As can be seen in Table 3, both categories were coded as dichotomous variables. Specifically, I distinguished between subject and non-subject relatives and animate and inanimate nouns.

	RELATIVIZED ROLE		ANIMACY OF THE HEAD	
	Subject	Non-subject	Animate	Inanimate
Adam	62 (35.4%)	113 (64.5%)	40 (22.9%)	135 (77.1%)
Abe	130 (42.6%)	175 (57.4%)	63 (21.0%)	242 (79.0%)
TOTAL	39.1%	60.9%	21.9%	78.1%

Table 3. Frequencies of relativized role and animacy of the head

Note that the vast majority of the children's relative clauses are attached to an inanimate noun. Overall, an average of 78.1 percent of their relative clauses modify an inanimate noun and only 21.9 percent occur with an animate noun. Pre-examination of the data revealed no significant difference between the two children, suggesting that they basically produced the same types of relative clauses. Figure 5 shows the relationship between the animacy of the head and the relativized syntactic role.



As can be seen in this figure, subject relatives are common with both animate and inanimate nouns; there is only a small difference between them. But non-subject relatives (i.e. object and adverbial relatives) are much more frequent after inanimate nouns: overall more than 90

percent of the non-subject relatives modify an inanimate noun. A χ^2 -test for independence revealed a significant association between the animacy of the head and the syntactic function of the relativized role, suggesting that the semantic feature of animacy is an important determinant of the children's spontaneous relative clauses ($\chi^2 = 75, 15$; df = 1; p < 0.001).

Interestingly, the majority of the children's non-subject relatives include a transitive verb; intransitive verbs occur only in some of the adverbial relative clauses (e.g. *That's the pumpkin that I was standing next to*), whereas subject relatives are mostly intransitive: 66.7 percent of the non-subject relatives include an intransitive verb and only 33.3 percent include a transitive verb (cf. Diessel 2004).⁵ Interestingly, transitive and intransitive subject relatives are headed by different semantic types of nouns. As can be seen in Figure 6, while transitive subject relatives are much more frequent after inanimate nouns ($\chi^2 = 16,29$; df = 1; p < 0.001).



Note that about one third of the intransitive subject relatives are copular clauses including the copula *be* (*Some apples that were sweet*; Abe 3,6); but even if we disregard copular clauses, 67 percent of the intransitive subject relatives are attached to an inanimate noun. If we consider the intransitive subject relatives more closely we find a correlation between the meaning of the head and the meaning of verb: while unergative verbs occur with both animate and inanimate nouns (cf. examples 32 and 33), unaccusative verbs are exclusively used with inanimate nouns. Note that most of the unaccusative verbs are transitive verbs in the passive (cf. example 34); true unaccusative verbs are rare (cf. example 35).

(32)	The doggie <u>that runs away</u> .	[Adam 3,8]
(33)	Look at that big truck going some place.	[Adam 3,0]
(34)	No that one that couldn't be snapped.	[Abe 3,6]
(35)	I take the ones that fall out.	[Adam 4,0]

Animacy is an important ontological category that is often reflected in linguistic structure (cf. Comrie 1989); but animacy is not the only semantic features that correlates with structural properties in children's relative clauses. There are other, more fine-grained semantic categories that vary with the relativized syntactic role. In a second step, I divided animate and

⁵ The predominance of intransitive subject relative clauses has also been observed in adult language (Fox and Thompson 1990).

inanimate nouns into several semantic subclasses. Animate nouns were divided into humans and animals, and inanimate nouns were divided into things, machines, and locations. The five semantic categories of the head were crossed with four relativized syntactic roles: (i) transitive subject (i.e. A), (ii) intransitive subject (i.e. S), (iii) direct object (i.e. P), and (iv) adverbial (i.e. ADV). Figure 7 shows the proportion of the various structural types of relative clauses after different semantic types of nouns.



As can be seen in this figure, after human referents, subject relatives are predominant; after animals and machines, subject and object relatives are about equally frequent; after things (including abstract entities) object relatives are dominant; and after place nouns the relativized syntactic role typically functions as an adverbial.

How do we account for these relationships? Why are different structural types of children's relative clauses associated with different semantic roles? I suggest that the semantic biases in children's spontaneous relative clauses reflect the prototypical link between grammatical relations and semantic roles. One can think of the relationship between syntactic functions and semantic roles as an associative network that emerges from children's experience with language: the more often a semantic role is expressed by a particular syntactic category, the stronger the associative link between form and meaning (cf. Figure 8).



Figure 8. Association between grammatical function and meaning

Since the associations are largely independent of the clause type, it is a reasonable hypothesis that children acquire this network before they begin to produce relative clauses based on their experience with simple sentences (cf. Diessel and Tomasello 2005). When they begin to produce relative clauses, the network is so deeply entrenched that it is automatically transferred to complex sentences: a human referent in the main clause is associated with the subject in the relative clause; a noun denoting an object or thing in the main clause is automatically interpreted as the object in the relative clause; and a locative expression is automatically linked to an adverbial. This explains why children and adults have fewer difficulties with object relative clauses that are attached to inanimate nouns than with object relatives that modify animate nouns.

Note, however, that the association between grammatical relations and semantic roles is skewed in subject and object relative clauses. Disregarding intransitive subject relatives with a single referent, I examined the animacy features of subject and object (or adverbial) in children's relative clauses with two nominal referents.⁶ Figure 9 shows that subject and non-subject relative clauses include very different pairings of animate and inanimate nouns.



Figure 2. Animacy of subject and object (or adverbial) in subject and non-subject relatives

While subject relatives occur with various combinations of animate and inanimate nouns, non-subject-relatives are strongly skewed in favour of one particular type: 87 percent of the children's non-subject relative clauses contain an animate subject and an inanimate object (or adverbial); all other types are infrequent, suggesting that subject and object relatives tend to denote different types of situations. Specifically, object relatives denote situations in which the subject is higher on the animacy hierarchy than the object (or adverbial), whereas subject relatives are commonly used with two nominal referents that are equal in terms of their animacy features.

⁶ In relative clauses with more than two referents I concentrated on the core roles, i.e. subject and object, and disregarded adverbials.

Moreover, the two types of relative clauses occur with different types of subjects. The vast majority of the children's non-subject relative clauses include a first or second pronoun as subject. As can be seen in Figure 10, 79.0 percent of the non-subject relatives are of this type (cf. Fox and Thompson 1990, 2007); the rest occur with third person pronouns (7.8 percent), definite NPs (10.4 percent), and a few indefinite nouns (1.9 percent).

The subjects of subject relative clauses are radically different. Subject relatives do not occur with first or second person pronouns, but are primarily used with lexical nouns as subjects: 76.1 percent of the children's subject relatives are attached to a common noun functioning as subject inside of the relative clause. Note that almost half of the nouns are indefinite, introducing a new referent into the discourse.



Figure 10. Subject NP-type in subject and non-subject relatives

Thus, the two types of relative clauses occur with very different types of subjects: non-subject relatives occur with highly accessible subjects referring to the speech participants or other well-known referents (e.g. expressed by proper names), whereas the subjects of subject relatives are third person referents that often introduced a new discourse referent.

Finally, subject and non-subject relatives include different types of verbs. As pointed out above, the majority of the children's subject relatives include intransitive verbs, notably copula verbs are very common, whereas non-subject relatives are usually transitive; only some of the adverbial relatives are intransitive. What is more, even if we exclude intransitive relative clauses, there is a remarkable contrast between subject and non-subject relatives. As can be seen in Figure 11, non-subject relatives include a much larger proportion of activity verbs than subject relatives: 59.9 percent of the non-subject relatives occur with an activity verb such as *make*, *do*, or *eat*, whereas subject relatives are commonly used with stative verbs such as *have*, *own*, or *belong*. Moreover, while non-subject relatives include many cognition, perception, and communication verbs (e.g. *say*, *know*, *see*, *want*), these verbs rare in subject relatives.



Figure 11. Transitive verbs in subject and non-subject relatives

In general, the verbs of non-subject relative clauses tend to be high on the transitivity scale; they often include a prototypical transitive verb selecting an agent and patient or else denote a cognitive or verbal activity. By contrast, subject relative clauses are low in transitivity. The majority of the children's subject relatives include an intransitive verb and those that do occur with a transitive verb (i.e. a verb with two mandatory participants) are often stative selecting a non-agentive subject and a theme as object.

How do we account for these data? I suggest that the semantic contrast between subject and non-subject relatives reflects the fact that they are used with different pragmatic functions (cf. Fox and Thompson 1990). Subject relatives are low in transitivity because they are primarily used to characterize a discourse referent, which is often newly introduced in the preceding main clause. By contrast, object relatives are high in transitivity because they are commonly used to identify (or to retrieve) a referent that is defined by its relationship to one of the speech participants or some other well-known person (or object) that grounds the referent in the universe of discourse.

Note that while subject relatives involve the same order of grammatical relations as declarative sentences, they are semantically very different from simple sentences. As can be seen in Table 4, while non-subject relatives basically occur with the same types of nouns and verbs as simple sentences, subject relatives are radically different: they include more inanimate subjects, more lexical subjects, and more stative verbs than simple sentences, suggesting that subject relatives are semantically 'unusual' sentences. Both types of relative clauses are grammatical constructions with particular structural properties that are paired with specific semantic and pragmatic features.

	Subject	Non-subject	Simple
	relatives	relatives	sentences
Animacy of subject			
(i) Animate	55.6%	92.2%	96.1%
(ii) Inanimate	44.6%	7.8%	3.9%
NP-type of subject			
(i) pronominal	24.0%	87.6%	90.3%
(ii) lexical	76.0%	12.3%	9.7%
Meaning of transitive verbs			
(i) Activity	28.7%	59.9%	57.9%
(ii) Cognition/communication	5.7%	29.8%	32.7%
(iii) States	65.6%	10.4%	9.4%

Table 4. The meaning of children's relative clauses in comparison to simple sentences

Conclusion

This paper has argued that relative clauses constitute a network of constructions that children acquire in a bottom-up way. Three studies have been discussed. The first study examined the structure and meaning of the external properties of children's early relative clauses in spontaneous speech. The study showed that the earliest relative clauses are embedded in complex sentences with particular communicative functions in which the main clause is either propositionally empty or low in transitivity. Most of the constructions including early relative clauses are similar to simple sentences in that they denote a single state of affairs. The second study was an experimental study investigating how children process the internal properties of English and German relative clauses. In accordance with much previous research, the study showed that subject relatives cause fewer difficulties than object and adverbial relatives, which in turn are easier to process than genitive relatives. Examining the children's errors, it was argued that, apart from input frequency, the similarity between simple sentences and the various types of relative clauses is an important determinant of the acquisition process. Since subject relatives involve the same sequence of subject, verb, and object than simple sentences, they tend to cause fewer problems than other types of relative clauses, suggesting that the development of relative clauses is influenced by the children's prior knowledge of simple sentences. Finally, the third study examined the semantic and pragmatic properties of children's spontaneous subject and non-subject relatives. The study showed that the two types of relative clauses tend to denote different types of situations. Non-subject relatives typically include a first or second person pronoun as subject that is involved in a dynamic activity, whereas subject relatives occur with lexical subjects that are commonly embedded in intransitive clauses or transitive clauses that are low in transitivity. It was argued that the semantic differences between subject and non-subject relatives reflect differences in their pragmatic functions. While subject relatives are commonly used to describe (or to characterize) a referent, which is often newly introduced in the preceding main clause, nonsubject relatives are primarily used to identify (or to define) a referent by specifying its relationship to one of the speech participants or another well-known referent.

In sum, the acquisition of relative clauses is determined by multiple factors: the ambient language, the communicative interaction between parent and child, the similarity between constructions, and the complexity of the various types of relative clause. The earliest relative clauses that English-speaking children learn occur in particular constructions that share important properties with simple sentences: they contain a single proposition, involve the same sequence of grammatical relations, and the same associations between syntactic and semantic roles. Starting from such simple structures children acquire the network of relative clause constructions by extending constructions they know to slightly different grammatical patterns, which gradually increase in complexity. From this perspective, linguistic complexity results from many small extensions giving rise to intricate grammatical patterns that share individual properties with other grammatical patterns in the gradually emerging network of constructions.

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'STARTING SAMLL' EFFECTS IN THE ACQUISITION OF EARLY RELATIVE CONSTRUCTIONS IN SPANISH

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Abstract

Early Spanish relative constructions (RC) give evidence of various "*starting small*" processes (Elman, 1993) in children's development of complexity: Dialogue framing (half of the RCs are dialogical co-constructional results); adjunction, non embedding (CRs take an absolute position or do not expose and intonation integration); CRs structure similar to an independent clause type, with no gap nor genuine 'relative' function for the relative pronoun; Exemplar based acquisition with no default entrance but individually preferred constructional frames. All these phenomena point towards a non linear, frequency affected, and functionally oriented, experience based learning.

STARTING SAMLL' EFFECTS IN THE ACQUISITION OF EARLY RELATIVE CONSTRUCTIONS IN SPANISH

1. PRESENTATION

Spanish relative constructions basically produced with a relative pronoun strategy (RCs), are unanimously recognized as complex structures¹. RCs are credited to combine in a reduced constructional space a set of various operations: embedding; head dependence, and possible head anaphoric marking; focusing of an internal constituent; correference calibration of the focused constituent; correference marking –through a relative pronoun (REL), in an initial position, keeping internally a constituent gap (S and O relatives) or a resumptive pronoun (RES) (f.i., IO relatives) (Brucart, 1999). According to this set of properties, shared across languages, relative constructions have been considered by necessity to be a late developmental achievement (Echeverría, 1978; Hurtado, 1984).

Syntactic renditions of RCs acquisition tend to propose a default entrance, selected among possible options in terms of simplicity, markedness and lower processing cost, paired to a linear developmental path going from simpler to complex, unmarked to marked, accessible to unaccessible. So, RCs studies have based their developmental hypothesis upon the relativization accessibility hierarchy: subject > object > oblique > possessive (Keenan & Comrie, 1977; Barriga, 2002); a processing motivated preference (cf. Prideaux & Baker, 1986) to have the same function in the antecedent NP and REL: S[S] and O[O], rather than S[O], or O[S] (Echeverría, 1978; Hurtado, 1984; Sicuro-Corrêa, 1995). A simpler syntactic structure, with adjoined (Hale 1976) or conjoined types of RC structures to be preferred over embedded ones (Tavakolian, 1981). Lexically headed rather than determiner headed RC to be textually dependent and/or anaphoric reductions of lexically headed constructions (Bello, 1847/1988: §§ 323-325; Brucart, 1999).

Despite the appealing and elegant predictions that might point towards a converging default as a starting point for children to develop RCs, it is a well known fact that children data on various constructions and categories development have proved to be reluctant to expose initial defaults (Dabrobska, 2001; Gathercole, Sebastián & Soto, 1999; Rojas, 2004), or to honor abstract principles of grammatical models (Dabrowska & Lieven 2005; McClure, Pine & Liven, 2006; Lieven, Pine & Baldwin, 1997; Tomasello, 2000; 2003; etc.).

This is one of the foundational points in recent studies on RCs development inspired by Usage based theory of language acquisition, where no RC *default* is even mentioned (Diessel, 2004).² According to this view it is argued that children start to produce early RCs, not necessarily following the abstract predictions of syntax, but rather exposing the effects of experienced familiar use from which children adopt selective and lexically specific construction frames –i.e., form-function pairs–, which despite its apparent complexity, are in fact monopropositional in nature, and expose a unified communicative

¹ Gerundive constructions are heavily restricted and normatively stigmatized.

² Cf. also, Diessel & Tomasello 2001; Diessel & Tomasello, 2005; Kidd, Brandt, Lieven & Tomasello, 2007; Tomasello, 2003.
intent. In his fundamental study, Diessel (2004) elaborates extensively this point. Early RCs are mainly presentational constructions (*Here is a rabbit that I'm patting*: Diessel 2004: 3), which Diessel considers to be syntactically simple despite their complex appearance, since they correspond to a single assertion, and are dedicated to introduce new referents in discourse (Lambrecht, 1988; Moreno Cabrera, 1999).

The evidence there presented points towards one of the main proposals in Usage based research: that early RCs are based upon concrete exemplars experienced by a child. This experienced usage, by definition situated, particular and individual, is the rough material from which the child extracts chunks and pieces –not necessarily atomic–, whose possible formants are latter analysed and gradually organized, when every child finds internal patterns and regularities, and builds analogies, relations and organize a network among them (Tomasello, 2003). We must be aware that these early selected exemplars neither reproduce nor obliterate by definition the abstract regularities supposed to define linguistic facts; but they perform-expose those regularities in a probabilistic way, with all the haphazard and vagaries, also preferences and dominance, that real, situated, dialogically framed, concrete language use has in a particular ecological niche (Givón, 2008).

On the other side, Diessel interpretative proposal that supposed complex constructions like the presentational ones (or for the matter, other constructions in the space of complex clause constructions, as Diessel argues), are in fact simpler, monopropositional ones, may be considered as a 'starting small' type of argument.

Effectively, evidence has been obtained in other developmental and problem solving spaces, that *starting small* may be a way to enter complex systems (Elman, 1990; Newport, 1990; Seidenberg, 1999). Under this view, complex tasks may not be detected as complex but reanalyzed as simpler and, once and so reduced, they may be solved by simpler means (Newport, 1990; Rojas, submitted; Seidenberg, 1999). This would be a plausible case for early RCs in apparently complex frames that may be worked as simple ones.

Building upon both aspects of this proposal -Usage-based, and starting small–, this study will enter the analysis of pro-RC development in Spanish. Following classical (Bowerman, 1979; Braine, 1976; Limber, 1973), and recent child language studies on clause combining (Diessel 2004; Diessel & Tomasello, 2000 and 2001; Rojas, submitted), we can argue that children have their own, concrete and simple way to enter complex constructions based on their individual experience. This piece of research on RCs development would rely, hence, on the expectations that i) children will adopt particular frames with lexical specificities, not so much guided by markedness or complexity criteria, but closely affected by experienced use, and ii) with the effects of a percolation of complexity through their own processing resources.

The following research questions will guide this analysis:

- How complex are relative constructions in early language?
- Do we get evidence of the initial selection of less complex structures- sort of defaults?
- Can we trace back starting small effects in children's data?

2. The data

The data to be considered here comes from the *corpus ETAL*: *Etapas tempranas en la adquisición del lenguaje* (Early stages in language acquisition), pertaining to the Instituto de Investigaciones Filológicas, at the Universidad Nacional Autónoma de México (Rojas, 2007a). Attention will be focused to three subjects: two girls and one boy. They are all Spanish monolingual children of urban educated families. Age range considered goes from last observation (4;02 ~ 4;00) down to first two videos with no attested RC documentation (2;3 ~ 3;04). Usual criteria for data selection have been followed: only spontaneous child produced constructions have been considered, and no successive reiterations have been counted.

	Observations	Child conversational	Age range (in months)	Time	RCs
FLOR (Fem)	31-67	24 318	27 m – 48 m	74 hrs	188
ELIA (Fem)	20-29	7,244	40 m - 50 m	20 hrs.	80
JULIO (Male)	20-30	8,835	37 m – 48 m	22 hrs.	44
Total	57	40,397	27 m – 50 m	116 hrs.	312

Analysis will consider only RCs marked by the relative pronoun *que* (1i-1v), which sum a total of 312 tokens. Other RCs marked by *cual* 'which' *quien*, 'who', *cuyo* 'whose', are absent in children's data. The infrequent cases with other relative markers, like *donde* 'where' (2a), and *cuando* 'when' (2b), with or without exposed head, have not be considered and were not counted in data presentation in table 1.

Que-relatives may be lexically-headed by a noun phrase or a bare noun (1i); they also take a pronoun (1ii-1iii) or a determiner (1iv-1v) as a head. These last ones –determiner headed relatives (DET REL)– expose a definite determiner marked for number and gender (*el, la, lo* 'the-m/f/n') plus a REL (1iv-1v). Various arguments are made on DET being a derived head or anaphoric trace of the lexical omitted head (Brucart, 1999). Since this DET was historically a demonstrative, it is possible that it will keep some indexical force, and it needs not by definition be anaphoric, but deictic. In our analysis and for data presentation, we will take DET to be an anaphoric/indexical head. But its status in children's grammar will be kept as an open question needing further and specific research.

- 1i) *una casita que tiene mucho espacio* one house-DIM REL have-PRS.3S much room *`a little house* that has lot of space'.
- 1ii) ese que tienes that REL have-PRS.2S *'that one* that you have'.

- viuna, una que teníaespumasee-PST1s one,one REL have-IMPF.3Sfoam'I saw one, one that had foam'.foam
- 1iv) estamos viendo lo que salpica be-PRS.1P see-GER DET REL splash-PRS.3S 'we are looking **what** (=the that) splashes'.
- 1v) *dame la que tiene puntitos* give-IMP=IO.1S DET REL have-PRS.3S spot-DIM-M-P 'give me the one that (lit. = the that) has little spots'.
- 2i) *Al* cuarto **a** donde se fue *Kiso* to=the room to where RFL.3S=go.PST.3S Kiso 'To the room **where** Kiso (dog's name) has gone **to**'.

2ii)	Un	día	cuando	estaba	pequeña	me ponía
	One	day	when	be-IMPF.3s	small	O1S=put-IMPF.1S
	'One da	ay when	I was small I us	ed to put on me	e (cream)'.	-

3. ANALYSIS

3.1 Starting points: Default or CRs diversity?

From the first RC documentations, it becomes clear that individual preferences are the sign for earliest relatives. Just taking in consideration the first five RC produced by each child we get a handful of different exemplars exposing various constructional frames: *a*) Both: FN headed and DET-headed RCs (3i-3iv vs. 3v). *b*) RCs with no internal predication (3i) or with an overt internal predication (3ii-3v), which may be ritual or formulaic (f. i., *encontrar* 'find' –4.i-4iv– for Julio). *c*) The relative pronoun (REL) may have no internal function (3i), or have a function lexically determined by the preferred/ritual predicate (*encontrar* 'find' determines an Object REL in 4i-4iv). *d*) As for embedding, RCs may exclusively be constructed with a free head, or inserted in a preferred/ritual verb frame: like *mira* 'look (imperative)' for Julio (4i-4iv), and *éste es* 'this/it is' for Elia (5i-5iii). On the contrary, in Flor's data, RCs mainly adhere to syntactically free NPs (3i-3ii).

Consider then the following first five exemplars from every child, which expose all these syntactically variegated constructional exemplars.

3) FLOR (2;03-2;04)

- 3i) M: ¿qué es eso? what's that?
 - F: la cama que agua, que...aquí the bed **REL** water, **REL**... aquí 'the bed that water, that ... here'

- 3iii) F: ese señor que sí tiene huevo that man REL AFF have-PRS.3S egg 'that man that really has (an) egg'
- 3iv) Mother (M) and Flor (F), engaged in book reading
 F: esa es la ropa this be.PRS.3S DET clothes
 'this is the clothes'
 M: ¿cuál?
 - 'which one'
 F: *que.*. *de ese nene es*REL, of that baby be.PRS.3S
 'that, belongs to that baby'
- 3v) F: mía *e que* se cayó look-IMP DET REL RFL.3S=fall.down-PST.3S look *the that* fell down 'look the one which fell down'
- 4) JULIO (3;01-3;02)
- 4i) J: mi(r)a-que'cont(r)ó
 look-IMP REL find-PST.3S
 'look that (=what) he found'
- 4ii) J: una, mí(r)a, que'cont(r)é! one, look-IMP REL find-PST.1S 'one, look that (what) I found'
- 4iii) J: mi(r)a-que'cont(r)é, velo look-IMP REL find-PST.1S, see-IMP=O.3S
 'look that (=what) I found, see it'.
- 4iv) J: *mí(r)a* la ata **que'**cont(r)é look-IMP the tire REL find-PST.1S 'look *the tire* **that** I found'
- 4v) Scene: J. shows M. a picture he's just made) J: *mi(r)a-que me quedó* look-IMP REL IO.1s=result-PST.1S
 'look that (=how) it resulted to me'

5) Elia (3;04)

- 5i) esta es **la casa** que estaba this be.PRS.3S the house REL be-COOP.3S 'this is *the house* **that** was'
- 5ii) esta es **mi diadema que** me trajo una amiga this be.PRS.3S my diadem REL IO.1S=bring-PST.3S a friend 'this is my diadem that a friend brough to me'
- 5iii) *tu pájaro es de las feas, las cosas horribles que no me gustan* your bird be.PRS.3S of the uggly, the things horrible REL NEG IO.1S=please-PRS.3P 'your bird is (one) of the uggly ones, *the horrible things* that do not please me'
- 5iv) *no te enseño éste, mi premio que me regaló Tana* NEG IO.2S=show-PRS.1S this, my price REL IO.1S give-PST.3S Tana 'I dont show you this one, *my price* that Tana gave to me'
- 5v) E: muerde

'it bites'

- M: ¿a quién? whom?
- E: *a unas personas* que *están llorando* to some person-P REL be-PR.3P cry-GER 'to *some persons* that are crying'.

Individual preferences

In sum, every child exposes a different profile for her earlier RCs: Flor and Elia prefer lexical heads + RC. Julio selects a verb frame, *mira* 'look' and no overt head. Elia adopts a different constructional frame: *éste es* 'this is NP REL, and also appends RCs to syntactically free NPs. Flor clearly prefers RCs with free NPs, and only exposes a single frame with *mira* 'look' (see Table 2 as a summary).

	Predica	te fram	Type of head			
	Lex-fixed		Free NP	NP	Pronoun	Det
			Heads			
Flor	mira DET REL	1	4	4	0	1
Julio	<i>mira @</i> REL	4	1	1	0	0
Elia	este es FN REL	3	2	5	0	0

1 able 2. First live KCs exemplars per chi
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These differences among early exemplars, which are individually selected, are only to be expected from probabilistic recurrent encounters with family usage data, and ratify that as

for syntactic complexity, there is not an initial default with a less complex status: no unique entrance to RCs, but rather a handful of individual preferences, lexically driven and partially ritual, which cut across the criteria credited to define a possible syntactic default.

Emergent regularities?

The earlier RCs, which clearly expose individual differences and no default, lead us to explore whether we could find latter some syntactic factors affecting children's RCs production, looking for possible structural patterns, which may emerge in the course of development.

In order to test RCs development, and the emergent regularities they might present, we will explore various syntactic variables credited to define RCs complexity:

- RCs external syntax: In this section the syntactic freedom or integration of CRs will be considered.

- RC internal syntax. Here we will focus on the adaptations presented by the RCs, in terms of the relative pronoun (REL) expected properties, to test its genuine pronominal character and syntactic function, concurrent or not with a gap presence.

In every case, we will track whether or not the possible regularities have a lexical source as a foundation; and we will pay attention to frequency and developmental chronology.

3.2 External syntax

Freedom and Embedding

Across the observed period and unexpectedly from any syntactic perspective, most RCs produced by our children do not clearly qualify as sentence embedded constructions (N 170=55%). They appear as isolated fragments, in an absolute position (ABS) with no exposed syntactic dependence but sequencing. RCs may be even in a different conversational turn, one turn distant from their possible head (7i-7iii).

7i) Mother and Flor (31), engaged in book reading Flor: *esa es la ropa*

esa es la ropa this be.PR.3S DET clothing 'these is the clothing'

Mum: ¿cuál?

'which one'

Flor: *que... de ese nene es* REL, of that baby be.PR.3S 'that, belongs to that baby'

7ii) Scene: Flor (41) is asking the mother a particular toy Flor. *juete nenes* toy babies 'babies' toy'
Mum: *cuál juguete de los niños?, cuál*? 'which children's toy? which one?'

Flor: *que se mueve* REL RFL.3S=move-PRS.3S 'that it moves'.

7iii) Scene: Jul (28) painting with watercolour markers which he has been asked to cover Jul: ayer yo tapé los otos, yesterday I cover-PST.1S the other 'yesterday I put the lid to other ones' *ae que me compó mi papá**DET REL OI.1S=buy-PST.3S my Dad 'the ones that my Dad bougth for me' *ayer, que me copó* yesterday REL OI.1S=buy-PS-3S yesterday, that he boutgh for me'.

This lack of integration of RC from any syntactic frame –even a head, as in the previous exemplars– may also involve [head RC], not just the RC. In these cases both head and RC keep apart from any main clause. This is a normal and frequent case in conversation, where [head RC] are the answer to a recurrent identification question: *cuál* 'which one' (8i-8ii).

8i)	Scene: Julio (26) has asked the aunt some water
	Aunt: a ver enséñame, ¿cuáles vasos?
	'see, show me, which glasses?'
	Jul: <i>(l)os vasos</i> que son (r)icos.
	DET glasses REL be.PRS.3P tasty
	<i>'the glasses that</i> are tasty'.

8ii) Scene: Elia (25) wants some toys from the upper shelf, which Observer tries to reach.

Eli:	la sirena
	'the mermaid'
Obs:	ay! no alcanzo, ¿ cuál sirena?
	'ay!, I can't reach up, what mermaid?'
Eli:	la de la que tiene este cola.
	DET of DET REL have-PRS.3S umh tail
	'the one with the one that has, umh tail'
Obs:	la que tiene cola, ah!
	'the one that has tail, oh'
Eli:	ésa.
	'that one'.

These and similar cases of [Head RC] with no syntactic integration can be argued to be a conversational result, prompted by the question asking for a referent identification: *¿cuál*? 'which one?' Such questions do settle a context for a free NP-RCs to occur in an independent conversational turn (Brucart, 1999).

But free [Head RCs] may also occur in the course of the child's own discourse, not only across dialogue turns. Children expose by themselves free [Head RCs], with no

conversational support, when involved in description activities (9i-ii) or when quarrelling or negotiating on reference, in a sort of 'referential competition' situation (Givón, 2008) (9iii).

- 9i) Elia (27), asking for a boy she had seen at Christy's home
 Eli: ¿y... y *el hijo que tenías*?
 and...and the son REL have-PST.2S?
 'and what about the son you had?
- 9ii) Flor (37) in a book looking activity, considering an image.
 Flor: un sodo que (es)tá mu(y) bonito a fox REL be-PR.3S very nice 'a fox that is very nice'.
- (9iii) Scene: Flor (35) discusses with Mom about the brush to be used to cumb her. Flor: no es mi cepillo 'it's not my brush' ete mi, et'e mi cepillo, es mi ce-... ete es mi cepillo 'this is my, this is my brush, my br-... this is my brush' Mom: ¿me dejas peinarte? 'will you permit me to comb you?'
 Flor: este que no es ese cepillo this REL NEG be-PR.3S my brush 'this one that is not that brush'.

Various discourse situations ask for elaborated reference. They are the ecological niche of noun phrases with an RC expansion, which adds to bare heads a specific information that characterize or helps to identify the focused item the head refers to.

Adding to the point that free RCs or [Head-RC] are not exclusively a dialogical coconstructional result, let's consider more elaborated sequences, where children keep both the lexical head and the RC joined together, but with an intonation brake parting them from the previous and supposedly main clause (10i-10v).

Among them, the clearer cases have both, an intonation brake and as a closure (CL): a pronoun or a noun phrase which takes in the main clause the position which otherwise [Head RC] might have taken. Then, after the intonation brake, CL is reformulated and elaborated by means of [Head-RC], as an appositive clarification (10i-10iv) –cf. similar previous cases in (1iii) and (5iv), not repeated here for economy–. These constructions overtly expose and mark that [Head + RCs] are independent constructions, not integrated to any previous main clause, but sort of antitopic phrases, which months later will occur preposed, with similar marking conditions (i.e. a pause and a closure) in a topic position (10iv-10v).

10i). Elia (23): *dame* ese, ese cuado, ese que lo tengo, que lo tengues give-IMP=OI.1S that, that square, that REL O.3S=have-PR.1S 'give me that one, that square, that one that I have, that you have' 10ii) Scene: Flor (34) with Granny (Grn)

- Grn: *voy a sacar una ropa que dejé en la lavadora*, 'I'm going to take out the clothes that I left in the washing machine'
- Flor: *me quiedo taela* (=traerla) IO.1S=want-PR.1S bring-INF=O.3S 'I want to bring them' *la la la opa que que dejates en la bebaloda.* the the clothes REL REL leave-PST.2S in the washing machine 'the clothes that you left in the washing machine'

10iii) Julio (25) and his aunt are looking some images

Jul: aquí, la eñata (=piñata) (pointing a stick) 'here, the piñata' Aunt: ¿qué?

what?

- Jul: ía, **eso**, **lo que tiene**. look-IMP, that, DET REL have-PR.3S 'look, that, what (lit. the that) he holds' Aunt: un palo. a stick.
- 10iv) Flor (52)

la que me la dio mi mamá, *ahora la voy a poner* DET REL IO.1S=O.3S=give.PST.3S O3S=go-PR.1S to put-INF 'the one my mother gave it to me, now I will put it'

10v) (Flor 64) talking about putting music in the tape-recorder una que tú no te sabes, pónmela one REL you NEG RFL.2S=know-PR.2S, put-IMP=O.3S 'One you don't know, put it for me'.

To consider the overall presence of free [Head-RCs] in children's data, see in table 3 the relative proportion of free constructions versus [Head RC] integrated to a predicative frame.

	Integ	rated RCs	Free	RCs	Total RCs
	Ν	%	Ν	%	\sum
Flor	91	.484	97	.516	188
Julio	24	.545	20	.455	44
Elia	27	.338	53	.662	80
Group	142	.455	170	.545	312

This table shows that more than half RCs do not fit some criteria used to credit them complexity. And this is the normal situation but for Julio, who as we have already seen, slightly prefers RCs integrated to a particular predicative frame with *mira* 'look'. The rest

of the children produces more [Head-RC] frames without any external syntactic function; they are not inserted in any clause, and are not syntactically dependent to any predicate. We do not have anything to say about sentence embedding here, since the frames are free NP plus RC, and in the extreme cases isolated RCs in an absolute position. We have anything to say either about the supposed functional parallelism between head and REL, since heads have no syntactic relation. What we have instead is a set of referential or deictic forms (pronominal, nominal, DET) with an appended RC, which jointly constitute a basic construction frame. Head-RCs have the type of relation that a complement has to the complementée, a sort of topic–comment relation, CRs are NP expansions, rather than embedded clauses. Moreover, early RCs are not necessarily appended to NP or PRO in the same turn. In effect, RCs themselves and [DET–RC] or [NP–RC] frames have in early child language a freedom that RCs alone will scarcely keep in adult language (Brucart 1999). In early child language, RCs seem to be parsed as possible independent frames that may occur alone, or associated to a NP, with which a stable frame [Head-RC] is early established.

Consider now table 4 to have an idea about how often free [Head-RC] are prompted by conversation, against the frequency of free constructions that rely on children's own adaptations: when producting and absolute NP-RC in one turn, or an intonation brake or a syntactic closure, part NP-RCs from a possible main clause.

	Σ	%
Isolated RCs	41	.240
Dialogic niche	48	.283
Intonation brake	32	.190
Pronominal closure	49	.287
Total	170	1.000

Table 4. Free Head RCs conditions

Here we can attest that important as it is in early child language the conversational support, dialogue is here just one type of context, though an early one, which only accounts for a quarter of free Head-RC constructions. Children can and do produce isolated [RCs], and independent [Head-RC] by themselves, with an intonation brake or a closure. In fact, jointly considered, children's own free [Head-RCs], with no dialogic support, are the most frequent and accessible way for children to integrate RCs in their discourse.

We have again positive evidence that [RCs] are first parsed as isolated pieces, linked with more or less fluency to a NP to form [Head-RCs] frames. These are early, self-contained and independent constructions, which serve as a basic niche for children to adopt the use of RCs. Although the ties between Head and RC may initially be also loose and Head and RC may be flanked by an intonation brake or even occupy each a different conversational turn.

Construction frames

Notwithstanding that isolated [RCs] and independent [Head-RCs] tend to be dominant in children's early production –as we have seen in table 3–, we already know that from the very first moment children also insert [Head-RCs] in various predicative frames, which in the earliest data (Table 2) are in fact item based (mainly, *mira* 'look' and este *es* 'this is...'). As previous work has established for their parallels, (Diessel, 2004) we can expect these particular frames will keep its initial readiness, and turn in time to be dominant.

The analysis of the lexical frames preferred by children across the period under study proves that in fact the frames first adopted *-mira* 'look' and *este es* 'this is' – become for children main discursive niches for RCs to occur. But children's individual preferences emerge early and keep operating across the period. And we attest in our data a wider frame diversity than previous studies would lead us to expect.

Julio, who has exposed from his first RCs a preference for the frame *mira* 'look', continues to use this frame as his dominant one (=32%). But he also has a set of secondary frames: *hay-había* 'there is/was [...]', *este es* 'this is [...]', *quiero* 'I want [...]', and a handful of constructions with various verbs, none of them particularly prominent: *ver* 'see', *tapar* 'cover', *prestar* 'lend', *prender* 'turn on' (see 12i-12iii).

- 12i) Julio (25), ritually starting to tell Little Red-hood story *bía-una vez una capeuceta.... que se llama ... Ju... Juya.*be-IMPF.3s one time a little-hood, REL RFL.3S=call-PRS.3S Ju... Julia
 'Once upon a time there was a Little Red Hood... whose name was... Julia'.
- 12ii) Julio (26) telling a riddle

ete's una señora que se va llevaruos huevosthis is a ladyREL RFL.3S=go.PRS.3S take.away-INFDET eggs'there was a lady that was going to take away some eggs'

12iii) Julio (26), playing with a lamp

pende la luz que sí es turn.on-IMP the light REL AFF be.PRS.3S 'turn on the light that it's the right one'.

Elia continues to select as a main frame the first one she uses: the presentative *este es* [...] 'this is ...' (=15%); but she also adds other presentative constructions: *tengo* [...], 'I/we have ...', and *aquí hay* [...] 'there is ...'; together again with a handful of activity verbs: *enseñar* 'show', *dar* 'give', *buscar* 'look for', *quitar* 'take out' (with one or two occurrences per verb type). (13i-13iii).

- 13i) Elia (23): *es unos juguete que son para jugar* be.PRS.3S DET toys REL be.PRS.3P to play-INF '(those) are some toy which are for playing'
- 13ii) Elia (24) (d)áme la mochila que tiene... give.IMP=IO1S the backpack REL have-PRS.3S 'give me, give me the back pack containing...'
- 13iii) Elia (25) *voy a buscar unos zapatos que son así, mira, éstos* go.PRS.1S to look.for-IMP DET shoes REL be.PRS.3S like.this, look, these 'I'm going to look for some shoes which are like this, loook, these ones'.

Flor, the child with a wider RCs production, adopts the frame *este es* [Head-RC] 'this is...', as her preferred one, though it was not among her earliest productions. This frame emerges

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at (F42: 2,06,4), two months after her initial verb framed RCs *mira* 'look', which also becomes recurrent. Besides, Flor uses two more frames built around *tengo* [...] 'I have ...' and *hay* [...] 'there is/are' which become partly prominent, and more frequent than *aqui está* [...] 'here it is'. She also incorporates other lexically free and rather diverse verb frames: *dar* 'give', *querer* 'want', *poner* 'put', *sacar* 'take out', etc. (14ii-iv) (Table 5 for details).

- 14i) Flor (34) from a window sees somebody has entered the courtyard *hay* una sudadera azul *que entró a la casa* there.is a t-shirt blue REL enter-PRT.3S to the house 'there is (a person with) a blue t-shirt coming into the house'
- 14ii) Flor (37) while eating and mentioning dirt things *yo ten(g)o p(l)ato que no tiene mugue* I have-PRS.1S dish REL NEG have-PST.3S ... dirt I have a dish that does not have dirt
- 14iii) Flor (34) asking for some toys in a bird's cage *ime das* os nenes que tene?
 IO.1S=give-PRS.2S DET babies REL have-PRS.3S 'will you give me the babies that (the cage) has inside?
- 14iv) Flor (44) ¿me cuentas un cuento que traiga un libro? OI.1S=narrate-PRS.2S a story REL bring-SBJ.PRS.3S a book? 'will you tell me a story that a book has?'

	Julio	Elia	Flor	Group
Predicate frames	26	27	72	
Frame types	11	12	28	39
Lexical verbs:				
Mira 'look-IMP'	13	0	5	18
este es 'this is'	3	14	24	42
<i>hay</i> 'there is/are'	3	3	5	11
quiero 'I want'	0	0	4	4
tengo 'I have'	1	1	6	9
vi/viste 'I saw/have you seen?'	1	0	4	6
<i>dame</i> 'give me'	0	1	4	5
oye 'listen-IMP'	0	0	2	2
<i>hace</i> 'he makes'	0	0	2	2
Various $(1 \text{ token/each})^3$	3	8	19	28

Table 5. Verb frames for [Head-RC] insertion

³ In adition to the verbs in the table list, the set of verbs with a [Head RCs] insertion are mainly transitive activity verbs which take O as an elaboration site: *buscar* 'look for', *cantar* 'sing', *cazar* 'hunt, *comer* 'eat', *contar* 'tell a story', *dejar* 'leave', *enseñar* 'show', *escarbar* 'dig', *llamarse* 'be called' *llevar* 'take', *necesitar* 'need, *pasar* 'pass', *pegar* 'hit' *prender* 'turn on', *prestar* 'lend',

These data lead us to conclude that there is no specific construction being a general default to anchor a [Head-RC] insertion. Although some constructions are first used and tend to be preferred as sort of attractor-frames, every child may select particular constructions, which may be similar to the ones other children prefer. But every child's selection for some particular frame has to be determined in close inspection to child's own data.

Despite this frame diversity it is not out of question that there may be a reason for the confluence and/or –on the opposite– individual preferences we attest; a possible functional assembly that may joint together a set of frames, which in some not overtly marked way are having the same effect, and probably doing the same operation.

In fact, it seems to be the case that what all these frames have in common is a slot position [...], where a focal NP can be inserted. This position tends to be the Object for most attested frames (look, I want, etc.); it may also be a Predicative position, if a particular child adopts *este es* 'this is' identificational-equative construction focusing a NP as her preferred frame. And it could equally possible have been an S, if the locative presentative frame *aquí está/n* –lit. here be.loc-PRS3s/p, meaning sort of 'here you are', 'here it is /they are' – had been preferred by some child; which has not been the case in these data, but could still be possible for another child.

Our data do not point towards a unique syntactic position, nor an item-based unique frame, but towards a set of constructions with an elaboration site: a slot where a prominent referential or descriptive NP is inserted; Objects being a well known position to put new focal information, as Subjects in intransitive verbs are (Clancy, 2003; Du Bois, 2003a; Givón, 1984). Not to insist on the informational prominence the construction *este es un/el* 'this is a/the...' projects upon the identificational noun phrase that takes the Predicate position. What we meet across the various syntactic frames that [Head CRs] take in discourse is a focus position that functions as an elaboration site (Kuno, 1987). And the same information property may be credited to [Head CRs] even when occurring isolated, in an absolute position: both, when prompted by WH-questions, which build a focus position for their answers, or as absolute NPs which are by themselves focal (Zubizarreta, 1999).

As for the various constructional frames involved in this focusing operation, this communality could be generalized by considering them presentative ones (f.i. Alfonso & Melis, 2007). I would rather insist on the focus side of the generalization, since dialogue prompted cases, or absolute [Head RC] frames give the same focusing result that conventional presentative frames do, despite not being inserted in any overt 'presentative' frame.

On the grammar side, it is true that when we consider this elaboration site in syntactic terms, we see that OBJ and PRED-NOM are the preferred syntactic position. They jointly represent the 81% of [Head-RCs] inserted in a predicate frame, with a frequency ranging between $96 \sim 85 \sim 68$ % in our children's data (see Table 6 bellow for their absolute proportions). However, this preference does not seems to depend upon some abstract

quitar 'take away', *sacar* ' take out', *tapar* 'cover', *tirar* 'throw away'. Only a few and infrequent intransitive verbs (*estar* 'be.loc', *llamarse* 'be called', *ir* 'go, *llegar* 'arrive') offer a Subject position as a [head RC] elaboration site.

properties of Objects or Nominal Predicates. We can trace back the dominance of particular syntactic position to an emergent effect of the lexical predicates in children's preferred constructions (Clancy, 2003; Du Bois, 2003), which include a slot to be worked out as an elaboration site.

	Syntactic I	Nule	Syntactic slot in a Predicative frame						$\sum \mathbf{RCs}$		
	Ν	%	0[]	%	PN []	%	S []	%	Obl []	%	
FLOR	97	.516	49	.261	13	.069	24	.128	5	.027	188
ELIA	53	.663	9	.105	14	.198	2	.023	2	.465	80
JULIO	20	.455	20	.455	3	.068	0	-	1	.022	44
Group	170	.545	78	.250	30	.096	26	.083	8	.026	312

 Table 6. External position of [Head –RCs]

At the end, what we can generalize is that it is not the deterministic effect of presentative frames adoption, nor any syntactic variable which define children's particular sites for [Head RC], but the joint effect of child's adoption of selective construction and the informational properties of those constructions, that have a focus position to elaborate and solve reference building and reference negotiation by means of a RCs which expands a referential or descriptive noun phrase.

3.3. Internal syntax

Clause adaptations

One of the main sources of complexity in canonical RCs refers to the internal adaptations the RCs expose: particularly the empty space or syntactic gap RCs have, the resumptive pronoun they may include, and the dual binding relation which relative pronouns operate: backwards referring to the head, onwards associated to the syntactic gap.

From a wider perspective, this problem is associated to a general issue, the modifications any dependent clause might present in its internal structure, *qua* dependent clause. We know well that clause linkage tends to be marked by clause internal adaptations, which range in a cline from null adaptations –so that a clause may not have any mark to expose its dependent status– towards various types of dependency marking, and a looser or tighter integration: from boundary marking, to illocutionary force integration, informational structure restrictions, and argument sharing or integration. Up to the positive side of this dependence cline, heavy reductions and internal marking are expected: uninflected verbs, subjunctive verb inflexion, and argument sharing reductions, dependent argument forms, and the like. The more marked adaptations side is expected to align with the more clearly embedded and dependent clauses (Aissen, 2004; Givón, 2007; Lehamn, 1988; Van Valin & La Polla, 1997).

The point to be explored onwards asks whether children's RCs do, or do not expose any adaptation that marks them to be dependent. For RCs the expected internal adaptations are mainly related to REL properties: correference and syntactic function. REL marks a correferential link between the head and the internal constituent in the RC, whose syntactic position REL is credited to occupy. Relativization accessibility (Keenan & Comrie; 1977)

considered from a Usage perspective leads to expect Subject REL will be the most frequent ones, followed by Object, Indirect Objects, and Oblique RELs. The point is a little bit tricky in Spanish, a subject dropping language, since any subjectless RC need not to be considered to have the subject represented by REL; the very same subjectless sentence could occur outside any dependent clause context and independently of REL presence.

Suspending for a while the supposed truth that internal subject omission in RCs is a proof of the binding and syntactic properties of REL in early child language, we will consider the evidence that children expose on their RC productions internal adaptations, that prove them to be dependent. But we expect RCs in child language be more similar to independent main clauses, despite REL presence. In effect, some recent experimental work on children's RCs has exposed the impact of RCs similarity to independent clauses on acquisition processes (Diessel & Tomasello, 2005). But previous studies of spontaneous data have not particularly emphasized this type of comparison.

Being REL function and binding properties the most conspicuous aspect of RC complexity, we will consider onwards, the syntactic properties of REL, in order to evaluate how adapted are Children's RCs to its dependent status, as compared to an independent clause.

REL function in question

Thematic association. In a similar vein to the embeddedness problem, the analysis of REL position and function in children's RCs give us the unexpected result that REL do not necessarily have any syntactic function to fill in RCs, which may have no clear syntactic gap nor constituent omission whose function will be in charge of REL pronoun. This is clearly seen in cases like (15i-15ii).

(15i) Julio (28) is telling Goldilocks and the three bears story

habíatlesositosquese caiuna niña la sillaexist-IMPF.3Sthreebear-DIM-PRELRFL.3S=fall-PRS.3Sone girl the chair'there were three bearsthat a child falls down from the chair'

(15ii) Elia (24)

mevoy a sabe(r)una canción que una casita es bonitaIO.1S=go-PRS.1S to know-INF a songREL a house-DIM be-PRS.3S nice'I will learn a songREL a little house is nice'

15iii) Flor (67) telling a story

era una niña **que** *el abuelito se metio en una, a un abujero de ratones* be.IMPF.3S a girl REL the grandfather RFL.3S=go-PST.3S in a, to a hole of mice 'there was a girls the her granfather went into a mice hole'.

Head NP are expanded in these cases by means of a RC configuration, which internally has no gap, nor trace, nor any evidence of structural dependence: only discourse continuity is kept in a lax way and the relation between Head and RC is a thematically supported one. This RCs, sort of 'syntactic *anacoluthon*', taken seriously and not merely considered anomalous, permit to envisage a possible and early way for children to build RCs. Children may work on the linking side of these constructions on the basis of a thematic association – a well known procedure to keep discourse continuity–, with no syntactic conditions to bind

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the RC to its external context and no modification on its internal form. REL would be in these cases just a sort of local continuity mark.

Resumptive linking. Together with these thematically linked RCs, with no internal adaptation, we have the same effects in RCs resulting from a Resumptive PRO strategy (RES). A pronoun takes the syntactic position expected to be associated to REL, leaving RCs with no internal gap. So children have a Possessive RES in CR instead of a genitive REL (16i); an IO-RES as in (16ii), instead of a case marked IO-REL.

- (16i) Elia (29) is narrating the life of a national hero when he was a child. *un pobre que se murió* sus papas a poor REL RFL.3=die-PST.3S POS.3P parents 'a poor (child) that his parents got dead' (=whose parent died)
- 16ii) Flor (44)

la nena que, la que le pusiste la piyama the baby REL, DET REL OI.3S=put.on-PST.2S the pajamas 'the girl that, the one you put her the pajamas'.

In colloquial adult Usage, RES-strategy is normal for IO-RELs and is quite frequent for GEN-RELs though grammarians proscribe them from writing. But children also produce Object-RES (17i-iii) and Subject-RES RCs (18i-ii), which in adult Usage are almost absent (O-RES), or plainly ruled out (S-RES).

17i) Elia (29) asking for some nasal drops (Object RES)
Eli: *unas, unas que las tengo aquí* some, some REL O3S=havePRS.1S here some, some that I have them here'.

17ii) Flor (52) (Object RES)

la que me la dio mi mamá, ahora la boy a poner DET REL OI.1S=O.3S=give-PST.3S my Mum, now O.3S=go.PRS.1S to put-INF 'the one **that** my Mum gave **it** to me, now I'm going to put it'.

- 17iii) Julio (29), excited tells about a baloon his father has just bought (Object RES) *mío, mi (gl)obo que me lo comp(r)ó* mine, my balloon REL OI.1S=O.3S=buy-PRT.3S 'mine, my balloon that he bought it for me'.
- 18i) Julio (30) looking a book (Subject RES) te voy a enseñar uno que ése es un caballo IO.2S=go.PRS.1S show.INF one REL that be.PRS.3S a horse 'I will show you one that that.one is a horse'.
- 18ii) Flor (63) (Subject RES-PRO)
 es una niña que ella se dumía
 be.PRS.3S a girl that she RFL.3=sleep.IMPF.3S
 '(this) is a girl that she got slept'.

What we want to emphasize here is that in both, Thematic (THM) and RES conditions, RCs do not have any empty place for REL. In (THM), the internal site does not exist; in RES the internal function is filled by a pronoun (RES). Although RCs with RES pronouns are considered to be the result of a secondary relativization strategy, and may be considered more elaborated types of RCs than simple REL constructions (Comrie & Kuteva, 2007), the fact is that they are simpler. Even if we have an internal link in RCs with a RES, these constructions are in all respect similar to an independent clause. Relative-word need not to be here but a linking mark, and internal syntax of RC is similar to an independent clause.

RCs with a RES pronoun just expose a topic continuity procedure, which being an anaphoric operation may apply all over the grammar, and by itself do not define structurally dependent clauses but only topic continuous ones. We propose, hence, to consider RES constructions as a starting small effect: on the formal side, there is just a local relation between a Heads and an RC marked by REL as a topic continuity mark; and a sequence of thematically or topic continuous constructions, on the functional one.

But again we could also suppose a Usage effect of experienced adult models; being in fact possible in adult Spanish Usage to have a RES pronoun inside the RCs, down from IO relativization – as a necessary condition–, and in GEN-REL, as a generalized one. Effectively, but for written texts, the RES-strategy has practically replaced in adult Spanish the marked Genitive-REL *cuyo* 'whose', with a REL + interna possessive (*que su* 'REL POS'). RES-strategy also emerges in various peripheral syntactic positions, but it is infrequent and restricten in O-REL constructions, and not at all permitted in adult S-REL (Lope Blanch, 1984; Palacios, 1983). However, our children's data expose what would count as a RES strategy even in S and O positions. So we can not but insist that this is a child's way to build relatives: putting together two main clauses, keeping topic continuity by means of RES, and adopting as a surface mark a REL, with no other syntactic integration at all. These RCs all by themselves could be produced as independent clauses, and REL will be a sort of topic continuity mark⁴.

Hanging relatives

We can add on this line of argumentation the constructions initiated by the child, and then interrupted, after REL production. Here the REL produced by child does not arrive to have an internal function, since the construction is not finished, but only announced (17i-17iii).

- 17i) Elia (23) *tenemos muchas cosas que*... have-PST.PL1 many things REL 'we have many things that...'
- 17ii) Flor (61), doing some gardening tú escarbas, las plantas que, que... you dig-PST-2s, the plants REL, REL 'You dig the plants that, that...'

⁴ In children's data Case + REL is just starting to emerge, but we do not have any Case + REL combined with RES; ase condary evidence thet REL does not fill any syntactic position in RCs when it coocurs with RES.

'look, here it is a story that...'

These fragmented productions make clear that a REL may be produced after a nominal head, without the child's having planned the internal configuration of RCs. REL presence can only be explained here if we credit child's adoption of a sequential frame where N + REL keep a relation –not necessarily a pronominal or syntactic one– in a still unplanned RC construction.

Children's RCs that are similar to independent clauses, with no internal function for REL but just a thematic link or a resumptive pronoun, are mapped in Table 7. They jointly represent a 17% of RCs. with very similar numbers for every child: Flor has an 18%, Julio a 17% and Elia a 15% of this types of RC constructions, where REL is not associated to any internal gap.

	Ν	o gap		Possible gap	Internal gap	
	Unplanned	THM	RES	[S]	[0]	\sum RCs
FLOR	9	11	13	103	52	188
ELIA	4	5	4	58	9	80
JULIO	3	3	2	21	15	44
Group	16	19	19	182	76	312
%	54 = .173			= .583	= .244	

Table 7. Interna	al gap, possibly	associated to REL ⁵
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Topic continuity or Subject gaps in RCs

For a subject dropping language, like Spanish, the absence of S in a RCs can not be used to determine a subject gap, since a 'gap' –i. e., subject drop- is possible outside RCs. Subject internal REL constructions have in Spanish the same type of structure that an independent clause has; particularly in the context of situated reference, a normal condition for child speech (Givón, 2008), or referential continuity, a discourse condition for RCs. So, even if RCs configuration seem to have a canonical S-REL, we can argue that there is no need to consider a gap presence in RCs when considering Subject continuous RCs.

- 18i) *yo tengo un perro en mi casa que, que hace guau guau* I have-PRS.1S a dog at home REL, REL make-PRS.3S arf arf 'I've got a dog in my house that, that barks arf arf
- 18ii) ésta es a mamá que está enojada This be.PRS.3s the Mum REL be.PRS.3s angry 'This one is the mother that is angry'

⁵ In this table, RES cases have been substracted from S-REL and O-REL countings.

18iii)	este amarillo	es el hijo		que	está	con todos sus papas
	this yellow	be.PRS.3S	the son	REL	be-PRS.3S	S with all his parents
	'this yellow of	one is the so	on that s	stays	with all his	s parents'

As we have seen in Table 7, Subject internal continuity in children's RCs is most frequent. This option represents a total of .583 RCs. Besides, Elia exposes even a more radical preference for S-RELs (=.737) face O-RELs (=.173). Flor has lower rates for S-RELs (=.545), since she produces substantially O-RELs (= .277), and even a couple or IO-RELs (= .011) (See 16ii above). Finally, Julio has the closest relation between S-REL (= .477) and O-REL (= .341), since he has adopted from the first moment some ritual predicates in RCs, which ask for an O-REL (*encontré* 'I found', *tengo* I have'). We can see this even distribution, overall favorable to S-REL, more clearly in Fig. 1, where the cases of "no gap condition" have been left aside, in order to focus S-REL and O-REL selection.



Figure 1. Topic continuity in RCs and possible REL-function

We ratify here, that S accessibility is higher than O in RCs binding; as it is expected here and outside RCs conditions. And since Subject continuity in RCs is not marked, we could add S-REL to RCs that keep the form of an independent clause; which amounts to more than a half of all RCs. Topic continuity supported in S-REL, with no marking inside RC make the universe of simple unmarked RCs, a dominant one. The few cases with a RES subject (see 18i-18ii, above) expose even more clearly an independent clause frame taken as a RC. Henceforth the set of RCs internally marked as dependent will only be Object internal REL, which we turn to consider onwards.

Hard cases made easier: Object RELs

O-REL constructions are main and almost undisputed candidates to expose the complexities attributed to RCs in general. Spanish Object presence is considered categorical, but under certain conditions it is possible to have Object omissions in main

clauses (Campos, 1986; Fernández Soriano 1999: §19.4.2). Semantic properties of verbs – those accepting a generic reading and low transitivity: *tener* 'have', *querer* 'want'– and O referential properties (indefinite or generic), and informational status (given), all are involved in these competing options. Accordingly, we can but enter O-REL analysis without the certainty that we are facing an Object gap associated to REL presence, or a plane O dropping. We take here onwards, Object possible omission in other contexts, as a flagging prevention for Object internal RC analysis. We will start by considering O-REL as Object continuous topic constructions, before we credited them the complexities of a genuine RCs construction.

This point of view is confluencial with recent studies about O-REL properties that may impact young children's production and experimental understanding (Diesel &Tomasello, 2005; Kidd, Brandt, Lieven & Tomasello, 2007). Under the assumption that covered regularities and restrictions –functional, semantic, or constructional– as well as modelled usage, will make again easier and learnable what seem to defy children's early capacities.

O-RELs are in general rather spare in children's earliest data. Their emergence depends upon the adoption of a set of verbs in RC. In effect, as we have seen, RCs are externally bound to frames with recurrent predicates where [head RCs] are inserted (*mira* 'look', *este es* 'this is', etc.). But there are also recurrent predicates in RCs themselves, that although may be child particular, are mainly integrated by a well defined set of verbs, in a minimal verb frame constructions and involving as an argument (S or IO) with 1S or 2S person reference. So, they are apparently building a grounding relation between items refered by Heads and the speech act particiants.

On the extreme, with the highest O-REL comparative frequency, we find Julio's production, who adopts from the beginning a couple of RCs predicates which ask for an O-REL (*encontré* 'I found', *tengo/tienes* I have-you have') and give O-REL the better relative counts (n 17/44 = 34%).

(19) Julio O-REL

mira la gata que **conté** mira lo que **tenes** allí u regalo, que **tiene** 'look the cat I found' 'look what you have there' 'a present he has'.

On the opposite side, Elia radically prefers S-REL and produces the shortest number of O-REL ($n \ 13/80 = 17\%$). Among her O-REL constructions (20), *tener* 'have' –with a grasping-handling-possessive reading– shows a particular prominence. Significant for Elia are also 'giving' and object transfer' verbs with a 1S as a benefactive IO.

(20) Elia O-REL

ese que **lo tengo**, unas que **las tengo aquí**, mi diadema que **me trajo una amiga** mi premio que **me regaló** una compañera 'this one I have''one I have her''my tiara a friend brought to me''my price a mate presented to me'.

As for Flor, she arrives to produce a relevant number of O-REL relatives, but she starts relatively late and only slowly adds different O-REL to her exemplars list; first on the basis

of two construction frames (see 21). Again it is *tener* 'have-hold' the preferred one, and 'giving' and 'object manipulation' verbs (leave, put, receive, give, buy) with a 1S benfactive. But the constructional diversity she develops on time leaves out of the question the productivity that O-REL constructions get for her (See Table 8).

(21) Flor O-REL

′	
ime das os nenes que tene ?	'will you give me the babies she has'
la opa que, que dejates en la bebaloda	the clothe that you left in the laundry
la capeta que yo te taje	'the folder I brougth to you'
mis pasas que me compró Inés	'the rasins Ines bought for me'
el pelo que lo vi	'the dog that I saw'.

Once more, the landscape that our data designs on the domain or O-REL is an accidented one. Children's O-REL constructions expose the individual differences that result when focus of attention, processing preferences (Bates, Bretherton & Snyder, 1988) and individual experiences are jointly played. But we can make anyway some generalizations

On the verb side of the corner we see recurrent predicates of particular semantic frames: object manipulation, objects transfer and bare object contact, which are used for a grounding expansion, anchored in speech act participants. This regularity gives verbs like *tener* 'have- hold', ' *give'*, '*receive'*, *find*, and the like, the lions share among O-REL constructions (See Table 8, bellow).

What we can see in table 8 is a more or less extended verb inventory in every child, which is on a pair with a more or less rich and diverse object representation. (Only Flor includes her own perceptions and desires: 'which I want', 'which I saw'). There is a main grounding verb, semantically general and polisemous: *tener* 'have', as a sort of O-REL attractor. But verb inventory includes concrete manipulative actions –*put, move, bring*; concrete-social relations –*give, present, buy*-, and internal experiences (*see, want*), all mostly related to what sound like a natural history of child's relations to concrete objects.

The semantic frame motivation for early verbs involved in O-REL constructions is further supported when we see some specific pairings among activity verbs and entities referred as Os in O-REL constructions. Once children not only use general frames for concrete objects for grounding them in discourse, they add specific verbs in O-REL constructions for specific items: books and stories are narrated or told; songs are played (put) in a recorder; paintings and designs are done and erased; and many object are reported as made (22).

'I want the one that Cami erased' (a design)
'did you listen the one I put (some music)
'now one that we have not sang' (a song)
'look what it says (the book)'
'Mom, look what Dady has made (a design)

	Elia	Julio	Flor
VERB TYPES / RCS CASES	7/13	8/17	22/60
Contact-holding verb			
Tengo-tienes 'I/you have'	5	6	12
Object transfer verbs			
encontré/ perdí	5	6	12
'I found , lost,			
me dieron /compraron/ regalaron / trajeron			
'they gave/ bought/ presented/ brought to me'			
Object manipulation verbs			
Poner, sacar, llevar, quitar, dejar, pescar	1	1	10
'put in, put out, take in, take out, leave, catch'			
Speech activity verbs			
decir, cantar, contar, leer (a story) pedir	1	1	4
'say, sing, tell, read -a story- ask, demand'			
Various Activity verbs			
Hacer 'make'	1	1	5
borrar, comer, romper usar		1	7
'erase', eat', 'brake', 'use'			
Other non activity verbs			2
quiero 'want'			4
ver 'see'			3
hay 'exist'			1

Table 8. Verb types with Object continuity RCs

A second type of generalization concerns the semantic category of the items that take the O-REL position. They are all concrete objects. This is true not only for Noun headed RCs, but also for DET-REL constructions, that indexically refer to situated items by means of a generic determiner plus a relative: *lo que* (lit. DET REL the that= 'what'). This is why noun, pronoun and DET headed RCs, all share the same types of internal predicate.

- (23i) *lo que tienes* DET.N REL eat-PRS.2S 'what you have'
- 23ii) mira lo que encontré look-IMP DET.N REL you find-PST.1S 'look what I found'
- 23iii) *et'es lo que quiero* this is DET.N REL want-PRS.1S 'this is the one I want'

23iv) *mila lo que me compró mi papa* look DET:N REL IO.1S=buy-PST.3S my Dad 'look what my Dad bought for me'.

Supporting the complex syntax of an O-REL, we find concrete objects surrounding children's space, and a rich knowledge of general and specific relations and activities objects are involved in, which are at children's disposal to help them to identify or ground concrete items in discourse situation.

Even if O-REL show a syntactic gap in their internal configuration, O-REL children produce are the joint result or a conspiracy effect from rich Object representation, -which may be implanted on the basis of recurrent discourse practices, commenting on objects closer vector –the one who holds them, caused motion) take, in-out) and social transfer (giving, receiving, and the like).

Although, O-REL coocur with O-RES the most, and among their internal predicates, at least *tener* 'have' and *querer* 'want' are mentioned by grammarians to accept O-dropping, We cannot add these facts as an argument here, because we would need as a basis to know the syntax of child's Object dropping in main clauses, which to my knowledge has not been studied yet.

IV. CONCLUSION

Looking towards a possible learning explanation to what otherwise would be considered to be unlearnable and developmentally unexplainable, this paper has argued that early relative constructions do not necessarily have the syntactic properties that would define them as complex constructions outside children's reach.

We have found in early production data that RCs main niche is not embedding; RCs tend to be adjoined to plain and syntactically independent heads, and suppose no external function for the head. We also have found a significant absence of internal function for REL, and evidence pointing towards REL not necessarily be a pronominal form, since RCs may not have an empty space to be filled by the relative word; either because RCs is only thematically linked to the head, and there is not a correferential argument to be binded by REL, or because the correferential argument is overtly exposed in the RC by means of a RES pronominal, leaving no need to consider REL as its anaphoric exponent. Subject internal RELs, are a particular and dubious frame, which in a subject dropping language needs not to have an S, nor, as a consequence to have in REL the S-exponent in RCs.

In every case, RCs tend to have the same structure that a main clause may have. This is particularly the case for S-REL, for RES RCs and for THM linked RCs.

The main functional effect of having a REL marking is to have a topic continuity mark. REL only asks to be considered a pronoun when marked by case, which in early child language does not yet occurs, and it will not for many months after RCs configuration first emerge. So, although the main source of REL binding would refer to RC subject –as the relativization hierarchy predicts- this prominence does not guarantee we face a relativization scenario, but simply a subject based topic continuity effect. Cases where relative word can be credited an internal function reduces to Object RCs.

Though we need to know more of the Object dropping conditions in early child language and in adult Usage, possibly dropping with *tener* 'have' and *querer* 'want', opens the scenario for unmarked topic continuity advancing to a secondary syntactic position, and not just to S.

Even if O-REL would end to be clear modified RCs, with an internal gap, O-REL cases, expose some simple ways to make out of a complex structure a simpler one. Here it is not the case that the structure has not been modified, –despite O-REL are the main source of RES–, but the point is that internal configurations of RCs profits from a handful of semantic frames, whose reduced types and centrality make possible for the child to apply them ritually and have a high memory acces.

So, we can conclude that as far as syntactic criteria may characterize early RCs as complex frames –let's say embeddeness, REL dual function --external-internal-- and a functional parallelism between head and REL–, children data does not quite comply with it. Certainly it is not the case that there are no regularities in children's early RCs, but these regularities do not honor the abstract predictions on complex dependence of relatives or functional parallelism. Only the relativization accessibility hierarchy agrees with the continuity based on the subject of RCs, we have observed. But even in this case, we cannot definitively state that REL is taking the role of an S, and RC exposing a definite dependency link towards a main clause, which may not even exist if the RC is a free one.

Hard and disputable as it may be attempting to characterize in its own terms the organization of children's entrance to complex syntactic facts, we consider that children are operating in a way that can be paraphrased as a 'starting small' landscape. Children treat RCs as chunks that may be produced by themselves; they recruit some frames, not necessarily verbed ones, since they may locally relate a RC to a referential or descriptive NP, without taking care of more.

The fact that some predicative frames recur from child to child and emerge as preferred ones for individual children point towards a preferential syntactic position to insert a lexical NP and a successive RC. It is more an information effect that an abstract and a priori condition for RCs to occur.

We have considered all these syntactic twists –having a RES, forgetting the gap, taking a HEAD + RCs alone, with no syntactic frame, or rather selecting some particular syntactic frames– as 'starting small' effects. We want to emphisize that what we have is a set of ways to act and reduce the complexity of RCs. Sort of "divide and you will vanquish" (Elman 1993; 2005), "adopt a construction frame" (Diessel y Tomasello, 2001), "put a main clause as an RCs" (Diessel y Tomasello, 2005), which make easy to get a RCs result.

List of abbreviations

PST	pretérito
IMPF	Imperfecto
PRS	Presente
IMP	imperativo
GER	gerundio
Ν	neutro
F	femenino
М	masculino
NEG	negation
AFF	afirmation
DET	determiner
DIM	diminutivo
S	singular
Р	plural
REL	relative pronoun
RES	resumptive pronoun

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1. Introduction *

1.1. The adaptive ecology of REL-clauses

In an earlier companion paper (Givón 2008a) I traced the acquisition of complex verb phrases (verb complements) in native English-speaking children at the age range of 1;8–2;8. The findings suggested that complex VPs are acquired relatively early, in the distinct adaptive ecology that characterizes early child communication:

(1) Communicative ecology of early childhood: (Givón 2008a, 2008b)

- a. **Speech act**: The child's, and indeed adult's, speech-acts are primarily manipulative (Carter 1974; Bates et. al. 1975).
- b. **Domain of reference**: The child's, and indeed the adult's referents are mostly non-displaced, both spatially and temporally.
- c. **Discourse coherence span**: The child's conversational turns, most characteristically one- or two-word long, are most commonly also one-clause long, so that the child and the adult typically alternate single clauses, building up multi-propositional coherence primarily *across turns* rather than within turns (Ervin-Tripp 1970; Keenan 1975, 1975; Scollon 1976).

Within bounds, the same features also characterize the adaptive ecology of pre-human communication (Givón 1979, 2008b).

The acquisition of complex VPs proceeds during this early period of child grammaticalization in a distinct fashion, whose first three features as summarized below recapitulate Diessel (2005):

(2) Manner of acquisition of complex VPs: ((Diessel 2005; Givón 2008a)

- a. Deontic modality markers are acquired before epistemic ones.
- b. Direct-manipulative deontic function (SAPs are centrally involved) are acquired before non-direct deontic description of 3rd person event participants.
- c. The main verbs are grammaticalized to from the very start.
- d. The complex two-clause construction is distributed across adjacent adult-child or child-adult turn (Ervin-Tripp 1970; Ochs *et al.* 1979) before they get syntax. That is, from parataxis to syntaxis.
- e. The child and adult usage through the acquisition period is surprisingly synchronized, both in terms of type of constructions and their text frequency.

Complex verb phrases are thus *functionally simplex* from the very start (Thomasello and Diessel 2001; Diessel 2005). Their adaptive goal is not to focused on the 'main' proposition\, but rather to use deontic main verbs such as 'want', 'can' or 'let', and epistemic main verbs such as 'know', 'think', 'guess' or 'say', as markers of the intentional or epistemic modal values of the complement proposition.

The communicative ecology of child communication has shifted radically by the time RELclauses are acquired. To begin with, REL-clauses are acquired much later. By stage III of verbal modality acquisition (ca. 2;6-2;8), when children use V-complement structures at a surprising frequency (as do the adults), REL-clauses are virtually unused by the children, and are also relatively infrequent in the adult interlocutors's speech. To drive this across, consider the summary tabulation of the comparative frequency of complex VP-clauses and restrictive REL-clauses (including closely related *restrictive post-nominal modifiers*) in three contiguous acquisition stages in this and the previous study.[FN 1]

	STAGE											
	 III					IV				V		
	CHI	===== [LD	ADU	==== J LT	CHII		ADUL	==== T	CHIL	 D	ADUL	T
subject	CVP	REL	, CVP	REL	CVP	REL	_ CVP	REL	CVP	REL	, CVP	REL
EVE	10	/	32	/								·
NAOMI	39	1	35	1	43	2	43	1	47	5	46	6
NINA	18	2	43	1	92	3	45	2				
ADAM	9	/	24	1	39	4	19	3	48	4	30	2
total:	===== 76	3	 134	3	====== 174	==== 9	 107	===== 6	95	==== 9	 76	8
mean;	19	0.75	33.5	0.75	58	3	35.6	2	47.5	4.5	38	4
cvp/rel ratio:	25:1		44:1		19:1		17:1		10:1		9:1	

TABLE 1. Text frequencies of Complex VPs (CVP) vs. complex NPs (REL) (pp. 1-10 of CHILDES transcript)

These results are instructive. First, the text frequency of complex VPs fluctuates, but doesn't seem to grow any more during that transition period, neither for the child nor for the adult, reaching an apparent plateau. In contrast, the text frequency of REL-clauses doubles or tripples for both. Consequently, the text-frequency ratio of the two constructions, expressed as complex VPs over complex NPs, is growing in a remarkably similar fashion for the child and adult. It is highest-**25:1** for the children **44:1** for the adults--at stage III, the last stage of our study of complex VPs and first in the study of complex NPs. It then goes down in both the child and adult to ca. **20:1** at stage IV and ca. **10:1** at stage V, a ratio that converges with the adult oral norm. To illustrate this converges, consider the distribution of the two types of complex clauses in a sample of adult oral autobiographical narrative.[FN 2]

TABLE 2: Text frequencies of complex VPs (CVP) and complex Nps (REL)--adult (finite in the integration of the integrate of the integration of the integrate of th

(first 10 pp. of transcript)

CVP	474
REL	41
CVP/REL ratio:	11.5

Second, as we shall see further below, at the time when REL-clause arise in child's discourse, ca. age span 2;6--4;6, the three main features of the communicative ecology (1a,b,c) have already shifted considerably towards the more mature adult norm: (a) More declarative and interrogative speech-acts; (b) more displaced referents; and ©) longer multi-propositional turns of coherent discourse.

Third, the purposive context of communication has also shifts markedly between the acquisition of complex VPs and the acquisition of REL-clauses. Deontic and epistemic complex VP structures are acquired in the interactive context of intense, rapid-exchange (short turns) **modal negotiations** between child and adult, where the complex structures emerge first as collaborations, shared across adjacent child-adult or adult-child turns (Ervin-Tripp 1970; Ochs *et al.* 1979). The proximate goals of these modal negotiations, shared by both child and adult, seems to be:

(3) Proximate goals of modal negotiations: (Givón 2008a)

a. **Deontic**:

"This is what I want you to do for me" (manipulation/request).

"What would you like me to do for you?" (solicitation/offer)

b. **Epistemic**:

"This is my certainty /verity level regarding this proposition." (assertion)

or

"What is your certainty/verity level regarding this proposition?" (inquiry)

Child-adult discourse at the developmental stage(s) when REL-clauses are acquired is still profoundly interactive, but the child's conversational turns have become increasingly multipropositional (1c). The interactive context within which adult and child REL-clauses are produced may be characterized as **referential negotiations**, with the aim of establishing **common reference**. The proximate goals of such negotiations are strictly epistemic, and are reminiscent of the muchearlier developmental stage of establishing *joint attention*:

(4) **Proximate goals of referential negotiations**:

a. Joint attention:

"How can I make sure that you and I are *attending to* the same referent?"

b. Common referent:

"How can I make sure that you and I are *talking about* the same referent?"

In other words, the mutual proximate goals now have to do with the genesis of the grammar of **referent tracking** or **referential coherence**.

The two types of complex/embedded clauses thus seem to differ in age of acquisition, in the communicative ecology during acquisition, in the manner of acquisition, and in the proximate communicative goals that drive the acquisition process. They also differ in the ultimate syntactic product they engender: Complex VPs, due to grammaticalization of main verbs into modal operators, often display full clause -union. And when co-lexicalized, they yield complex **lexical verbs.** Complex NPs most typically do not reach full clause -union. And when co-lexicalized, they yield complex lexical nouns.

The syntactic difference between the two complex constructions may be illustrated by their differential sensitivity to zero co-reference and 'extraction' tests. Thus compare the behavior of V-complements (5b-f) with the REL-clauses (5g) below:

(5) a. Simple :	the letter that [she sent [0]]
b. Modality COMP:	the letter that [she wanted [to send [0]]]
c. Manipulation COM:	the letter that [I told her [to send [0]]]
d. Cognition COMP:	the letter that [I thought [he sent [0]]]
e. Utterance COMP:	the letter that [they told me [she sent [0]]]
f. Perception COMP:	the letter that [heard she sent [0]]]
g. REL-clause:	*the letter that [I saw the woman [who sent [0]]]

Complex VPs thus behave syntactically as simple single clauses, while complex NPs behave like two clauses (Ross 1967).

These profound differences, taken together, raise a fundamental question--is **recursivity** as defined formally by either Simon (1962) or Hauser *et al.* (2002) a meaningful concept, or is it an *epiphenomenon* that--it just so happens--falls out of two separate and distinct processes of *grammar genesis*? We will return to this question at the very end.

1.2. The grammar referent tracking

About half of the grammatical machinery of any language is dedicated to referent tracking: Determiners, syntactic case markers, pronouns and anaphora, REL-clauses, pragmatic voice, topic and focus constructions, presentative devices, WH-questions and switch-reference devices (Givón 2001). The **adaptive-communicative niche** of REL-clauses must be thus viewed within the wider context of the grammar of referential coherence (Givón ed. 1983; Givón 1992; 1995, ch. 8; 2005, ch. 5). The following example is but a brief illustration of the more general dimensions of this complex grammar-coded domain and the special niche REL-clauses occupy within it. Consider the mid-discourse narrative in (6) below:

- (6) a. There was **this** man [standing near the bar],
 - b. but we ignored **him** and went on across the room,
 - c. where **another man** was playing the pinball machine.
 - d. I sat down and ordered a beer.
 - e. The bar tender took his time,
 - f. Guess **he** was busy.
 - g. So I just sat there waiting,
 - h. when all of a sudden **the man [standing next to the bar]** got up and started screaming.

In coding 'man', introduced for the first time in (6a), with the referring-topical indefinite marker 'this', the speaker cues the hearer first that s/he doesn't expect him/her to have an **episodic-memory** trace of the referent. Since the marker is 'this' rather than 'a', the speaker is also alerting the hearer that the newly-introduced referent is topical, likely to recur in the subsequent discourse, and thus must be marked as such in the **new episodic memory** structure that the hearer is in the midst of constructing. In coding the same referent with the anaphoric pronoun 'him' in (6b), the speaker assumes that the referent is not only accessible, but is still **currently activated**, i.e. still under **focal attention**.

Another referent is introduced for the first time in (6c), this time with the indefinite marker 'another'. In using of the first-person pronoun 'we' in (6d), next, the speaker assumes that his/her own referential identity is accessible to the hearer from the immediate **speech situation,** i.e. available in **working memory**. 'The bar tender' is introduced for the first time in (6e)--but marked as definite. This is possible because the prior discourse had activated 'bar', which then remains activated by the persistence of the narrated situation. And 'bar tender' is an automatically-activated connected node of the **lexical-cultural frame** 'bar', already encoded in **semantic memory**. In continuing with the anaphoric pronoun 'he' in (6f), the speaker again assumes that the referent is both accessible to the hearer and currently activated, i.e. still under **focal attention**. And in using the first-person pronoun 'I ' in (6g), the speaker assumes that his own identity is still accessible to the hearer from the **speech situation**, held in **working memory**.

Finally, the man introduced earlier in (6a,b) and then absent for five intervening clauses, is re-introduced in (6h). The use of a definite article suggests that the speaker assumes that this referent is still accessible in the hearer's **episodic memory.** However, the hearer's memory search is not going to be simple. Another man had been mentioned in the interim in (6c), described as 'was playing the pinball machine'. Both referents are assumed to still be accessible in the hearer's **episodic memory**, and would thus compete for the simple definite description 'the man'. To differentiate between the two, a *restrictive relative clause* is used, matching 'standing next to the bar' in (6h) with the restrictive REL-clause 'standing near the bar' in (6a). In using this grammatical cue, the speaker reveals his/her assumption that the hearer still has an episodic trace of both the referent and the proposition in (6a).

The two restrictive REL-clauses used in (6) above, reveals three important communicative uses of this construction:

•**Presentative**: To give salient information about topical referents upon their first introduction into the discourse (6a).

•Long-range retrieval: To help the hearer search in their episodic memory and retrieve a previously-introduce important referent when it is re-introduced into the discourse after a considerable gap of absence (6h).
•**Referential competition**: When the preceding discourse, and thus presumably its episodic trace, contains other lexically-similar referents that my compete with the intended referent (6h).

As we shall see below, the range of communicative functions coded by REL-clauses in both child and adult discourse is considerably broader.

2. Texts and subjects

The previous study of the acquisition of complex VPs (Givón 2008a) used three English speaking children--Eve, Naomi and Nina--from the CHILDES data-base. The age range there was ca. 1;8--2;8. For each child, the period was divided into three stages (I, II, III), by intuitively survey of the type and frequency of complex VPs produced.

In the present study, we began the analysis with stage III (ca. 2;6-2;8) of the previous study, and then added two more stages, one ca. 3;6 (IV) and one ca. 4;6 (V). In stage IV, we lost Eve, so we added Adam in stages III, IV, V to maintain continuity. In stage V we lost Nina. We thus had 4 children for stage III, 3 for stage IV and 2 for stage V.**[FN 3]** For each child at stage III we studied ca. 60 pp. of the printed CHILDES transcript. For each child at stages IV and V we studied ca. 90 pp. of the printed CHILDES transcripts. Whenever the absolute text-density was important, we express the results in terms of a uniform baseline, e.g. per number of pages.

3. **REL-clause types in the CHILDES texts**

3.1. What counts as a REL-clause?

It is relatively easy to define in structural terms what counts as a restrictive RELclause in adult English (e.g. Givón 1993,vo. II, ch. 9), and such criteria were applied in Diessel's (2005) study. But do children acquire adult-type REL-clauses right away, or are there precursors that don't look like full-fledged relative clauses but perhaps function the same way? For the purpose of this study, it was decided to be more inclusive and consider all **large restrictive post-nominal modifiers** (RPN modifiers) that can be paraphrased, without stretching the meaning to much, by a REL-clause. This pulls in an array of structures that either have no verb or have no REL-pronoun. Within certain bounds, however, they are functional equivalent of restrictive REL clauses in both children and adults. If one is interested in possible developmental precursors of adult structures, there are good reasons for not excluding these non-standard types.

The following are the categories of restrictive post-nominal modifiers that were considered. Adult-produced examples were used only when no child-produced examples were found in the transcripts.

(7) Structural classification of non-restrictive REL-clauses

a. HEADED REL-clauses:

- (i) Subject: 'The pretty thing that's on the floor'. (Naomi-V, p. 22)
- (ii) Dir. Object: 'That's all I wanna say'. (Naomi-V, p. 22)
- (iii) Ind. object: 'And everything they go on tick-tock[s]'. (Adam-IV, p. 16)
- (iv) PART (subj.): 'Once there was a [???] sitting on the back of...' (Naomi-V, p. 20)
- (v) PASS (subj.): 'Something made out of clay'. (Nina-IV, adult, p. 13)

b. HEADLESS REL-clauses:

- (i) Subject (of passive): 'So you can tape what 's left'. (Naomi-V, adult, p. 22)
- (ii) **Dir. object**: 'I hope I'll get what I said'. (Nina-V, p. 19)
- (iii) Indir./Locative: 'Here's where the cat goes'. (Nina-V, p. 23)
- (iv) **Predicate**: 'Gas is what makes my car run'. (Nina-III, adult, p. 5)
- (v) Reason: 'That's why they had to squeeze out'. (Nina-V, p. 19)
- (vi) Extent: 'Hey, is that how far it goes?' (Nina-V, p. 21)
- (vii) Manner: 'That's how you unbutton them'. (Nina-IV, adult, p. 13-14).

c. INFINITIVE REL-clauses:

(i) Subject: 'Where's the bottom to go in these panties?' (Naomi-IV, adult, p. 10)

- (ii) **Dir. object**: 'Oh, so many things **to remember** ...' (Naomi-V, adult, p. 29)
- (ii) Indir. object: 'I want something to play with'. (Adam-IV, p. 15)

d. VERBLESS restrictive modifiers:

- (i) Possessive: 'I scratched it on the metal of your bedroom study'. (Nina-V, p. 20)
- (ii) **Prepositional**: A bear **just like mine**'. (Adam-IV, p. 17)

'I got all the books **from my the other school**...' (Naomi-IV, p. 8)

e. CLEFT: 'It's Rusty who has fingers'. (Adam-III, adult, p. 31)

The numerical distribution of the five main types of REL clauses in the child and adult language, in the three developmental stages studied here are summarized in tables 3, 4 and 5 below.

	===== EV	======================================		NAOMI		NINA		ADAM		
TYPE:	CHI	ADU	CHI	ADU	CHI	ADU	CHI	ADU	TOT/C	TOT/A
EEE		1		= ===== 8		= ===== 3	1	= ===== 2	= ====== 1	= ====== 14
INF	/ / 1	/ / / / 1 /	 	/	2	1	/	/ 3 /	2 / 9	1 9 4
H-LESS				4	/ 5	2 4	/			
V-LESS				/			2			
CLEFT	/	/	/	/	/	/	/	1	/	1
TOTAL:	 1	1		12	====== 7	 10	3	6	== ===== 12	 28

TABLE 3:Distribution of modifier types:Stage III (ca. 2;6)SUBJECT

One may express the text frequency of the various REL-clause, including the various RPN modifiers, in the child and adult at this early stage on a *per-page* basis, yielding:

•Child: 12/4 subj = 3 per subject per 60pp. = 0.05 page of transcript

•Adult: 28/4 subj = 7.0 per subject per 60pp. = **0.11**/page of transcript

TYPE: ====== REL			SOD						
	NA	OMI	NI	NA	AI	DAM			
	CHI	ADU	CHI	ADU	CHI	ADU	TOT/C	TOT/A	
	4 1 2	11	10	10 2	9	= ===== 7	23	= ======= 28	2
INF		5	1		3 /	/ 4	5	7 7	
H-LESS		2	1	1			3 8		
V-LESS	2	3	2	12	4	6		21	
TOTAL:	9	21	14	25	16	 17	39	63	:=

TABLE 4:Distribution of modifier types:Stage IV (ca. 3:6)SUBJECT

The text frequencies at this stage, expressed again on a per-page basis, are:

• Child: 39/3 subj = 13 per subj. per 90pp. = 0.144 per page of transcript

•Adult: 63/3 subj. = 21 per subj. per/90 pp. = 0.233 per page of transcript

TABLE 5:Distribution of modifier types: Stage V (ca. 4;6)SUBJECT

	=====		=====				
	NAC	OMI	ADA	AM			
TYPE:	CHI	ADU	CHI ADU		TOT/C	TOT/A	
REL	8	13	4	===== 4	12	====== 17	
INF	/	/	2	1	0	3	
H-LESS	11	8	7	1	18	9	
V-LESS	1	2	5	2	6	4	
TOTAL:	20	23	18	8	36	33	

The text frequencies at this stage, again expressed on a per-page basis, is:

- •Child: 35/2 subj. = 17.5 per subject per 90pp. = 0.194 per page of transcript
- •Adult: 33/2subj = 16.5 per subject per 90pp. = 0.183 per page of transcript

When these text frequencies are plotted together for the three stages and then expressed as a child-over-adult ratio, as in Table 6, below, they yield a vivid demonstration of how the child catches up with the adult in the use-frequency of REL-clauses.

TABLE 6:	Text frequen	cy of all po (per pag	st-nominal i e of transcri STAGE	restrictive modif pt)	iers
		III	IV	V	
C A	HILD: DULT:	0.05 0.11	0.14 0.233	0.194 0.183	
== C	======================================	 0.45	 0.6	======================================	

What is also striking about this is that the adult text frequencies are relatively low. That is, however important the adaptive/communicative function(s) of REL-clauses may be in referent tracking, they are either not urgently needed at the type of child-adult communication seen in our transcripts. Alternatively, such function(s) can be performed by alternative, perhaps paratactic, means.

Some assessment of these two possibilities may be furnished by noting that in the adult narrative cited earlier (Table 2), the text frequency of Rel-clauses was 41 per10 pages or **4.1**/page--roughly 20 times the frequency in stage V transcripts. However, ta printed CHILDES transcript page has much fewer words (ca. 52/page) than the typed adult narrative we used for comparison (ca. 640/page), yielding a ratio of 640/52 = 12.3. This figure can now be used to multiply the per-page frequency of ca. 0.2/page for both adults and children in the CHILDES transcripts, yielding a comparable figure of **2.4** REL-clauses per comparable page of text vs. the adult oral narrative **4.1**/page.

This is obviously a very rough approximation, especially that it combines child and adult word-per-page of CHILDES text. Nonetheless, in a rough way it suggests that the text frequency of adults and children at stage V of our transcripts does not deviate markedly from the adult oral norm.

The difference in frequencies may be ascribed to the fact that the CHILDES texts are of rapid-exchange, highly-collaborative **conversations**, while the adult oral text is a single-perspective **narrative**. In the latter, no reference negotiations apply, and perhaps fewer alternative referent-tracking devices--such as paratactic ones--are used.

Given that the three main communicative functions of REL clauses--presentative, long absence, and referential competition--are all cognitively more complex than simple referential continuity, it would make sense that the frequency of REL-clauses in narrative would be higher than in highly collaborative conversation.

4. The communicative use of restrictive post-nominal modifiers

4.1. Early stage (III ca. 2;6)

Diessel (2005) suggested that the existential-presentative use of REL-clauses was the earliest one to appear in English-speaking children in the CHILDES data-base. The data analyzed in this study does not bear this out, even though there is a considerable overlap in the actual children studied (Naomi, Nina, Adam). Part of this is of course due to our structural definition here being more inclusive.

At stage III (ca. 2;6; Table 3 above), where our study started, there was only one postnominal restrictive REL-clause produced by a child (Adam), and it is not an existentialpresentative but rather a pronoun-less, 'be'-less **participial** REL-clause. True, it does introduce a new participant (indefinite). Though not with the verb 'be', but with 'look':

(8) URS: What do you have, Adam?

ADA: Looking for bear sleeping. (Adam III, p. 15)

The most frequent type of RPN modifier produced by the four children at this stage is the *verbless* one, with 9 out of the total of 13 (2 by Eve, 2 by Adam, 5 by Nina). Eve's use is perhaps marginal:

(9) EVE: My glass. MOT: Your glass? EVE: Yep. MOT: Which glass? Your [???] glass? EVE: Yes. With the ice cubes in it. (Eve III, p. 3-4)

One of Eve's two uses of PP modifiers in (9) is embedded inside the other. The first ('With the ice cubes') is **headless** and qualifies 'glass' in the directly preceding discourse. The other ('in it') modifies 'ice cubes'. The referential negotiation, and the communicative use of restrictive modifiers here, involves the sub-function of **referential competition**.

Consider next Nina's stage-III use of verbless PP restrictive modifiers:

a. MOT: That's a pretty pretty dolly.
 NIN: Yes, she has a blouse like that dolly.
 She has a skirt like that dolly. (Nina III, p. 42)

b. NIN: What are these things? MOT: That's a tree.NIN: What, what are those things on the tree? (Nina III, p. 36)

The two uses of the PP modifier in (10a) may be termed *presentative*. But in (10b) the PP modifies a demonstrative-marked noun accessible in the speech situation, not exactly a classical presentative.

Likewise, Nina's use of a post-nominal restrictive adjective, as in (11) below, again modifies a demonstrative-marked noun visible on the scene:

(11) MOT: I like rabbits, don't you?
NIN: Yup. I like them. Like this one the red.
MOT: You like red rabbits?
NIN: Yup. (Nina III, p. 32)

Nina's last two uses of restrictive post-nominal modifiers in (12) below, both of infinitival REL-clauses, indeed modify indefinite referents--but **non-referring** ones, again hardly a classical presentative:

(12) [context: Pretend phone conversation with uncle Frank.]NIN: Hi, Frankie is there something for me to play with?MOT: What did he say?NIN: He said he had something to play with for me. (Nin III, p.4)

At this early stage, it appears, children use of various RPN modifiers, most of them not classical adult REL-clauses, in communicative functions that fully parallel to the use of REL-clauses. One of those is the presentative, but it is hardly predominant. And neither is the re-introduction of a referent with a previously-established episodic trace following a considerable absence.

If one could single out any communicative function as more prevalent in the child use at this early stage, it is probably the context of **referential competition**, often involving referents in the immediate speech situations. This is of course hardly an accident, since the referential universe of child-adult communication at this early stage is still predominated by referents that are accessible in the immediate speech situation(see Givón 2008a as well section 5.1., Table 9, below).

Probably the most striking fact about the use of restrictive modifiers in our transcripts, at all three stages, is how they appear in the highly interactive context of **referential negotiations**. This is just as striking in the adult usage, which is syntactically more sophisticated but still embedded in the same interactions. Thus consider the two negotiations in (13) below, where the child's incomprehension of the complex clauses forces the adult to simplify:

(13) a. EVE: Hi, Fraser, what's that?

MOT: What? That's Sara's new toy **that she got in the mail this morning**? EVE: Eh? [incomprehension] MOT: Sarah's new toy. [giving up on complexity] (Eve III, p. 28)

- b. EVE: What's that?
 - MOT: That's a card I was going to send to those people who had a baby.

NAO: Had a baby?

MOT: Yeah.

NAO: [???].

MOT: That's okay.

NAO: A little baby. Baby.

MOT: Yeah, I was going to send that to the people who had the baby.

NAO: It's for Nomi?

MOT: No, it's for another baby, honey. (Naomi III, p. 2)

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4.2. Intermediate stage (IV; ca. 3;6)

At our intermediate stage (IV; see Table 4 above), bona-fide REL-clauses begin to predominate the child sample, at 23/40, with verbless RPN modifiers a distant second at 8/40. And headless REL-clauses make their first appearance in the child's usage, at 4/40.

Consider first the use of bona fide REL-clauses. In (14a) below, Naomi is looking for a cover to change diapers on her doll. Her use of the definite 'the cover' is not licensed by previous mention, prompting her mother to ask for clarification, supplied by a REL-clausethat is paratactically detach from its main clause, two turns earlier.

(14) NAO: Baby sit there and I'm gonna change you. Up there.

I can't find the cover.

MOT: What cover?

NAO: The cover that I'm looking for. (Naomi IV, p. 8)

In (15) below, Naomi first produces the verb-less restrictive PP to narrow the domain of 'book', discussed earlier, i.e. with an established **episodic trace**. Then she uses two object REL-clauses in succession, both modifying definite objects visible at the scene--indeed identified first by a demonstrative. The second use is paratactic, an NP detached from its main clause ('These are...').

(15) MOT: You have to do the work in the book?

Okay, well I will tell you, let's see...

NAO: I got all the books **from my other school**,

so I have to sit down and...

MOT: Okay.

- NAO: Read these. All these. These are all the books **I have**.
 - And all the puzzles **I have**.
- MOT: All the puzzles **you have**? (Naomi IV, p. 14)

In (16) below, Naomi uses a 'be-less' participial REL-clause to describe a referent visible on the scene, in a book the two interlocutors are reading together. While the 'girl' is referring-indefinite, Naomi's usage is not a classical presentative, since the indefinite referent is equally accessible to both interlocutors. At best, one may term this use **descriptive**, and the modified NP is again paratactically detached from its main clause:

(16) MOT: Here's a mommy. A big mommy.NAO: Yup. With gir g g girl standing by her.MOT: And the mommy has a bib... What does she have on?NAO: Apron. (Naomi IV, p. 26)

In example (17) below, a 'be-less' passive subject REL-clause is used in a contrastive context, perhaps involving **referential competition**, and again the modified NP is paratactically detached from its main clause:

(17) MOT: You're gonna hold *me*?NIN: No, this lady **named Florence**. (Nina IV, p. 6)

In (18) below, next, the REL-clause again modifies a noun visible to both interlocutors (in a book they are reading), and the usage seems to be again **descriptive**:

(18) MOT: What's that?NIN: That's the kind of food that they eat.MOT: You mean pancakes?NIN: Yeah [???] pancakes. (Nina IV, p. 20)

The two examples in (19) below seem to involve, at least in part, reference to a previous shared experience, thus presumably with an **episodic trace**. In both cases, the modified NP is paratactically detached from its main clause:

- (19) a. MOT: Why don't you find a home for all of them? Put them in their homes and take care of them.
 NIN: All the animals that belong... All the animals that we were playing with, Mommy. (Nina IV, p. 65)
 - b. NIN: Yup, so the people could go in. MOT: Have you seen them around? NIN: Mommy. I want the same people that were at the doll, that were at the doll. MOT: You saw some... Did you play with the doll house yesterday? (Nina IV, p. 70-71)

The last example (20) is a complex referential negotiation, where both child and adult resort to post-nominal modifiers. The first, a subject REL-clauses produced by the child, is paratactically detached:

(20) MOT: What park should we go to? NIN: To the merry... To the park that has the animals. MOT: Which one is that? NIN: [???]. MOT: Which one? NIN: The [???]. MOT: The big one. How about the little park that's near the school? Would you like that? What's there? NIN: Uh, a, a lions. MOT: No. Oh, you mean at the park near here with those animals on the springs? NIN: Yeah. (Nina IV, p. 80-81)

What we see in the stage-IV data so far is an expansion of the functional range of REL-clauses used by the child. But again the presentative use is not particularly prominent. In fact, in the entire 3-children transcripts of stage IV, only one example of the classical presentative form was identified, again in a context where the referents are visible on the scene:

(21) [context: a long stretch of playing with toys]
ADA: A jeep. I goin' put some in the jeep.
There['s] a man **driving** and need somebody...
And this [is] somebody **sitting in the back**.
I putting things in the jeep.
MOT: Oh. I see. (Adam IV, p. 79)

The other REL-clause form that makes its appearance for the first time in stage IV is the **headless REL-clause**, with a WH word. There are 3 child uses and 7 adult uses of this construction in out stage-IV transcripts. Let us consider first the adult uses:

- (22) a. MOT: Which one's the hokey-pokey book? NAO: I'll show you. This one. MOT: Oh, I didn't know that was what that was called. Oh, The Pokey Little Puppy. (Naomi IV, p. 19)
 b. NAO: More snacks please.
 - FAT: Are you all finished with all those?
 MOT: She's had her next to the last one.
 FAT: Nomi, what you need is a napkin, don't you?
 NAO: Where are the rest of them? (Naomi IV, p. 56)

- c. NIN: How do you take these buttons off? MOT: You unbutton them. NIN: I can't. MOT: There we go. That's how you unbutton them.
- d. MOT: What did he find on his head? ADA: Is that bead? MOT: No, that's where the acorn hit him, and he went to tell the king. ADA: Tell you falling from a tree. (Adam IV, p. 12)

(Naomi IV, p. 13-14)

- e. ADA: What are these?MOT: That's what you call chalk.ADA: Chalk for putting in the mouth?MOT: No, not for putting in the mouth. (Adam IV, p. 20)
- f. ADA: I bringing it.
 MOT: No, you don't have what I ordered.
 ADA: What I 'pposed to have?
 MOT: I said four quarts of milk. Where's the milk? (Adam IV, p. 34)
- g. ADA: What's that?MOT: That's where you keep your milk.I'd like two quarts of milk, please. (Adam IV, p. 43)

All 7 examples are **contrastive**, involving **referential conflict**, arguments or misunderstandings about the referent. Of those, 6 are predicate constructions--one a pseudocleft, the remaining five with a contrastive-stressed 'that' as the subject. The sole nonpredicate form, (22f), is still contrastive.

The 3 child-produced examples are given in (23) below.

(23) a. NAO: Just whisper.

MOT: Whisper. Because he's crabby? NAO: Yep. That's **why he should take a long long... long nap**.

MOT: Okay. (Naomi IV, p. 18)

b. MOT: So he didn't understand you.

NAO: Go insi[de]. He wanted to walk around the hose..

And. Go right there and. Stand up there and go to sleep. MOT: Oh.

NAO: That's why he didn't want [to] talk. (Naomi IV, p. 62)

c. NIN: Go to sleep.
MOT: Where am I going to sleep?
NIN: Right here next to the dolly.
That [is] where you gonna go to sleep. (Nina IV, p. 6)

These child-produced forms are all contrastive, all with a stressed 'that' as subject.

In sum, the children at this stage show can expansion of the syntactic form of their RPN modifiers, with two more-standard REL-clause forms taking over, one with multiple functions, the other restricted to **contrast** or **referential conflict**. The children of course continue to use infinitival and verbless forms, but their functional load diminishes as it transfers to the more standard RE-clause form(s).

4.3. Late stage (ca. 3;6)

Out of the 35 RPN modifiers produced by the two children studied for stage V (Table 5, above), 12 are standard REL-clause forms and 17 are headless REL-clauses. Only 6 are verbless forms; and not one infinitival REL-clause was found in the sample. The adult distribution is broadly similar: 17 standard forms, 9 headless, 3 infinitival and 4 verbless, for a total of 33.

Of the 18 child-produced headless REL-clauses, fully 15have the stressed 'that' as their subject, in what appears to have become the standard contrastive form. The other 3 are used in analogous context of **conflict** or **uncertainty**. Thus:

(24) a. FAT: An opossum. He's got holes in his ears, doesn't he? NAO: [???] squeak anymore. FAT: [???]. NAO: I hope I'll get what I said. FAT: Oh yeah, what you said will be on there. NAO: It really is. (Naomi V, p. 2)
b. NAO: I don't want to go to summer camp. FAT: Why now? NAO: Because I have to do what the teacher says I have to do and I don't like to do that. FAT: What sort of things don't you like to do? (Naomi V, p. 6)

c. MOT: It looks like you're there? ADA: Yeah. MOT: What does that mean? ADA: That mean what I see on television. MOT: Oh, what you see on television. (Adam V, p. 11-12)

5. The communicative ecology: Quantitative assessment

In this section I will attempt to characterize the changes in communicative ecology that form, leastwise in my judgement, the adaptive foundation for the use of restrictive postnominal modifiers. This assessment is not always easy, given the nature of the transcripts and the extreme context-dependency required in making some of the determinations. The marking frequency of many grammatical sub-systems at this stage is still rather low, and the conversational style of both the child and adult is highly elliptic.

5.1. Displaced referents

In the preceding companion study (Givón 2008a) I assessed the distribution of 1^{st} and 2^{nd} person (SAP) vs. 3^{rd} person subjects of modal expressions during the acquisition of modal expressions (stages I, II, III; ca. 1;8–2;8). The data illustrated vividly the extreme **egocentricity** of communication during these early stages, albeit only with respect to the selection of subjects of complex VPs (i.e. controllers of modal attitudes). A compressed summary of those results, for both child and adult interlocutors, is given in Table 7, below.

or comp		DE	ONTIC	III (Su	IIIIIary) I			
	CHILD		ADULT		CHILD		ADUI	LT
STAGE	1-2 3		1-2 3		1-2 3		1-2	3
I II III	97% 92% 83%	3% 8% 17%	92% 92% 85%	6% 8% 15%	63% 67% 63%	37% 33% 37%	40% 69% 71%	60% 31% 29%

Table 7: Percent of 1st/2nd vs. 3rd person subjects

With one exceptional adult (the mother in Nina-I, epistemic), both the adults and children showed a predominant use of 1st/2nd subjects (83–97%) in deontic-modal constructions, and

a much higher percentage of 3rd person subjects in epistemic-modal constructions (29–37%). A slight shift toward 3rd person subjects of deontic-modal expressions in stage III is perhaps visible (83–85%).

What may be more relevant for the acquisition of REL-clauses is that RPN other modifiers are not commonly used with three types of referents:

- speaker-hearer pronouns (or proper names), accessible in the **speech situation**.
- • 3^{rd} person referents, of whatever marking, visible in the speech situation.
- •anaphoric-pronouns or zero-marked 3rd person referents still under the scope of **focal attention** or **working memory** (immediate repetition).

What I tried to measure next, therefore, is the frequency distribution of 3rd person referents that are not accessible in either the speech situation or current attention/working-memory. For this purpose, we divided accessible vs. inaccessible referents, and counter the first 10pp of the CHILDES transcripts of stages I (ca. 2;0), III (ca. 2;7) and V (ca. 4;6). The rough numerical results are given first in Table 7. below.[**FN 3**]

	11		JULI											
	SU	BJ.	Ol	===== BJ	SU	BJ	OBJ		OB	J-ref	TOTAL			
SUBJECT	N	%	N	%	N	%	N	%	===== N	%	N	%		
EVE-I 10		109 55					6		= ==== = ===== /		= <u>=</u> 170	100.0		
NAOMI-I	106		14		/		2		/		122	100.0		
NINA-I	132		29		/		3		/		164	100.0		
TOTAL-I:	347		98		/		11		/		456	100.0		
EVE-III	64		17		10		18		10		119	100.0		
NAOMI-III	129		42		7		26		18		222	100.0		
NINA-III	121		72		15		14		8		230	100.0		
ADAM-III	135		54		19		7		6	Ď	221	100.0		
TOTAL-III:	449		185		51		65		42	2	792	100.0		
NAOMI-V	87		24		65		13		40)	207	100.0		
NINA-IV	177		80		11		20		44	Ļ	332	100.0		
ADAM-V	139		65		/		13		19)	236	100.0		
TOTAL-V:	403 169		76	46			103		797	100.0				

TABLE 7:	Accessible vs. inaccessible refe	rents (raw figures in pp. 1-10 of transcript)
	ACCESSIBLE	INACCESSIBLE

From Table 7. I then computed the percent of inaccessible referents for each child at each developmental stage, collapsing together the grammatical sub-categories (subject/object, referring /non-referring). The results are given in Table 8. below

Table 8: Percent	of inaco	cessible referent STAGE	t s		
I		III		V	
EVE-I NAOMI-I NINA-I	3.5 1.6 1.8	EVE-III NAOMI-III NINA-III ADAM-III	31.9 18.4 16.0 14.4	NAOMI-V NINA-IV ADAM-V	57.0 21.3 13.1

The results reveal considerable variation, due first to the small text sample (10 pp.), given the considerable within-text variation of topic. Considerable cross-subject variation also arose from the imprecise assessment of developmental stage.[FN 4] While these results cannot be subjected to inferential statistics, a clear jump in the percentage of inaccessible referents seem to occur in all children between stage I and III, where RPN modifiers make their first appearance. For two of the three children there is also a similar jump from stage III to stage V. When the results for the children are collapsed together, the following overall pattern obtains:

STAGE	distribution	percent
 I: Ш·	 11/456 158/792	2.4 %
V:	225/797	28.2 %

Table 9: Overall percent of inaccessible referents

5.2. Displaced temporality

One major use of REL-clauses in adults is to brink back into the discourse referents that have been mentioned earlier in the ongoing discourse, or ones that may have been discussed or known sometime in the past, and that the speaker assumes the hearer still hold a mental trace of in their episodic memory. In early childhood development, when communication is centered on the here-and-now, there is scant need for such grammatical devices. It is thus of interest to see how temporal reference used by the children shifts

from the almost absolute anchoring in the **speech situation** characteristic of early childhood, to the more **displaced temporality** of past, future or habitual.

Tables 10, 11 and 12 summarize the frequency distribution of temporal reference in the children's discourse at stages I, III and V, respectively. The 'here-and-now' category collapses the *progressive*, *present* and *immediate future*, with the latter taking in all direct manipulative speech-acts. For the methodology of making such determinations at a stage where the grammar of tense-aspect-modality is often unmarked, as well as the notion of 'clause' in children's discourse, see Givón (2008a). **[FN 4]**

	HERE	(pp. 1-30 of transcript) HERE&NOW DISPLACED											
	PR/PR/IMM		==== H4	HAB		PAST		FUT		ТОТ			
	==== N	~ %	===== N	%	N	%	N	 %	= ==== N	%	====== N		
EVE	228	= ==== 97.0			===== 7		= ===== /		= ===== 7	= ==== 3.0	235		
NAOMI	257	98.8	/	/	2		1		3	1.2	260		
NINA	340	100.0	/	/	/	/	/	/	/	/	340		
TOTAL:	825	98.8	/	/	9		1		10	1.2	835		

TABLE 10: Temporal displacement--stage I

TABLE 11: Temporal displacement--stage III

	NOW&	VOW&IMM DISPLACED										
	PR/PR/IMM		HAB		PAST		======================================		TOT		TOT	
	===== N	%	N	%	N	%	N	%	== ==== N	%	 N	
EVE	163	83.5	4		20		= ==== 8		32	= <u>=</u> 16.5	 195	
NAOMI	211	67.8	8		73		19		100	32.2	311	
NINA	281	76.5	26		41		19		86	23.5	367	
ADAM	372	87.3	11		43		/		54	12.7	426	
TOTAL:	1,027	79.0	49		177		46		272	21.0	1,299	

]	NOW	(pp. 1 &IMM	-30 of	transcri	pt) DIS	CED					
	==== PR/PF	===== R/IMM	HAB		PAST		======================================		TOT		TOT
_	N	%	N	%	N	%	N	%	N	%	 N
NAOMI NINA(IV)	213 308	55.0 64.0	18 13		148 60		8 100		174 173	45.0 36.0	387 481
ADAM	248	74.4	50		22		13		85	25.6	333
TOTAL:	769	64.0	81		230		121		432	36.0	1,201

TABLE 12: Temporal displacement--stage IV

The results, while not amenable to inferential statistics, are striking. At stage I of our study (ca. 2;0), the children anchored virtually all are their clauses in the current speech situation--on the average only an average of **1.2%** displaced temporality. At stage III (ca. 2;6), where the children are just beginning to produce restrictive RPN modifiers, the average has risen to **21.0%**. And at stage V, the final one in our study, the average was **36.0%**. While one cannot claim a direct causal link, it is fairly clear that REL-clause are acquired by children during the time when they begin to communicate about events and states that are not any more anchored in the here-and-now of the current speech situation.

5.3. Length of coherence clausal chains inside single turns

Another characteristic of early child communication is the rather **local coherence** of the discourse, where often the topic shifts every turn. What is striking in early childhood discourse--ca. 2;0 and below--is that the child's turns are often just the **one-clause** long. This gives rise to an extremely collaborative discourse style, where both topics and constructions are shared and elaborated across adjacent turns (Ervin Tripp 1070; Scollon 1976; Ochs *et al.* 1979). At this early stage of communication, topic negotiations are often protracted and repetitious (Keenan 1964a, 1964b) and the discourse style highly **paratactic**, shunning complex NPs, in particular large RPN modifiers. Multi-propositional discourse in single turns, the hallmark of more sophisticated adult discourse with single-person control of perspective, emerges only gradually.**[FN 5]**

Table 13, 14, 15 below summarize the distribution of turn-length in stages III, IV and V, respectively, of our study. The counts were performed on the first 15 pp. of each child/stage text.

		1	2	2	3		4		5-	+	тот	AL
SUBJECT	===== N	%	===== N	 %		%	===== N	 %	===== N	%	N	%
EVE	81	==== 86.1	12	12.7	1	1.2					= <u>=</u> 94	100.0
NAOMI	74	69.2	22	20.6	6	5.6	2	1.8	3	2.8	107	100.0
NINA	86	66.6	28	21.7	6	4.6	5	3.8	4	3.3	129	100.0
ADAM	84	64.7	22	16.9	10	7.6	7	5.4	7	5.4	130	100.0
TOTAL:	325	70.7	84	18.3	23	5.0	14	3.0	===== 14	 3.0	460	100.0

Table 13. Number of clauses per turn (child)--Stage IIILength of chain

Table 14.Number of clauses per turn (child)–Stage IVLength of chain

		1		 2	3			===== 	5-	===== +	T01	 ΓAL
SUBJECT	==== N	%	===== N	~ %	===== N	 %		%	===== N	===== %	= ===== N	%
NAOMI	=======================================	48.5	11	==== 15.7	==== 7	====== = 10.0	 5	= ==== 7.1	=====	18.7	70	100.0
NINA	77	62.2	22	17.7	10	8.0	8	6.4	7	5.7	124	100.0
ADAM	50	57.4	15	17.2	12	13.9	6	6.9	4	4.8	87	100.0
TOTAL:	====== 161	57.2	 48	====== 17.0	 29	10.3	 19	===== 6.7	24	 8.8	===== 281	100.0

Table 15.Number of clauses per turn (child)–Stage VLength of chain

SUBJECT	====	====== 1	2	====== }	3	======	4		5-	 +	TOT	====== 'AL
	===== N	===== %	===== N	===== %	===== N	 %	===== N	<u> </u>	===== N	 %	===== N	<u> </u>
======= NAOMI ADAM	==== 30 26	44.2 46.5	===== 15 11	==== 22.1 19.6	===== 8 5	===== 11.7 8.9	==== 1 4	1.4 7.1	14 10	20.1 17.9	==== 68 56	100.0 100.0
TOTAL:	====== 56	====== 45.2	26	===== 20.9	13	====== 10.5	5	4.0	24	19.4	===== 124	====== 100.0

With considerable cross-subject variation, the general trend is nonetheless fairly obvious. One-clause turns drop gradually, from ca. **70%** of all children turns at stage III to ca. **57%** at stage IV to ca. **45%** at stage V. Correspondingly, turns of 5 or more clauses stand at ca. **3%** at stage III, **8%** at stage IV and **19%** at stage V, the stage where some of the children have long bursts of multi-clause narrative chains.

I will illustrate the two extremes of this developmental scale with one example from stage I (ca. 2;0) and one from stage V (ca. 4;5). In the first (25), the collaborative nature of early-stage topic negotiations is striking, as is the rapid **topic shifts** initiated by the child. This contrasts sharply with the adult's turns in (25), which pull repeatedly toward **topic continuity** in the first portion of the interaction, until in frustration the adult takes charge.

(25) **One-clause child turns, stage I** (Naomi-I, p. 45):

[Context: discussing objects in the immediate environment] NAO: Baby ball. MOT: Baby has a ball. NAO: Got [???].Got [???]. MOT: What? NAO: Got **shoe**. MOT: Got show, yeah. Yes. The baby has a dress on. NAO: Jacket on. MOT: And a jacket on, right. CHI: Shoes on. MOT: Yes, Daddy has shoes on. NAO: Knee. MOT: Yeah. Daddy has knees. Where is the baby's elbow? NAO: Elbow. MOT: Do you know where the elbow is? NAO: Elbow [pointing to Daddy's head]. MOT: No, that's Daddy's head.

Contrast this short-burst child discourse style with (26) below, where same child at stage V produces a 13-clause turn, taking charge of topic continuity to the point of discouraging the adult's 'clarifying' intervention:

[Context: playing in the bathtub]

FAT: That's so you can slide down and get your hair rinsed.

NAO: Oh. Whoopsie. I slided down for real fun. And isn't that nice?

All the fiends except **Froggy** and Pogo. **Froggy** and Pogo live next doors.

They live next door and little. Froggy says "here I go [???]".

'at['s] all. So he just swam under everything. Until one day. [???].

All the people ran in his house. And he most of all [???].

FAT: Most of all what, Nomi?

NAO: I wasn't talking to you.

At our stage V, children are of course still capable of engaging in short-turn backand-forth discourse, superficially similar to that in (25). But such rapid-switch interactions tend to exhibit much higher **cross-turn collaborative coherence**, characteristic of adult conversation (Chafe 1997; Ervin-Tripp 1997). Thus consider another interaction with the same child at stage V:

(27) **One-clause child turns** (Naomi V, p. 94-95)

[Context: Imaginary play with a doll]

NAO: Um also, she um also she had chicken pox.

MOT: Chicken pox!

NAO: [???].

MOT: She **itching**?

NAO: Uh-huh.

MOT: Oh, you still have the **chicken pox**.

NAO: Oh yeah.

MOT: And such a **young baby** too.

NAO: She's only **two**.

MOT: Yeah. She must feel a lot better now.

NAO: She still has chicken pox.

MOT: Uh-huh.

NAO: Are you cold?

5.4. Speech-act distribution

The last feature of the communicative ecology that changes rapidly during early language acquisition is the frequency of speech-act types. In our earlier companion study of the acquisition of verbal modality (complex VPs) between the ages of ca. 2;0 and 2; (Givón 2008a), it was shown that the frequency of **manipulative speech-acts**, which predominate the early stages of child communication (Carter 1974; Bates *et al.* 1975), had already stabilized at ca. **30%** by age 2;0. Thus, by the time children in our CHILDES transcripts begin to acquire post-nominal restrictive modifiers, the major shift in speech-act distribution has already taken place.

The counts of speech-act distribution in the transcripts of stages III, IV and V show wide swings across subjects and across different portion of the transcript for the same child/stage. Long stretches of child narrative, as in (26) above, tend to tilt towards a high frequency of declaratives; while more rapid-shift short-turn exchanges show a higher frequency of manipulatives. The frequency distribution Tables 16, 17, 18 below testify to such variation, rather than to any continuing developmental trend from stage III to IV to V.

		Speech det								
	===== Ma	Manip.		clar.	Ques	stion	TOTAL			
SUBJECT:	===== N	 %	===== N	 %	===== N	%	==== N	%		
EVE	30	36.1	====== 39 72	46.9	==== 14	17.0	==== 83	100.0		
ADU	37	23.8	/3	47.0	45	29.2	155	100.0		
NAO	66	45.5	63	43.4	16	11.1	145	100.0		
ADU	38	28.1	47	34.8	50	37.1	135	100.0		
NIN	32	21.3	86	57.3	32	21.4	150	100.0		
ADU	34	19.1	42	23.5	102	57.4	178	100.0		
ADA	61	32.6	74	39.5	52	17.9	187	100.0		
ADU	23	18.6	64	52.0	36	29.4	123	100.0		
ADU:	189 =	 44.4%					425			
CHI:	132 =	22.3%					591			

Table 16: Speech-act distribution-stage III (pp. 1-15 of transcript)Speech act

	Ma	Manip.		Declar.		tion	TO	TAL
SUBJECT:	N	%	N	%	N	%	N	%
NAO ADU	51 36	40.4 40.9	61 36	===== 48.4 40.9	==== 14 16	11.2 18.2	==== 126 88	100.0 100.0
NIN ADU	63 26	31.9 17.7	121 39	61.4 25.6	13 87	6.7 56.7	197 152	100.0 100.0
ADA ADU	17 16	12.5 17.5	90 37	66.6 40.6	28 38	20.9 41.9	135 91	100.0 100.0
======= ADU: CHI:	====== 131 = 78 =	28.6% 23.5%					458 331	

Table 17: Speech-act distribution-stage IV (pp. 1-15 of transcript)Speech act

Table 18: Speech-act distribution–stage V (pp. 1-15 of transcript) Speech act

	Ma	Manip.		clar.	Que	stion	TOTAL		
SUBJECT:	===== N	 %	 N	~ %	 N	%	===== N	 %	
========= NAO	===== 15	9.5	128	81.5	14	= ==== 9.0	157	100.0	
ADU	33	32.3	40	39.2	29	18.6	102	100.0	
ADA	37	27.4	80	59.2	18	13.4	135	100.0	
ADU	28	42.4	21	31.8	17	25.8	66	100.0	
ADU:	===== 52 =	17.8%					 292		
CHI:	61 =	36.3%					168		

6. Paratactic precursors of children's REL clauses

In his seminal study, Diessel (2005) suggests that the acquisition of both complex VPs and complex NPs proceeds through **expansion**, starting from an earlier **holistic** single-clause constructions and eventually expanding, at least semantically, to two clauses packed together as a complex construction. In my earlier study of the acquisition of complex VPs (Givón 2008a),

I suggested that the expansion model did not accurately characterize the acquisition of complex VPs. Rather, the process of **condensation** was involved there, whereby the precursors of complex VPs were **paratactic** two-clause combinations spread across **adjacent conversational turns**.

Earlier above, I have shown that before children acquire adult-type REL-clauses, they already produce several types of RPN modifiers that are functionally equivalent to REL-clauses. Those constructions may be considered early precursors of standard REL-clause forms. I have also showed that the presentative clause, the presumed early holistic one-clause stage identified by Diessel (2005), is not found in any particular frequency in the early stages of REL-clause acquisition, leastwise not in the transcripts studied here. What I would like to suggest now is that a **condensation**--rather than an e**xpansion**--model also characterizes the early stages of acquisition of restrictive REL-clauses.

It is not easy to prove that some paratactic construction is 'the precursor' of syntactic RELclauses. To begin with, the notion of 'semantic equivalence' is rife with difficulties, and the difference between run-of-the-mill conjoined clauses and paratactic clausal modifiers may hinge of subtle pragmatic difference between **asserted** and **presupposed** information. Demonstrating the semantic equivalence of paratactic and syntactic configurations is thus, at best, suggestive.

What follows below is the entire inventory of paratactic constructions used by the children at stages II, IV and IV of our study. The plausibility of these constructions being the developmental precursors of the RPN modifiers discussed earlier above is thus not proven, but only suggested. In each of the examples, either the RPN modifier itself or the entire modified noun phrase is packed under **a separate intonation contour** from its proper main clause.

Consider first the paratactic RPN modifiers found in the transcripts of stage-III:

(28) **EVE-III** (ca. 60 pp. of transcript)

(a) EVE: My glass. MOT: Your glass? EVE: Yep. MOT: Which glass? Your [???] one? EVE: Yes. With ice-cubes in it? MOT: With an ice-cube in it? EVE: Yeah. [p. 3-4]

(b) RIC: Let's put it...

EVE: There. You make it right there. You make it there, **by your other flower**. [p. 43]

©) FAT: A bill from Dr. Finn for Eve's chin.
 EVE: A bill, from Dr. Finn, to fix Eve chin. [p. 60]

(29) NAOMI-III (ca. 60 pp. of transcript)

MOT: That's a card I was going to send to these people who had a baby.
NAO: Had a baby?
MOT: Yeah.
NAO: [???].
MOT: That's okay.
NAO: A little baby. Baby.
MOT: Yeah, I was going to send that to the people who had the baby. [p. 2]

- (30) NINA-III (ca. 60 pp. of transcript)
- a. MOT: What's this? NIN: A little ducky. **Swimming in the water**. [p. 13]
- b. NIN: Oh there's a new picture of one. MOT: Of what? NIN: Of building houses. [p. 13]
- c. NIN: Oh, this is a picture... **of hippopotamus and seals and a man**. MOT: Oh, that the little box that the rhinoceroses came in. [p. 33]
- d. MOT: And what else is this dolly wearing?
 NIN: A blouse like that one. Louise gave me that one.
 MOT: That a pretty, pretty dolly.
 NIN: Yes, she has a blouse like that dolly.
 She has a skirt like that dolly. [p. 42]
- (31) ADAM-III (ca. 60 pp. of transcript)
- a. ADA: [???] paper. Have some. Have some table. Ursula brought this Adam.
 NOT: What? Have something on the table that Ursula brought Adam? ADA: Sit a right there. [p. 5]
- b. ADA: Like a house. Cowboy like a house. MOT: Cowboy likes a house? It's a restaurant, where you go to eat. [p. 23]

For the four children at stage III combined, out of a total of 14 RPN modifiers, 10 appeared in paratactic constructions.

The comparable list for the three children at **stage IV** is as follows:

- (32) NAOMI-IV (ca. 90 pp. of transcript)
- a. NAO: Because I want the black dolly. The black dolly. The dolly with the brown sleeper.
 MOT: You want this one?
 NAO: Yes.
 MOT: This is the one with the brown [sleeper?]. [p. 8-9]
- b. NAO: Up there. I can't find the cover. MOT: What cover? NAO: The cover that I'm looking for. [p. 8]
- c. MOT: You have to do the work in the book? Okay, well I will tell you, let's see. NAO: I got all the books from my the other school, so I have to sit down and... MOT: Okay.
 NAO: Read these. All these. These are all the books I have and all the puzzles I have.
 - MOT: All the puzzles *you have*? [p. 16-17]
- d. MOT: Here's a mommy. A big mommy.
 NAO: Yup. W[ith] ger gir g g girl standing by her.
 MOT: And the mommy has a bid... What does she have on?
 NAO: Apron. [p. 26]
- e. MOT: I don't know what we can get to fasten this and we'll have to think about it. So we can get...
 NAO: [???] something to play with. [p. 80-81]
- (33) **NINA-IV** (ca. 90 pp. of transcript; total RPN modifiers =14; ; paratactic = 9)
- a. MOT: Okay, tell me the story about Pinocchio.
 NIN: Okay... Once upon a time here was a three many Pinocchios
 and they had a great time. And we had two stories. [p. 6]
- b. MOT: You're gonna hold me?NIN: No, this lady named Florence. [p. 6]
- c. NIN: Now slap her legs down.
 And go to sleep in your sleeping bag. like your friend Elizabeth is.
 This is Elizabeth and this is Nina. [p. 7]

- d. MOT: Why don't you find a home for all of them? Put them in their homes and take care of them.
 NIN: All the animals that belong... All the animals that we were playing with, Mommy. [p. 65]
- e. NIN: Yup, so the people could go in. MOT: Have you seen them around? NIN: Mommy. I want the same people that were at the doll. that were at the doll. [p. 70-71]
- f. MOT: Is it going to be in the city or in the country? NIN: In the country. MOT: And what are we going to see in the country? NIN: People that are not gonna be burned up. [p. 76]
- g. MOT: You went to see a movie with daddy? NIN: Yup.MOT: And what was the story of the movie?NIN: Uh, the people that are in love. [p. 76]
- h. NIN: In the morning Yup. They are going to a movie that, that's Hikey and Fixey and the Fox. [p. 77]
- i. MOT: What park should we go to?
 NIN: To the merry... To the park that has the animals.
 MOT: Which one is that? [p. 80-81]
- (34) ADAM-IV (ca. 90 pp. of transcript)
- a. ADA: See the engine? URS: Yes ADA: A box, that is a boxcar and that a log car. Carrying logs. [p. 3]
- b. MOT: What kind of whale is that?ADA: Have big sharp mouth. Have big sharp teeth. It's a baby whale. [p. 10]
- c. ADA: What are these? MOT: That's what you call chalk. ADA: Chalk for putting in the mouth? MOT: No, not for putting in the mouth. [p. 20]

MOT: This isn't a doggie. ADA: What is it? A bear **just like mine**. MOT: Mmhm. [p. 28]

Out of the combined sample for the three children of **39** RPN modifiers, **18** are paratactic. Finally, consider the following examples from the two children at **stage V**:

- (35) NAOMI-V: (ca. 90 pp. of transcript)
- a. FAT: Okay, one more story and then you come out of the tub.
 NAO: There was two frogs and one Pokey. And they all lived together.
 Frogs, two frogs and one Pokey and they always pooped in their face. [p. 14]
- b. NAO: Know what? MOT: What? NAO: I have... I picked up that thing. That pretty thing that's on the floor. MOT: The wall paper, piece of wallpaper? NAO: Yeah. [p. 34]
- c. NAO: Okay. Once there was...Once there was. Humpty Dumpty sitting on a wall.He fell down and hurt hisself. Tumbling from it, [???] cried. [p. 37-38]

(36) ADAM-V: (ca. 90 pp. of transcript)

- a. MOT: Alvin.
 ADA: Rocky.
 MOT: Oh, Rocky, I'm sorry.
 ADA: Rocky with nothing on his... with his friends. [p. 13]
- b. ADA: What's in here? URS: Oh, that's something for your mother. ADA: That's a book, right? A book about knights? A book about knights. [p. 46-47]

Out of the combined **37** RPN modifiers produced by two children at stage V, **9** appeared in paratactic constructions.

The frequency distribution of paratactic RPN modifiers in our transcripts at stages III, IV and V, combined for all children, is summarized in table 19 below.

STAGE	# of subjects	total RPN modifiers		total paratactic	%	paratactic
					==	
III	4	14 (3	5.5/child)	10		71.4%
IV	3	39 (1	3/child)	18		46.1%
V	2	37 (1	8.5/child)	9		24.3%

Table 19: Percent of paratactic RPN modifiers

While these distributions are in no way definitive, they nonetheless suggest a developmental trend, whereby the putative paratactic precursors appears at the highest frequency (71.4%) at the early stage, and then taper off gradually (to 46.1%, then 24.3%) as the children produce more--and more standard forms of--restrictive REL-clauses.

7. Tentative conclusions

7.1. The adaptive ecology of communication

It has become fashionable, ever since Slobin's (2002) course reversal, **[FN 7]** to assert that the three developmental processes that define human language–language ontogeny, language diachrony and language evolution--have little to do with each other. Heine and Kouteva (2007) have already argued, I think convincingly, that parallels between language diachrony and language evolution feed into a fruitful line of inquiry (see also Givón 2008c). My own reading of the acquisition data, including those surveyed here and in the companion study (2008a), is that the course of child development is a powerful, stimulating analogue of language evolution--provided one remembers the difference between analogy/similarity and identity.

In particular, the developmental course of the three grand features of the human **communicative ecology**:

- the rise of displaced reference;
- •the liberation of declarative/epistemic speech-acts from
- their prior subservience to the deontic/manipulative;
- the rise of multi-propositional discourse

is fundamentally the same process in language ontogeny and language evolution. In language ontogeny as in language evolution, the adaptive ramifications of these three major developmental trends form the context within which the rise of restrictive modifiers begins to make sense. And it is only when the third grand feature has come on line, and the child is capable of producing **multi-propositional paratactic discourse**, that the syntactic pre-conditions for the genesis of complex syntactic construction have been reached.

7.2. Interactive discourse and syntactic development

Relative clauses are acquired in the intensive, interactive conversational context of **referential negotiations**. In the ecology of earlier child communication, such negotiations were handled by rapid-shift, short-burst turns, with much repetition and back-and-forth thrusts and parries (Keenan 1974, 1975). This negotiation style made restrictive modifiers superfluous, but it remains a highly inefficient **pre-grammatical strategy**. The new strategy, adding restrictive REL-clauses to the earlier referent-marking arsenal--full nouns, demonstratives and articles, emphatic stress, pragmatic word-order, pronouns and zero anaphora--is obviously more efficient, in the relatively rare discourse contexts where it is required.

The relatively late acquisition of REL-clauses and their relative rarity in face-to-face informal communication, of both children and adults, go hand in hand. Only within the more complex referential demands of maturing communication does the acquisition of REL-clauses begins to make sense, with an increased recourse to the communicative functions coded by REL-clauses:

- •Presentative constructions (making new referents salient)
- •Reference to prior discourse (searches in episodic memory)
- •Navigating referential competition

7.3. 'Expansion' vs. 'condensation' and parataxis to syntaxis

The **expansion-from-holistic** thesis in child language development has its origins in the works of Tomasello (1992; 2000; see also Tomasello and Diessel 2001). In a recent paper, Tallerman (2007) criticized this *analytic* approach as an inadequate model for language evolution, a criticism that may or may not apply quite as forcefully to language ontogeny.**[FN 8]**

Be the general validity of this developmental model as it may, the data of my two companion studies suggest that an alternative model, **condensation from parataxis**, one that is well established in the diachrony of complex clauses, also applies to their ontogenesis. And while the communicative context--negotiations of deontic and epistemic modality of propositions vs. negotiations of reference--may differ between the types of complex constructions, the general **parataxis-to-syntaxis** condensation model seems to apply to both.

7.4. Whither 'recursivity'?

We come back now to a central question broached earlier above. Our cumulative data of both language diachrony and language ontogeny suggest that the two main types of complex clauses, complex VPs vs. complex NPs, differ in multiple major features; respectively:

•time of acquisition: early vs. late

• prevailing communicative ecology:

•domain of reference: here-and-now vs. displaced
•speech acts: deontic (early) vs. epistemic (late)
•coherence span: limited (early) vs. expanded (late)

- negotiating epistemics and deontics of events vs. negotiating reference
- •terminal usage frequency: high vs. low
- •ultimate syntactic product: clause union vs. no clause union
- •ultimate lexical product: complex verbs vs. complex nouns.

Both developmental trends seem to yield 'recursivity'. But the processes through which such 'recursivity' arises are of very different sorts. In the genesis of complex VPs, a main-clause verb is recruited as a **deontic or epistemic operator** on the embedded' clause, and it is the **embedded clause** that retains communicative center stage. In the genesis of complex NPs, an embedded clause is recruited as a **marker of referential status** of a main-clause referent; and it is that **main-clause referent** that retains communicative center stage. In both cases a clause is recruited to operate on another clause. But it is the **main** clause that becomes the operator in genesis of complex VPs, and the **subordinate** clause in the genesis of complex NPs.

Both Simon (1962) and Hauser *et al.* (2002) define complexity formally, abstractly, and configurationally, with 'recursivity', coming out of to Chomsky's early machine-theory work, being but a sub-case of Simon's more general notion of **hierarchy**. But is 'recursivity' a meaningful concept in language? Or is it but an accidental by-product of development, perhaps an *epiphenomenon* that 'falls out' of two separate and distinct processes of *grammar genesis*?

Perhaps all 'recursivity' means is the following: In the genesis of morphology, **lexical words** are recruited to become grammatical operators on both clauses and other words. In the genesis of complex syntax, **whole clauses** are recruited as operators on other clauses (complex VPs), or on words (complex NPs). But in the case complex VPs, the recruited clause soon shrinks to its lexical core--**the verbal word**, which then becomes a **morpheme**--bye-bye synchronic 'recursivity'. In the genesis of complex Nps, on the other hand, the recruited clause remains a clause--welcome synchronic 'recursivity'. The common denominator is valid, at best, only during the the **initial recruitment process**, the early stage of the genesis of complex syntax.

Footnotes

*

I am indebted to Holger Diessel for his stimulating study on the acquisition of complex clauses (2005); to Brian MacWhinney for making the CHILDES data-base available electronically; to Cecilia Rojas for helpful discussion of her study of the acquisition of REL-clauses in Spanish; and to Bernd Heine and Tania Kouteva for the stimulating chapters 5 and s 6 of their book (2007).

1

The child-adult communication studied here was based on the CHILDES database, courtesy of Brian MacWhinney. The subjects of the previous study, stages I,II,II (Givón 2008a), were Eve, Naomi and Nina, with ca. 60 pp. of printed transcript each. The transcripts of Adam were added to Stage III. Stage IV involved Naomi, Nina and Adam, with ca. 90pp. of printed transcripts each, and stage V Naomi and Adam with ca. 90pp. of printed transcript each. The age range for stage III was 2;4-2;8, for stage IV ca. 3;6, and for stage V ca. 4;6.

2

The comparison adult text used here was tape-recorded in 1981 when the speaker, a retired rancher, trapper, oil-field roustabout, Ol' Time fiddler and natural *renconteur*, was in his early 60s. The text counted here was taken from the transcribed chapter 3 of his yet-unpublished life-story. 3

Nina's transcripts did not continue beyond our stage IV, so her stage IV was counted as stage V for the purpose of this measure.

4

The methodology depends heavily on the analysis of the immediate context, i.e. preceding and following turns of both child and adult, to indicate the intended temporality of the oft-unmarked and immensely elliptic child utterances.

5

The most extreme type of multi-propositional discourse is, of course, edited written text, whose coherence and grammatical structure(s) are controlled by a single mind (Keenan and Bennett 1977; Givón 1979, ch. 5).

6

Collaborative cross-turn construction of coherent discourse is a well-documented option in adult face-to-face communication discourse (Chafe 1997; Ervin-Tripp 1997).

7

See e.g. his earlier pronouncements on the similarity between ontogeny and diachrony (Slobin 1977).

8

In sum, Tallerman points out that if a multi-word sequence ('you give me apple') is learned first as a holistic unit ('yougivemeapple'), there is no learning procedure that will guarantee the eventual assignment of three specific meanings to any particular three parts of the unsegmented whole. The use of single words to stand for whole propositions ('apple!') in early childhood, (or of lexical-specific predator calls in primate communication), is not a case of holistic meaning, but rather of well-defined lexical meaning, with the rest of the proposition ('you', 'me', 'give', manipulative speech-act) inferred from the context. Syntactic development, leastwise in language evolution, is thus *compositional* rather than *analytic*. But the facts of early language ontogeny, in particular the proverbial one-word stage (Bloom 1973; Scollon 1976) suggest precisely the same context-dependent reading of single-word 'holistic' utterances (see discussion in Givón 2008a).

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1/childcomp.08

THE ONTOGENY OF COMPLEX VERB PHRASES: HOW CHILDREN LEARN TO NEGOTIATE FACT AND DESIRE

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1. Overview

The acquisition by children of complex verb-phrase ('complex predicate'; 'verbal complement') constructions has been studied recently in two ground-breaking works, Diessel and Tomasello (2001) and Diessel (2005). Among their many findings, five closely-related observations concern us most here. They may be summarized as follows:

- (i) In the early stage of child use of verb-plus-complement constructions, the main verb acts as a grammaticalized modal operator--epistemic or deontic--on the complement clause.
- (ii) Consequently, verb-plus-complement constructions behave semantically as a single propositions, whose semantic focus falls on the complement clause itself.
- (iii) Only in later stages of acquisition do children develop the use of the verb-pluscomplement construction as a complex two-clause construction, the presumed adult pattern, in which the main clause has its own independent semantic value.
- (iv) Therefore, in the course of the child's acquisition of complex verb-phrases, an initial *simplex* single-clause construction is later re-interpreted--by **expansion**--as a *complex* two-clause construction.
- (v) The process of acquisition by children thus proceeds from a *holistic* to a *composite* semantic interpretation of the very same construction, apparently without any syntactic correlates to the semantic change.

Diessel and Tomasello's observations, if they hold, imply that the diachrony of complex VP constructions proceeds in the exact opposite direction from their ontogenesis. This is so because in diachronic syntax, the main developmental trend in the rise of complex two-predicate clauses is for **paratactic** two-clause configurations, falling under two separate intonation contours, to undergo **condensation** into **syntactic**, complex two-predicate clause under a single intonation contour (Givón 1979, 1991, 2006, 2007; Heine and Kuteva 2007, 2008).

In this paper, while taking the findings of Diessel and Tomasello as an important point of departure, I will suggest that there is a way in which their observations (i) and (ii) can be granted without necessarily subscribing to (iv) and (v). And as for (iii), its specificity to children (vs. adults) needs to be re-visited.

2/childcomp.08

The main thrust of my argument concerning theses (iv) and (v) is fairly transparent, harkening back to a body of work that is, deservedly, part of the acquisitional canon, such as Ervin-Tripp (1970), Scollon (1974, 1976), Ochs *et al.* (1979). Those works suggest that in the early stages of child communication, both propositions (semantics) and clauses (syntax) are distributed-over **multiple child-adult or adult-child conversational turns**. And that those cross-turn **shared constructions** are the true precursors of the single-turn clauses that emerge in subsequent stages of child communication.[**FN 1**] To quote Ochs *et al.*'s conclusions:

"...caretaker and child **together** construct a single proposition. We suggest that a child may learn how to articulate [full-formed] propositions through such a mechanism. That is, she may learn ho to encode propositions by participating in a sequence in which she contributes a component of the proposition... We may ask: To what extent is a child able to encode the proposition he wishes to convey in a single utterance?... Which dimension of the utterance context (verbal and/or nonverbal) does the child exploit...?..." (1979, pp. 267-268)

In this paper, I hope to show that such cross-turn "joint constructions" are copiously present in the early stages of acquisition of complex verb phrases. Much of the seeming disagreement turns out to hinges on a subtle point of methodology. Diessel and Tomasello tracked down the first appearance in the child's use of complex VPs such as:

- (1) a. DEONTIC: I want to eat the apple.
 - b. DEONTIC: Let me have a toy.
 - c. EPISTEMIC: I know (that) it is broken.

They noted that when the child first produces such constructions, their semantic value is simplex, so that (1a) and (1b) are a simple, unitary **direct manipulative speech-acts** of *request*, and (1c) a simple, unitary **emphatic assertion** of 'It is broken'. Only later do the corresponding complex usages emerge, usually with non-SAP subject, as in respectively:+

- (2) a. DEONTIC: She **wanted** to eat an apple.
 - b. DEONTIC: He **let** him have the toy.
 - b. EPISTEMIC: They **knew** (that) it was broken.

In such late uses, presumably, both the main and complement propositions have independent semantic values.

But--do the simplex constructions in (1) have precursors at an *earlier* stage, when the child is not yet using these constructions in their full-ledged form? What I propose to show here is that cross-turn sharing of complex constructions, *a la* Ervin-Tripp, Scollon and Ochs *et al*, is the real precursor of the early-stage child usage in (1). Such cross-turn sharing of complex structures is amply present in the data base (CHILDES transcripts) studied by Diessel and Tomasello. But in order to identify such paratactic precursors, one must look not only at single utterances produced by the child, but at larger chunks of multi-turn interactions between the child and adult.
Another topic that begs some discussion is Diessel and Tomaesello's characterization of the **adult standard** for complex VPs, the benchmark children reach later in development. They view the adult standard--the child's target construction--as consisting of two semantically independent clauses, and their observations (i), (ii) and (iii) pertain only to early child language.

The characterization of adult complex-VPs as consisting of two independent propositions, prevalent ever since Chomsky's early transformational work, has been challenged head-on by Sandy Thompson (2002; see also Thompson and Mulac 1991; Boye and Harder 2007). Along the same lines, I would like suggest that the whole rationale for the use of deontic and epistemic main verbs in complex verb phrases is, to begin with, to create **deontic and epistemic modal envelopes** on the complement proposition. In adult as in child usage, the non-modal 'two-propositions' use of such constructions is a secondary late development, and does not characterize the bulk of everyday usage. This is a complex argument, involving both the diachrony of modal development (Hopper and Traugott 1983; Heine et al. 1991; Heine and Kuteva 2007) and the question of what text-type--or **communication type**--is the benchmark--**prototype**--of human language. At the very least, I would like to show that the pattern of adult usage of complement-taking main verbs does not differ significantly from that of early childhood. And further, that non-academic, non-philosophical oral language conforms, substantially, to Diessel and Tomasello's description of the early child modal development stage.

2. Data-base

The transcripts of child-adult communication studied here were selected from the CHILDES data-base, courtesy of Brian MacWhinney.[FN 2] This is the same data-base studied by Diessel (2005), with two of the three English-speaking children (Naomi, Nina) also appearing in Diessel's (2005) 5-children sample, and one (Eve) added. For each child, three developmental stages were selected be informal criteria. In stage-I, very few examples of complex verb phrases are found. In stage-II, more. In stage-III, many more. Approximately 60 printed pages of CHILDES transcripts were studied for each child at each stage, aiming for contiguous single recording sessions whenever possible. Since the original transcripts on hard disk are often un-paginated, page numbers for later reference were added after the printing. In the case of Naomi's stages I and II, multiple recording sessions were combined to make up the aimed-for bulk. [FN 3]

3. Modal interaction units

3.1. Simple modal interactions

The use of deontic and epistemic main verbs as modal operators on complement propositions does not occur in a communicative vacuum. To appreciate how such constructions are used, one must inspect the **adaptive-communicative goal context** within which they are embedded. I will call these contexts in child-adult communication **modal interaction units** (MIUs). If the CHILDES transcripts are any indication, such units can be broadly classify as carrying either epistemic or deontic speech-act goals. By **epistemic** I mean, rather traditionally,

"pertaining to the facts of the world around us (including the transaction's participants)", as in (1c) above. By **deontic** I mean, just as traditionally, "pertaining to what I want you to do for me or what you want me to do for you", as in (1a,b) above.

What I have done with the ca. 60 pp. of CHILDES transcripts for each of the 3 children and each of the 3 developmental stages, is isolate and extract all the MIUs--coherent chunks of diadic communication--that surrounds each complex VP construction (or a cluster thereof) in the text, be they deontic or epistemic. Some of these MIUs are short and simple, and thus either purely deontic or purely epistemic. Examples of those are:

(3) Simple modal interactions

a. Deontic : (Eve-I, p. 2)	
EVE: Napkin.	(request)
MOT: Oh, do you want a napkin too?	(offer)
b. Deontic: (Eve-I, p. p. 3)	
EVE: Fraser blow nose, blow nose.	(request)
MOT: Wipe your nose? Can you blow?	(offer)
c. Deontic : (Eve-I, p. 15-16)	
EVE: Bottle.	(request)
MOT: What?	(request for interpretation)
EVE: Eve	(request)
MOT: Do you want to taste it?	(offer)
Let's see if Sarah would like to have a drink	(manipulation)
EVE: Eve want some too.	(request)
d. Epistemic: (Eve-I, p. 57)	
EVE: Eating bread too.	(observation of facts)
MOT: She's eating bread too, I think.	(quantification of facts)
e. Epistemic: (Eve-I, p. 59)	
FAT: What are you doing?	(question of facts)
EVE: Have shower hat.	(statement of facts)
FAT: Well, I know you are wearing a shower hat.	(quantification of facts)
EVE: Eve wear-ing shower hat.	(statement of fact)

f. Epistemic: (Eve-I, pp. 55-56)
EVE: Got [=dog] bark-ing.
RIC: He got what?
EVE: Got bark-ing. [x5]
MOT: There's a dog barking outside... Yeah.
COL: I'm not sure. Yeah, I think it is.
I'm sure it is.
Instead of saying 'dog' she says 'got'
EVE: Got eat-ing bread too.

(statement of fact) (question; mis-communication) (repeated statement of fact) (interpretation of statement) (epistemic quantification) (resolving mis-communication) (re-statement of fact)

With one conspicuous exception ('Eve **want** some too' (3c)), all the complex epistemic and deontic constructions in (3) are contributed by the adult. But whoever contributes them, these complex grammatical constructions are embedded inside a **modal-interactive context**, an envelope within which--and through which--the two participant strive to take care of their deontic or epistemic goals, or resolve their epistemic or deontic conflicts. It is thus the entire multiple-turn MIU that should be counted as the **developmental precursor** for the child's eventual acquisition of the use of these complex syntactic structure--and thus of transacting in a more sophisticated, effective fashion deontic and epistemic negotiations. Such verbal sophistication is almost entirely absent in our Eve-I (age 1;9), Naomi-I (age 1;10) and Nina-I (age 1:11) transcripts.

The collaborative nature of these modal interaction is evident in the child's interspersed contribution, often mere fragments of the intended proposition/clause. Thus in (3c) above, Eve first contributes the object ('bottle'), then the subject ('Eve'). Only at the very end, after the mother has interpreted the deontic goal correctly and used the appropriate deontic verb ('Do you **want** to taste it?'), does Eve produce a full proposition ('Eve **want** some too'), albeit with a simplex use of the modal verb (nominal object rather than verbal complement).

3.2. Complex modal interactions

Often, especially in longer MIUs, the modal focus of the negotiation may shift in midstream. The change may involve:

- •Who initiates, and thus controls, the interaction.
- •Shift(s) of modality in mid-MIU by either interlocutor,
- weaving deontics into epistemics and vice versa.

The modal complexity of MIUs is more conspicuous in the later, stage-II or -III transcripts. Thus, consider (4) below, where the mother, rather characteristically, recruits an epistemic argument, together with its attendant modal-grammatical machinery--here two *quotative* verbs--to settle the initial deontic conflict (Naomi-III, p. 4):

(4)	EVE: Give me a diaper.	(request = DEONT)		
	MOT: Yes, I'll get you a diaper, honey.	(promise = DEONT)		
	You let go again.	(manipulation = DEONT)		
	Okay, want to come down	(offer = DEONT)		
	and get this diaper changed?			
	NAO: No.	(refusal = DEONT)		
	MOT: You told me about it, Nomi.	(past-quotative = EPIST)		
	You said: "Mommy change my diaper".	(past-quotative = EPIST)		
	NAO: Boom Mommy.	(utter disdain = DEONT)		

But the child herself is quite capable of pulling the same trick, indeed of replying in modality-shifting kind, as in (Naomi-III, p. 51-52):

(5)	NAO: I want to sit by the tape-recorder.	(request = DEONT)
	MOT: I'm sorry, you're too heavy.	(regretted facts = EPIST)
	and you' re going to break it.	(dire prediction = EPIST)
	Why don't we do something else?	(manipulation = DEONT)
	NAO: It's not brok-en!	(counter statement of facts = $EPIST$)
	MOT: Well, you are breaking it now honey.	(counter statement of facts = $EPIST$)
	You are hurting it.	(counter statement of facts = $EPIST$)

The sweet child, verbally helpless just 4 months earlier, has learned well, indeed from a master, the subtle art of **modal fencing**. **[FN 4]** And the rapiers wielded in service of our modal goals--be they deontic or epistemic--are this relatively small group of complement-taking main verbs, the so called **modality** verbs, **manipulation** verbs, and **perception-cognition-utterance** verbs (Givón 2001, vol. 2). Ultimately, though, the mother's modal fencing skills in (5) are too much for her daughter.

3.3. Boundaries of modal interaction unitss

Sometimes the initial boundary of the MIU is not altogether obvious, especially in cases when a long interaction precedes the complex grammatical-modal form--without the use of any complex grammatical expressions in that preceding sequence. Thus consider (6) below, a lengthy and relatively conflict-free epistemic negotiation (Nina-I, p. 3):

(6)	NIN: Big.	(statement of fact = $EPIST$)
	MOT: Yeah.	(agreement on facts = $EPIST$)
	NIN: Big crocodile.	(expanded statement of facts = EPIST)
	MOT: Big crocodile. It sure is.	(quantification of facts = EPIST)
	NIN: Rabbit	(topic shift; statement of new facts)
	NIN: Little rabbit.	(expanded statement of new facts = EPIST)
	MOT: That's a little rabbit.	(agreement on of facts = $EPIST$)
	NIN: On a bicycle.	(expanded statement of facts = $EPIST$)
	MOT: Oh, is the rabbit riding on the bicycle?	(challenging question of facts = EPIST)
	NIN: Yeah.	(assent of facts = $EPIST$)
	MOT: What is the rabbit doing?	(question of facts = $EPIST$)
	EVE: Fall down.	(statement of facts = $EPIST$)

The second modal interaction in (6), involving the new topic (='rabbit') and the complex expression with the progressive auxiliary ('is'), may easily be detached from the first one (topic = 'crocodile'), marked with the epistemic quantifier 'be sure', without any loss of coherence to either.

In deciding the boundaries of MIUs, a cluster of criteria were considered, most salient among them:

- •*Economy*: Are one or more complex modal-grammatical expressions clustered together naturally?
- •Contextual relevance: Is the immediate context more relevant than the distant one? How immediate is immediate?
- •*Thematic coherence*: Is the thematic thread maintained or interrupted?

When these criteria come into conflict, they must be weighed--and sometimes weighted-against each other. In this study I have elected, whenever possible, to not let modality discontinuity by itself--deontic-to-epistemic or epistemic-to-deontic shifts--be the sole motivation for inserting an MIU boundary, as long as the topical thread is not disrupted by the modal shift. This choice, I think, is well-supported by what we have noted above (4,5) about cross-modal shifting within an MIU.

Conversely, I consider a successful topic shift by either the adult or the child as a good grounds for inserting an terminal MIU boundary. This may be seen in Nina's abrupt shift in (6) above from 'crocodile' to 'rabbit'. Considerations of both topical and modal coherence thus form the bulk of my motivation for packaging MIUs the way I have.

3.4. Identifying the child's speech-act intention

In the early stages (I, II), the child's modal intention is often left unmarked. How does one, working from the CHILDES transcripts, determines the speech-act value of the child's oft-truncated utterance?[**FN 4**] The question can perhaps be recast by punting: How do the adult interlocutors guess, seemingly without fail, the child's modal intention?

The answer is that the adults seem to have little trouble, knowing the child intimately, and knowing the ongoing communicative goal-context. To illustrate how this transpires, consider the following series of short modal interactions. Each opens with a short, rather opaque initial modal move by the child, followed immediately by the adult's interpretation--most often accurate--of the child's speech-act intention; often followed then by the child's confirmation of the adult's modal interpretation (Eve-I):

(7)	 a. EVE: Oh look, my pencil. MOT: There's one in the kitchen on the table counter There's one in the kitchen. You may have that one. 	(request?)(stating relevant facts)(stating relevant facts)(offer)	
	EVE: Write another pencil.	(confirmation of original goal)	
	(p. 1)		
	b. EVE: Candy?	(request?)	
	MOT: Candy? I think not.	(rejection)	
	EVE: Candy.	(reiterated request)	
	MOT: You have animal crackers on the table.	(counter offer)	
	(p. 1a)		
	c. EVE: That Fraser pencil.	(statement of fact?)	
	COL: Can you write?	(epistemic-modal question)	
	EVE: Yeah.	(epistemic confirmation)	
	(p. 1a)		
	d. EVE: Mom napkin.	(request?)	
	MOT: Oh, d'you want a napkin too? There.	(offer)	
	e. EVE: Look Fraser napkin.	(statement of facts?)	
	COL: Yes. You' ve got one.	(agreement & added facts)	
	EVE: There.	(agreement on facts)	
	(p. 2)		
	f. EVE: Fraser blow nose, blow nose.	(request?)	
	MOT: Wipe your nose?	(question on modal intent)	
	Can you blow?	(counter offer)	
	That's a good girl.	(reward for compliance)	
	(p. 3)		
	g. EVE: Sit Pop lap.	(request?)	
	FAT: You don't want to sit on my lap now.	(rejection)	
	Tomorrow.	(counter offer)	
	EVE: 'Morrow.	(acceptance of alternative)	
	(p. 3)		

h.	EVE: I put sugar in it.	(offer?)
	MOT: I had sugar in my coffee.	(incompatible facts)
	I don't need any more sugar.	(decline offer)
	(p. 4)	
g.	EVE: I brush- ing .	(statement of facts?)
-	COL: What are you doing?	(question of facts)
	EVE: [???] brush-ing.	(re-statement of facts)
	(p. 5)	
i.	EVE: [???].	(uninterpretable utterance)
	MOT: Do what?	(request for interpreted)
	EVE: Self.	(request?)
	MOT: What? Oh, you want one yourself	? (offer)
	EVE: Eve get a Kleenex.	(restated request)
	MOT: Alright, take one.	(offer)
	(p. 8)	
j.	EVE: Fall down.	(statement of facts)
0	MOT: I know you fell down.	(epistemic amplification of facts)
	EVE: That mine.	(topic change)
	(p. 17)	
k.	EVE: [???] fall.	(statement of facts?)
	MOT: It fell?	(question of epistemic intent)
	I don't know whether it did.	(amplification of epistemic uncertainty)
	EVE: It [???] fall down. Fall down	(restatement of fact?)
	EVE: Be a horsie.	(topic & modality shift; request?)
	MOT: Be a horsie. Okay.	(granting the request)
	EVE: Be a clip-clop.	(re-stating request)
	(p. 47-48)	
1.	EVE: Baby.	(statement of facts?)
	MOT: What' s Eve doing?	(question of facts)
	EVE: Carry- ing a baby.	(restatement of facts)
	MOT: Yeah.	(agreement on facts)
	(p. 43)	-

On the relatively rare occasion when the adult's interpretation of the child's opaque modal gambit is rejected by the child, negotiations may ensue, and may proceed till the issue is resolved. Thus consider (Eve-I):

(8) EVE: Get a spoon. MOT: Hmm? EVE: Got a spoon. MOT: I forgot a spoon? No, you don't get a spoon. You don't need one. (request?)
(incomprehension
(statement of fact?)
(epistemic interpretation)
(deontic interpretation; denial of request)
(denial of request)

(p. 4)

More often, in cases of confusion, the adult responds with a question to clarify the child's modal intention. This may be seen in (7f,g,h,k,l) above, as well as in (Eve-II):

(9)	EVE: Fraser Fraser [???] top.	(1	request?)
	COL: What do you want me to do?	(question about intent)
	EVE: Take the top [off].	(re-statement of request)
	Fraser open my tinker-toy [box].	(re-statement of request)
	COL: Okay.	((granting request)
	(p	24)	

As I hope to show later on, a fine-grained qualitative analysis of these modal interaction units reveals the multiple instances where complex modal-grammatical expressions are assembled collaboratively across child-adult or adult-child conversational turns.

4. What counts as complex modal/grammatical construction?

In his study, Diessel (2005) was rather strict about what counted as a complex verbcomplement construction in the child. Thus, for example, several complex construction that fit the V-COMP syntactic pattern were not included; most conspicuously:

(10)	a. Serial-verb constructions:	Let's go (and) have supper.
		Come (and) get it.
	b. Cognate-object constructions:	Have a drink/a seat.
		Take a nap/a bath.
		Make a mistake/ a bad judgement
		Give a lecture/a massage.
		Get a haircut/satisfaction

For the sake of completeness, the use of such constructions by both child and adult was included in this study.

A more pressing reason for expanding the range of relevant constructions involves the facts that almost all deontic and epistemic verbs that take clausal complements also take simple nominal objects (Dixon 1991; Givon 1993, 2001). What is more, in both language diachrony

(Givón 2006; Heine and Kuteva 2007, 2008) and language ontogeny, the use of these verbs with nominal complements tends to precedes their use with verbal complements. At least in principle, such simplex uses of deontic and epistemic verbs in child language ought to be counted as **potential precursors** of the complex verbal version. What I hope to document here is that many modal MIUs reveal a rather flexible boundary between the simplex and complex uses of both child and adult. At this point I will illustrate this with only a few simple examples.

Our three children use 'want' and other modal verbs with nominal objects ('want-NP') long before they use them with verbal complements ('want-to-VP'). However, in almost all the early examples of their use of 'want-NP' in the CHILDES transcripts, a clear verbal interpretation of the nominal construction is possible, and indeed is natural. Thus, in the Naomi-I transcripts, 20 instances of 'want-NP' were recorded, as against only 3 of 'want-to-VP'. As characteristic examples, consider (Naomi-I):

(11)	a.	'want'-NP:	Want toast.		(⊃	'to eat'; p. 28)
			Want juice.		(⊃	'to drink'; p. 28)
			Toast coming. I w	v ant it.	(⊃	'to eat'; p. 30)
	b.	Want'-to-VI	P: Wanna get dow	/n. (p. 4	9)	
			Want hug.	(p. 1	51)	
			I want it hug.	(p.	51)	

The last blend construction in (11b) is also found as an early stage of the diachronic development of verbal complements (Givón 1991; Heine and Kuteva 2007, 2008).

The text-frequency disparity between the nominal and clausal complement is somewhat reduced in the Naomi-II transcripts, albeit with too-small a sample: 4 'want'-NP vs. 2 'want-to-VP'. And it is further reduced in Naomi-III transcripts: 36 'want-NP' vs. 21 'want-to-VP', a veritable explosion of the latter.

The same can be said of epistemic verbs such as 'know', 'see' or 'look', although here the overall text-frequencies are much lower (an observation made by Diessel, 2005 and confirmed in this study). Thus for example, in the Nina-I transcripts, one finds 10 instances of the child's use of 'look-at-NP' or 'look-here/there', but only 2 instances of 'look' associated with a clausal complement (Nina-I):

(12) a.	'look'-at-NP:	Look at Mommy. (p. 49)
		Look at dolly book. (p. 49)
		Look at dolly book. (p. 49)
		Look at dolly book. (p. 49)
		Look at dolly book here. (p. 49)
		Look at this. Dolly book. (p. 49)
		Look at dolly book here. (p. 49)
		Look at dolly. (p. 49)
		Look here. (p. 49)
		Look. This way. (p. 49)

b. 'look'-S: Look. Drink a dolly. (p. 42) Look here's Mommy book. (p. 49)

In either complement form in the early-stage transcripts, 'look' serves, equally well, as a grammaticalized epistemic speech-act marker of **directing attention**.

The same distributional tendencies are observed with 'see', with the bulk of the examples involving the same epistemic speech-act function. Thus in the Nina-II transcripts, we find 3 examples of the child's use of 'see'-NP and only 1 of 'see'-S (Nina-II):

(13) a.	'see'-NP:	Let Snoopy see him. (p. 17)
		Oh, you want to see it. (p. 25)
		You see that in there? (p. 32)
b.	'see'-S:	See Snoopy has those feet. (p. 17)

Finally, in the Nina-III transcripts, we find not a single instance of the child's use of 'see-NP', but 4 of 'see-S' in its various versions, again with the same epistemic speech-act function of directing attention (Nina-III):

(14)	'see'-S:	See what this is.	(p. 14)
		See they knock the tree down.	(p. 49)
		Oh, see they move.	(p. 15-16)
		And a ribbon in her hair. See.	(p. 43)

Similar considerations can be applied to verbs such as 'have', 'make', 'take', 'get', 'go', 'come' and others, which can be used as auxiliary main verbs in complex modal constructions, but still appear at higher frequencies with nominal (or prepositional) objects in the early stages. Their early use with nominal objects is again, at least potentially, a developmental precursor to their later, complex-modal use in language ontogeny, much as it has shown to be in language diachrony.

I have for these reasons elected to err on the side of inclusive caution, counting, in both adult and child, all the instances of verbs that *can* become modal operators over verbal or clausal al complements.

5. The adaptive-ommunicative context: A quantitative analysis

In this section I will present four quantitative measures that probe into the general adaptive-communicative, functional, contextual--characteristics of the child-adult modal interactions found in our CHILDES transcripts. In the main, this opening foray into our conversational texts reveals the essential soundness of the way Diessel and Tomasello characterize the early child use of modal expressions. What it also reveals, however is that the adult is using, substantially, the very same modal structure as the child.

5.1. Who takes the initiative for launching modal interaction?

As noted earlier, each of our MIUs is launched by either the child or the adult, and either can initiate a modal change in mid-interaction. It was thus of interest to see who takes the initiative in launching a new modality. Fore this purpose, modal-initiative gestures were divided into into the two broad general types, **deontic-manipulative** and **epistemic-informative**. Under deontic-manipulative, I counted all direct here-and-now manipulative speech-acts, as well as expressions of intension-to-act in the immediate future. The latter may be considered, at least in the rearly-stages CHIDES transcripts, a species of *promise* or, occasionally, *warning* or *threat*. For example, in (15a,b,c) below the modal use of 'would-like', 'can't' and 'want' are clearly manipulative. But so are, in a fairly obvious way, the uses of 'be-gonna' and 'will' in (15d,e,f). Thus (Eve-II):

(15) a.	MOT: Would you like a gr	aham cracker?	(offer)
	EVE: Yeah.	(p. 1)	(acceptance of offer)
b.	EVE: Sue, put my sweeper	down.	(request)
	MOT: Can't you do it?		(rejection & counter-request)
	EVE: No.	(p. 9)	(refusal)
c.	EVE: CromerFraser sit in	chair.	(request)
	COL: Do you want me to si	t over there?	(offer)
	EVE: In the chair.	(p. 15)	(reconfirmed request)
d.	MOT: Are you gonna sit at	the table?	(request/invitation)
	EVE: No. (Eve-II, p. 1)		(refusal)
e.	EVE: That my box. Look th	nat?	(protest; directing attention)
	MOT: I' m goin' to steal you	ur box.	(immediate intent; threat?)
	EVE: What do-ing, Mom?		(question of facts; alarm?)
	MOT: I' m going to use you	ur box. (p. 5)	(immediate intent)
f.	MOT: You lost two of them		(statement of fact; blame)
	EVE: [???] lost two.		(re-statement of facts)
	MOT: I think I' ll just cut th	nat off, Eve.	(manipulation, warning)
	It' ll be easier.		(softened manipulation)
	Wait a second.		(manipulation)
	EVE: Think [???] cut that of	off. (Eve-II, p.	6-7) (echo of warning; promise?)

Under epistemic-informative I grouped 'present/progressive', 'past/perfect' and 'nonimmediate future'. In the children's speech, the distinction between 'present' and 'progressive', or 'past' and perfect', is not easy to demonstrate, due to lack of grammatical marking. One could of course maintain that the context--the adult's directly-preceding turn--disambiguates the distinction.

Thus consider:

(16) a. MOT: Who is that?		(Q-PRES)
EVE: That Jim.		(PRES)
MOT: What' s he do-ing?		(Q-PROG)
EVE: Jump- ing	(Eve-II, p. 47-48)	(PROG)
	• 0	

b.	MOT: What is Mommy do- ing ?	(Q-PROG)
	NIN: Fix a dolly.	(PROG?)
	MOT: Is she fix-ing up dolly?	(Nina-I, p. 36) (Q-PROG)

In (16a), the adult 'present' question is answered with the child's 'present' (unmarked) form, while the adult's 'progressive' question is answered with the child's suffixally-marked 'progressive' form. In (16b), the adult's 'progressive' question is answered be the child's unmarked form, which at this stage in Nina's speech may mark either present, past, future or progressive. In context, however there is no reason to assume that the intended meaning was not 'progressive'. For the purpose of the current measurement, the difference between 'present' and 'progressive' is not all that important, given that both are sub-species of here-and-now--**non-displaced temporal reference**.

Either initiating an MIU or initiating a mid-MIU modality change were counted as taking the modal initiative. Thus in (17) below, the child initiates the interaction and the same modality is maintained by both interlocutors throughout:

NAO: Fix.	(request)
MOT: You can do it, honey.	(manipulation)
You just have to be patient.	(manipulation)
NAO: Fix. Fix.	(repeated request)
MOT: Oh, get it in the right place	(manipulation)
and then you can do it.	(manipulation)
NAO: Fix.	(repeated request)
MOT: Get it in the right place.	(manipulation)
You don't want to break it.	(warning)
NAO: Fix. (Naomi-I, p. 22)	(request)
	 NAO: Fix. MOT: You can do it, honey. You just have to be patient. NAO: Fix. Fix. MOT: Oh, get it in the right place and then you can do it. NAO: Fix. MOT: Get it in the right place. You don't want to break it. NAO: Fix. (Naomi-I, p. 22)

In (18), on the other hand, the child initiates the interaction in a deontic mode (18a), the mother shifts to the epistemic ('perfect') in (18c), then immediately back to the deontic in (18d). The child then shifts to the epistemic in (18e) and then back to the deontic in (19f), which is maintained to the end of the interaction (Naomi-I):

(18) a. NAO: More juice.	(request)
b. MOT: More juice?	(clarification of request)
c. The juice is almost gone .	(EPIST, PERF)
d. Want some vitamins, Naomi?	(offer)
e. NAO: All gone. All gone.	(EPIST, PERF)
f. More vitamin.	(request)
g. MOT: Wait.	(manipulation)
h. NAO: Sit. Juice. Mommy. I want it.	(manipulation)
(Naomi-I	, p. 27)

Tables 1-3 below summarize the overall results of who takes the initiative and in what modality, for each child at all three developmental stages.

	Deontic ====================================		Epistemic									
Initiator			PROG/PRES		PA	PAST/PFV		FUT		===== = [AL-E	TOTAL	
	 N	 %	===== N	 %	==== N	 %	==== N	%	N	 %	==== N	~ %
I:		:		: :		====== :		= ====	- ====			
ADULT	31	68.8	11	24.4	3	6.6	/	0.0	14	31.2	45	100.0
CHILD II:	55	65.4	21	25.0	9	10.7	/	0.0	30	34.6	84	100.0
ADULT	22	56.4	12	30.7	4	10.2	1	2.5	17	43.6	39	100.0
CHILD III:	41	54.6	28	37.3	5	6.6	1	1.3	34	45.4	75	100.0
ADULT	41	60.2	16	23.5	10	14.7	1	1.4	27	39.8	68	100.0
CHILD	40	55.5	29	40.2	3	4.1	/	0.0	32	44.5	72	100.0

Table 1: Modal initiator: Eve-I-II-II

	Deontic		Epistemic									
Initiator	==== (IMN	====== 1 FUT)	======================================		======================================		FUT		TOTAL-E)		TOTAL	
	 N	 %	===== N	 %	===== N	===== %	 N	 %	N	%	===== N	 %
I:		= ====	====		====			= =====		- ====		- =====
ADULT	58	53.2	39	35.7	10	9.1	2	1.8	51	46.8	109	100.0
CHILD	29	34.9	50	60.2	4	4.8	/	/	54	65.1	83	100.0
II:												
ADULT	17	33.3	23	45.1	11	21.5	/	/	34	66.6	51	100.0
CHILD	66	49.3	65	48.5	3	2.2	/	/	68	50.7	134	100.0
III:												
ADULT	30	34.1	29	32.9	20	22.7	9	10.3	58	65.9	88	100.0
CHILD	42	46.1	35	38.4	13	14.2	1	1.3	49	53.9	91	100.0

Table 2.Modal initiator: Naomi-I-II-II

Table 3. Modal initiator: Nina-I-II-III

	De	ontic			E							
Initiator	==== (IMN	====== И FUT)	======================================		PAST/PFV		======================================		TOTAL-E		TOT	AL
	===== N	%	==== N	 %	===== N	%	 N	%	= ==== N	%	===== N	%
I:												
ADULT	46	46.4	46	46.4	6	6.1	1	1.1	53	53.5	99	100.0
CHILD	41	39.4	58	55.7	5	4.8	/	/	63	60.5	104	100.0
II:												
ADULT	48	35.8	74	55.2	10	7.4	2	1.4	86	64.1	134	100.0
CHILD	88	64.2	46	33.5	3	2.1	/	/	49	35.7	137	100.0
III:												
ADULT	88	41.8	102	48.3	19	9.0	2	0.9	123	58.2	211	100.0
CHILD	49	45.8	43	40.1	11	10.2	4	3.7	58	54.2	107	100.0

While the numerical data is not amenable to inferential statistics, it appears that neither subject (Eve, Naomi, Nina) nor developmental stage (I, II, III) nor status (child vs. adult) set a trend. Overall, the child and adult seem to stand roughly on a par, first in terms of who takes the initiative, and second in terms of the balance between deontic and epistemic **modal goals** of the modal initiative.

5.2. Spatio-Temporal displacement

Early communicative modes, be they those of animals, 2nd language pidgin or early child language, are notoriously anchored in the intimate referential universe of here-and-now (Carter 1974; Bates *et al.* 1976). The following 3 tables (4-6) document this vividly about child communication at this early stage. Taking all MIUs in each transcript, all utterances ('clauses') bracketed by a period [.] were counted, including one-word utterances (except yes/no). The latter elliptic interjections take their semantic valuation anaphorically from the preceding utterance, and would not have significantly changed the overall results. All deontic-manipulative utterances were counted as 'immediate-future'. And again, the difference between 'progressive' and 'present' for the child is not altogether reliable.

	non-d	isplaced	(here& no	ow)		displa			
	PRES	PROG	IMM-FUT	TOT	===== PAST	PFV	FUT	TOT	**************************************
I:									
ADULT:	53	53	197	303	22	6	9	37	89.1%
CHILD	21	51	111	183	19	1	0	21	89.7%
II:									
ADULT:	94	29	94	217	22	16	7	45	82.8%
CHILD	75	25	101	201	14	7	8	29	87.3%
III:									
ADULT:	100	26	166	292	38	11	9	58	83.4 %
CHILD	38	20	136	194	21	4	5	30	86.6 %

Table 4: Temporal displacement: Eve-I-II-III

TOT

18/childcomp.08

	non-o	lisplaced	d (here& no	displaced				ТОТ		
	PRES	PROG	IMM-FUT	TOT	PAST	PFV	FUT	TOT	===	======================================
I:					: =====		=====	- ====	: ===	
ADULT:	89	66	134	289	8	2	11	21	310	93.2%
CHILD	115	53	98	266	1	3	3	7	273	97.4%
II:										
ADULT:	50	54	84	188	20	/	/	20	208	90.3 %
CHILD	85	93	190	368	5	/	/	5	373	98.6 %
III:										
ADULT:	74	36	121	231	50	2	27	79	310	74.5 %
CHILD	47	40	144	278	26	4	13	43	321	86.6 %

Table 5: Temporal displacement: Naomi-I-II-III

Table 6: Temporal displacement: Nina-I-II-III	
non-displaced (here& now)	displaced

	non-u	ispiaceu		••)		uispi	accu	101		
	PRES	PROG	IMM-FUT	TOT	PAST	PFV	FUT	TOT	TOT %	/6 here & now
I:										
ADULT:	131	124	161	416	17	2	/	19	435	95.6%
CHILD	160	29	113	302	7	4	/	11	313	96.4%
II:										
ADULT:	163	52	178	393	22	3	10	35	428	91.8 %
CHILD	114	22	224	360	8	3	3	14	374	96.2 %
III:										
ADULT:	193	63	157	413	50	4	15	69	482	85.6 %
CHILD	111	48	146	305	35	/	17	52	357	85.4 %

In all three subjects/diads, at all three stages, the discourse is predominantly here-and-now oriented. This is consonant with Diessel and Tomasello's observation that the child's modal grammatical devices are used, overwhelmingly, to mark **direct deontic or epistemic speech-acts**. But in all three children there seems to be a drop in the percent of here-and-now temporal reference in the last stage (III). Most important, across diads and stages, the adult discourse is just as here-and-now oriented as the child's. This is consonant with my suggestion that the grammatical modality markers are used by the adult--at least in these transcripts--in very much the same way as by the child. Though the adults may be adjusting to the children and down-shifting.

5.3. Speech-act value

We have already seen the high prevalence of deontic interactions is our transcripts. Next, we focus more narrowly on the **speech -act value** of all utterances, dividing them between those that carry a **deontic-manipulative** intent and those that have an **informative**--either declarative or interrogative --intent. This determination is not bound by grammatical marking, since as noted earlier above, the child's utterances at these early stages are often elliptic and grammatically unmarked, so that their modal intent is determined--by the adult interlocutor as well by the researcher--from the immediate discourse context. And further, many of the adult's manipulative gestures are so-called **indirect speech-acts**, using either the declarative or interrogative grammatical form. Tables 7-9 below summarize the numerical results.

Table	7:	Speech-act distribution: Eve-I-II-III	
		Speech act	

		dec	ontic		epistemic				
		==== M	======== Manip.		Declar		ion	TOTAL	
		==== N	 %	===== N	======================================		 %	==== N	%
I:	ADU:	175	47.5	102	27.7	==== 91	24.4	368	100.0
II:	CHI: ADU:	124 35	50.0 14.3	119 120	47.9 49.1	5 89	2.1 36.6	248 244	100.0 100.0
	CHI:	63	24.9	169	66.7	20	8.4	253	100.0
III:	ADU:	78	21.1	161	43.5	130	35.5	369	100.0
	CHI:	104	35.3	148	50.5	42	14.5	294	100.0

	de	ontic		epistemic					
	Manip.		Dec	Declar		tion	TOTAL		
	==== N	%	===== N	%	===== N	 %	 N	%	
I: ADU:	128	38.6	===== 127	===== 38.9	===== 71	22.5	326	100.0	
II: ADU:	97 68	33.6 32.8	166 97	57.6 46.8	25 42	8.8 20.4	288 207	100.0 100.0	
CHI:	116	31.1	176	44.9	80	24.0	372	100.0	
III: ADU:	68	22.0	129	41.8	109	36.2	308	100.0	
CHI:	106	36.1	137	46.7	50	17.2	293	100.0	

Table 8: Speech-ACT distribution: Naomi-I-II-IIISpeech act

Table 9: Speech-ACT distribution: Nina-I-II-III Speech act

			_							
		epis	temic		deor	-				
		Manip.		Dec	lar.	Questi	on	TOTAL		
		==== N	%	 N	%	====== N	%	==== N	%	
I: A	ADU: CHI:	===== 155 110	35.5 31.7	==== 107 231	==== 24.5 66.7	===== 174 5	40.0 1.6	==== 436 346	100.0 100.0	
II: A	ADU: CHI:	181 215	42.4 58.2	113 137	26.5 37.1	132 17	30.1 4.7	426 369	100.0 100.0	
III: A	ADU: CHI:	131 110	26.2 30.6	145 184	29.0 51.2	223 65	44.8 18.2	499 359	100.0 100.0	

With much cross-diad and cross-stage variation, two trends seem to emerge out of these measures. First, within bounds, the child and adult use manipulative speech-act at a similar rate, ranging in the 20-50 percentile. And second, the children lag behind the adults, rather conspicuously, in producing **interrogative speech-acts**, although their usage rises slowly toward the last stage (III).

5.4. The subject of modal expressions

Another known characteristics of early childhood speech is that it is mostly about the **speech-act participants**--speaker and hearer. This is indeed strongly implicit in Diessel and Tomasello's observations about the child use of grammatically-coded modalities. To demonstrate this, I counted the subjects of all grammatically-marked deontic or epistemic 'higher verbs' within all MIUs, dividing them into 1st/2nd person vs. 3rd person.

As we shall see later on, there is a strong correlation between reference to 3rd person subjects and extension of modal-verb usage from marking direct speech-act (Diessel and Tomasello's early child stage) to mere epistemic description (their observed use in late-stage child and presumed adult standard). What is striking about our results, once again, is the virtual identity of the child and adult text-distribution patterns. Tables 10-12 below summarize the numerical distributions.

			• 	Deon	tic]	Epist	emic		
			pers	son					pers	son			
SU	BJECT:		 1-2		3	TC	T	1-2		3		TC	ЭТ
==== T		==== N	 %	===== N	%	 N	%	===== N	: %	N	%	=== N	 %
1:	ADULT: CHILD:	==== 142 20	= ==== 87.6 83.3	==== 20 4	= ==== 12.3 16.6	=== 162 24	===== 100.0 100.0	===== 52 14	71.2 87.5	==== 21 2	28.8	=== 73 16	= ==== 100.0 100.0
II:	0111221			·	1010		10010	1.	0.10	-	1210	10	10010
	ADULT: CHILD:	62 32	88.5 100.0	8 /	11.5 /	70 32	100.0 100.0	42 7	66.6 87.5	21 1	33.4 12.5	63 8	100.0 100.0
III:													
	ADULT: CHILD:	122 46	87.5 73.0	17 17	12.5 17.0	139 63	100.0 100.0	58 5	93.5 50.0	4 5	6.5 50.0	62 10	100.0 100.0

Table 10: 1st-2nd vs. 3rd pers. subject: Eve-i-II-III

140	Deontic							Epistemic					
			ре	erson					perso	==== n			
SUI	BJECT:	 1-2		3		TC	TOT		2	3		TO	DT
		===== N	===== %	==== N	%	==== N	%	==== N	%	==== N	 %	==== N	 %
I:	ADULT:	===== 123	86.0	===== 17	===== 14.0	=====	100.0	===== 110	===== 68.7	==== 50	31.3	===== 160	100.0
	CHILD:	53	98.1	1	1.9	54	100.0	14	60.8	9	39.2	23	100.0
II:													
	ADULT:	54	94.7	3	5.3	57	100.0	82	82.0	18	18.0	100	100.0
	CHILD:	94	92.1	8	7.9	102	100.0	42	66.6	21	33.4	63	100.0
III:													
	ADULT:	96	88.8	12	11.2	108	100.0	111	84.1	21	15.9	132	100.0
	CHILD:	104	98.1	2	1.8	106	100.0	66	88.0	9	12.0	75	100.0

Table 11: 1st-2nd vs. 3rd pers. subject: Naomi-I-II-III

Table	12:	1st-2nd	vs. 3 rd	pers.	subject:	Nina-I-II-III
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			De	eontic						Epist	emic		
SUBJECT:		1-2		3		TC	ТОТ		 2	3		ТОТ	
===		=== N	===== %	==== N	===== %	==== N	~ %	==== N	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	==== N	==== %	==== N	 %
I:		====	==== =		====		==== =	====	==== =	==== :	====		====
	ADULT:	177	100.0	/	/	177	100.0	81	30.6	183	69.4	264	100.0
	CHILD:	118	99.1	1	0.9	119	100.0	19	9.2	186	90.8	205	100.0
II:													
	ADULT:	177	91.7	15	8.3	193	100.0	133	63.0	78	37.0	211	100.0
	CHILD:	97	90.6	10	9.4	107	100.0	42	64.6	23	35.4	65	100.0
III:													
	ADULT:	122	79.2	32	20.8	154	100.0	158	59.3	107	40.7	256	100.0
	CHILD:	69	73.4	25	26.6	94	100.0	40	43.9	51	56.1	91	100.0

While there is again a considerable amount of fluctuation in the numerical values, two trends seem to emerge. First, he percent of 1st/2nd person subject in epistemic-modal clauses is almost always lower than in deontic ones. And second, the modal behavior of the child and adult is once again remarkably similar.

If one were to summarize the broad characterization of modal behavior in the CHILDES transcripts, or at least in the modal interactions that form the communicative context for grammatically-marked complex-VP expressions, one would have to say that Diessel and Tomasello's observation are upheld, but that the adults in this communicative context behave essentially like the children. As we shall see further below, this observation can be extended further.

6. Modality-marking grammatical devices

6.1. General considerations

We come now to the structural core of this study--the classification and quantification of the modality-marking grammatical devices used by the child and adult in their modal interactions. While the rough division into deontic and epistemic holds in the main, it needs some refinement. The general division of modality-marking verbs into three major syntactic classes still holds (Givón 2001, ch. 12; Diessel 2005). For English: (i) **Modality verbs** ('want to do it') take an equisubject non-finite. complement. (ii) **Manipulation verbs** ('make someone do it') take an nominal object-manipulee and an equi-object non-finite complement. (iii) **Perception-cognition-utterance verbs** ('know that someone did it') take finite complements. Broadly, one finds most deontic modal operators distributing in the first two groups, and most of the epistemic ones in the third. But many exceptions to and refinements of this general classification must be taken into account.

To begin with, we need to distinguish between the *potential* deontic use of a modal expression, and the *actual use* of such an expression a as a **direct manipulative speech-act**. Consider for example (19a,b) below, where both the child and adult use 'want' as a direct-manipulative speech act (Nina-III):

(19) a.	MOT: NIN:	Here's another fence. Want another fence.	[p.	25]	(offer) (request)
b.	NIN: N MOT:	Many other fence? Want to build some more f	ences? [p.	25]	(request) (offer)

In contrast, in both (20a, b) the child and the adult use 'want' as a description of 3rd-person volition, embedded in largely epistemic MIUs (Nina-III):

(20) a. NIN: Where, where can't [= 'can'] this go it	n the hole?	(FUT-HYPOTH)
Oh there. If they get out of there [,] the	nese things.	(FUT-HYPOTH)
Oh, they want to get out of there.		(PRES-VOLIT)
MOT: What happened? [p.	45-46]	(PAST)
b. MOT: What's on the wall of the station?		(Q-PRES)
NIN: A apple.		(PRES)
MOT: No, that's a clock.		(PRES)
NIN: Who are [???]?		(Q-PRES)
MOT: People want to know what time it is.	[p. 52]	(PRES-VOLIT)

The correlation between person $(1st/2nd vs. 3^{rd})$ and speech-act (manipulative vs. descriptive, respectively) is very strong but not absolute, at least not for the child. Thus, for example, in (21) below Nina uses a 3^{rd} -person 'want' in a clear request speech-act context, a natural over-generalization from the much-more-common deontic-manipulative use of the verb (Nina-III):

(21)	NIN: I forgot [to put] some more sticks in this, in	this	(PAST)
	Two sticks wanna go in this truck.		(request)
	MOT: Well, we' ll have to take some things out.	p. 47]	(manipulation)

The same two-way modal potential is found in the use of modal auxiliaries by both adult and child. Thus in (22a,b), both the child and adult use 'can' to mark a direct speech-act of manipulation (Nina-III):

(22) a. NIN: A dog cookie.	(request)
After he eats that one,	
can I, can I give him give him another one?	(request)
MOT: Do you think he' d like to eat another one? [p. 1]	(Q-FUT/HYPOTH)
h NINI. A honomo	(maginagt)

b. NIN: A banana.		(request)
MOT: Oh, can you make him eat a banana?	[p. 3]	(manipulation)

In (23a,b), on the other hand, both child and adult use 'can' as a **description of ability**, not surprisingly involving a 3rd person subject in an epistemic context (Nina-III):

(23) a. MOT: What's that?		(Q-PRES)
NIN: A circle.		(PRES)
MOT: Is that the right place for it?		(Q-PRES)
NIN: Where can the other one go?	[p. 30-31]	(Q-PRES/POSSIB)

b. MOT: What's he doing?	(Q-PRES)
NIN: Swing one one	(PRES)
MOT: What about this man?	(Q-PRES)
Do you think he can hang by your magnet?	p. 22] (Q-PRES/ABIL)

A similar potential for such variation may be seen in the use of 'want-NP' and 'have-to-VP'. On the other hand, aspectual operators such as the progressive 'be', the perfect 'have', or the perfective 'finish-to-VP' and '(be all) gone' are clearly used only in an epistemic sense.

The situation is a bit more simple with the use of manipulation ('causative') verbs in the CHILDES transcripts. Only two of those are use in any frequency, and they split down the modal line: 'let' (and at a much lower frequency 'want') is used by both child and adult only in **direct-manipulative** speech-act, with 1st or 2nd person subject, as in (24a,b) below. And 'make' is used, by both, primarily as a **description of manipulation/causation**, as in (24c,d)--even with 1st-2nd person subject. Thus (Nina-III):

(24) a.	NIN: Yeah, let me give that to Poy MOT: What do you want to do?	now. I want	(request) (solicitation)
	NIN: I wanna give that to Poy now.	[p. 1-2]	(request)
b.	MOT: Let's set up a big village here	e.	(manipulation)
	NIN: Okay, let's do so.	[p. 11-12]	(consent/request)
c.	MOT: What did you do?		(Q-PAST
	NIN: I make the little bounce like a	a ball.	(PAST, CAUS)
	I did it, Mommy.	[p. 28]	(PAST)
d.	NIN: Where's the gas?		(Q-PRES)
	MOT: Gas is what makes my car ru	n.	(PRES; CAUS)
	NIN: Oh.	[p. 28-29)	

The same potential for double-usage exists in several perception-cognition-utterance verbs, most conspicuously 'know', 'think', 'guess', 'say, 'look' and 'see''. But since, as Diessel (2005) has noted, these verbs are acquired much later, most of the usage in our transcripts--by both child and adult--involves **epistemic quantification** of the complement clause, with 1st-2nd person subject (Diessel and Tomasello's 'grammaticalized' early-stage usage). Most commonly, 'know' and 'think' are used in cases of **epistemic uncertainty or conflict**. Thus consider (Nina-III):

(25)	a. MOT: What colors are rabbits usually?	(Q-PRES)
	Do you know ?	(Q-PRES, EPIST)
	NIN: Yup.	(PRES)
	MOT: What color?	(Q-PRES)
	NIN: Red. Blue.	(PRES)
	MOT: No, they're white.	(PRES)
	NIN: Or red and blue.	(PRES)
	You know that together, Mommy. [p. 32-33]	(PRES)
	b. MOT: Is she gonna put what on her hair?	(O-FUT)
	NIN: Her ribbon on her hair.	(FUT)
	MOT: I don't know . [p. 41]	(PRES, EPIST)
	c. NIN: Any more sticks?	(O-PRES)
	MOT: I don't think so. [p. 18]	(PRES, EPIST)
	d MOT: Her ears are near her earrings, right?	(PRES)
	NIN [•] Yun Let me see	(PRES): (request)
	MOT: Oh. I guess she really doesn't have ears	(PRES, EPIST)
	[n. 4]	(-42]
		· ·1

Many of these are also terrific examples of **cross-turn sharing** of complex constructions.

The perception verbs 'look', 'see' and 'feel' are used, at high frequency, as markers for the speech-act of **directing attention**. The attention is mostly visual with 'look', but often not strictly visual with 'see'. Again, most typically such usages involve a 2nd person subject (imperative form). Thus (Nina-III):

(26)	a.	NIN: He's, he's eating a banan	na.	(PROG)
		MOT: He is? My goodness.		(PROG)
		NIN: Look at poy.	[p. 3]	(direct-attention)>(PRES)
	b.	MOT: What soft material.		(PRES)
		Feel how soft it feels.		(direct-attention)>(PRES)
		NIN: And her hair.		(PRES)
		MOT: That's a		(PRES)
		NIN: And a ribbon in her hain	: See ? [p. 43]	(PRES)<(direct-attention)
	c.	NIN: The wheels don't move.		(PRES)
		MOT: No, I guess not.		(PRES, CONCESSION)
		NIN: Oh see they move.		(direct-attention)>(PRES)
		MOT: Oh, they do?	[p. 15-16]	(Q-PRES)

d.	NIN; Who goes in this little house?	(Q-PRES)
	MOT: All the animals go in there.	(PRES)
	See, this man is called Noah.	(direct-attention)>PRES
	NIN: Oh. What is he doing with the animals?	[p. 53] (Q-PROG)
e.	MOT: Look. What is the clown doing?	(direct-attention)>(Q-PROG)
	Look, look at the clown, Nina.	(direct-attention)>(PRES)
	NIN: Oh.	
	MOT: Look at him.	(direct-attention)>(PRES)
	See what he's doing.	(direct-attention)>(PROG)
	Can you see?	(direct-attention)
	NIN: Yup.	
	MOT: Look at the funny clown.	(direct-attention)>PRES
	You don't see him.	(PRES; complaint of inattention)
	Look what I made him do?	(direct-attention)>(PAST?)
	See, Nina?	(direct-attention)
	Look . What's he doing? [p. 18]	(direct attention)>(PROG)

All such uses of perception verbs, in spite of being themselves direct-manipulative speechacts, are embedded in highly epistemic contexts. The later expansion of their use into non-direct epistemic modulation is driven, presumably, by their epistemic adaptive context.

6.2. Stage I

Tables 13 and 14 below presents the distribution of uses of all types of complex modal expressions by the child and adult, respectively, in the Eve-I transcripts, together with representative examples embedded in their MIU contexts.

Table 13: EVE-I: Distribution of child use of complex modal expressions

(a) Equi-subject modality:	
'can'-VP: Non-deontic: (1)	
EX: MOT: And [when] Sarh's a big girl, so can	she. (FUT/ABIL)
EVE: So can she. [p. 23-24]	(FUT/ABIL)
'(be)-gonna'-VP: Deontic-manipulative : (1)	
EX: EVE: 'Sue gon read Lassie'	(request; Sue = You)
MOT: 'I'm not gonna read Lassie'. [p	o. 9] (refusal)
Epistemic-future : (2)	
EX: EVE: She goin burp.	(FUT)
MOT: What?	(Q)
EVE: She's goin burp.	(FUT)
MOT: She gonna burp.	(FUT)
She has to have milk first. [p.	14] (OBLIG)

'have-(to)-V	P: Deontic-manipulative : (1)		
	EX: EVE: Drink gain.		(request)	
	MOT: After Sarah has	a turn.	(deferral)	
	EVE: Eve have it.		(request)	
	MOT: Yes, you can ha	ve it,	(permit)	
	but you have to	o wait	(oblig.)	
	EVE: Have to wait.	[p. 31]	(oblig)	
'wanna'-VP:	Deontic-manipulative : (4)		
	EX: MOT: You write on Eve	's paper.	(manip.)	
	EVE: No.		(refuse)	
	MOT: Look here's a lot o	of paper	(offer)	
	EVE: Wanna write Fras	er paper [p. 🤅	36] (demand)	
(b) Equi-objec	t manipulative:			
'let'-NP-VP:	Deontic-manipulative : (1)			
	EX: EVE: Get a stool.		(request)	
	MOT: Get the cup, plea	ise	(manip.)	
	and I 'll pour it.		(offer)	
	Bring the cup, ev	ve.	(manip.)	
	EVE: Let me have it.	[p. 41]	(request)	
'help'-NP-(V	(P): Deontic manipulative:	(1)		
I X	EX: EVE: Sue help Eve.			(request)
	MOT: Help Eve do y	what?		(solicit/offer)
	EVE: Radiator.			(request)
	MOT: Oh, you wann	a sleep on the r	adiator? [p. 44]	(offer)
(c) Epistemic :	(none attested)			
Table 14: Eve-	I: Distribution of adult use of	of complex mo	dal expressions	
(a) Equi-subje	ct modality:			
will'-VP: D	eontic-manipulative: (41)			
Ež	K: EVE: Fraser wipe Eve nose	'gain.	(requ	est)
	MOT: Come here. Mommy	ll wipe your n	ose. [p. 5] (offe	r)
'can'-VP: De	ontic-manipulative: (9)	1 5		,
EX	: EVE: Eve have it.	(1	request)	
	MOT: Yes, you can have it	[p. 31] (i	permit)	
Noi	n-manipulative: (4)	1	· · · · ·	
	EX: MOT: And [when] Sarl	h's a big girl,	(FUT)	
	so can she.	[p. 23-24] (FUT/A	BIL)

'may'-VP: Deontic-manipulative : (5)	
EX: EVE: Look, oh, my pencil. (reques	t)
MOT: There's one in the kitchen. (PRES))
You may have that one. [p. 1] (offer)	
'want'-NP/WH: Deontic-manipulative : (11)	
EX: EVE: Napkin.	(request)
MOT: Oh, do you want a napkin too? [p. 2]	(offer)
'want-VP: Deontic-manipulative : (9)	
EX: EVE: Cracker on table.	(request)
MOT: Oh, you want to have a cracker on the table?	[p. 25] (offer)
'would-like'-NP: Deontic-manipulative (2)	
EX: MOT: Would you like some fruit? (of	fer)
EVE: No. [p. 64] (ret	fuse)
'would-like'-to-VP: Deontic-manipulative : (7)	
EX: MOT: Would you like to have your lunch	now? (offer)
EVE: No. [p. 14-15] (refuse)
'know-how'-to-VP: Non-manipulative: (1)	
EX: EVE: Baby Sarah.	(PRES)
MOT: She doesn't know how to drink ou	t of a glass. [p. 17] (PRES)
'like'-NP: Deontic-manipulative : (2)	
EX: MOT: Would you like to have some lunch?	(offer)
EVE: No.	(refuse)
MOT: Papa will fix you one if you like . [p. 2]	24] (offer)
Non-manipulative: (2)	
EX: MOT: Is that good? (Q-PR	ES)
EVE: Yeah. (PRES	5)
MOT: D'you like it? [p. 22] (PRES	S)
'need'-NP: Deontic-manipulative: (3)	
EX: EVE: [For]got a spoon. (PAST))/(request?)
MOT: I forgot a spoon? (Q-PA	.81)
No, you don't get a spoon. (refus	e)
You don't need one. [p. 4] (refus	se)
supposed to VP: Non-manipulative(?): (1)	
EX: EVE: That Fraser spoon.	(PRES)
MOI: Inank you.	
What am I supposed to do with it?	? [p. 57] (FUT?)/(solicit?)
try-NP/VP/elliptic: Deontic-manipulative : (2)	
EX: MUI: Not very good. No.	(PKES)
EVE: 1 try again.	(offer/intent)
Woll what are you to it at	(Inamp)
Well, what are you trying to do	0? [p. 21] (Q-PKOG)
INON-IMANIPULATIVE: (1) (see directly above)	

'(be)gonna'-VP: Deontic-Manipulative: (8)	
EX: EVE: Sue read Lassie.	(request)
MOT: No, Mommy' s not gonna read La	ssie. [p. 12] (refuse)
Non-manipulative : (4)	
EX: EVE: She goin burp.	(FUT/imminent)
MOT: She gonna burp. [p. 14]	(FUT/imminent)
'go-and-V' (serial): Deontic-manipulative : (3)	
EX: FAT: You go eat your lunch. [p. 61]] (manip.)
'why don't you'-VP: Deontic-manipulative : (2)	
EX: MOT: Why don't we have lunch?	(manip)
EVE: Drinking. [p. 20]	(request)
(b) Cognate object (V-NOM) constructions:	
'have'-NOM: Manipulative context: (12)	
EX: EVE: Eve have drink of milk.	(request)
MOT: After Sarah has a turn. [p. 29]	(refuse)
(c) Equi-object manipulation (causative):	
'let'-NP-VP: Deontic-manipulative (3)	
EX: MOT: Is your grape juice all gone?	(Q-PERFV)
EVE: Yeah.	(PERFV)
MOT: Okay, let's wipe your face then. [p.	7] (manip)
'get'-NP-to-VP: Non-manipulative(?): (1)	
EX: EVE: [???] Eve ring.	(request)
MOT: You don't have a ring.	(PRES)/(refuse)
When you get to be a lady,	(FUT)/(promise?)
then you can have a ring. [p. 40]	6] (promise)/(FUT)
'help'-NP-VP: Deontic manipulative: (1)	
EX: EVE: Sue help Eve.	(request)
MOT: Help Eve do what?	(solicit/offer)
EVE: Radiator.	(request)
MOT: Oh, you wanna sleep on the radia	tor? [p. 44] (offer)
'leave'-NP-VP: Deontic-manipulative: (4)	
EX: MOT: You want me to smack you?	(warning)
EVE: No.	(rejection)
MOT: Then put it away.	(manip.)
Don't touch it again	(manip)
Leave it lay right there.	(manip)
Leave it alone. [p. 50]	(manip)

'want'-NP-to-VP: Deontic-manipulative: (2)	
EX: EVE: [???].	(request)
MOT: Do what?	(solicit)
EVE: [???]-ing Eve.	(request)
MOT: What do you want me	to do? [p. 45-46] (solicit)
(d) Perception-epistemic:	
'see'-NP: direct-attention: (4)	
EX: MOT: Where is the penny?	(Q-PRES)
EVE: [???] fall down floor.	(PAST)
MOT: There it is.	(direct-attention)
I see it, by the table.	(direct-attention)
On the floor. See it? [p. 31]	(direct attention)
'see'-if-S: direct-attention: (2)	
EX: MOT: Wanna go see if the coffee is	read? (manip.; direct-attention)
EVE: Yep. []	p. 46] (consent)
'see', S: Direct-attention: (2)	
EX: MOT: See. She's heavy. See. She's he	avy. [p. 43] (direct-attention)
'look-at'-NP: Direct-attention : (4)	
EX: EVE: Look. rocking-chair.	(direct-attention)
MOT: It's moving again	(PROG)
Look at the rocking chair.	(direct-attention)
It's doing it again	(PROG)
There is goes again.	(direct-attention)
What is the rocking chair do	ing? [p. 4-5] (O-PROG)
(d) Cognition-epistemic:	g. [p. : 0] ((21100))
'know'-if-S: Epistemic-quantifier: (1)	
EX: EVE: $[222]$ fall	(PAST)
MOT: It fell?	(O-PAST)
I don't know whether it did	[p. 47] (EPIST-PAST)
'know'-S: Epistemic quantifier: (2)	
EX: EVE: Fall down	(PAST)
MOT: I know you fell down [n	171 (EPIST-PAST)
S 'think' Enistemic quantifier: (1)	
EVE: Eating bread too	(PROG)
MOT: She's eating bread too. I think	n 57] (EPIST-PROG)
'think'-S' Enistemic quantifier: (2)	
EX: MOT: There's a dog barking outside	Yeah (PROG)
COL: I'm not sure. Yeah. I think it i	s. I'm sure it is. [p. 56) (OUANT-PROG
'be-sure'-(S): Epistemic quantifier: (2) (see above	(2)

In sum, at this early stage Eve's use of equi-subject modal expressions shows already some late-stage, non-manipulative (non-speech-act) uses of 'can' and 'be-gonna'. The use of 'have-to' and 'wanna' is 100% manipulative (direct speech-act). The use of equi-object manipulation/causation verbs is deontic-manipulative (direct speech-act), though the sample is small (only two examples of 'let' and 'help). Eve shows no use of perception-cognition-utterance verbs at this early stage.

Eve's adult interlocutors, while capable of non-manipulative usage of equi-subject modal predicates, still favor, overwhelmingly, the manipulative direct speech-act use characteristic of early childhood: 41-0 for 'will', 9-4 for 'can', 5-0 for 'may', 20-0 for 'want', 7-0 for 'would like', 2-2 for 'like', 2-0 for 'try', 8-4 for 'be gonna', 3-0 for 'need', and 1-0 for 'be supposed to'. With equi-object manipulation verbs, the adult's usage ratio is just as skewed towards the direct manipulative speech-act: 10 direct-manipulatives vs. 1 descriptive-causative. Finally, with epistemic verbs, all 12 adult uses of perception verbs involve the direct speech-act of **attracting attention.** And all 8 uses of cognition verbs involve their use as **epistemic quantifiers** on the complement clause. The adult interlocutors in the Eve-I transcripts behave, on the whole, like the early-stage child in Diessel and Tomasello's description.

Table 15 and 16 below summarized the distribution of complex modal expressions and their deontic or epistemic uses, for the child and adult, respectively, in the Naomi-I transcripts.

Table 15: NAOMI-I: Distribution of child use of complex modal expressions

(a) Equi-subject (modality) verbs

'will'-VP: No	on-deontic: (1)	
EX	: NAO: Daddy. (I	PRES)
	MOT: Daddy's in Florida. In Florida. (PRES)
	He' II be home tonight. (FUT)
	NAO: Daddy will be home tonight. [p. 19] (FUT)
'can'-VP: De	contic-manipulative(?): (1)	
EX	: NAO: Closed door.	(request)
	More.	(request)
	What's this? What's this? What's this?	(Q-PRES)
	Can't get [it] off.	(request?)
	Close door.	(request)
	FAT: Close the door. [p. 59]	(manip.)
'want'-NP: D	eontic manipulative: (20)	
E	X: MOT: Want some vitamins, Naomi?	(offer)
	NAO: All gone. All gone.	(PERFV)
	More vitamin.	(request)
	MOT: Wait.	(manip)
	NAO: Sit. Juice. Mommy. I want it. [p. 27]	(request)

'wanna'-VF	P: Deontic-manipulative: (3)	
	EX: NAO: Sit. Get up. Hug.	(requests)
	Want hug.	(request)
	Want it hug.	(request)
	FAT: Do you want me to hug G	eorgie or Naomi? [p. 51] (solicit)
'go'-to-V:	Non-manipulative: (1)	
U	EX: NAO: Mouse tired.	(PRES)
	MOT: Oh, does he want to go to	sleep? (O-PRES/VOLIT)
	NAO: Go to sleep.	(PRES/VOLIT)
	MOT: Oh. I don't think so. [p. 2]	(PRES/EPIST)
'like'-NP: N	on-manipulative: (2)	
E	X: MOT: Naomi eat it.	(manip.)
	NAO: I like it. I like it.	(PRES/EVAL)
	MOT: It's good.	(PRES/EVAL)
	NAO: No. [p. 32]	(PRES/EVAL)
'need'-NP: 1	Deontic-manipulative: (7)	
	EX: FAT: How are you doing Nomi?	(O-PRES)/(solicit)
	NAO: Sugar, Need sugar, Need sug	par on. (request)
	FAT: You need sugar?	(offer)
	NAO: Need sugar on [p 42]	(request)
'need'-VP:]	Deontic-manipulative: (1)	(1040000)
F	EX: NAO: Leave it.	(request)
-	I need cook	(request)
	I need it. I need it. [p. 45]	(request)
		(
(b) Equi-OBJ	(manipulation) verbs	
'get'-NP: D	eontic-manipulative: (7)	
E	X: NAO: Get it. Get it. Get.	(request)
	MOT: What are you getting , honey?	(O-PROG)/(solicit)
	NAO: Getting oof-oof. Getting woo	f. $(PROG)/(request)$
	MOT: Getting off?	(O-PROG: misinterpret)
	NAO: Oof-oof.	(clarification of request)
	MOT: What are you getting?	(O-PROG)
	Are you going to get a doggie	? (O-intent)/(solicit)
	NAO: Get doggie. [p 17]	(request/intent)
'get'-NP-LC	C: Causative descriptive(?): (1)	(request ment)
got iti Le	EX: NAO: Closed door	(request)
	More	(request)
	What's this? What's this? Wh	at's this? (O-PRFS)
	Can't get [it] off	(request?)
	Close door	(request)
	FAT: Close the door [p 59]	(mapin)
	[p. 57]	(manip.)

'leave'-NP-(ADJ):	Deontic-manipulative: (11) EX: NAO: Plate. FAT: An empty plate. NAO: Empty plate	(PRES) (PRES)	
	Leave it. Leave it. Leave	ave it. Leave it. (1	manip.)
	Leave it alone. Leave	it. Leave it alone. ((manip.)
	Leave it alone. Be care	eful. [p. 45-46] (manip)
			1/
(c) Perceptual-epis	temic verbs		
'see'-NP: Direct-	attention: (2)		
EX: NA	O: Sun. Sun coming. Sun com	ing. (PROG)	
	Sun coming. Sun coming.	(PROG)
MO	DT: Yeah. It is getting bright.	(PROG	i)
	Sun. See sun. Where sun?	[p. 24] (direct-	attention)
'S. 'see': Direct-	attention: (1)	-	
EX: NA	O: Eating aspirin. Mommy see	e. (direct-a	ttention)-(PROG)
	More Juice. More Juice. M	ore Juice. (request)
	Eating. Eating. [p. 34]	(PROG)	
'listen' (ellipsis):	Descriptive: (1)	× ,	
	EX: FAT: What are you doing	with the sea-shell?	(Q-PROG)
	Are you holding it	over your ear?	(O-PROG)
	NAO: Holding hear.	5	(PROG)
	FAT: Are you listening?		(O-PROG)
	NAO: Listen. [p.	501	(PROG)
	Line Listen [p.	50]	(1100)
(d) Cognitive-episte	mic verbs:		
'think' (ellipsis) I	Descriptive: (1)		
	EX: MOT: We're not doing it		(PROG)
-	I'm just thinking [o	f nutting N to bed]	(PROG)
	NAO: Thinking	i putting i to bed].	(PROG)
	MOT: Thinking yeah W	ith my head	(PROG)
	You think up there	radius notation notation $radius notation notation notation radius notation notat$	(manin)
	100 tillik up tilete	. [p. 20]	(mamp.)
(e) Evaluative-eniste	mic verbs.		
(c) Evaluative-cpisit	valuative (1)		
FX·N	JAO· I feel better		(self-eval)
LA. 1 N	AOT: Good That's good		(eval)
IN IN	I'm glad you fool better	[n 35] (DDEC)	(colf_avel) (avel)
	I III giau you icci ochel.	[h, 22] (LVE2)	-(sen-eval)-(eval)

Table 16: NAOMI-I: Distribution of adult use of complex modal expressions

(a) Equi-subject (modality) verbs	
'will'-VP: Deontic-manipulative : (7)	
EX: MOT: Do you want to comb your hair, Naomi?	(offer)
NAO: Comb hair.	(request)
MOT: Mommy will get something for you	(offer)
to comb your hair. [p. 18-19]	
Non-manipulative: (7)	
EX: MOT: Sailboats. [looking at picture]	(PRES)
NAO: Sailboats.	(PRES)
MOT: We'll see a sailboat this summer. [p. 9]	(FUT)
'would'-VP: Deontic-manipulative : (1)	
EX: NAO: That's moon. (PRE	S)
MOT: That's not the moon, honey. (PRE	S)
Would you please don't push (requ	est)
your hands on the tray, honey? [p. 2]	.5]
'can'-VP: Deontic-manipulative: (16)	
EX: NAO: Toy doggie. PRES/(request	st?)
MOT: Show me were it is. (manip)	
Can you point? [p. 7] (manip)	
Non-manipulative: (4)	
EX: NAO: Home.	(PAST)
MOT: The piggie didn't want to stay home.	(PAST)
See, sometime other people cry too	(HAB)
because they have to stay home.	(HAB)
Just like Nomi when she can't go outside. []	p. 12-13] (HAB/ABIL)
'could'-VP: Deontic-manipulative : (2)	
EX: NAO: Shadow.	(request)
MOT: Shadow pictures. We could do shadow.	[p. 15] (offer)
'should'-VP: Deontic-manipulative : (2)	
EX: NAO: Brush hair.	(request)
MOT: You should wash your hair today. [p. 1]	9-20] (manip.)
'might'-VP: Epistemic : (1)	
EX: NAO: What's this?	(Q-PRES)
MOT: I don't know .	(PRES)-(EPIST)
I think it might be a matzo crumb too. []	p. 32] (PRES)-(EPIST)
'must'-VP: Epistemic : (1)	
EX: MOT: Naomi, did you see	(PAST)
how the trees are blowing in the wind?	(PROG)
Must be windy.	(PRES)-(EPIST)
NAO: Windy. [p. 23]	(PRES)

'want'-NP: Deontic-manipulative: (13)		
EX: MOT: Want some vitamins, Naomi?	(offer)	
NAO: All gone. All gone.	(PERFV)	
More vitamin. [p. 27]	(request)	
'want'-to-VP: Deontic-manipulative : (6)		
EX: NAO: Fix.	(request)	
MOT: Get it in the right place.	(manip.)	
You don't want to break it. ((manip.)	
NAO: Fix. [p. 22]	(request)	
Non-manipulative: (3)		
EX: NAO: Mouse tired.	(PRES)	
MOT: Oh, does it want to go to sleep?	? [p. 2] (Q-PRES/V	OLIT)
'would-like'-to-VP: Deontic-manipulative : (2)		
EX: FAT: Nomi, would you like to	have some Famiglia	(offer)
this morning?		
NAO: Mmm mmm Mommy.	[p. 41]	(accept)
'like-NP: Non-manipulative : (3)		
EX: MOT: Did you like the matzo Nomi.	(PAST)	
NAO: I drop it. [p. 28]	(PAST)	
'like'-VP: Non-manipulative: (1)		
EX: The after that we could go over to scho	ool (promise)	
and go outside for a while.	(promise)	
NAO: Yeah.	(consent)	
MOT: Yeah, outside is where you like	to be, (PRES)	
isn't it? [p. 20-21]		
'know-how'-to-VP: Non-manipulative : (1)		
EX: NAO: Toy doggie.	PRES/(request?)	
MOT: Show me were it is.	(manip)	
Can you point?	(manip)	
Do you know how to point? [p.	7] (HAB/ABIL)	
'need'-NP: Deontic-manipulative: (1)		
EX: NAO: Juice.	(request)	
MOT: [to F.] I think she needs some a	aspirin. (manip.)	
NAO: [???]. What 's this?	(Q-PRES)	
MOI: Aspirin. [p. 33]	(PRES)	
try-to-VP: Non-manipulative : (1)	wava haad-	
EA: MOI: Would you please don't push	your nands	
back on your tray, noney.	(man1p.)	
i m trying to clean you off.	[p. 25] (PKOG)	

'(be)-gonna'-VP: Deontic-manipulative : (1)	
EX: NAO: Woof-woof.	(request)
MOT: What are you getting?	(solicit)
Are you going to get a dogie?	(solicit)
NAO: Get doggie. [p. 16-17]	(request)
Non-manipulative(?): (2)	
EX: MOT: Watch.	(direct-attention)
It' s going to pop.	(FUT)
NAO: [???] hot. Toast coming. [p. 29]	(FUT)
'have-to'-VP: Deontic-manipulative: (5)	
EX: NAO: Want it. Want it.	(request)
MOT: It's coming, Naomi.	(promise)
You have to wait till it pops out. [p. 2]	29] (manip.)
Non-manipulative: (1)	
EX: NAO: Piggy crying.	(PROG)
MOT: See the tears? Look at the tears.	(attract-attention)
That's because the piggy had to stay hor	ne. [p. 12-13] (PAST/OBLIG)
'finish-up'-NP: Deontic-manipulative context : (1)	
EX: NAO: More Famiglia. (r	equest)
FAT: You've got a little bit more in there. (P	PRES)
You finish that up first. (r	nanip.)
NAO: No more. [p. 44] (r	reject)
'go'-to-V: Non-manipulative: (1)	
EX: NAO: Mouse tired.	(PRES)
MOT: Oh, does it want to go to sleep? [p. 2] ((PRES/VOLIT)
'go'-(and)-V: Serial-verb (manipulative context?): (1)	
NAO: Point. (agree)	
MOT: Point with your finger. (manip.)	
See, like this. (direct-attention	1)
Go point. [p. 7] (manip.	
(b) Faui-object (manipulation) verbs	
'let'_NP-VP: Deontic-manipulative: (8)	
$EX: NAO: Oof_oof [bringing a dog puppet]$	(\mathbf{PRFS})
MOT: Let's make a shadow of that nunnet h	(1 RLS)
"have'-NP-VP: Non-manipulative (CAUS). (1)	
$\mathbf{FX} \cdot \mathbf{MOT} \cdot \mathbf{How} \text{ should we plan our day}^{(1)}$	(FUT?)
Maybe we'll have Naomi take a nep	$(\mathbf{FUT}/\mathbf{CAUS})$
this morning [n. 20]	$(1^{\circ}0^{\circ})$
uns morning. [p. 20]	

'leave'-NP-ADJ: Deontic-manipulative context: (1)	
EX: NAO: Leave it. Leave it.	(manip.)
FAT: Yeah, leave it alone, Nomi. [p. 45] (manip.)
'want'-NP-VP: Deontic-Manipulative : (1)	
EX: NAO: I want it hug.	(request)
FAT: Do you want me to hug Georgie or I	Nomi? [p. 51] (offer)
'make'-NP-VP: Deontic-manipulative : (3)	
EX: NAO: Comb hair.	(request)
MOT: Here's a brush, Naomi.	(offer)
Make your hair feel good. [p. 18-	-19] (offer)
Non-manipulative (CAUS): (1)	
EX: NAO: Where sun? (PRE	ES)
MOT: The sun is making it warm [p.	24] (PROG/CAUS)
'get'-NP-VP: Deontic-manipulative context : (1)	
EX: MOT: Lie down on the floor (ma	nip.)
so Mommy can get you dressed. (ma	nip.)
NAO: No. [p. 39] (ref	use)
(c) Perception-epistemic verbs	
'see'-NP: Direct attention: (6)	
EX: MOT: Look, see the shadow. (attract-	attention)
NAO: Shadow. [p. 20] (PRES)	
Describe perception: (5)	
EX: NAO: Where daddy?	(Q-PRES)
MOT: Daddy is working tonight, hone.	(PROG)
Daddy will be nome tonight.	(FUI)
You'll see him tomorrow morning. [p. 24	4] (FUT/PERCEP)
See -II-5. Direct attention: (1)	(monin)
EA: MOT: Let's see if you remember an of them.	(IIIaIIIp)
$\mathbf{M} = \mathbf{M} \mathbf{M} \mathbf{M} \mathbf{M} \mathbf{M} \mathbf{M} \mathbf{M} \mathbf{M}$	(Q-FKLS)
VAO. WI. Outlin. [p. 7]	(I KLS)
EX: NAO: What's this?	$(\mathbf{O}_{\mathbf{P}}\mathbf{P}\mathbf{P}\mathbf{F}\mathbf{S})$
$F\Delta T$: I can't see what you're pointing at [n 58]	$(Q^{-1} RLS)$
S 'see'. Direct attention: (1)	(I KL5/I EKCLI)
EX: NAO : [222] (222)	
MOT: There it is See $[n \ 16]$ (direct-attention	(PRFS)
'see' S: Direct-attention: (4)	
EX: NAO: What's this? Man [doing] (O-PRO	G)
MOT: See this man is making shoes [n 62] (dire	ect-attention)-(PROG)
'watch'-NP: **Direct attention**: (1) EX: MOT: Hold it up nice. (manip) Sit down and **watch** the shadow. [p. 18] (direct-attention) 'watch'. S: **Direct-attention**: (1) EX: MOT: Watch. It's going to pop. (direct-attention)-(IMM. FUT) NIN: [???] hot. Toast coming. [p. 29] (PRES/PROG) 'look-at'-NP: **Direct-attention**: (3) EX: NAO: Piggy crying. (PROG) MOT: See the tears? (attract-attention)>(PROG) Look at the tears. [p. 12-13] (attract-attention 'look', S: **Direct-attention:** (1) EX: MOT: Look. see the shadow. (direct-attention)>(PRES) NAO: Shadow. [p. 20] (PRES) 'show'-DAT-NP: **Direct attention:** (5) EX: MOT: **Show** me the mommy. (direct-attention) NAO: Mommy. [pointing]. [p. 5] (PRES) 'show'-DAT-WH/S: **Direct attention**: (1) EX: NAO: Toy doggie. (PRES) MOT: **Show** me where is. [p. 7] (direct-attention) 'hear'-NP-VP: **Direct attention:** (2) EX: FAT: Do you hear the birds singing? (direct attention)>(PROG) (PRES) NAO: [???]. FAT: Yes, the sun is out. [p. 42] (PRES) 'listen' (ellipsis) **Direct attention**: (1) EX: FAT: Are you listening? (Q-PROG) NAO: Listen. (PROG) FAT: Yeah, listen. [p. 50] (direct-attention) **Description**: (1) EX: FAT: Are you holding it over your ear? (Q-PROG) NAO: Holding ear. (PROG) FAT: Are you **listening**? (Q-PROG) NAO: Listen. [p. 50] (PROG) (d) Cognition-epistemic verbs WH/S. 'know' **Epistemic quantification**: (1) EX: NAO: What's this? (Q-PRES) MOT: I don't **know**. [p. 32] (PRES/EPIST) 'know'-WH/S: **Epistemic quantification:** (3) EX: NAO: Elbow. (PRES) MOT: Do you **know** where the elbow is? (Q-PRES/EPIST)

NAO: Elbow. [pointing to picture] [p. 5] (PRES)

'think'-S:	Epistemic quantific	ation: (7)		
	EX: NAO: What's th	nis.	(Q-PRES	5)
	MOT: I don't k	now.	(PRES/E	EPIST)
	I think i	t might be a matzo crumb.	. [p. 32] (PRES/E	EPIS)
S, 'think':	Epistemic quantific	ation: (2)		
	EX: NAO: Go to slee	ep.	(request)	
	FAT: I don't thi i	1k so. [p. 2]	(PRES/EPIST)/(refusal?)
	EX: NAO: What's th	is?	(Q-PRES)	
	FAT: It's a piece	of foam I think. [p. 47]	(PRES/EPIST)	
'think' (abo	out): Descriptive: (4)		
	EX: MOT: Dor	n't cry. I'm thinking about	it, honey. (PRC	DG)
	We	re not doing it. I'm just thi	inking. (PRC	DG)
	EVE: Thin	king.	(PRC	DG)
	MOT: Th	inking, yeah. With my he	ad. (PRO	OG)
	Ye	ou think up there. [p. 20)] (HA	AB)
'remember'	-NP: Direct-attention	n: (2)		
	EX: NAO: What	's this? Man. [doing?]	(Q-PRO	G)
	FAT: See, t	his man is making shoes.	(diratte	ention)>(PROG)
	Do yo	ou remember the other sho	bemaker? [p. 62]	(dirattention)
'remember'	-WH/A: Direct atter	ntion: (2)		
	EX: MOT:	Just like Nomi when she c	an't go outside sh	e cries (HAB)
		Remember how you cry v	when you can't	
		go outside? []	p. 12-13] (direct-	attention)>(HAB)
S. 'unders	stand' (ellipsis): Non-	directive: (1)		
	EX: N	IAO: Hi.	()	greeting)
	Ν	AOT: Hi what? I don't un	derstand. [p. 8] ((PRES)
'be-hard'-t	to-'understand': Non-d	lirective: (1)		
	EX: M	OT: We're making toast o	ut of bread. (I	PROG)
	N.	AO: [???].		
	М	OT: It's kinda hard to und	erstand. [p. 29] (l	PRES)
'figure ou	t'-WH/S: Directive c	context: (1)		
	EX: NAO:	Daddy. Hi		(greeting)
	FAT:	Let's figure out	.	(dir. attention)>
		what Nomi is going to w	ear today. [p. 53/] (FUT)

(e) Utterance-epi	istemic verbs		
'say'-dir.quote:	Directive contexts : (15)		
	EX: NAO: Piggy sleeping.		(PROG)
	MOT: Piggy is sleeping.		(PROG)
	Can you say: "Piggy is sleep	oing"? [p.	12] (mark dir. quote)
	Descriptive : (2)		
	EX: MOT: You don't want that delicious	honey.	(manip.)
	NAO: Yes.		(assent)
	MOT: You said: "Yes".		(PAST/DIR. QUOTE)
	You don't mean a word of it.	[p. 32]	(PRES/EPIST)
'tell'-DAT-WH/	S: Directive context: (4)		
	EX: NAO: Hat.	(PRES)	
	MOT: Tell me who this is. Peter.	(EPIST.	QUANTIFIER)
	NAO: Peter. [p. 9]	(PRES)	

Much like Eve, Naomi's at stage-I use of equi-subject modality verbs shows only one non-manipulative (non direct speech-act) use of the modal 'will'. The bulk of her usage, in the higher-frequency operators 'want' and 'need', is heavily skewed toward the manipulative (direct speech-act). Similarly with equi-object manipulation verbs, the bulk of Naomi's usage, with the higher-frequency 'get' and 'leave', is deontic-manipulative (direct speech-acts). And as in Eve-I, epistemic verbs appear at a very low frequency in Naomi's stage-I transcripts.

Naomi's adult interlocutors, much like Eve's, favor the deontic-manipulative use of equisubject modality verbs by a wide margin, at least those verbs that can be used in both a deonticmanipulative (speech-act) and a non-manipulative descriptive sense. The ratio of the two usages is 55-20 for this verbal category. For the three most frequent modality verbs, the ratio in favor of the deontic-manipulative usage is even more lopsided: 16-4 for 'can', 19-3 for 'want', and 5-1 for 'have to'. Naomi's adult interlocutors' use of equi-object manipulation verbs is just as skewed toward the direct manipulative speech-act: 14-2. Finally, with epistemic verbs: Perception verbs on the whole are used by Naomi's stage-I adult interlocutors for the speech-act of **directing attention** (as against description of perception), at a ratio of 22-8. For utterance verbs, the ratio of speech-act use (directing attention) vs. description is 15-2 for 'say' and 4-0 for 'tell'. In cognition verbs, the ratio of epistemic-quantifier use vs. descriptive use is 4-0 for 'know' and 9-4 for 'think'. The 4 instances of 'remember' are all used as the speech-acts of **directing attention**. The one instance of 'figure out' is likewise directive, and the two uses of 'understand' are descriptive. Overall, as in the Eve-I transcripts, Naomi's adult interlocutors conform to Diessel and Tomasello's description of the *child*''s early stage, matching closely Naomi's own stage-I modal usage.

Tables 17 and 18 below summarize the distribution of complex modal expressions used by the child and adult, respectively, in the Nina-I transcripts.

Table 17: NINA-I: Distribution of child use of complex modal expressions

(a) Equi-subject modality verbs:	
'go': Locative motion description: (1)	
EX: MOT: Is the rabbit going fast? Uh? (Q-PROG))
NIN: Go. (PROG)	
MOT: It's going. [p. 3] (PROG)	
'like'-NP: Non-manipulative description: (2)	
EX: NIN: Kitty cat. Big kitty cat. (PR	ES)
MOT: Do you like kitty cat? (Q-	PRES)
NIN: Like kitty cat. Like kitty cat. [p. 24] (PI	RES)
(b) Equi-object manipulation verbs	
'have'-NP-LOC: Manipulative context: (2)	
EX: NIN: Duck room, have it o[n] wee.	(request)
On the black. On the black.	(request)
MOT: Are you going to put the duck in t	he black space? (solicit)
This is a puzzle. [p. 27]	
'make'-NP: Manipulative context: (2)	
EX: MOT: Did you make the blocks fall down?	(Q-PAST)
NIN: Here.	(request)
MOT: Uh?	
NIN: Make it, Mommy.	(request)
MOT: You want me to make it? [p. 44]	(solicit)
'get'-NP: Manipulative context: (9)	
EX: NIN: Get the ball. (request)	
MOT: Get the ball? (offer)	
You want me to get the ball? (offer)	
NIN: Get the ball. [p. 54] (request)	
'take'-NP-LOC: Descriptive context : (2)	
EX: MOT: What am I doing? What is Momm	y doing? (Q-PROG)
NIN: Take it off. [???] off.	(PROG)
MOT: Taking the pants off.	(PROG)
NIN: Take off clothes. [p. 39]	(PROG)
(c) Perception epistemic verbs:	
'look'-(at)-(NP): Direct attention : (11)	
EX: NIN: Open that. [book]	(request)
MOT: That doesn't open.	(PRES)
That's the end of the book.	(PRES)
Want to look at it some more?	(offer)
NIN: Look rabbit. [p. 18]	(direct-attention/request)

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'look' [.]-S: Direct attention: (2)	
EX: MOT: What are you giving dolly to drink?	(Q-PROG)
NIN: Look. Drink a dolly. [p. 42]	(direct-attention)-(PROG)
'fee'-ADV: Descriptive: (2)	
EX: MOT: Oh, you're hugging the lady.	(PROG)
Does she feel better?	(Q-PRES)
NIN: Feel better. [p. 60]	(PRES)

Table 42: NINA-I: Distribution of adult use of complex modal expressions

(a) Equi-sul	oject modality verbs	
'will'-VP:	Deontic-manipulative: (5)	
	EX: NIN: Read.	(request)
	MOT: Won't you read the bunny?	(manip.)
	NIN: Read the bunny. []p. 2]	(request)
	EX: NIN: The book.	(request)
	MOT: No, you can't open that.	(prohibit)
	It' II tear. [p. 22]	(warn)
'can'-VP:	Deontic-manipulative: (32)	
	EX: NIN: Look, Mommy.	(direct-attention/request)
	MOT: Do you want me to take off	your shoes too? (offer)
	Can you take off your shoe?	(manip.)
	NIN: Hard. [p. 40]	(complain)
'shall'-VF	P: Deontic-manipulative: (16)	
	EX: NIN: Other kitty cat.	(request)
	MOT: Shall we find some other kit	tty cat? [p. 25] (offer)
'have-to'-	VP: Deontic-manipulative : (3)	
	EX: NIN: The book.	(request)
	MOT: No, you can't open that. It	'll tear. (prohibit)
	You have to just turn the p	pages. [p. 22] (manip.)
'want-to'-	VP: Deontic-manipulative : (16)	
	EX: NIN: More rabbit books.	(request)
	MOT: Do you want to find anot	ther book (offer)
	with a rabbit in it?	
	NIN: Here. [p. 19]	(request)
'would-lik	e-NP: Deontic-manipulative : (2)	
	EX: NIN: Yummy. [eating a cool	kie] (PRES)
	EX: MOT: Would you like some	more cookies? [p. 38] (offer)

'would-like'-t	o-VP: Deontic-manipulative : (2)		
	EX: MOT: Want me to drink do	olly's milk?	(offer)
	NIN: Yeah.		(request)
	MOT: Oh, it's so good. Um	m.	(PRES)
	Would you like to p	lay with dolly's	milk? [p. 49] (offer)
'like'-to-NP:	Non-manipulative: (7)		
	EX: NIN: Panda.	(PRES)	
	MOT: Do you like the panda?	(Q-PRES)	
	NIN: Yeah. [p. 8]	(PRES)	
'like'-to-VP:	Non-manipulative: (7)		
	EX: MOT: The guitar makes music, c	loesn't it?	(PRES)
	NIN: Yeah.		(PRES)
	MOT: Do you like to sing? [p. 1]	13-14]	(Q-PRES)
'try'-NP: De	ontic-manipulative: (3)		
EX	: NIN: Hard.	(PRES/comp	lain)
	MOT: Is it hard to put it on?	(Q-PRES)	
	NIN: Here.	(request)	
	MOT: You try it. Try again. [p. 27-2	8]	
'try-to-VP:	Deontic-manipulative : (5)		
	EX: NIN: Hard.	(PI	RES/complain)
	MOT: It is hard?	(Q	-PRES)
	NIN: Yes.	(P.	RES)
	MOT: You try to take off your sh	ioe. [p. 40] (m	nanip.)
'(be)-gonna'-	-VP: Deontic-manipulative: (11)		
	EX: NIN: Read.		(request)
	MO: Won't you read to bunny	?	(manip.)
	NIN: Read to bunny. Read to	bunny.	(request)
	MOT: Are you going to read t	to bunny? [p. 1	6] (manip.)
'go'-(LOC):	Manipulative context : (5)		
	EX: MOT: Would you like to go out to	o supper with N	Iommy? (offer)
	NIN: Supper. [p. 56]		(agree)
	Descriptive : (2)		
	EX: MOT: Is the rabbit going fast?	(Q-PROG)	
	NIN: Go.	(PROG)	
	MOT: It's going. [p. 3]	(PROG)	
'go'-(and)-V ((serial): Manipulative context: (3)		
	EX: MOT: Go find the ball. Go	o find the ball.	(manip.)
	Can you find the ba	all? [p. 52]	(manip.)

'why-don't-you'-VP: Deontic-manipulative : (1)		
EX: MOT: Oh dear, we have to s	tart over again.	(manip.)
Oh, let's start over aga	ain.	(manip.)
Why don't you bring	me the yellow block?	? (manip.)
Where is the yellow b	olock?	(Q-PRES/manip.)
NIN: Here.	[p. 44]	(PRES/comply)
(b) Equi-object manipulation verbs		
'let'-NP-VP: Deontic-manipulative: (22)		
EX: MOT: Look at the puzzle.	(direct-attention)	
Let's take att the pieces out	. (manip.)	
NIN: Yeah. [p. 26-27]	(agree)	
'make'-NP: Manipulative context: (3)		
EX: NIN: Make it, Mommy.	(request)	
MOT: You want me to make it?	(offer)	
Okay, let's make it. [p. 44]	(manip.)	
Non-manipulative: (2)		
EX: NIN: Here.	(PRES)	
MOT: You are making a building?	(Q-PROG)	
NIN: Building. [p. 45]	(PROG)	
'make'-NP-VP: Manipulative context: (4)		
EX: MOT: Shall we make dolly dar	nce? (manip.)	
Let's see, dance, dance.	(manip.)	
Make dolly dance.	(manip.)	
You make dolly dance.	[p. 38] (manip.)	
'want'-NP-VP: Deontic-manipulative : (11)		
EX: NIN: Untie.	(request)	
MOT: Want me to tie it?	(offer)	
NIN: Off. Shoe off. [p. 41]] (request)	
'get'-NP: Manipulative context: (16)		
EX: NIN: Get big ball. Big ball.	(request)	
MOT: Shall we get the big ball? [p.	51] (offer)	
'take'-NP-LOC: Manipulative context: (4)		
EX: NIN: Books	(PRES/request?)	
MOT: Look at the puzzle.	(direct-attention)	
Let's take all the pieces of	ut. (manip.)	
NIN: Yeah. [p. 26-27]	(agree)	

(c) Perception-epistemic verbs:	
'see'-NP: Direct attention : (3)	
EX: MOT: What's the rabbit doing?	(Q-PROG)
NIN: Hopping.	(PROG)
MOT: Uh-huh. And he's painting too.	(PROG)
See the rabbit? [p. 17-18]	(attract attention)
'see'(ellipsis): Manipulative context: (3)	
EX: NIN: Other kitty cat.	(request)
MOT: Shall we find some other kitty of	cat? (manip.)
Let's see . [p. 25]	(manip.)
'see'-if-S: Manipulative context: (3)	
EX: MOT: It's hard?	(Q-PRES)
NIN: Yes.	(PRES)
MOT: You try to take off your shoe.	(manip.)
See if you can take it off. [p. 40])] (manip)
'see'-NP-VP (raising): Manipulative context:	
EX: MOT: Oh, did it fall down?	(PAST)
NIN: Yeah.	(PAST)
MOT: Oh, can you build it so	ome more? (manip)
Let's see you build it.	[p. 43] (manip.)
'look'(at-NP): Direct attention : (1)	
EX: NIN: Books.	(request)
MOT: Look at the puzzle.	(direct-attention)
Let's take all the pieces out. [p	o. 26-27] (manip.)
'look' (,) S: Direct attention: (1)	
EX: MOT: Shall we build something?	(manip.)
NIN: Oh, something.	(request)
MOT: Oh, look let's put all the blocks	(direct-attention/manip.)
on top of each other. [p. 43]	
'look-like-NP: Descriptive : (1)	
EX: NIN: Big mouse, big mouse.	(PRES)
MOT: He looks like a mouse,	(PRES/EPIST)
but he is a seal. [p. 16]	(PRES)
(d) Cognition-epistemic verbs	
'S, 'think': Epistemic quantifier: (1)	
EX: NIN: A bird. (P	RES)
MOT: That's a bug, I think . (P	RES/EPIST)
Yes, that's a bug. [p. 10] (P.	RES)

'think'-S: Epistemic	quantifier: (3))		
EX: MOT	: Do you think d	lolly is getting hung	ry again?	(Q-PROG/EPIST)
NIN:	Yeah.	[p. 47-48]	((PROG)
'think' (ellipsis): Epis	temic quantifie	r:		
EX:	MOT: He's fallin	ng down.	(PROC	G)
	NIN: Yeah.		(PROC	G)
	MOT: Do you th	nink so? [p. 3]	(PROC	G/EPIST)
'WH/S, 'remember': E	pistemic quanti	fier: (1)		
E	X: MOT: He's pl	aying the guitar.		(PROG)
Ν	IN: [???].			
Μ	OT: Who plays	the guitar, Nina? Re	member?	(Q-PRES/EPIST)
'understand' (ellipsis): Descriptive: (1)		
	EX: MOT: Wh	at can you sing?	(P	PRES/ABIL)
	NIN: Up o	down.	(P	PRES)
	MOT: I de	on't understand. [p.	13-14] (P	RES)
	1			
(e) Utterance-epistemic	verbs	4 (0)		
say-dir.quote: Man	pulative contex	t : (9)		•
EX:	MOT: Can you	say: "Giraffe"?	(ma	nip.)
	NIN: Giraffe.	[p. 8]	(con	nply)
'say'-WH/S: Descri j	otive: (2)			
EX: NI	N: Meow, meow			
MO	OT: Meow? Is th	at what the cat says	? (Q-F	PRES)
NI	N: Meow.	[p. 9]		

At her stage-I, Nina is the least advanced child in our sample. When she does use the vestiges of complex modal expressions, however, they tend to conform to Diessel and Tomasello's observations. More striking is the way her mother conforms to the presumed early-child usage patterns. Virtually all her equi-subject (modality) and equi-object (manipulation) verbs in complex modal constructions are used as **direct manipulative speech-acts**. Virtually all her epistemic verbs of perception are used in the speech-act of **directing attention**. Virtually all her cognition verbs are used as grammaticalized **epistemic quantifiers**. And the bulk of her utterance verbs are used in **manipulative contexts**. At this early stage of child-adult communication, the adult again seems to behave like the child.

In the interest of brevity, I will only give a numerical summary of the distribution of child and adult modal pattern found in stages II and III, dispensing with the examples, which on the whole are similar to those given above for stage-I.

6.3. Stage II

6.3.1. Eve-II

A summary of the distribution of use s of grammar-marked deontic and epistemic modalities in the Eve-II transcripts, by child and adult, are given in tables 19 and 20 below, respectively.

modality verbs	manipulative	non-manipulative
'have-to-VP	13	/
'gotta'-VP	2	/
'can'-VP	1	/
(you/I) better-VP'	2	/
'gonna'-VP	6	1
'need'-NP	4	/
'want'-NP	4	/
'try'-to-VP	1	/
'forget'-to-VP	/	1
manipulation verbs		
'let'-NP-VP	4	/
perception-epistemic	attract-attention	descriptive
'look'	4	/
'feel'	/	1
cognition-epistemic	epistemic-quant.	descriptive
'think'-S	1	/

Table 19. Distribution of child uses of modal patterns in Eve-II

Table 20. Distribution of adult uses of modal patterns in Eve-II

modality verbs	manipulative	non-manipulative
'will'-VP	20	7
'can'-VP	7	2
'would'-VP	1	1
'might'-VP	/	1
'gonna'-VP	6	2
'have'-to-VP	3	/
'want'-NP	1	1
'want'-to-VP	1	/
'would-like'-NP	5	/
'need'-NP	5	/
'(had)-better'-VP	5	/

manipulation verbs		
'let'-NP-VP	3	/
'want'-NP-VP	3	/
perception-epistemic	attract attention	descriptive
'look'-WH/S	1	/
'look'-like-NP	/	1
'watch'-NP-VP	1	/
'show'-NP-VP	6	/
'hear'-NP	3	/
'listen' (ellipsis)	1	/
'feel'-ADJ	/	1
cognition-epistemic	epistemic quantifier	descriptive
'know'-if-S	1	/
'know'-S	3	/
'know' (ellipsis)	3	/
'remember'-WH/S	1	1
'think'-S	11	/
S, 'think'	1	/
utterance-epistemic	manipulative	descriptive
'ask'-DAT (ellipsis)	1	/
'say'-dir.quote	1	/

With some obvious differences, both the child and adult in the Eve-II transcripts conform to Diessel and Tomasello's early-stage child pattern. Most of their modality and manipulation verbs are used in direct manipulative speech-acts. Most of their perception verbs are used in the direct speech-act of directing attention. Most of their cognition verbs are used as epistemic quantifiers. And most of their utterance verbs are used in manipulative contexts. The 2-3 months of extra development haven't yet changed the usage pattern.

6.3.2. Naomi-II

A summary of the distribution of uses of grammar-marked deontic and epistemic modalities in the Naomi-II transcripts, by child and adult, are given in tables 21 and 22 below, respectively.

Table 21. Distribution of child uses of modal patterns in Naomi-II

modality verbs	manipulative	non-manipulative
'will'-VP	5	/
'can'-VP	9	/
'gonna'-VP	31	4
'go-and-V' (serial)	6	/
'go'-LOC	17	/
'want'-NP	4	/
'wanna'-VP	2	/
'stop'-(VP)	4	/
'like'-NP	5	/
manipulation verbs		
'let'-NP-VP	2	/
'have'-NP-VP	1	/
'make'-NP	3	/
'get'-(NP)	8	/
perception-epistemic	attract-attention	descriptive
'see'-(NP)	2	/
'see'-NP-VP/S	6	/
S, 'see'	2	/
'look'-(at)-NP	18	/
'look'. S	2	/
utterance-epistemic	manipulative	descriptive
'say'-WH/S	/	1
'say-dir. quote	/	1

Table 22. Distribution of adult uses of modal patterns in Naomi-II

modality verbs	manipulative	non-manipulative
'will'-VP	7	/
'can'-VP	5	/
'could'-VP	2	1
'should'-VP	2	/
'may'-VP	1	/
'gonna'-VP	5	1
'have'-to-VP	3	1
'gotta'-VP	1	/
'want'-NP	2	/
'want'-to-VP	7	/

'need'-NP1//'try'-to-VP/1'come-(and)-V (serial)1/manipulation verbs/'let'-NP-VP9'have'-NP/'have'-NP2'have'-NP-VP2'want'-NP-VP2'want'-NP-VP1'make'-NP1'make'-NP1'get'-NP-VP/11'see'-NP/'see'-NP1'see'-NP-VP (raising)1'see'-WH/S11/1/1/11	
'try'-to-VP/1'come-(and)-V (serial)1/manipulation verbs/'let'-NP-VP9'have'-NP2'have'-NP2'have'-NP-VP2'want'-NP-VP2'want'-NP-VP1'make'-NP1'make'-NP/11'make'-NP-VP/11'see'-NP-VP/1'see'-NP'see'-NP-VP (raising)11/'see'-WH/S11/11/ </td <td></td>	
'come-(and)-V (serial)1/manipulation verbs/'let'-NP-VP9'have'-NP2'have'-NP2'have'-NP-VP2'want'-NP-VP2'make'-NP1'make'-NP-VP4'get'-NP-VP/11perception-epistemicattract attention'see'-NP/11'see'-NP-VP (raising)11/'see'-WH/S11/1<	
manipulation verbs'let'-NP-VP9'have'-NP/'have'-NP2'have'-NP-VP2'want'-NP-VP2'make'-NP1'make'-NP-VP4'get'-NP-VP/11perception-epistemicattract attention'see'-NP/1'1'see'-NP-VP (raising)11/'see'-WH/S11/	
'let'-NP-VP 9 / 'have'-NP / 2 'have'-NP-VP 2 / 'want'-NP-VP 2 / 'make'-NP 1 1 'make'-NP-VP 4 / 'get'-NP-VP / 1 perception-epistemic attract attention descriptive evident 'see'-NP / 1 1 'see'-NP-VP (raising) 1 / 1 'see'-WH/S 1 / 1	
'have'-NP/2'have'-NP-VP2/'want'-NP-VP2/'make'-NP11'make'-NP-VP4/'get'-NP-VP/1perception-epistemicattract attentiondescriptive'see'-NP/1'see'-NP/1'see'-NP-VP (raising)1/1/1'see'-WH/S1/	
'have'-NP-VP2/'want'-NP-VP2/'make'-NP11'make'-NP-VP4/'get'-NP-VP/1perception-epistemicattract attentiondescriptive'see'-NP/1'see'-NP-VP (raising)1/'see'-WH/S1/1	
'want'-NP-VP2/'make'-NP11'make'-NP-VP4/'get'-NP-VP/1perception-epistemicattract attentiondescriptive'see'-NP/1'see'-NP-VP (raising)1/1'see'-WH/S1/1'see'-WH/S1/	
'make'-NP11'make'-NP-VP4/'get'-NP-VP/1perception-epistemicattract attentiondescriptiveevident'see'-NP/1'see'-NP-VP (raising)1/1'see'-WH/S1/1	
'make'-NP-VP4/'get'-NP-VP/1perception-epistemicattract attentiondescriptiveevident'see'-NP/1'see'-NP-VP (raising)1/1'see'-WH/S1/1	
'get'-NP-VP/1perception-epistemicattract attentiondescriptiveevident'see'-NP/1'see'-NP-VP (raising)1/1'see'-WH/S1/1	
perception-epistemicattract attentiondescriptiveevident'see'-NP/1'see'-NP-VP (raising)1/1'see'-WH/S1/1	
'see'-NP / 1 'see'-NP-VP (raising) 1 / 1 'see'-WH/S 1 / 1	tial
'see'-NP-VP (raising) 1 / 1 'see'-WH/S 1 / 1 See'age! / 1 1	
'see'-WH/S 1 / 1	
S. see / / 1	
'look'-at-NP / 1 /	
'show'-NP (ellipsis) 1 / /	
'hear'-(ellipsis) / / 1	
'listen' (ellipsis) 2 / /	
cognition-epistemic epistemic quantifier descriptive	
'know'-(ellipsis) 5 /	
S, 'know' 1 /	
'know'-WH/S 3 /	
'know'-S 1 /	
'remember-(S/WH/S) 5 /	
'think'-S 3 /	
S, 'guess' 1 /	
utterance-epistemic manipulative descriptive	
'say'-dir.quote 1 /	
'say'-NP 2 1	
'say'-WH/S / /	

As in the case of the Eve-II trabscripts, the bulk of the modal behavior by both the child and adult in the Naomi-II transcripts conforms to Diessel and Tomasello's description of early-stage child usage.

6.3.3. Nina-II

Tables 23 and 24 below summarize the comparable results for Nina's stage-II transcripts.

modality verbs	manipulative	non-manipulative
'will'-VP	11	1
'can'-VP	1	/
'gonna'-VP	6	1
'go-and-V' (serial)	2	/
'go'-LOC	3	2
'go'-to-V	3	/
'come-(and)-V (serial)	1	/
'want'-NP	27	1
'wanna'-VP	25	2
'like'-NP	/	1
manipulation verbs		
'let'-NP-VP	17	/
'have'-NP	/	14
'make'-NP	2	/
'get'-(NP)	13	/
'get'-LOC (incho.)	5	2
perception-epistemic	directive-manip	o. descriptive
'see'-(NP)	2	2
'see'-S	1	/
S. 'see'	1	/
'look'-(at)-NP	1	/
'show-DAT-NP	1	/
cognition-epistemic	epistemic-qua	ntifier directive
'know'-WH/S	2	/
'pretend'-S	/	1
'wonder-WH/S	3	/

Table 23. Distribution of child uses of modal patterns in Nina-II

Table 24.	Distribution	of adult uses of modal	patterns in Nina-II
modal	ity verbs	manipulative	non-manipulative

modality verbs	manipulative	non-manipulat
'will'-VP	14	6
'would'-VP	1	/
'can'-VP	16	8
'may'-VP	2	/
'shall-VP	13	/
'must'-VP	/	3
'might'-VP	/	/
'have-to'-VP	7	1

	21	<i>,</i>	
'gonna'-VP	21	6	
'go'-LOC/WH	/	1	
go-(and)-V (serial)	l	/	
'come'-(and)-V (serial)	1	/	
'want'-NP/WH	14	1	
'want'-to-VP	27	2	
'would-like'-NP	2	/	
'would-like'-to-VP	6	/	
'like'-NP	/	4	
'like'-to-VP	/	2	
'need'-NP	1	/	
'be-ready-(to-VP)	2	/	
'finish'-NP	1	/	
'why-don't-you'-VP	1	/	
manipulation verbs			
'let'-NP-VP	12	/	
'have'-NP	/	21	
'want'-NP-VP	5	/	
'would-like'-NP-VP	1	/	
'make'-NP	8	/	
'make-NP-(into)-NP	2	/	
'get'-NP-(NP)	6	/	
'get'-LOC (incho.)	2	1	
'get'-to-VP (incho.)	1	/	
perception-epistemic	attract attention	descriptive	evidential
'see'-(NP)	14	5	3
'see'-WH/S	3	/	/
'see'-if-S	2	/	/
'see'-S	1	/	/
'look'-at-NP	1	/	/
'look'-LOC	1	/	/
'look-WH/S	2	/	/
'look-like'-NP	/	1	/
'watch'-NP	/	1	/
'show-DAT-(NP)	3	/	/
cognition-epistemic	epistemic quantifier	descriptive	direct attention
'know'-(ellipsis)		-	
S, 'know'			
'know'-WH/S	2	/	/
'remember-NP	/	/	2
'think'-S	8	/	/
S, 'think'	1	/	/
'think'-if-S	1	/	/

'understand'-(ellipsis)	/	1	/
S, 'guess'	1	/	/
'bet'-S	1	/	/
'pretend'-S	1	/	/
utterance-epistemic	manipulative	descriptive	
'tell'-WH/S	1	/	
'ask'-for-NP	/	1	

With allowance for some variation, the distribution of child and adult modal usage in the Nina-II transcripts matches closely those found in Eve-II and Naomi-II transcripts, above.

6.4. Stage-III

A summary of the distribution of the use of grammar-marked deontic and epistemic modalities by the child and adult in the Eve-III transcripts is given in tables 25 and 26 below, respectively.

Table 25.	Distribution	of child	uses of	modal	patterns	in	Eve-III
-----------	--------------	----------	---------	-------	----------	----	---------

modality verbs	manipulative	non-manipulative
'will'	2	2
'can'-VP	7	2
'gonna'-VP	12	2
'go'-V (serial)	4	/
'want'-NP	6	/
'want'-to-VP	1	/
'need'-NP	1	/
'have-to-VP	12	/
'like' -(ellipsis)	1	/
manipulation verbs		
'let'-NP-VP	6	/
'get'-NP	4 (context)	/
'have'-NP	4 (context)	/
'make'-NP	9 (context)	/
perception-epistemic	attract-attention	descriptive
'see'-NP	2	2
'see'-S	2	/
'see'-NP-VP (raising)	5	/
'look'-NP.S	1	/

cognition-epistemic	epistemic-quant.	descriptive	attract attention
'think', S	1	/	
'guess'-S	1	/	
'find-out'-WH/S	1	/	
'remember'-S	/	/	1

Table 26. Distribution of adult uses of modal patterns in Eve-III

modality verbs	manipulative	non-manipulative
'will'-VP	30	9
'would'-VP	5	1
'can'-VP	15	5
'could'-VP	1	/
'may'-VP	5	/
'might'-VP	/	1
'shall'-VP	6	/
'should'-VP	7	/
'must'-VP	2	/
'have-to'-VP	7	1
"ve-got-to'-VP	1	/
'supposed-to'-VP	/	1
'go'-LOC	3 (context)	1
'gonna'-VP	9	2
'want'-NP	4	/
'want'-to-VP	3	/
'would-like'-NP	2	/
'like'-NP	/	1
'need'-NP	5	/
'try'-to-VP	1 (context)	/
'go'-(and)-V (serial)	5 (context)	/
'come'-(and)-V (serial)	1 (context)	/
'wait'-and-V (serial)	1 (context)	/
'(had)-better'-VP	2	/
'why-don't-you'-VP	5	/
manipulation verbs		
'let'-NP-VP	3	/
'want'-NP-VP	1	/
'would-like-NP-to-VP	1	/
'make'-NP	10 (context)) 2
'make'-NP-VP/PRED	6 (context)	/
'have'-NP	8 (context)	/
'take'-NP	2 (context)	/
'get'-NP	2 (context)	/

perception-epistemic	attract attention	descriptive	
'see'-NP	6	3	
'see'-if-S	1	/	
'see'-NP-VP (raising)	/	1	
'look'-(at-NP)	3	/	
'watch'-NP-VP	1	/	
'hear'	1	/	
'listen'	1	/	
'feel'-ADV	/	/	
cognition-epistemic	epistemic quantifier	descriptive	direct attention
'know'-if-S	1	/	/
'know'-S	2	/	/
S, 'know'	1	/	/
'find-out'-WH/S	/	/	1
'remember'-(WH/S)	/	/	6
'forget'-about-NP	/	1	/
'think'-S	11	/	/
'think'-(ellipsis)	1	/	/
'guess'-S	2	/	/
'be-sure'- (ellipsis)	1	/	/
utterance-epistemic	manipulative	descriptive	
'say'-dir.quote	2	/	
'tell'-WH/S	/	1	
'ask'-DAT	1	/	

The general pattern seen above persists. And the adult modal use pattern in the Eve-III transcripts remains, essentially, the early-child pattern.

A summary of the distribution of the use of grammar-marked deontic and epistemic modalities by the child and adult in the Naomi-III transcripts is given in tables 27 and 28 below, respectively.

Table 27.	Distribution	of child	uses of	modal	patterns	in Naomi-III
-----------	--------------	----------	---------	-------	----------	--------------

modality verbs	manipulative	non-manipulative
'can'-VP	10	/
'could'-VP	1	/
'gonna'-VP	7	3
'go'-LOC	4	/
'want'-NP	36	/
'wanna'-(ellipsis)	4	/

utterance-epistemic 'say'-WH	manipulative	descriptive	
'think'-WH	2	/	/
cognition-epistemic	epistemic-quant.	descriptive	attract attention
'look'-at-NP-VP (raisin	ng) 2	/	/
'look'-(at)-NP	2	/	/
'see'-NP-VP (raising)	1	/	/
'see'-(ellipsis)	1	2	/
'see'-NP	2	1	/
perception-epistemic	attract-attention	manipulative	descriptive
'get'-LOC (icho.)	3	1	
'get'-NP	3	2	
'have'-(NP)	/	1	
'get'-NP			
'let'-NP-VP	1	/	
manipulation verbs			
'finish'-(ellipsis)	/	2	
'like'-NP	/	6	
'have-to-VP	1		
'need'-NP	3	/	

Table 28. Distribution of adult uses of modal patterns in Naomi-III

modality verbs	manipulative	non-manipulative
'will'-VP	9	3
'would'-VP	/	4
'can'-VP	9	4
'could'-VP	/	2
'be-able'-to-VP	/	1
'should'-VP	1	/
'have-to'-VP	1	/
'seem-to-be'-VP	/	1
'go'-LOC	3 (context)	1
'gonna'-VP	6	19
'go-(and)-V (serial)	1 (context)	/
'come'-(and)-V (serial)	1 (context)	/
'want'-NP	9	/
'want'-to-VP	9	1

'need'-NP	3	/	
'need'-to-VP	1	/	
'would-like'-to-VP	1	/	
'have'-to-VP	3	/	
'like'-NP	/	7	
'finish'-(VP/NP)	/	2	
'why-don't-you'-VP	2	/	
manipulation verbs			
'let'-NP-VP	3	3	
'want'-NP-VP	7	/	
'wish'-S	1	/	
'ask'-NP(VP)	/	1	
'help'-DAT-(VP)	2	2	
'get'(DAT)-NP	5 (context)	/	
've-got'-NP	/	2	
'be-time-for'-NP-to-VP	1	/	
perception-epistemic	attract attention	descriptive	epist. quantifier
perception-epistemic 'see'-NP	attract attention	descriptive 3	epist. quantifier 1
perception-epistemic 'see'-NP 'see'-(ellipsis)	attract attention / 1	descriptive 3 1	epist. quantifier 1 /
perception-epistemic 'see'-NP 'see'-(ellipsis) 'look'-(at-NP)	attract attention / 1 2	descriptive 3 1 /	epist. quantifier 1 / /
perception-epistemic 'see'-NP 'see'-(ellipsis) 'look'-(at-NP) 'listen', S	attract attention / 1 2 1	descriptive 3 1 /	epist. quantifier 1 / / /
perception-epistemic 'see'-NP 'see'-(ellipsis) 'look'-(at-NP) 'listen', S cognition-epistemic	attract attention / 1 2 1 epistemic quantifier	descriptive 3 1 / descriptive	epist. quantifier 1 / / direct attention
perception-epistemic 'see'-NP 'see'-(ellipsis) 'look'-(at-NP) 'listen', S cognition-epistemic 'know'-(ellipsis)	attract attention / 1 2 1 epistemic quantifier 3	descriptive 3 1 / descriptive /	epist. quantifier 1 / / / direct attention /
perception-epistemic 'see'-NP 'see'-(ellipsis) 'look'-(at-NP) 'listen', S cognition-epistemic 'know'-(ellipsis) 'know'-WH/S	attract attention / 1 2 1 epistemic quantifier 3 4	descriptive 3 1 / descriptive / /	epist. quantifier 1 / / / direct attention / /
perception-epistemic 'see'-NP 'see'-(ellipsis) 'look'-(at-NP) 'listen', S cognition-epistemic 'know'-(ellipsis) 'know'-WH/S 'remember'-(WH/S)	attract attention / 1 2 1 epistemic quantifier 3 4 /	descriptive 3 1 / descriptive / /	epist. quantifier 1 / / direct attention / 2
perception-epistemic 'see'-NP 'see'-(ellipsis) 'look'-(at-NP) 'listen', S cognition-epistemic 'know'-(ellipsis) 'know'-WH/S 'remember'-(WH/S) 'think'-S	attract attention / 1 2 1 epistemic quantifier 3 4 / 3	descriptive 3 1 / descriptive / / /	epist. quantifier 1 / / direct attention / 2 /
perception-epistemic 'see'-NP 'see'-(ellipsis) 'look'-(at-NP) 'listen', S cognition-epistemic 'know'-(ellipsis) 'know'-WH/S 'remember'-(WH/S) 'think'-S 'think'-(ellipsis)	attract attention / 1 2 1 epistemic quantifier 3 4 / 3 1	descriptive 3 1 / descriptive / / /	epist. quantifier 1 / / direct attention / 2 / /
perception-epistemic 'see'-NP 'see'-(ellipsis) 'look'-(at-NP) 'listen', S cognition-epistemic 'know'-(ellipsis) 'know'-WH/S 'remember'-(WH/S) 'think'-S 'think'-(ellipsis) 'wonder'-WH/S	attract attention / 1 2 1 epistemic quantifier 3 4 / 3 1 1 1	descriptive 3 1 / descriptive / / / / /	epist. quantifier 1 / / direct attention / 2 / / / / /
perception-epistemic 'see'-NP 'see'-(ellipsis) 'look'-(at-NP) 'listen', S cognition-epistemic 'know'-(ellipsis) 'know'-WH/S 'remember'-(WH/S) 'think'-S 'think'-(ellipsis) 'wonder'-WH/S 'mean'-dir.quote	attract attention / 1 2 1 epistemic quantifier 3 4 / 3 1 1 1 1	descriptive 3 1 / descriptive / / / / / / / /	epist. quantifier 1 / / direct attention / 2 / / / / / / / / / / / / / / / / /
perception-epistemic 'see'-NP 'see'-(ellipsis) 'look'-(at-NP) 'listen', S cognition-epistemic 'know'-(ellipsis) 'know'-WH/S 'remember'-(WH/S) 'think'-S 'think'-(ellipsis) 'wonder'-WH/S 'mean'-dir.quote utterance-epistemic	attract attention / 1 2 1 epistemic quantifier 3 4 / 3 1 1 1 1 manipulative	descriptive 3 1 / descriptive / / / / descriptive	epist. quantifier 1 / / direct attention / 2 / / / / / / / / / / / / / / / / /
perception-epistemic 'see'-NP 'see'-(ellipsis) 'look'-(at-NP) 'listen', S cognition-epistemic 'know'-(ellipsis) 'know'-WH/S 'remember'-(WH/S) 'think'-S 'think'-(ellipsis) 'wonder'-WH/S 'mean'-dir.quote utterance-epistemic 'say'	attract attention / 1 2 1 epistemic quantifier 3 4 / 3 1 1 1 1 manipulative 4	descriptive 3 1 / descriptive / / / / / descriptive 4	epist. quantifier 1 / / direct attention / 2 / / / / / / / / / / / / / / / / /

With one conspicuous exception--the adult's use of 'be-gonna' as a descriptive/epistemic future marker, the distribution of modal uses by both child and adult in the Naomi-III transcripts conforms to the general pattern seen above. The exception is due to two episodes where the adult chose to discuss the future at great length. Such referential displacement, as we noted earlier, was not characteristic of our CHILDES transcripts at this age range.

A summary of the distribution of the use of grammar-marked deontic and epistemic modalities by the child and adult in the Nina-III transcripts is given in tables 29 and 30 below, respectively.

Table 29. Distribution of child uses of modal patterns in Nina-III

modality verbs	manipulative	non-manipulative	
'will'-VP	5	6	
'would'-VP	2	1	
'can'-VP	7	3	
'could'-VP	1	/	
'should'-VP	2	1	
'gonna'-VP	7	9	
'go'-LOC	7 (context)	8	
'want'-NP	5	/	
'wanna'-(ellipsis)	1	/	
'wanna'-VP	5	1	
'like'-NP	/	/	
'try'-VP	5 (context)	/	
'it's time'-(for you-to-	VP 2	/	
manipulation verbs	manipulative	non-manipulative	
'let'-NP-VP	20	/	
'have'-NP	/	5	
'make'-NP	11 (context)	/	
'make'-NP-VP (caus.)	1	1	
'get'-NP	1 (context)) /	
'get'-LOC (incho.)	/	3	
perception-epistemic	attract-attention	descriptive	
'see'-(ellipsis)	3	/	
'see'-WH/S	1	/	
'see'-S	2	/	
S. 'see'	1	/	
'look'-at-NP	5	/	
'look'-at-NP-VP (raisi	ng)		
cognition-epistemic	epistemic-quant.	descriptive	
'know'-NP	1	/	
'forget'-(ellipses)	/	1	
'forget'-to-VP	/	1	
'understand'-(NP)-(elli	psis) /	2	
utterance-epistemic	manipulative	descriptive	
'say'-dir. quote	/	5	
'say'-S	/	1	

Table 30. Distribution of ad	ult uses of modal pa	atterns in Nina-III
modality verbs	manipulative	non-manipulative
'will'-VP	-4	6
'can'-VP	18	6
'could'-VP	/	1
'shall'-VP	16	/
'should'-VP	2	3
'must'-VP	/	1
'have-to'-VP	5	3
'go'-LOC	3	14
'gonna'-VP	1	22
'go-(and)-V (serial)	2	/
'go'-to-V	1	1
'come'-(ellipsis)	/	1
'want'-NP/WH	2	/
'want'-to-VP	23	2
'love'-to-VP	/	1
modality (cont.)	manipulative	non-manipulative
'would-like'-to-VP	5	/
'like'-NP	/	2
'like'-to-VP	/	4
'need'-NP/WH	/	3
'be-ready'-to-VP	/	2
'like'-NP		
'try'-NP	2	/
'try'-to-VP	1	1
'be-time'-(for-NP)-to-VP	1	/
'be-better'-VP	3	/
manipulation verbs		
'let'-NP-VP	8	/
'have'-NP	/	4
'make'-NP/WH	3 (contex	t) 2
'make-NP-VP	7	4
'get'-NP-ADJ	/	2
'take'-NP-ADJ	/	1
perception-epistemic	attract attention	descriptive
'see'-NP	4	4
'see'-(ellipsis)	11	/
'see'-WH/S	2	/
'see'-S	2	/
'see', S	1	/

S, 'see'	1	/	
'see'-if-S	1	/	
'look'-(at-NP)	15	/	
'look'-at-NP-VP (raising	g) 1	/	
'look'-WH/S	4	/	
WH/S, 'look'	1	/	
'look'-for-NP	/	2	
'look'-ADJ	/	1	
'watch'-NP	/	1	
'feel'-WH/S	1	/	
'feel'-ADJ	/	1	
cognition-epistemic	epistemic quantifier	descriptive	direct attention
'know'-(ellipsis)	10	/	/
'know'-WH/S	4	1	/
WH/S, 'know'	3	/	/
'remember'-NP	/	/	1
'wonder'-WH/S	3	/	/
'think'-S	22	/	/
'think'-(ellipsis)	2	/	/
WH/S-'think'	2	/	/
'guess'(-S)	2	/	/
'understand'-WH	/	1	/
'mean'-S	3	/	/
S, 'mean'	2	/	/
'pretend'-to-VP	1	/	/
'forget'-to-VP	/	1	/
utterance-epistemic	manipulative	descriptive	evidential
'say'-dir.quote	1	/	/
'say'-WH	/	1	/
S, 'say'	/	/	1
'tell'-S	/	/	1

While the distributional pattern of modal usage remains substantially the same, one change can be again noted, this time in both the child an adult: The expansion of the use of 'will' and 'gonna' towards the non-manipulative epistemic sense of 'future'. This may be related to a gradual displacement of reference away from 'here-and-now' (or the immediate future) toward a more remote future. Since this pattern, at least in the Nina-III transcripts, is found in both the child and adult, the developmental expansion is in the **communicative goals of the diad**, not just in the child's evolving competence. Indeed, a gradual expansion of the domain of reference toward non-immediate future has been shown earlier above in the Nina transcripts, in both the child and adult (section 5.3. above): Nina-I: **0%** non-immediate future uses in either the child or the adult.

Nina-II: 0.8% non-immediate use for the child and 2.3% for the adult. Nina-III: 4.7% for the child and 3.1% for the adult. While this a small incrementation, but it may turn out to be significant.

7. Paratactic precursors to complex syntax: Cross-turn distributed syntactic complexity

We come finally to the crux of this investigation, the distribution of grammatically-marked complex clauses across adjacent adult-child or child-adult conversational turns. I have attempted to arrive at a typology of the various ways this is done in our CHILDES transcripts. It is a preliminary and somewhat subjective typology, but all typologies have, in principle, a subjective component. I will begin by illustrating all the types with examples from the Nina-II transcripts. I will then present the quantitative distribution of the types for all three subjects at all three stages.

7.1. Qualitative analysis: Types of cross-turn distributed modal structures

The following examples of the types of cross-turn distribution of complex modal expressions are taken from the Nina-II transcripts. I have divided them into two main categories: (i) The child's various responses to adult-initiated marked modal structures. And (ii) the adult's response to two types of child modal expressions: (a) grammatically-unmarked and (b) grammatically marked. For each category, I'll give at least one deontic and one epistemic example. The response types are ordered from the least elaborate to the most elaborate and, eventually, grammatically-marked.

(i) Child responses to grammatically-marked adult modal expression (Nina-II)

(27) a. Appropriate yes-no elliptic responses EX: MOT: Would you like to play with the village? (offer) NIN: Yeah. [p. 5] (accept) (Q-FUT) EX: MOT: Do you **think** he' **ll** eat another one? NIN: Yup. [p. 1] (FUT) b. Response with an object of the complement clause EX: MOT: You want to give Poy a cookie? (offer) NIN: That one. [p. 1] (accept) EX: MOT: What is he eating? (Q-PROG) NIN: A dog cookie. [p. 1] (PROG) c. Response with an unmarked complement clause EX: MOT: What are you gonna do? (solicit) NIN: Pat him. [p. 4] (intent) EX: MOT: Do you **know** what these are? (Q-PRES) NIN: What this thing? [p. 11] (Q-PRES) d. Response with a marked complex modal construction EX: MOT: Can you make him do that? (manip.) NIN: I can't do that. [p. 18] (refuse)

EX: What is Poy doing?	(Q-PROG)
NIN: He's eating a cookie. [p. 1]	(PROG)
EX: MOT: That would hurt, wouldn't it?	? (Q-FUT/HYPOTH)
NIN: Yeah, on the road it would .	p. 48] (FUT/HYPOTH)
e. Child-initiated marked complex modal	construction with no adult prompt
EX: MOT: Many little houses.	(PRES)
NIN: Let. Let's put, let's build these	. [p. 13] (request)
EX: NIN: Oh, oh, there will be another p	icture. (FUT)
Just a minute.	(request)
See what this is. [p. 14]	(direct-attention)
EX: MOT: What's on his pajamas? Oh.	(Q-PRES)
NIN: He's hanging on two feet. [p.	21] (PROG)
(ii) Adult response to child's previous turn (Ni	na-II)
	· · · · · · · · · · · · · · · · · · ·

(28) a. Expansion: Adult marked complex-modal response to child unmarked expression

EX: NIN: The cookie for Poy.	(request)
MOT: Do you want to give Poy a cookie? [p.	1] (offer)
EX: MOT: What's he eating?	(Q-PRES)
NIN: A banana.	(PROG)
MOT: Oh, can you make him eat a banana? [p	. 3] (manip.)
EX: NIN: What's he doing?	(Q-PROG)
MOT: I don't know . [p. 14-15]	(EPIST-PROG)
EX: NIN: These wheels don't move, Momma.	(PRES)
MOT: Oh, I think they'll move. [p. 15]	(EPIST-FUT)
EX: NIN: Where does it belong?	(Q-PRES)
MOT: Where does it go?	(Q-PRES)
NIN: Yeah.	(Q-PRES)
MOT: I think it goes right here.	(EPIST-PRES)
NIN: Where?	(Q-PRES)
MOT: I don't know Maybe	(EPIST-PRES)
I don't know where it goes.	(EPIST-PRES)

b. Reinforcement: Adult marked complex-modal response to child's marked complex-modal expression:

EX: NIN: I want	(request)
MOT: What do you want to do? [p. 1-2]	(solicit)
EX: NIN: Would you make a whole building?	(request)
MOT: Would I make what? [p. 53]	(solicit)
EX: This is gonna be a nurse.	(FUT)
MOT: Is that gonna be a nurse?	(Q-FUT)

EX: NIN: Cami doesn't understand.	(PRES)
MOT: What doesn't Cami understand?	(Q-PRES)
NIN: Doesn't understand [how not to play] the rough.	(PRES)
MOT: You have to play gently, you mean.	(PRES)
NIN: Yup. [p. 3]	(PRES)
EX: NIN: He's eating that.	(PROG)
MOT: What is he eating? [p. 1]	(Q-PROG)

Of the five types of adult-child adjacent turns in (27a), the first three (27a,b,c) can be considered **joint constructions** of the complex modal structures, where the adult opens by contributing the modality marker and the child then contributes various chunks of the complement proposition--the gist of the communication--without any modal marking. Only in types (27d,e) does the child contribute the full complex construction, in (27d) with adult prompting, at (27e) without it. As we shall see below, these two types are not found in the early Stage-I.

Of the two types of child-adult adjacent turns in (28), (28a) is of course the most interesting kind of joint child-adult construction of a complex structure. The child contributes an unmarked, often truncated, expression, which is then interpreted via **modal expansion** by the adult. Again, this type is more prevalent in the early stages, awhile type (28b), **modal reinforcement**, appears later.

7.2. Quantitative analysis: Distribution of the various response types across diads and stages

======================================		(a)	(b)		(c)		(d)		(e)		TOTAL		
child s	stage	===== N	%	===== N	%	====== N	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	N	%	===== N	%	N	~ %
EVE	 I	25	32.0	12	15.3	36	46.1	 5	 6.6		0.0	 78	100.0
	II	20	19.2	10	9.5	19	18.2	19	18.2	36	34.9	104	100.0
	III	19	16.5	22	19.1	12	10.4	26	22.6	36	31.4	115	100.0
NAO	Ι	6	5.6	36	33.9	35	33.0	12	11.3	17	16.2	106	100.0
	II	6	4.7	7	5.5	6	4.7	25	19.6	83	60.5	127	100.0
	III	36	19.5	13	7.0	15	8.1	20	10.8	100	54.6	184	100.0
NIN	Ι	35	28.9	33	27.2	51	42.1	/	0.0	2	1.8	121	100.0
	II	41	24.2	30	17.7	28	16.5	21	12.4	49	29.2	169	100.0
	III	75	30.0	33	13.2	12	4.8	23	9.2	107	42.8	250	100.0

Table 31: Child responses to adult previous turn (i) interaction

		(a)		(b)		TOTAL	
child	stage	N	%	N	%	N	%
EVE	===== I	===== 75		===== 19	21.3	===== 94	100.0
	II	76	75.2	25	24.8	101	100.0
	III	30	65.2	16	34.8	46	100.0
NAO	Ι	82	85.4	14	14.6	96	100.0
	II	36	59.0	25	41.0	61	100.0
	III	45	41.6	63	58.4	108	100.0
NIN	Ι	117	100.0	/	/	117	100.0
	II	51	57.9	37	42.1	88	100.0
	III	59	65.5	31	34.5	90	100.0
			======		======		

Table 32: Adult response to child previous turn (ii)interaction type

Because of the way the original modal interactions were selected, (and within them the adjacent-pair types), and because of the low number of subjects and data points, it is not feasible to do inferential statistic on these numerical distributions. Still, several trends seem plausible and make sense.

(i) In the adult-child adjacent turns, type (a) should have no correlation to developmental stage, since it is a perfectly universal elliptic response strategy to both epistemic questions and deontic suggestions. Types (b) and (c) are the best candidate for early-stage syntax. Both show a drop in late stages. Types (d) and (e) are the end-products of learning, so their rise in the later stages should not be surprising.

(ii) In the child-adult adjacent turns, type (a) is the most striking early-stage cross-turn collaboration, where the child opens with relatively little grammatical modal structure, and the adult then expands on the unmarked structure. It is thus not surprising that this type is most prevalent at the early stage.

My aim in presenting the numerical distribution of all these types of interaction was merely to show the high prevalence in the text of adjacent turns of type (i-b,c) and (ii-a), where the complex structure distributes across adjacent turns. In such configurations, the adult contributes most of the grammatical marking, and the child either responds with (i), or contributes initially (ii), various chunks of the complement clause, including the most elliptic yes/no responses (i-a).

8. Child-adult comparisons

As I said earlier, I consider this study a supplement to Diessel and Tomasello's work. To quite an extent, my results uphold their general thesis that in early child language the use of

complement-taking main verbs is heavily tilted toward deontic or epistemic direc-speech-act marking, and thus that the main clause is not as semantically focal as the complement. But the results reported above also suggest that, at least in our early-stage CHILDES transcripts (roughly age 1;8 to 2;9), the adult's use of modal structures does not deviate significantly from that of the child.

This brings us to our earlier assessment of the type of communicative context we deal with here. We showed that the context was strongly tilted towards **non-displaced reference** (hereand-now, you-and-I, this-and-that-visible). It was heavily invested in **manipulative speech-acts**. And it was largely **speaker-hearer centered**. This is the quintessential communicative context of both pre-human and early-childhood communication. So it may be plausibly asked whether it isn't this 'primitive' communicative context that motivates the adult's child-like modal behavior. Are these adults slumming? Are they **down-shifting** their register?

To assess this possibility, I have selected as a comparison one chapter from recorded (and then transcribed) face-to-face oral narrative, the life-story of a retired rancher and oil-field worker. His story is, predominantly, about displaced time, place and referents, about other times and places and people not known to his audience.**[FN 6]** The question we are concerned with is his use of deontic and epistemic main verbs--to what extent does he use them as **grammaticalized direct speech-act markers**? His past-time narrative is tilted heavily towards the epistemic, since his listener (myself) was interested primarily in his life story. But deontic grammatical markers are found in both the narrative and direct-quoted conversation portions of the texts. This affords us a revealing comparison between the two communicative contexts--within the same speaker.

As an example of the use of epistemic and deontic modal operators in both in the narrative and quoted conversation portions of the text, consider:

(29) ...And I knew I was gonna get so far so that I ever drive over there to see the family. So about this time this [oil] boom started here, see. Boy, I mean it was, I think a hundred and seventy-five rigs in here through most of the Fifties, y'know, drillin' all this country up... So I came over here and started on this roughneckin' job. But when I got here there was an old preacher up there that had seven, a little seventeen-acre place, and he'd been wantin' to sell it and he ah, you know, he'd known him, I guess knew at least, kinda wanted family, he knew my dad. So he told me he said: "Harris you need a place", said "let me sell you that little ol' seventeen-acre farm..." It had a little three-room shack on it, see... It was up at Cedar, this side of Cedar Hill... That's where my dad lived is up in that Cedar Hill area. So ah... he said: "I'll sell it to you for fifty dollars down..." I said: "Well, OK, I'll buy it". And at that time, after we got all that movin' done, y'know, I wasn't making any money with the state... [p. 78]

To further illustrate the high concentration of **direct manipulative speech-act** use of deontic modal expressions inside direct-quoted conversation, consider:

(30) ...He said: "Well" he said, "I 'm gonna draw you a picture right here on this piece of paper, what you' re gonna find". He said: "We gotta, we gotta come out of that hole 'cause" he said, "this bit is wore out". And he said: "I can't get these other two guys to go up and I' m gonna have to have a man up there" he said. "Would you go up and try it for me as a favor?" he said, "'cause I got to come out"... [p. 73]

Table 33 below offers a quantitative summary of the uses of modal operator in the oral narrative portion of text (10 pp.; 70-79).

modality verbs	manipulative	descriptive
'be-gonna'-VP	-	10
'go'-to-VP		2
'have-to'-VP		11
'will'-VP		14
'would-VP		4
'want'-to-VP		11
'want'-NP		1
'can'-VP		7
'could'-VP		17
'most-'ve'-VP		1
'need'-NP		1
'might'-VP		1
'ought'-to-VP		1
'try'-to-VP		5
'come-V (serial)		1
'be-supposed-to'-VP		1
'be-liable'-to-VP		1
'threaten'-to-VP		1
'be-liable'-to-VP		2
'('ve)gotta'-VP		4
'start'-VP		1
'gotta'-VP		2
total MOD:	0 (0%)	 99

Table 33: Distribution of modal uses in the narrative textfunction

manipulation verb	s:	
'tell'-NP-how-to-VF	1	
'tell'-NP-to-VP	1	
'tell'-NP-WH-VP	2	
'have'-NP-VP		5
'let'-NP-VP		1
'keep-NP-VP		1
'get'-NP-(to)-VP		2
'want'-NP-VP		1
total MANIP	0 (0%)	14
epistemic verbs:	epistemic quant.	descriptive
'think'-S	4	2
S, 'think'	1	
'find-out-S		1
'know'-S	2	
S, 'know'	50	
S. 'know'	1	
'know', S	7	
'know'-if-S	1	
'know'-WH/S	7	6
'know' (ellipsis)	2	
'guess'-S	3	
S, 'guess'	1	
'figure'-S	1	
S, 'remember'	1	
'see'-that-S		1
'see'-if-S		1
S, 'see'	30	
. 'See', S	16	
'see'-WH/S		1
'see'-NP-VP	1	1
'tell'-NP-about-NP	2	1
'tell'-NP:""		10
'tell'-WH/S		2
'tell'-if-S		2
'say':"/""-'say'		53
'say'(,) S	2	
'mean', S	6	
'figure-out'- (ellipsis	s) 1 	
total EPIST	139 (63.1%)	81

Table 34 below offers the comparable distribution in the quoted conversational portion of the text.

:				
modality verbs	manipulative	descriptive 5		
'be-gonna'-VP	6			
'hate'-to-VP	2			
'go'-V (serial)	1			
'will'-VP	26	5		
'would'-VP	3			
'can'-VP	8	2		
'could'-VP	1			
'want'-to-VP	5	1		
'would-like'-VP	2			
'why-don't-you'-VP	1			
'feel-like'-VP		1		
'need'-NOM		1		
'supposed-to'-VP		1		
'have-to'-VP	5			
'gotta'-VP	4			
'vou-better'-VP	1			
'try'-VP	2			
total MOD:	67 (80.7%)	16		
manipulation verbs	3:			
'let'-NP-VP	6			
'want'-NP-VP	2			
	8 (100%)	0		

Table 34: Distribution of modal uses in the quoted conversationfunction

epistemic verbs:	epistemic quant.	descriptive
'know'-WH/S	1	-
'know'-if-S	1	
'know'-S	1	
S, 'know'	1	
S. 'know'	2	
'say'-S	1	
'hear'-S	1	
'see'-NP-VP (raising)		1
'tell'-NP-WH/S	1	
total EPIST:	9 (90.0%)	1

While the data again does not allow inferential statistics, its main thrust is fairly dramatic. Narrative about the past, be it oral or written, is predominantly an **epistemic** ('descriptive') enterprise. This is because the main transactional goal in this face-to-face narrative is descriptive-informative. It is hardly an accident that the bulk of epistemic verbs of belief, perception and utterance used in such narrative-- **63.1%** in this adult oral text--are used as **grammaticalized epistemic quantifiers** on the complement clause, withe the latter remaining the main semantic focus. The speech-act here is directed at the face-to-face listener.

Likewise, it is hardly an accident that the modality and manipulation verbs that appear in narrative, are used--100%-- in their **descriptive or epistemic** senses. Manipulation as a direct speech-act is not relevant in this here-and-now transaction, whose goal-posts have been set in advance, firmly, in the epistemic domain. But the face-to-face conversations inside the quotation marks had, apparently, primarily-deontic goals--to get things done. And the modal operators used in that context change their valuation dramatically: They are used at the level of 80%-to-100% as direct manipulative speech-act.

The modal intent of complement-taking main verbs, it seems, has nothing to do with the child vs. adult developmental stage. Rather, it has much more to do with the communicative context. Of course, it just so happens that the communicative context of early childhood is, as shown above, predominantly here-and-now, you-and-I and non-displaced reference, and heavily tipped toward deontics ('getting things done') over epistemics ('what is the state of the world').

9. Some tentative conclusions

9.1. Child development and the communicative context

(a) In their early stage of modal-structure development, children indeed exhibit a strong tendency towards using grammatical modal operators--deontic and epistemic verbs--as direct speech-act indicators.

(b) But their adult interlocutors exhibit the very same trend in their face-to-face communication with the child.

(c) This usage patterns is strongly associated with the intimate face-to-face communicative context of here-and-now, you-and-I, this-and-that visible.

(d) The same modal usage pattern is evident in oral face-to-face adult narrative and quoted conversation embedded within it.

(e) In the non-conversational portion of the adult oral text we studied, deontic modal operators are not used as manipulative speech-act markers because the transaction goals in that context are predominantly epistemic. Once inside the quotation marks, with the goals shifting toward the deontic, the very same modal operators shift their use back to the deontic-manipulative.

It is of course yet to be determined which discourse type, or rather, which communicative context, is the true **prototype** of human language use. My own private bias conforms with Sandy Thompson's, tilting strongly toward the phylogenetically-and-ontogenetically--indeed also diachronically--prior context of **face-to-face oral communication**.

9.2. Semantics vs. syntax

Diessel and Tomasello's description of the two stages of child modal-use development pertains, strictly speaking, to **semantic interpretation**. There is no independent syntactic evidence that the two usages--direct speech-act vs. descriptive--differ syntactically in any way. The semantic developmental trend observed by Diessel and Tomasello thus in no way supports the thesis that children **expand** simplex syntactic structures into complex ones. At most, the process involves a semantic shift-- **change of modal scope**. But the directionality of this change is context-dependent, and it is practiced by both children and adults, in the latter both synchronically and diachronically.

9.3. Syntactic condensation: From parataxis to syntaxis

Our survey of the data suggests, strongly if not conclusively, that the earlier precursor of the child's complex verb-phrase constructions, of whatever modal sense, is to be found in the **joint coding** of complex clauses across adjacent child-adult or adult-child conversational turns. This conforms closely to what has been observed in the diachronic rise of both complex verb-phrases (V-complements) and complex noun-phrases (REL-clauses). In both, earlier paratactic structures, with the two clauses packed under separate intonation contours, condense into later syntactic structures, with the two clauses falling under a joint intonation contour. The main difference between the diachrony and ontogeny of complex syntax, it seems, is that in diachrony this condensation takes place primarily across two adjacent intonation units of the **same speaker**. While in ontogeny, at least of complex VPs at this early developmental stage, the condensation occurs **collaboratively**, across adjacent child-adult or adult-child turns.

Footnotes

1

The cross-turn construction--thus sharing--of clauses, propositions and discourse topics is just as prevalent in adult communication (Chafe 1994, 1997; Ervin-Tripp and Kuntay 1997; Linell and Karolija 1997; *inter alia*).

2

Reference to the CHILDES data base... [re. Brian MacWhinney].

3

The transcribed recording sessions for each of the three children from the CHILDES data-base studied here are as follows:

	S	STAGE I	STAGE II	STAGE III
EVE:	age:	1;9	1;10	2;0
	date:	1-14-63	2-25-63	4-29-63
	pp:	1-69	1-60	1-62
		Ι	II	III
NAOMI	: age:	1;10;10	2;0;02	2;2;25
	date:	4-18-70	6-10-70	9-08-70
	pp:	1-26	1-41	1-52
	ref #	: Naomi.11	Naomi.35	Naomi.51
		1;10;14	2;0;18	
		4-22-70	6-26-70	
		27-39	42-62	
		Naomi.13	Naomi.38	
		1;10;17		
		4-25-17		
		40-53		
		Naomi.14		
		1;10;18		
		4-26-70		
		54-62		
		Naomi.15		
NINA:	age:	1;11	2;3;18	2;9;26
	date:	11-05-70	3-07-71	9-15-71
	pp:	1-65	1-54	1-57
	ref #:	Nina01.cha	Nina.18	Nina.34

4

Bates *et al.* (1979) deemed this issue problematic, suggesting that adults often misinterpret the child's speech-act intention at an early stage. I find this to be, largely, not the case at the age range studied here (1;8-2;9).

5

The following example is taken out of a fictional account of adult epistemic-modal fencing match between two characters, Momma and Mrs P.J. King (Pearson 1985):

"..."Pepsi Cola" she said. "Yes, I believe is was Pepsi Cola because I'm near certain it was Mr. Womble who ran the Nephi outfit". And Momma sat straight up and said, "Helen?"... But Mrs. Phillip J. King just went straight on and said, "It had to be Pepsi Cola. He owned the bottling plant you know in Burlington. I mean his daddy, now I don' think he ever owned it himself, but his daddy did and made a killing putting out Pepsi Cola until he sold the business and made another killing doing that. Momma said it was just a ton of money that changed hands. She was brought up in Burlington you know". "But Helen", said Momma... "And they tell me his wife was just a gorgeous woman but not from around here...Momma said he went out and got one all the way from Delaware or Ohio, she couldn't ever remember exactly which, but I imagine it was Delaware since P.J. tells me...that Delaware is one of your urban states...and **P.J. says** there's plenty of money in Delaware mostly on account of the Duponts, and she might have even been a Dupont herself, anyway I don't **know** that she **wasn't** and she was **probably** from Delaware **I imagine**, which is where they all come from ... " "Wasn't it cookies instead of Pepsi-Cola?" Momma wanted to know. "Didn't Mr. Alton's Daddy make those savannahs with white cream filling and those little oval shortbread cakes that came in the blue sack?" And Mrs. Phillip J. King got a little hot on account of the cream-filled savannahs and the shortbread cakes and she said to Momma, "Now Inez, he might have dabbled in cookies later but I can tell you for a fact it was Pepsi-Cola at the first because **Momma said** it was Mr. Womble at the Nehi and Mr. Foster at the Coca-Cola and Mr. Tod W. Smith at the Sundrop and Mr. Nance at the Pepsi-Cola, and Momma herself told me it was Pepsi-Cola that made him his money but I don't ever recall a whisper of cookies **passing her lips**..."..." (T.R. Pearson, A Short History of a Small Place, pp. 193-195)

6

The narrative was tape-recorded over several long sessions in Bloomfield, NM in 1981-1982, when the speaker as ca. 62 years old. The text was then transcribed but not edited, with punctuation marks reflecting, as much as possible, the oral intonation units. For the narrative portion, the first 10 pages (70-79) were counted. For the inside-the-quotes portion, the whole 32 page chapter (70-101) was counted. For the text, the endless conversations, the winter trapping and year-round fiddlin' and more, I am eternally indebted to Harris A. Brown (1923-1992). R.I.P.

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Nominalization and the Origin of Subordination Guy Deutscher

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This paper raises a few concerns about current discussions of the origin of subordination, and in particular, about the possibility that the processes which are portrayed as the emergence of subordinate clauses may actually be just fairly superficial rearrangements of already existing subordinate structures, whereas the real cognitive underpinnings of subordination are being overlooked.

There is a Jewish story about a man who is desperately searching for his keys on the pavement under a street light. When a passer-by asks him if that's where he lost the keys, the man says that they actually fell from his pocket somewhere further down the road, but that it's so much easier to search for them under the light.

When seeking the origin of subordination, we also run the risk of looking for it under the light, in the easily visible, but relatively superficial elements of the process, and ignoring a crucial element that is more elusive. In particular, I want to suggest that nominalization is the unsung hero in the story of subordination. The ability of a language to derive a noun from a verb, that is, to reify a verbal predicate and to present it as a nominal argument or modifier, is at the core of subordination. And yet, the origins of nominalization are little researched and little understood, and thus the standard accounts of the rise of subordination are robbed of much of their explanatory value. (By 'nominalization' I refer throughout this paper to the *derivational* process, the ability of a language to take verbs and turn them into various nominal forms, and especially to action-nominals, masdars, participles, infinitives, gerunds, and the like.)

In their recent monograph on the Genesis of Grammar, Heine and Kuteva (2007, following Givón 2006) suggest a useful binary typology for the paths through which subordinate clauses arise. They term the two main channels *expansion* (of a nominalized argument to a clause) and *integration* (of two independent clauses into one). I will consider both these channels, and suggest that they both run the risk of explaining the 'rise' of subordination by presupposing exactly what they aspire to explain. The accounts of expansion take as their starting point nominalized structures that to all intents and purposes are already subordinated. And many examples of 'integration' likewise describe the integration of structures which already contain a subordinate structure.

The paper is really a sort of thinking aloud, rather than a presentation of fully formed ideas. If all of the claims made here turn out to be completely baseless, I hope their refutation will at least help to put the orthodox accounts of the rise of subordination on a firmer basis.

2

1. Subordination through expansion - or expansion of already subordinate structures?

Discussions of the emergence of subordination through expansion generally take a nominalized verb as given, and only describe the paths by which such a nominalized form can develop into a more clause-like subordinate structure. Harris and Campbell (1995:310-13), for instance, suggest that the ultimate origin of subordination can be explained through the extension of structures such as 'I saw the dancing girl' to subordinate clauses such as 'I saw the girl who had danced'. The origin of 'I saw the dancing girl' is not deemed to require explanation, and Harris and Campbell's conclusion is that the 'first introduction of subordination' in language can be *explained* by the path which leads from 'dancing girl' to 'a girl who was dancing'.

Heine and Kuteva (2007) and most recently Heine (paper for this symposium) provide a reconstruction of the stages in the development from nominalized verbs in embedded positions to fully fledged subordinate clauses. Like Harris and Campbell, Heine also argues that this scenario entails a 'strong claim, namely that clause subordination is historically derived from non-subordinate sentences'. Again, the implication is that the initial stage in the process, a nominalized verb in embedded position, is not one that the explanation needs to account for. Heine's scenario does mention in passing a 'Stage 0', which consists of a simple noun in an embedded position of argument or adjunct. But his actual reconstruction starts from what he calls 'Stage 1: an extended noun stage', in which a non-finite verb 'typically in a nominalized, an infinitival, or an participial form' appears in an embedded position as argument or adjunct, but still has the internal structure of a noun phrase. The paradigm example of Stage 1 that Heine provides is (1a) below. From Stage 1, he demonstrates how languages progress in various steps towards 'Stage 4', subordinate clauses that are indistinguishable in their morpho-syntax from finite main clauses. (The corresponding example of Stage 4 would thus be (1b)).

a. (Heine's Stage 1:) [Algernon's shooting of the aardvark] drew international attention
 b. (Heine's Stage 4:) [that Algernon shot the aardvark] drew international attention

That languages proceed from Stage 1 to Stage 4 is not disputed. But can the passage from Stage 1 to Stage 4 *explain* the origin of subordination? Of course, definitions are a matter of arbitrary choice. One can decide to define subordination in such a way that (1a) would not be considered a subordinate structure. But if the issue is explanation, if we want to understand how subordination as an instance of 'syntactic complexity' arises from structures that are genuinely cognitively simpler, then surely we cannot take (1a) as our point of departure. For structures such as (1a) are to all intents and purposes already subordinate. If a language has the ability to create a phrase such as 'Algernon's shooting of the aardvark', and to embed this phrase in a higher clause, then it has the means of squeezing a whole proposition, with predicate, arguments and all, as an argument of another (higher) predicate. Is it not exactly the emergence of this ability that we are meant to explain?

Of course, no one doubts that structures such as (1a) are more restricted in their syntactic possibilities than (1b). But within the syntactic constraints of the nominalized structure, the pattern in (1a) even allows recursion: 'Algernon's financing of the filming of the shooting of the aardvark drew international attention', and so on. If there is any real cognitive leap in the genesis of subordination, it is between '[the aardvark] drew international attention' and '[the shooting of the aardvark] drew international attention'. Once that leap has been made, the rest, as Einstein said, are

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3

details. Once a verb has been pressure-packaged into a tight nominal wrapping, and in this way embedded in a higher clause, then it is only natural that speakers would try to let the verb expand from its restrictive wrapping, regain some of the flexibility of an independent verb, and thus achieve the ability to convey the additional information that an independent verb typically supplies (arguments, TMA, and so on). By the end of this process, when the verb has fully expanded while still maintaining its embedded status, we get finite subordinate clauses. But there is nothing very difficult in the morphosyntactic rearrangements that accommodate this expansion. They are just natural sequels to the only step in the process that is cognitively challenging, the pressure-packaging of a verb as a noun in the first place.

And yet, it is exactly the origin of the nominalized verb which the standard accounts presuppose. The most significant step in the process is thus left unaccounted for, and the claims that expansion has 'explained' the origin of subordination ring somewhat hollow.

Is the origin of nominalization obvious?

Of course, there can be one good reason why the nominalized verb would be taken for granted, and why its origin would not be included in the scenario for the genesis of subordination. If the origin of nominalized verbs such as 'shooting' were so clear and obvious that it simply did not warrant a mention, there would indeed be no reason to mention it. But is the origin of nominalization so obvious?

The genesis of grammatical markers has been the subject of intense study in the last few decades, and has been explored mostly under the umbrella of grammaticalization. It is thus natural that if one wanted to find out about the origin of nominalizers, one would search in the rich literature on grammaticalization. But as it happens, discussions of the origin of nominalization are conspicuous mostly by their absence from the grammaticalization literature. Hopper and Traugott's *Grammaticalization* (2003), for instance, does not mention 'nominalization' in the index. Heine and Kuteva's *Lexicon of Grammaticalization* (2002) has no mention of the source of nominalizing morphemes. Cross linguistic surveys of nominalization, such as Comrie and Thompson (2007) and Koptjevskaja-Tamm (1993, 2003) are wholly synchronic in orientation, and do not explore the origin of nominalizing markers either. Except for some discussions of Tibeto-Burman and other East Asian languages (to which I will return in a moment), there is a very curious silence on this subject.

At this point, one may immediately raise the following objection: but what about the extensive literature on the grammaticalization of case markers into markers on dependent verbs (Blake 1999, Genetti 1991, and many others)? What, in particular, about the grammaticalization of dative/allative markers into infinitive markers (Haspelmath 1989, Hopper and Traugott 2003:188ff., and so on)? Are these not exactly the paths by which nominalized verbs arise? Here we have examples, in language after language, of case markers which are extended to verbs, and result in nominalized verbal forms. Is this not the answer?

The problem is that if we look at the process in languages where verbal and nominal bases are clearly distinguished, we see immediately that when datives (and other case markers) are extended to verbs, they are actually added to 'verbal nouns', that is, to verbal forms that are already nominalized. The infinitive stems of modern Indo-European languages go back to such old verbal nouns (Szemerényi 1996:324-7). The dative adpositions that created the infinitives in modern European languages were added not to finite verbs, but to action-nominals and other nominalized forms (see

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also Hopper and Traugott 2003:189-90). Thus the role of these dative adpositions is merely the renewal of nominal morphology on verbs that are already nominalized, not the creation of nominalization in the first place. The same thing can be seen in the Semitic languages. In Akkadian, for example, we can see during the historical period how the dative/allative preposition *ana* grammaticalized into an infinitive marker (Deutscher 2000:128-9). But the preposition was added to a verbal form that was already fully nominalized, one which originally took case endings. Hebrew shows a very similar picture.

We thus see that the grammaticalization of dative markers into infinitive markers does not explain the origin of nominalization. Rather, it presupposes nominalization. More generally, therefore, it is plausible that the extension to verbs of other nominal markers, such as classifiers (Aikhenvald 2000:332) or demonstratives (Greenberg 1991), may likewise only reflect the extension of nominal morphology to already nominalized verbs.^{*}

A potentially more promising source for nominalizing morphemes appears, at least at first sight, to be compounding structures, as discussed primarily in Tibeto-Burman languages, but also in other languages from East Asia (see collection of papers in <u>http://tibeto-burman.net/nominalizationworkshop.html</u>), as well as, much more rarely, from elsewhere (e.g. the Niger-Congo language Supyire, Carlson 1994:108-16 quoted by Aikhenvald 2007:49). In these languages, lexical origins for nominalizing morphemes have in fact been suggested, especially for agent nominalizers, place-nominalizers, time-nominalizers, instrument-nominalizers and the like. Not surprisingly, the origins of such nominalizing morphemes can sometimes be traced back to full nouns meaning 'person', 'place', 'time', 'thing', and so on. For instance, in Tibetan a nominalizing suffix *-sa* is argued to have been historically a noun meaning 'ground' or 'place' (Delancy 1986, Givon 2007). The argument, presumably, would be that what started originally as N-N compounds ('N-place') was extended to V-N compounds ('V-place'), such as *yod-sa* 'live-place'. Then the head noun lost its independent status, and thus turned into a nominalizing suffix.

While there is no reason to doubt the ultimate lexical origin of morphemes such as -sa, I would like to point out a general theoretical problem in the compounding scenario. This is in fact the same problem that was mentioned above with regard to the alleged nominalizing role of case markers: one has to be wary of the possibility that the alleged V-N compounds are formed with verbs that are already nominalized. In languages where there is a clear morphological distinction between noun and verb bases, we see that it is difficult to form V-N compounds like 'live-place' with a real verb. Rather, the first element in the compound is already nominalized: 'living-place'. So the compounding scenario may again simply presuppose what it alleges to explain. Compounds with *sa* and other such nouns may not be the source of nominalization, as they may rely on pre-existing nominalization of the verb (even if that is zero-nominalization). Indeed, Trask (1995), who discusses the origin of the nominalizing morphemes in Basque, reaches a very similar conclusion. Rather like the Tibeto-

^{*} Indeed, the existence of remnants of nominal markers on finite verbs may in many cases not be the product of extension of nominal markers to finite verbs at all, but rather the result of a process by which nominalized verbs drift into the finite verb system by gradually acquiring more verbal characteristics. The renewal of the finite verb systems through gerunds, participles and other verbal nouns is a common and well known process (Bybee et al 1994). In the history of the Semitic languages, for instance, we can follow multiple waves of such 'finitizations' of verbal nouns (see e.g. Cohen 1984, Kouwenberg forthcoming, ch. 4), and the resulting finite forms may still carry with them remnants of their earlier nominal morphology.

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Burman examples, some of the Basque nominalizing morphemes seem to go back to nouns meaning 'time', 'abundance', and so on. But the verbs which appeared in compounds with these nouns were in fact already nominalized.

Asymmetry between verbalization and nominalization

The problem with V-N compounds raises a more general issue, which may help to explain why the origin of nominalizing markers is so elusive, and why they have rarely been caught in the net of grammaticalization studies.

As has been pointed out by Hopper and Thompson (1985:176), and repeated on various other occasions since, there are fundamental cognitive and syntactic asymmetries between the processes of verbalization and nominalization. Verbalization seems to be by far the easier way around. Cognitively, verbalization requires no abstraction. The meaning of a denominal verb 'to N' is generally just a convenient label for any plausible activity involving the noun N in some way (to milk, to oil, to father, etc. cf. also Clark and Clark 1979). Syntactically, many languages find it relatively easy in to take nouns and use them as predicates in this way.

Going in the other direction, however, seems to be a much more involved affair. The 'reification' required in the creation of an action-nominal involves a high degree of abstraction. An 'explosion' is not a physical object that is somehow involved in the action of exploding. It is the action itself, repackaged as a thing. And indeed, it seems that languages on the whole tend to need much heavier morphological guns for nominalizing than for verbalizing (Hopper and Thompson 1985:176, Woodworth 1991:62 ff.)

The fundamental asymmetry between nominalization and verbalization is also reflected in the availability of direct grammaticalization paths for creating the category-changing marker. The lexical origin of verbalization markers can be fairly straightforward. There are constructions in which a verbal lexical head grammaticalizes, loses its lexical status, but in doing so bestows upon the resulting construction a verbal status. The obvious example is factitive verbalizing morphemes that derive from verbs meaning 'make'. The English -fy, for example, ultimately derives from the Latin verb *facere* 'make', through the grammaticalization the construction 'make N/Adj'. The verbal head was bleached, coalesced with the noun, and the resulting construction retained the verbal status of the original one.

But there does not seem to be any equivalent construction with a nominal head that can directly grammaticalize and create a noun from a verb. (Or to be more accurate, the only such constructions are ones that already involve nominalization or subordination.) If we are not allowed to presuppose subordination or nominalization, there is no syntactic arrangement in which a noun serves as a head of complex which contains a verb. So it is no wonder that it is difficult to find equivalents among nominalizing morphemes to the straightforward grammaticalization-genesis of verbalizers like *-fy*.

Indeed, if we look at the common nominalizing suffixes of English, for instance, both those of Germanic origins (such as *-ing*) and Latinate origins (*-tion*, *-age*), we see that none of them has a 'straightforward' history of grammaticalization. In fact, they all have rather convoluted histories. What seems to unite them is that as far as can be ascertained, they start out as N>N derivations (creating collective nouns or abstract nouns from simple nouns). For example the Germanic suffix *-ing/ung* seems originally to have been denominal. Kluge (1995, s.v. *-ung*) explains: 'Letztlich liegen indogermanische *k*-Erweiterungen zu n-Stämmen vor, so daß das Suffix ursprünglich

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denominal gewesen sein muß'. Indeed, in Old English and older stages of other Germanic languages, *-ing/-ung* appeared more commonly with nominal bases (such as *cyn-ing* 'king', *Idum-ing* 'Edomite', and so on. cf. Munske 1964:66ff., and Jespersen 1948:205). The extension to verbs, and the function of nominalizing them, must therefore be a later development.

So we seem to be getting back to the same problem again and again: the morphemes that we see synchronically in the role of nominalizing verbs all somehow appear to go back to elements that were originally attached to nouns. In some mysterious way, such nominal and denominal morphology then migrates to verbs, and the acquisition of the power to nominalize is somehow meant to proceed from this process of migration. But how can the migration be explained unless the verbs were already nominalized in the first place?

Nominalization through back-formation

One mechanism that can provide a solution is a conceptual back-formation, which relies on the fundamental asymmetry between verbalization and nominalization to derive the latter from the former. If we take as given the ability to verbalize (which, is both cognitively and syntactically the easier way around), then we can derive nominalization from it by reverse analogy. The history of the French nominalizer *-age* can be used to demonstrate the steps involved in the process.

In modern French, *-age* is used as a nominalizer on a large number of verbs: *arrivage*, *arrosage*, *chauffage*, *pliage*, *raffinage*, *démontage*, *nettoyage*, and so on. But the origin of this suffix are clearly denominal. It comes from the Latin suffix -(*a*)*ticus*, which was used to form the designation 'something that relates to N' from a noun N: *aqua-ticus* 'something relating to water', *silva-ticus* (something relating to the woods/wild (Modern French *sauvage*, English *savage*), and so on.

In Old French, the suffix, which had become *-age* after the relevant sound changes, was still commonly used in N>N derivations, for forming collective and abstract nouns from simpler nouns: *visage* 'collection of traits which make up the $v\bar{s}us$ (appearance), *fleurage* 'ensemble of flowers', *corage* (from *cor* 'heart'), *hommage*, *vasselage*, *frerage*, *orphelinage*, and so on.

It is not known exactly with which verbs the passage of *-age* to verbs started. Meyer-Lübke (1966:61-3) uses as a demonstration the verb auner 'to measure by the *aune'* (*aune* = the measure of an outstretched arm, English 'ell'). But an equally good candidate could have been marier 'marry' (Deutscher 2005:249-251). The process, in any case, could have been one of back-formation. French had a noun mari 'husband', to which *-age* seems to have been added directly, giving *mari-age* 'the state of being a husband'. But the noun mari also gave rise to a verb marier 'to marry'. There were thus two different words in the language which both derived from the noun mari: the abstract noun *mariage* and the verb *marier*. As these two are so close in meaning, it was natural for the verb and the abstract noun to come to be linked in speakers' minds . The role of the noun *mari* as the original link between the abstract noun and verb could have faded from linguistic consciousness, and so speakers could naturally assume that *mariage* was derived from the verb *marier*, and that the abstract noun thus denoted, not 'the state of being a mari', but rather 'the state resulting from the action of *marier*' (or the action of *marier* itself). This conceptual back-formation thus invested -age with a new power which it had not possessed before, to create an abstract noun from a verb. And once the link was established, the pattern could be

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extended to other verbs, including those that, unlike *marier*, had never been denominal to start with.

To what extent this path is generalizable remains to be investigated. (In theory, a similar process of conceptual back-formation can also explain zero-nominalizations.) But it does at least provide one way in which nominalizing morphology could have made its way onto verbs, and a way in which morphemes which had not previously had the power to nominalize acquired this power. The important point about such a scenario is that it does not require us to *presuppose* nominalization (although it does presuppose verbalization), and so in theory, it can also explain the first emergence of nominalization in a language.

At the very least, is should be clear from the above that the origin of nominalization requires far more attention than it has so far been accorded. As long as we do not fully understand it, we cannot pretend that the process of expansion has explained the emergence of subordinate clauses. The following section suggests that discussions of 'integration' also run the risk of explaining subordination by presupposing subordination.

2. Subordination through integration - or integration of already subordinate structures?

The second path in Heine and Kuteva's typology for the emergence of subordinate clauses is the integration of two clauses into one. I will restrict the comments below to relative clauses. Heine and Kuteva (2007:225) argue that "presumably the most frequent source of markers introducing (restrictive) relative clauses is provided by demonstrative pronouns". They take this to imply that relative clauses originate, through a process of integration, from independent clauses containing a demonstrative. In other words, they argue that two initially independent clauses, one with a demonstrative, are somehow integrated into a main clause and relative clause. They sketch this development as follows (2007:226):

- (2) From $[S_1+S_2]$ juxtaposition to $S_1[S_2]$ relativization:
 - a. There is the car; that (one) I like
 - b. There is a car [that I like]

However, it seems that the actual process of integration that the examples attest to is rather different, and should be sketched as in (3):

- (3) a. There is the car; that $(one)_{[I like]}$ (i.e. 'that one which I like')
 - b. There is a car [that I like]

In other words, the argument here is that the process that creates relative clauses like (3b) is the integration of a main clause with an already subordinate structure, a relative clause headed by a demonstrative ('that one which I like'). What we have here is indeed a process of condensation: an erstwhile head of a relative clause loses its independence and becomes a mere relativizer. But this process does not show the emergence of subordination. It is simply the rearrangement of already subordinate structures.

As far as I can see, the examples that are provided to support the integration claim by Heine and Kuteva (as well as by Hopper and Traugott 2003:196 ff., and the

examples of condensation discussed in Givón 2007) are in fact of the type sketched in (3). However, rather than use these examples, I would like to discuss examples from Akkadian, because that language neatly shows the difference between (2) and (3), and because it also gives a good indication of the actual ultimate origin of relative clauses.

Akkadian relative clauses

Akkadian is a Semitic language which was spoken in ancient Mesopotamia, and is attested in writing over roughly two millennia, starting around 2500BC. The earliest attested period, from 2500BC to 2000BC, is conventionally called 'Old Akkadian', and it will be the main subject of discussion here. The main type of relative clauses in Old Akkadian was marked by an element that must originally have been a demonstrative pronoun (and whose cognates serve as demonstratives in other Semitic languages). The forms of this demonstrative are given in (4):

(4)		NOM.	ACC.	GEN.
	MASC.SG.	šи	šа	ši
	MASC.PL.	šūt	šūt	šūti
	FEM	šāt	šāt	šāti

The relative marker agreed with the head noun in case, gender, and number, as in the examples below:

- (5) Šarru-kīn šar māt-im [šu Enlil māḥir-a lā iddin-u-šum]
 Sargon king.OF land-GEN [REL(NOM.M.SG)Enlil rival-ACC not he.gave-SUB-to him]
 'Sargon, king of the land, that Enlil has not given him a rival, [did so and so]...'
 (i.e. Sargon, king of the land, to whom (the god) Enlil has given no rival, [did so and so])
- (6) *eql-am* [*ša* ... *nītiq-u*] *lišqi`ū* field-ACC [REL(ACC.M.SG) we.passed-SUB] they.should.water 'they should water the field that we passed'

Note the crucial fact that the verb in subordinate clauses in Akkadian is marked by a special subordinative suffix, glossed here SUB. This suffix mostly takes the form -u, but in Old Akkadian can also take the form -n(i). This fact is important because it gives an explicit and unambiguous indication of whether a certain clause is independent or subordinate.

In later stages of Akkadian, after 2000BC, the case, gender and number agreement on the marker introducing the relative clause were discarded, and just one form, ša (the original singular masculine accusative) emerged as an all purpose invariable relativizer:

(7) *awīl-um* [*ša ana bull-îm illik-u*] man-NOM REL to extinguish.INF-GEN he.went-SUB 'the man that went to extinguish it...' (CH §25)

Given that the origin of the Akkadian relativizer is transparently a demonstrative pronoun, Akkadian at first sight may appear to be one more example in the long line of languages that attest to the integration of a paratactic clause with a demonstrative pronoun into a relative clause structure, just as Heine and Kuteva sketch in (2) above.

But as it happens, in Akkadian we have a few more details which make it

transparent that the actual development was nothing of the sort, and that the origin of relative clauses is entirely different. The story of the Akkadian relative clauses can be sketched briefly as follows (for a fuller account, see Deutscher 2001). Akkadian has both head and dependent marking in the genitival construct. The dependent noun is marked by a genitive case ending, and the head noun is marked by the 'construct state' (which for convenience I gloss .OF). The construct state is not shown by a particular suffix, but rather by the absence of a case suffix on the noun. Thus, the noun 'judgement' would usually appear with a case ending (NOM: $d\bar{n}$ -um, ACC: $d\bar{n}$ -am, GEN: $d\bar{n}$ -im) but in the construct state, it is simply $d\bar{n}n$:

(8) $d\bar{\imath}n$ šarr-im judgment.OF king-GEN 'the judgment of the king'

Now, in addition to the main productive type of relative clauses in Akkadian, which was shown above, there was also another, older, relative construction in the language, one without any demonstrative as a relative marker. In this construction, the onset of the relative clause was marked only by the construct state on the head noun:

(9) *tuppi* addin-u-šum tablet.OF I.gave-SUB-to him 'the tablet that I gave to him'

This older construction was still in semi-productive use in the earliest attested period, but became restricted to poetic and elevated styles after 2000BC.

Now, what is the origin of the newer type of relative clauses, those with a demonstrative pronoun? It is clear that the newer relative clauses were modelled on the older relative construction. Old Akkadian examples such as (10) below show that the demonstrative must have started out in life, very simply, as a pronominal head of an old style relative clause. This demonstrative pronoun must have been perceived to be in the construct state, and it simply functioned as a head of the relative clause, just as any noun would:

(10) *šūt* [*in* TU.RA *uḫḫirū-n*] *līḫuz* those(ACC.M.PL).OF [in illness were.delayed-SUB] he.should.take 'he should take those who were delayed because of illness'

What should be clear is that the demonstrative pronoun was, from the very beginning, the head of a subordinate clause. (That this is so can be seen from the fact that the verb is in the subordinative form.) The newer type of RCs must have started out in life as some sort of appositional pattern: 'the judgement, the one which he gave [...should not be changed]'. However, this was not the juxtaposition of two independent clauses, but the apposition of an already subordinate relative clause, which had a demonstrative as its head. This structure is shown in (11a). Then, in a process of integration or condensation, as sketched by Givón (2007), the demonstrative pronoun was degraded from an independent head of a relative clause to a mere marker of the onset of the relative, as in (11b):

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(11) a. <u>before integration</u>

dīn-um	šи	[idīn-u]
judgment-NOM	that (one).OF	[he.rendered-SUB]
'the judgment, tl	nat (one)[he rendered	ed] (should not be changed)'

b.	after integration		
	dīn-um	[šu	idīn-u]
	judgment-NOM	[REL	he.rendered-SUB]
	'The judgment _{Ith}	at he rendered] (sho	uld not be changed)'

Akkadian thus shows that the demonstrative pronoun became a marker of relativization not through a process of integration of two independent clauses, but rather through the integration of an independent clause with an already existing relative clause, one which was originally headed by this demonstrative. So the process that turned a demonstrative into a relativizer was not the genesis of relativization, but only the renewal of a marker in an already existing subordinate structure. The old marker for the onset of the relative clause was the construct state on the head noun, the new marker was a demonstrative.

What, then, is the actual origin of relativization in Akkadian? Here we have to look at the origin of the older style of relative clauses, those introduced by the construct state on the head noun. And in fact, their origin is not difficult to guess when one compares (8) and (9) above. There is an exact parallel between the grammar of genitival constructs and of relatives clauses (see further in Deutscher 2001). A similar parallel between genitives and relatives has of course been demonstrated for Tibeto-Burman by Matisoff (1972) and in a lot of subsequent literature, and has also been pointed out for many other languages (Aristar 1991).

The most plausible origin of relative clauses in Akkadian is the expansion of genitival constructions. (In fact, this development must have occurred already in Proto-Semitic, since relative clauses marked by the construct state are attested in the earliest strata of most Semitic languages, cf. Lipinski 1997:324.) And how were the genitival structures extended to relative clauses? Presumably through the agency of nominalized verbs: something like 'the judgment of his giving' was expanded to 'the judgement which he gave', through the stages sketched by Heine (this volume). Givón (1991) in fact sketched a similar scenario for the development of relative clauses in Biblical Hebrew.

Akkadian thus shows that appearances can be deceptive. Its productive type of relative clauses is introduced by what had originally been a demonstrative. But this demonstrative did not get to there through the integration of two independent clauses. Rather, it got there through the integration of a main clause with an already existing subordinate structure. The actual origin of relative clauses in Akkadian must have been expansion, and thus, again, nominalization.

Is Akkadian the exception or the rule?

The main question we need to ask is whether the development in Akkadian was unusual, or whether it is actually representative of the many languages where relative clauses with demonstratives are claimed to have arisen through integration. The first port of call for the comparison should of course the Germanic languages, which have supplied the main evidence for the alleged integration of paratactic clauses in the 'demonstrative channel'. (For expositions of relativization in the early stages of the on its own:

different Germanic languages, see e.g. Stong-Jensen 1977, Mitchell 1985, Hock 1991, Harbert 1992, Pittner 1995.) While the Germanic languages differ in important details and present a picture that is far from simple, the general situation in early Germanic seems to be very similar to that in Akkadian. This can be illustrated by examples from Old Icelandic (Stong-Jensen 1977). In Icelandic, there was an existing relative clause structure with an invariable relative particle *es*, which could introduce relative clauses

(12) ...vóro þar þeir menn [es Norðmenn kalla Papa]
 were there those men [REL Northmen call Papa]
 'there were there those men that Northmen call Papas' (Stong-Jensen 1977:14)

There were also relative clauses which were based on the model of (12), but which were headed by a demonstrative pronoun:

(13) ok blótaðe hrafna þriá þá [es hánom skylldo leið visa] and worshipped ravens three.ACC.M.PL those.ACC.M.PL [RELhim should way show] 'and he worshipped three ravens, those that should show him the way' (Stong-Jensen 1977:13)

The relation between (12) and (13) is parallel to the relation between the older and the newer types of relative clauses in Akkadian. (12) is equivalent to Akkadian relative clauses introduced only by the construct state on the head noun (as in 9 above), and (13) is equivalent to the newer type of relative clauses, which were based on the old model, but originally had a demonstrative as their head (as in 11a, or 11b, depending on whether one considers the Icelandic examples to have undergone integration or not). In any case, it is clear that the demonstrative $\dot{p}\dot{a}$ in (13) is the head of an already existing relative clause, not an element of an independent clause.

The picture in Old English seems to be similar. The demonstrative *bam* in (14) is the head of an already existing relative clause, one formed with an invariable particle δe (corresponding to Icelandic *es*):

(14) Da wæs æt ðam geongan grim andswaru eðbegete then was for the.DAT.M.SG youth.DAT.M.SG grim answer easy.to.get *pam* [ðe ær his elne forleas]
DEM.DAT.M.SG [REL earlier his courage lost]
'then was for the youth a grim answer was easy to get, (for) the one that earlier lost his courage' (Hock 1991:56)

Thus, the Germanic demonstrative pronouns which later came to be the sole markers for the onset of the relative clauses do not seem to have started as elements of independent paratactic clauses. Rather, just as in Akkadian, they started as heads of already existing relative clauses. The ultimate origin of relative clauses in Germanic may also, just like in Akkadian, be expansion, and thus nominalization. (In fact, Lehmann 1984:378 suggests a scenario for relativization through expansion for Old German.)

A similar picture also emerges with the examples of integration in other languages. As mentioned above, the examples of condensation of relative clauses discussed by Givón (paper for this symposium, as well as 2000:183) all seem to be of exactly of the same nature: the demonstrative pronouns that undergo condensation/

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integration are in fact heads of already existing relative clauses, not elements of independent paratactic clauses.

The genesis of relative clauses through integration, allegedly exemplified in many languages by relative markers of demonstrative origin, may therefore turn out to be mostly a mirage. (This is not to deny, of course, that integration of independent clauses ever takes place. Especially adverbial clauses are often clearly derived from coordinated clauses. The doubts expressed here are about the integration of relative clauses through the demonstrative channel.)

Conclusion

I have argued that nominalization is the unsung hero in the story of subordination. Nominalization has so far largely escaped the net cast by grammaticalization studies, yet it is probably the single most important element in the genesis of subordination. It is the core element in the channel of 'expansion', and ultimately, it may also turn out to be behind many of the examples that are alleged to be cases of 'integration'. Any attempt to explain the genesis of subordination can thus only begin to make sense if it explains the origins of nominalization, and if it shows how the ability to repackage a verb as a noun arises in contexts where it had not existed before. I tentatively suggested one way that can account for the genesis of nominalization. But the subject requires far more attention.

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The co-evolution of syntactic and pragmatic complexity: diachronic and crosslinguistic aspects of pseudoclefts

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Abstract

In this paper we analyze the genesis and development of a syntactically and pragmatically complex construction type, pseudoclefts. Two questions are addressed. First, given that cleft constructions are made up of readily available components of grammar—relative clauses and copular clauses—do they grammaticalize instantaneously and appear in full-fledged form? To the extent that they emerge gradually, what constrains their development? Second, are cross-linguistic differences in the syntactic and pragmatic properties of pseudoclefts largely idiosyncratic, language-particular choices, or are they predictable from a general grammaticalization scenario? To address these questions, we first present a quantitative, corpus based analysis of the 300-year history of pseudoclefts in English. Using a variety of qualitative and quantitative measures, we identify relevant properties of pseudoclefts at different developmental stages. We then apply the same measures of grammaticalization in a synchronic, comparative analysis of pseudoclefts in contemporary English, German, and Swedish to determine their crosslinguistic validity. We find that pseudoclefts do indeed develop gradually in a process characterized by subtle changes in the construction's presuppositional structure. The construction becomes available in a widening range of presuppositional situations. Driving this process is the conventionalization of pragmatic accommodation, as suggested by Lambrecht (1994). Furthermore, our proposed grammaticalization scenario allows us to assign precise degrees of grammaticalization to the less developed pseudoclefts of German and Swedish—relative to English and relative to each other and to explain why their synchronic discourse functions differ from those of English pseudoclefts.

1. Introduction: Cleft constructions and grammaticalization

The diachrony of information structure constructions has been among the foundational issues of functional typological linguistics as well as research on grammaticalization. The synchronic finding that morphological focus markers resemble copulas and that the non-focused (presupposed) constituent of focus constructions often exhibits properties of relative clauses allowed the reconstruction of a diachronic process in which morphological focus marking systems develop from syntactic (especially cleft) constructions (Givón 1979, Heine & Reh 1984). The phenomenon of primary interest in the grammaticalization of information structure, then, has been the cleft-to-focus marker pathway, as an example of the simplification of bi-clausal to monoclausal syntax.

In this paper we approach this issue from a different perspective. In keeping with the theme of this symposium, we approach cleft constructions not from the perspective of the reduction of syntax to morphology, but with an eye to the emergence of syntactic focus constructions themselves. How do cleft constructions come into existence in the first place? The schematic representations below, showing a focus-initial and a focus-final cleft construction, may serve to illustrate our stance. While the diachronic step from Stage 1 to Stage 2 has figured prominently in previous research, little attention has been devoted to the input to Stage 1.



1.1 Clefts as universally available syntactic constructions

The reason for the lack of attention to the diachrony of cleft constructions themselves is likely to be found in a view of clefts along the lines of Harris and Campbell (1995), who categorize clefts as one kind of "universally available syntactic constructions from which any language may draw for alternative syntactic expressions." (p. 54) Clefts belong to a privileged set of grammatical constructions in that

"[w]hile not every language has clefts, it is likely that such constructions are easily added to grammars. The focus cleft may be so widely available

because it is structurally equivalent to a copular clause with a relative clause modifying one of its constituents." (p. 56)

If clefts are indeed structurally equivalent to their diachronic sources – a copular clause and a relative clause – it would seem that they can reveal little, if anything, about the evolution of syntactic complexity, as there is no need for any kind of development to take place. In fact, taking the view of clefts as universally available to its logical conclusion would suggest that clefts come into existence essentially instantaneously, and in full fledged form.

Harris and Campbell suggest that some development does occur however. Cleft constructions start out as "exploratory expressions", i.e. as novel, stylistically marked constructions used by some speakers some of the time, which may eventually "catch on". Importantly, "[o]nly when the expression [i.e., the cleft] is used in additional contexts and is generalized ... may we speak of a grammatical change having taken place." (p. 54) What remains unclear is what exactly this grammatical change consists in, and how the process of generalization proceeds in the case of clefts. This leads us to our first research question:

Do cleft constructions emerge instantaneously or gradually? To the extent that their development is gradual, what distinguishes a less developed cleft from a more generalized one, and what constrains the process of generalization?

1.2 Cross-linguistic differences in cleft constructions

Besides leaving little room for diachronic evolution, the view of clefts as universally available leaves two obvious facts unaccounted for. First, as pointed out by Harris and Campbell in the above quote, clefts may be universally available, but they are not universally present. Some language have clefts, but others don't. Second, the cleft constructions found in different languages – even structurally equivalent ones – vary in their grammatical properties and constraints.

Plausible reasons for why some languages have cleft constructions while others don't have been given. For example, already Jespersen (1937) suggested that

[i]n some, though not in all cases, this construction may be considered one of the means by which the disadvantages of having a comparatively rigid grammatical word-order (SVO) can be obviated. This explains why it is that similar constructions are not found, or are not used extensively, in languages in which the word order is considerably less rigid than in English, French, or the Scandinavian languages, thus German, Spanish and Slavic (p. 85, cited in Lambrecht 2001: 465)

Lambrecht (2001: 488) adopts Jespersen's typological explanation, adding the positional freedom of prosodic accents as an additional motivating factor. We don't have anything

to add to these observations here. Rather, our concern is the second issue raised by the universal availability of clefts. How do we deal with the fact that the end result of the grammatical change resulting in clefts is not always the same? Why don't clefts of the same type, e.g. pseudoclefts, have more or less the same properties across languages?

It is not difficult to show that there are, indeed, such differences. The non-equivalence of clefts in even closely related languages has been empirically demonstrated in contrastive translation corpus studies. For example, M. Johansson (2002) examined the degree to which cleft constructions used by authors of English novels are translated in the Swedish editions of the same novels. The rate at which they are translated into Swedish clefts is generally low. Similar non-equivalence effects for clefts have been shown by S. Johansson (2001) for translations from English into German and Norwegian.

To illustrate, we can try to put ourselves into the position of a translator confronted with the English pseudocleft construction in (1). The sentence in (1) does not translate well into its German counterpart in (2), regardless of whether *do* is rendered by *machen* 'do, make' or *tun* 'do'.

- (1) What we do is read late medieval poetry.
- (2) Was wir machen/tun ist spätmittelalterliche Dichtung lesen.

To us as native speakers of German, (2) sounds odd, although it may not rise to the level of ungrammaticality (for those who draw a distinction between acceptability and grammaticality). In any event, no skilled translator would be likely to use the German pseudocleft construction to translate (1).

How does one account for such contrasts? It is difficult to put a finger on exactly what it is that makes (2) sound odd, let alone to make a principled argument that extends to the construction in general and would predict other cases of non-equivalence. The enormous body of literature dealing with the synchronic constraints governing cleft constructions even just within English bears witness to the difficulty of this problem. It is therefore perhaps not surprising that so few systematic cross-linguistic analyses of clefts, let alone larger typological comparisons, have been attempted.

One recent example of such cross-linguistic comparison is Miller's (2006) survey of focus phenomena in European languages. At the outset of his discussion of clefts, Miller notes that some languages have only a "rudimentary" cleft construction (p. 171). Later on he states that German pseudoclefts construction "occurs infrequently, although available in principle" (p. 180). The term "rudimentary" has an intuitive appeal but its implications are not clear. Some sort of development is implied but not made explicit. Also, if a construction is available (in principle) why do speakers not use it?

It is tempting to write the cross-linguistic contrasts off as most unpredictable, language-particular preferences which only make sense within the ecological context of the grammar of particular language systems. If that is the case, and the language-specific constraints on clefts are essentially a function of the grammatical niche which particular languages allow them to occupy, exploring these niches will not benefit those looking for cross-linguistic generalization but only those interested in the individual systems.

An entirely different approach is to try and find a pattern in the diversity. The driving hypothesis behind this approach is that a large amount of cross-linguistic variability may reflect different degrees of grammaticalization. On such an account, the constructions of English and German, for example, might simply occupy different points on a common developmental trajectory. Genuinely idiosyncratic differences may exist, but the common core could be larger than expected. Of course, this solution presupposes a model of such a grammaticalization process. And, as we pointed out above, such a general model is missing because of the common assumption that clefts do not undergo any development to speak of. Let us summarize our discussion here in our second research question.

Research question #2:

Are the synchronic properties of pseudoclefts in different languages systematically related to the construction's historical development? If so, to what extent can the cross-linguistic variability be reduced to language-specific cut-off points on a universal grammaticalization continuum?

1.3 Pseudoclefts in Present-day English

In the remainder of this introductory section we briefly review the synchronic form, function and grammatical constraints governing Present-day English pseudoclefts. We adopt Lambrecht's (1994, 2001) information structure framework. While Lambrecht's framework is formulated in synchronic terms, it also provides us with all the necessary tools to explain the historical data. As we will argue, the same types of constraints governing modern usage were also historically responsible for shaping the grammaticalization of pseudoclefts.

Our working definition of a cleft construction, following Lambrecht (2001: 467), is

"a complex sentence structure consisting of a matrix clause headed by a copula and a relative or relative-like clause whose relativized argument is coindexed with the predicative argument of the copula. Taken together, the matrix and the relative express a logically simple proposition, which can also be expressed in the form of a single clause without a change in truth conditions."

Besides the canonical sentence structure in (3), speakers of English have two focus-initial and one focus-final cleft construction at their disposal (Lambrecht's examples).

(3)	I like CHAMPAGNE.		(canonical sentence)
(4)	a.	It is CHAMPAGNE (that) I like.	(<i>it</i> -cleft)
	b.	What I like is CHAMPAGNE.	(wh-cleft)
	c.	CHAMPAGNE is what I like.	(reverse <i>wh</i> -cleft)

In this paper we deal with the pseudocleft construction illustrated in (4b), whose initial *wh*-clause, *what I like*, qualifies as a "relative-like" clause type (cf. the definition above). We follow common usage in referring to the construction as "pseudoclefts" and to the initial constituent as "*wh*-clause" even though technically we only deal with *wh*-clauses built on *what*. Our restriction to pseudoclefts involving *what* is partially practical, but also partially theoretically motivated. Among the pseudoclefts built on *wh*-words, those using the equivalent of 'what' appear to be most common. In contemporary English, the vast majority of *wh*-clefts are formed with *what*, whereas for example *why*-clefts, *where*-clefts, and especially *who*-clefts, are rare. There also seems to be an implicational relationship between the *wh*-words used in pseudoclefts favoring *what*. If a pseudocleft construction in a particular language allows more than one *wh*-word, one of them will be 'what'. For example, Johansson (2002: 22) mentions the existence of Swedish 'where'-pseudoclefts along with pseudoclefts using 'what', and German has 'who'-clefts besides the 'what'-type. We therefore regard it as a motivated decision to focus on the *what*-pseudoclefts.

Among the English cleft constructions only the *it*-cleft construction in (4a) has received detailed attention from a historical perspective (Ball 1991, 1994).¹ In the case of pseudoclefts, the one previous study we are aware of is Traugott's (to appear) recent exploratory work on the history of three types of pseudoclefts, *all-clefts, what*-clefts, and reverse *what*-clefts. She tests the specific hypothesis, derived from the work by Kim (1995) and Hopper (2001), that pseudoclefts emerged in particular conversational contexts. One of her main findings is that while such a development may have occurred in the history of *all*-clefts, the same case cannot be made for *what*-clefts.

1.4 Synchronic constraints on pseudoclefts

The story of pseudoclefts in the history of English is the story of how the information structure contrast between (1) and (2) came to be conventionally marked.

- (5) I hurt my FOOT.
- (6) What I hurt is my FOOT.

In Ball's (1991) account, the Present-day English *it*-cleft resulted from the coming together of several Old English cleft or cleft-like constructions in Late Middle, triggered by a complex combination of language-internal pressures such as word order changes and changes in the distribution of alternative constructions. The explanatory burden in her account rests entirely on language-particular factors. As discussed above, this approach is characteristic of the synchronic research on clefts in general, where explanations are sought strictly within the bounds of particular language systems. Cross-linguistic implications are left unexplored.

According to Lambrecht (2001), the unique function of the cleft construction in (6) is to avoid the pragmatic ambiguity of (5). The canonical sentence in (5) is ambiguous in that it is compatible with two different presupposition-focus construals: one in which the entire VP (*hurt my FOOT*) is focal and one in which only the accented constituent (*FOOT*) is understood as focal. Note that sentence (5) could answer both (7a) and (7b), while (6) can only answer (7b).

- (7) a. What happened to you?
 - b. What was it you hurt?

The question test further shows that (6) also disambiguates the sentence topic. While (5) can be understood either as saying something about the speaker ('I') or as saying something about 'what I hurt', (6) is unambiguously about 'what I hurt'.

At the same time as unambiguously coding a particular presupposition-focus articulation, pseudoclefts also require a specific set of assumptions on the part of the speaker and the addressee in order to be used felicitously, which Lambrecht calls *pragmatic presuppositions*. These are

"[t]he set of propositions lexico-grammatically evoked in a sentence that the speaker assumes the hearer already knows or believes or is ready to take for granted at the time the sentence is uttered." (Lambrecht 2001: 474)

For example, the pseudocleft in B's reply in (8) is pragmatically appropriate because the preceding question introduces just the right set of assumptions, viz that B is hurting.

- (8) A: Is your knee still giving you trouble?
 - B: No, what I hurt was my FOOT.

This assumption is what Lambrecht calls *knowledge presupposition*. In addition, the cleft also requires there to be what he calls a *consciousness presupposition*.

"[T]he proposition that the speaker is hurting must not only be mutually known but it must also belong to the current discourse register, that is, it must have been somehow activated in the minds of the speech participants, or else it must be easily inferable from something that has been activated in their minds. (Lambrecht 2001: 475)

In the case of pseudocleft constructions, these two types of pragmatic presupposition together are roughly equivalent to Prince's (1978) formulation that the *wh*-clause of pseudoclefts must represent "given" information, i.e. information which "the cooperative speaker can assume to be appropriately in the hearer's consciousness at the time of hearing the utterance." (p. 888)

The unique aspect of Lambrecht's framework is that it recognizes a third type of pragmatic presupposition, called *relevance presupposition*, which we will argue is of particular importance in the evolution of pseudoclefts. Following Strawson (1964), Lambrecht argues that the speaker must also assume that

"the state of affairs expressed in [the presupposed] proposition is *of present concern* in the discourse, so that her assertion can be interpreted as expressing *relevant* information with respect to this state of affairs." (Lambrecht 2001: 476, italics added)

This is equivalent to saying that the *wh*-clause in pseudoclefts needs to contain a *possible topic* at the time the cleft is uttered. In a question-answer pair such as (8) this goes without saying, as the proposition 'the speaker hurt x' is contained almost verbatim in the question. However, as pointed out for example by Kim (1995), speakers of English also use the pseudocleft construction to address issues which were *not* clearly the topic of the immediately preceding discourse. In those cases, speakers will often use some additional indication of the proposition's relevance.

We follow Lambrecht in referring to the full set these constraints jointly as the *presuppositional structure* of cleft constructions. It is important to point out that while the different components of presuppositional structure reviewed above are meant to characterize cleft constructions in general, individual constructions in individual languages can have slightly different presuppositional structures. We will return to this important point below.

1.5 Pragmatic accommodation

Finally, we want to point out the importance of one apparent disclaimer in the definition of pragmatic presuppositions above. It says that that addressee needs to be at least "ready to take for granted" the proposition presented in the *wh*-clause of pseudoclefts. This provision allows propositions which, strictly speaking, do not constitute shared knowledge to be presented and to be accepted as such in situations where the presumption of such knowledge is easy to *accommodate*.

The notion of pragmatic accommodation explains some puzzling facts. For example, one of the arguments provided by Prince in support of her definition of the presupposition associated with clefts (cited above) is that pseudoclefts cannot be used discourse-initially ("out of the blue"). The idea behind the 'discourse-initial' test is that at the outset of a conversation there are, arguably, no shared assumptions about what may be "in the hearer's consciousness". Thus, when first meeting someone, (10) is unacceptable while the non-clefted (9) is fine.

- (9) Hi! My name is Ellen!
- (10) *Hi! What my name is is Ellen!

(Prince 1978: 888)

On the other hand, Declerck (1988) points out that (counter Prince) pseudoclefts *can* be used as "discourse openers". He presents as evidence the constructed examples (11) and (12), where the pseudocleft appears as the first sentence of a talk or announcement (we have added the underlining, whose relevance we discuss immediately below).

- (11) What I have <u>often</u> asked myself is how other linguists manage to keep abreast with the rapid developments in the different fields of linguistics while still finding time to go on writing articles themselves.
- (12) My dear friends, what we have <u>always</u> wanted to know, but what the government has never wanted to tell us, is what exactly happens at secret conferences like the one you have been reading about in the papers this week.

(Declerck 1988: 213, underlining added)

Declerck concludes from the felicity of (11) and (12) that there are in fact two types of pseudoclefts in English: the one seen in (10), to which the presupposition of "givenness" applies, and the one in (11) and (12), to which it does not apply, and in which the *wh*-clause presents "new" information. Later in his book, he provides another constructed example of the latter kind.

- (13) A: I hear you've got a job at Johnson's. A nice place that is. I suppose you're happy now?
 - B: Well, I don't know. What I'd <u>really</u> like to do is run a business of my own.

(Declerck 1988: 216, underlining added)

We believe that the contradictory effects seen in "discourse-initial" pseudoclefts can be handled in a unified way by using the notion of pragmatic accommodation. There is no need to posit two separate constructions. Note the additional modifiers *always, often,* and *really*, which have been placed in the *wh*-clauses. While Declerck does not discuss their role in making (11) - (13) acceptable as discourse openers, we would argue that these modifiers are crucially implicated in overcoming Prince's 'givenness' constraint, i.e. in making it possible for the *wh*-clause propositions to be pragmatically accommodated. To test their import, we invite the reader to judge the felicity of (11), (12), and (13) if *always, often,* and *really* were removed.

In our view, the function of *always* and *often* in (11) and (12) is to boost the perceived *relevance* of the idea that the speaker of (11) has 'asked herself something', and that 'we' in (12) 'have wanted to know something'. These modifiers induce assumptions of their own, which increase the relevance of the proposition containing them. If the goal of (11) and (12) is to raise the open propositions 'I have asked myself x' and 'we have wanted to know x' to topic status out of the blue, an addressee will be more likely to go along with this move if they are presented as something the speaker has *often* asked herself, and as something we have *always* asked ourselves.

Similarly, the addition of *really* in (13) also allows the proposition 'I would like to do x' to be accommodated more easily. However, in this case we don't have to adduce relevance as a factor. Rather, the focus particle *really* simply indexes alternative values for 'I would like to do x', and one such value is contextually available, viz. B's job at Johnson's. That is, in (13) pragmatic accommodation can be ensured by simply modifying the proposition at the level of *knowledge*. The use of *really* indirectly relates the proposition 'I would like to do x' to an overtly mentioned propositional referent, the known fact that 'B works at Johnson's', because to *really* want to do something implies the existence of other, dispreferred alternatives.

In all three cases, we see that synchronic information structure constraints can be overcome by relying on the addressee's ability and readiness to accommodate certain feasible presuppositions. To anticipate our findings regarding the grammaticalization of pseudoclefts, we can now put forth the following hypothesis. Given that presuppositional structure is construction-specific, and given that the range of application of a construction with a particular presuppositional structure is not rigid but somewhat negotiable, such that speakers will occasionally exploit the construction to capture additional, less clearly established presuppositions, the constructions will over time become less pragmatically restrictive. That such a process may be responsible for the diachronic change of information structure constraints has, in fact, been suggested by Lambrecht himself (although in connection with the not directly related *it*-cleft):

"The pragmatic accommodation of certain presuppositional structures may to a greater or lesser extent become CONVENTIONALIZED and eventually GRAMMATICALIZED ... It can happen that the presuppositional structure of a frequently used construction is exploited so regularly that it loses some of its force, sometimes resulting in a new meaning for the construction." (1994: 70)

2. The emergence and development of English pseudoclefts

We begin by addressing the question whether pseudoclefts develop instantaneously or gradually, and if the latter, what their developmental stages reveal about the constraints on their evolution. To this end, we trace the 300-year history of pseudoclefts in English, from their first appearance in texts at the end of the 17th century to their status in late 20th century written and spoken discourse. We first establish the big picture in quantitative terms: do we see a sudden jump followed by stasis or a sustained frequency increase? We then turn our attention to the earliest pseudoclefts in our data to determine what constrained their emergence. Finally, based on the properties of the earliest pseudoclefts, we derive two additional quantitative measures which allow us to establish changes in the degree of grammaticalization more directly. Overall, we show that the development of pseudoclefts was not only gradual, but followed well-defined, measurable stages, which reflect subtle shifts in the construction's presuppositional structure.

Our diachronic data come from two historical corpora of English, the *Penn-Helsinki Parsed Corpus of Early Modern English* (Kroch et al. 2004) and the *Corpus of Late Modern English Texts* (De Smet 2005), as well as two 20th century British English corpora, the *Lancaster-Oslo/Bergen Corpus* and the *Freiburg-LOB corpus* (Hofland et al. 1999). The two historical corpora are composed of texts representing three consecutive 70-year periods of Early and Late Modern English, respectively. The LOB corpus and the FLOB corpus contain matched quantities of text samples from identical discourse genres, published in 1961 and 1991, respectively. See Table 1 for details.

Historical period	Corpus	No. of different text samples	Total no. of words	No. of attested pseudoclefts
1570-1640	PPCEME 2	70	652,799	0
1640-1710	PPCEME 3	54	565,016	3
1710-1780	CLMET 1	24	2,096,405	106
1780-1850	CLMET 2	40	3,739,657	119
1850-1920	CLMET 3	52	3,982,264	249
1961	LOB	~500	~1,000,000	118
1991	FLOB	~500	~1,000,000	148

Table 1. Historical and 20th-century corpora of written English

To ensure that we identified every pseudocleft token in the data, we performed an exhaustive extraction of all instances of the word *what* (or *whate*, in the earliest period) from each corpus, and then manually inspected the (thousands of) hits to identify all instances. This methodology also made it possible to retrieve and quantify related constructions involving *what*, such as predicative copular constructions with *wh*-clause subjects and preposed *what*-relatives, to shed light on their roles within the overall process.

2.1. General rise in frequency

Figure 1 shows the general increase in text frequency of pseudoclefts, calculated from the absolute numbers given in Table 1. A statistical measure correlating the passage of time with the development in frequency confirms the intuition that the observed increase is significant (Kendall's tau = 0.87, p < .025).²

² For the purpose of our statistical measures in this section LOB and FLOB were merged into one data point in this and the following calculation.





A basic text frequency count, as in Figure 1, runs the risk of reflecting not only frequency differences between periods but also genre effects. The construction's rate of occurrence in a particular corpus period might be higher or lower simply because the contained texts are of a genre which, for one reason or another, favors or disfavors the construction. The risk of such effects is particularly high in the earlier periods, which are represented by only a few dozen texts (cf. Table 1). Genre effects might, for example, be responsible for the unexpected spike in the 1710-1780 period.

We therefore performed a second calculation designed to neutralize the variable of genre, by relating the construction's frequency not to the total number of words in a text, but to the frequency of another, related but stable construction. The idea is that if both constructions are subject to the same or similar genre effects, these effects should be controlled for to some extent. In our case, we took advantage of the fact that predicational copular constructions with referential *wh*-clause subjects, as in (14), were already in existence at the time that pseudoclefts, such (15), first appear.

- (14) But what they do is so much above my understanding, I can't pretend to give an account of it.
- (15) But what I wonder at is this: I find I did not start at his Proposal, as when it came from one whom I contemn'd.

(both examples PPCEME 3)

Figure 2 shows the result of this relative frequency analysis. During the earliest period, specificational (pseudocleft) constructions are four times less frequent than predicational ones. During the final period, they are four times more frequent. Again, the development is statistically significant (Kendall's tau = 1, p < .05).

Figure 2. Relative frequency of pseudoclefts and predicational copular constructions with referential *wh*-clause subjects (cf. [14] and [15]). Shown is the percentage of pseudoclefts.



Taken together, our two frequency measures point to roughly the same picture: a sustained growth which continues well into the 20th century, suggesting that the development of English pseudoclefts is still ongoing.

2.2 The earliest pseudoclefts: possible source constructions

Having established the general time frame and trajectory of their development, we now focus on the first appearance of pseudoclefts in our data. As already mentioned, predicational copular constructions with referential *wh*-clause subjects existed prior to the emergence of pseudoclefts. This historical sequence, together with their syntactic similarity, suggests that predicational copular constructions may have played a part, or perhaps even served as the diachronic source, in the evolution of pseudoclefts. In fact, Traugott (to appear) explicitly argues for such a scenario in the case of *all*-clefts and suggests that *wh*-clefts may have developed along the same lines. We therefore consider this possibility and evaluate its plausibility on the basis of our data.

If predicative constructions shaded into specificational ones over time, one would expect to find instances of usage which are ambiguous between the two functions. Such cases do indeed exist in our data. An example which seems to permit both analyses is (16), taken from a 1679 sermon. The writer explains why it is impossible to prove the Catholic doctrine of "transubstantiation", i.e. the belief that the substance of bread and wine changes into the body and blood of Jesus Christ during the Holy Communion, referred to as "the Sacrament".

(16) The very same assurance which a man hath of the truth of the Miracle [= of transubstantiation], he hath of the falsehood of the Doctrine, that is, the clear evidence of his senses for both. For that there is a Miracle wrought to prove, that what he sees in the Sacrament is not bread but the body of Christ, he hath onely the evidence of his senses; and he hath the very same evidence to prove, that what he sees in the Sacrament is not the body of Christ, but bread.

(PPCEME 3 underlining added)

the issue comes down to the question whether 'being the body of Christ' and 'being bread' is a property ascribed to 'what ones sees in the Sacrament', or whether the construction functions to supply values to an open proposition 'one sees x in the Sacrament'. In favor of a specificational (i.e., pseudocleft) analysis one might cite the fact that the construction is clearly about the uncertainty of 'what he sees': Is it the body of Christ or is it bread? Apparently, two competing values, each of which could fill the same open proposition ('he sees x in the Sacrament') are being considered. On the other hand, the *wh*-clause 'what he sees' is referential, in the sense that both the speaker and the audience can be expected to know, and be able to identify prior to hearing the construction, what one sees during "the Sacrament". The speaker's argument makes sense only if one already knows what happens during the Holy Communion. So, the referential status of the *wh*-clause speaks against a pseudocleft analysis. In the case of examples like (16) we took the referentiality of the *wh*-clause to be the critical factor, and did not classify them as pseudoclefts because they are not unambiguously specificational.

However, the larger question is whether the ambiguity of cases like (16) is evidence that contextual ambiguity may have formed the basis of an extension from a predicational to a specificational construction. Such a scenario would not be unexpected given previous accounts of semantic change in grammaticalization. After all, reanalysis in the case of contextually ambiguous use of a construction is at the heart of pragmatic theories of grammaticalization, for example context-induced re-interpretation (Heine, Claudi and Hünnemeyer 1991) or pragmatic inferencing (Hopper and Traugott 1991). In fact, an ambiguity account would point precisely to perception verbs, such as *see* in (16), as well as utterance verbs, as the bridging context for the necessary extension. An interesting property of objects of perception is that one may experience them, and refer to them, and yet not be able to identify them. For example, note that B's answer in the question-answer pairs in (17) allows the pseudocleft format even though a referent is clearly established in context.

- (17) a. A: What was that?
 - B: What you heard there was the call of a Canada goose.

b. A: What did you say?

B: What I said was to hurry because they're closing in five minutes.

B's answers in (17) specify what was heard and what was said. At the same time, the *wh*-clauses have a referent in discourse. In theory, then, perception and utterance verbs

provide a clear bridging context between predicational and specificational copular constructions.

However, despite its theoretical appeal, we are not fully convinced that 'predicationreinterpreted-as-specification' was a major contributing factor to the emergence of pseudoclefts in English. A problem with this account is that cases of genuine ambiguity, as in (16), are infrequent. For one construction to gradually shade into the other, one would expect ambiguous usage to have been relatively widespread during the initial period. But, ambiguous cases were not more common at the end of the 17th century than they are today, and rare overall.³

Another reason for questioning a pragmatic inferencing account as the main factor is the existence of a construction type which is in many ways a more likely diachronic source of pseudoclefts, as it shares many features with the earliest attested instances of pseudoclefts and was in fact quite frequent at the time. Throughout the formative period of pseudoclefts in the late 17th and 18th centuries, preposed, non-restrictive *what*-relative clauses were common in texts. The examples in (18) illustrate such relative clauses with NP, PP, VP, and sentential antecedents.

- (18) a. You hath reposited them in the same place where she keeps her goodness, and, what I am afraid is much dearer to her, her money.
 - b. These boundaries were advanced as far as the Danube, or, <u>what is the same</u> <u>thing</u>, to the Suabian Alps.
 - c. My Lord Chesterfield laughs at her letter to him; and, <u>what would anger her</u> <u>more than the neglect</u>, ridicules the style and orthography.
 - d It is a brown desert of considerable extent, that produces nothing but heath and fern; and <u>what rendered it the more dreary when we passed</u>, there was a thick fog that hindered us from seeing above twenty yards from the carriage.
 - e. In truth, I can find no excuse for you, and, <u>what is more</u>, I am certain you can find none for yourself.

(all examples CLMET 1)

These preposed *what*-relatives had the syntactic distribution of parenthetical sentence adverbs (in fact, writers sometimes used parentheses around them in texts). Also, as seen in the examples above, they were restricted to modifying the second of two conjuncts. Note that in all examples the *what*-relative is preceded by a conjunction. The predicates occurring in these relative clauses were typically adjectives expressing some form of comparison (being 'more', 'worse', 'the same' etc.).

Most relevant in regard to grammaticalization are cases like (18d) and (18e) in which the relative clause has a sentential antecedent. In these cases, the two together form a syntactically independent unit, unlike (18a-c). In this respect they strongly resemble pseudoclefts, and could easily have been re-analyzed as them. The difference between (18d) and (18e) and standard pseudoclefts is, of course, the absence of a copula and the

³ To be fair, we have not quantified such cases. This conclusion is based on the impression of the first author after having seen all of the diachronic data.

fact that the sentential antecedent is not marked as a syntactic argument but has the form of an independent main clause. The only link between the relative clause and the antecedent is the coreference relation. Strictly speaking, these constructions fall outside of our initial definition of clefts. We will simply call them "copula-less pseudoclefts".

Despite this glaring syntactic difference we still analyzed cases like (18d) and (18e) as early pseudoclefts and included them in our count. To understand why, note first how frequent they were in the early history of pseudoclefts, as shown in Figure 3.

Figure 3. Proportion of copula-less pseudoclefts, including the specific variant *what is more*. No value is given for the 1640-1710 period because the total number is too small.



Figure 3 shows that at the beginning of the diachronic development of pseudoclefts the copula-less variant made up almost half of all cases. Since then, it have gradually disappeared. Today they are no longer found in texts except in the formulaic *what is more*, which remains as a relic of this originally productive construction. Its once frequent and productive use suggests that the preposed *what*-relative construction may well have influenced the formation of pseudoclefts.

Another argument for analyzing the copula-less variant as an early form of pseudoclefts is that such usage is in fact still present in contemporary English. Copula "omission" in spoken English is rare but well attested (e.g. Weinert and Miller 1996). The rate of copula omission in Present-Day American English is about 7% (Koops and Ross-Hagebaum forthc.). Where no copula is used, the focus phrase takes the form of an independent main clause. An example is given in (19).

(19) What they did, they took the stubs and they cleaned em up.

(Santa Barbara corpus)

The disappearance of the copula-less construction from texts at the same time as the standard (copula-full) pseudocleft rose in frequency can be seen as an indicator of syntactification of the pre-posed relative construction. It seems that, rather than having disappeared, the copula-less pseudoclefts merged with the emergent pseudocleft construction as the use of the copula became obligatory.

Finally, the most important argument for a diachronic link between the preposed relative clause construction in (18d,e) and the emerging pseudocleft is that both constructions were lexically highly restricted in terms of the predicates they licensed: relational predicates, especially adjectives, with a narrow range of meanings. The remainder of our historical analysis will be concerned with these properties and their change over time.

2.3. Modification of *wh*-clause

We saw that preposed *what*-relatives were specifically used with adjectives expressing comparison, resulting in clauses like *what's more* or *what's worse*, where the relative clause compares the second of two conjoined constituents with the first one. Speaking more generally, by describing the second conjunct as having more or equally much of some property, the antecedent of *what* is being related to the first entity. The function of overtly relating the focused constituent to a preceding one, or to the preceding discourse in general, is pervasive in the earliest pseudoclefts. This is seen very clearly in the types of modifiers occurring in the *wh*-clause. Often, the *wh*-clause contained an adverb of comparison, as in (20).

(20) But what <u>most</u> alarmed him was a hint that it was in her (Miss Matthews's) power to make Amelia as miserable as herself.

Another common form of modification were adverbials expressing a high or exceptional degree of some property.

(21) What is <u>ridiculously</u> lucky is, that Lord Lincoln goes into waiting, to-day, and will be to present her!

(both example CLMET 1, underlining added)

It is striking how rarely early pseudoclefts occurred in their bare form, i.e. without additional modification of any kind. We have identified eight common types of modifiers occurring in the *wh*-clause of pseudoclefts, as summarized in Table 2.

Comparison	What concerned her <u>even more</u> / <u>equally</u>
	What <u>chiefly</u> / <u>mainly</u> interested him
Exceptional degree	What is <u>especially</u> / <u>particularly</u> / <u>very</u> clear
	What I had <u>always</u> liked about her
Spatio-temporal deixis	What is crucial <u>here</u> what he needed <u>now</u>
Focus particle really	What I <u>really</u> meant to say
Epistemic modality	What <u>may</u> appear odd what she <u>actually</u> wanted
Anaphoric so	What made it <u>so</u> difficult
Temporal adverbs	What <u>finally</u> convinced him what <u>first</u> stuck me
Addition	What she could <u>also</u> do what is notable <u>too</u>

Table 2. Types and frequency of modifiers found in the wh-clause of pseudoclefts

Recall that it was precisely such modifiers (expressions of exceptional degree and *really*) which we saw in the introduction, where they functioned to save otherwise unacceptable pseudoclefts.

The uniting feature of these modifiers is that they relate the *wh*-clause proposition, and by extension the focused constituent, to aspects of the prior discourse or to the discourse context more generally. This is especially obvious in cases of known presupposition triggers such as *more* or *finally*. By introducing an additional presupposition of their own, they facilitate the accommodation of the *wh*-clause presupposition, i.e. the task of "finding" the relevant presupposition in the current discourse context. The high rate of occurrence of these modifiers indicates that the construction was originally used specifically in this way, which suggests that in most situations presupposition "boosting" modifiers were practically required.⁴

Going beyond the earliest pseudoclefts, we can use the rate of occurrence of the modifiers in Table 2 as a measure of the changing restrictiveness of the construction. Figure 4 shows the proportion of unmodified *wh*-clauses in pseudoclefts across the entire period. In order to base the measure on large enough numbers of examples, only pseudoclefts from the 1710-1780 period onwards are included.

⁴ The possibility of operationalizing information structure constraints on the basis of modifying elements like these has also been shown for other cleft types, e.g. the so-called "inferential cleft" (Koops 2007).



Figure 4. Proportion of unmodified *wh*-clauses in pseudoclefts (relative to modified ones)

Figure 4 shows that in the earliest period *wh*-clauses were used in 4 out of 5 cases with some additional modifier as indicator of shared knowledge or relevance. Today, in written discourse, these modifiers seems to have reached a ceiling (or rather, floor) level of about 2 in 5 cases.

2.4. *Wh*-clause predicate types

Coming back one more time to the preposed relative clauses with sentential antecedents (our "copula-less pseudoclefts") seen in (2d) and (2e), these constructions illustrate a second feature shared by early pseudoclefts overall, which then gradually faded. Early pseudoclefts overall occurred almost exclusively with particular types of predicates, notably adjectives. Table 3 shows the most frequently attested predicates throughout the 1710 - 1780 period.

1710 - 1780	
be more	10
surprise (me)	4
be remarkable	3
be worse	3
like	2
add to	2
be a hardship	2
be astonishing	2
be of importance	2
be ridiculous	2
be surprising	2
contribute	2
suffice	2

 Table 3: Predicates in the earliest pseudoclefts (occurring twice or more)

The majority of the predicates are adjectives, and those which are verbs express similar evaluative notions. A semantic classification of all predicates in the 1710 - 1780 period shows that they evaluate the focus phrase on a small number of scales: simple quantity of some mentioned or understood property (*what is more, what will suffice, what added to its charm*), exceptionality (*what was remarkable / astonishing / surprising, what struck me*), amiability or pleasantness (*what I liked, what was worse*) and importance (*what is of importance, what matters*). Again, as with the modifiers, we see that early pseudoclefts were constructed to explicitly relate the *wh*-clause proposition, and thereby the focused constituent, to established aspects of the discourse, thus making them easier to accommodate.

We use the frequency of these relational predicates as an indicator of historical change. Tables 4-6 show that over time the spectrum of *wh*-clause predicates shifted from more to less overtly relational predicates.

1780-1850		1850-1920		1961, 1991	
be worse	7	want	22	be more	18
be more	6	be more	19	DO	11
like	4	say	17	need	13
DO	4	DO	16	say	8
mean	4	mean	8	mean	7
want	4	know	8	have (got)	7
strike (me)	3	see	8	matter	7
tell	3	be worse	5	see	6
		like	4	HAPPEN	5
		propose	4		
		puzzle (me)	4		

Tables 4-6 : Most frequent predicates appearing as wh-clause predicates in pseudoclefts
Starting in the second period (Table 4) predicates which are not inherently relational (marked in boldface) start to appear in the top frequency ranks, especially utterance verbs (e.g. *what he* <u>said / meant / told</u> us ...), perception verbs (*what we* <u>saw / heard</u>), and cognition verbs (*what we* I <u>want / know</u> ...). Note also that the semantically general verbs *do* and *happen* (marked in boldface and small caps) enter the top frequency range in the last two periods, with *do* reaching the number two spot in the 20th century.

The verbs 'do' and 'happen' are of particular interest in the research on pseudoclefts because in contemporary spoken English they are the most frequent *wh*-clause predicates (e.g. Hopper 2001, see also below). However, as we have seen, historically these verbs are relative latecomers. Moreover, there seems to be a stepwise introduction of them into the construction, such that *do* preceded *happen*, as shown in Table 7.

	1640-1710	1710-1780	1780-1850	1850-1920	1961, 1991
do	0	0	4	16	13
happen	0	0	0	2	6
Other predicates	3	106	115	231	247
Percentage of do/happen	0%	0%	3%	7%	7%

Table 7: 'Do' and 'happen' as wh-clause predicates across time

Before concluding this section and moving on to the cross-linguistic analysis, we take a quick look at pseudoclefts in late 20th century spoken English. Given that spoken language is known to be more tolerant of innovation and generally ahead of written discourse, this will provide some idea of where English pseudoclefts are headed.

We replicated all of the quantitative measures above on a corpus of contemporary conversational English, the *Santa Barbara corpus of Spoken American English* (Du Bois et al. 2000-2005). Figures 5 and 6 show that on all quantitative measures spoken pseudoclefts are far ahead of written ones in the direction of the historical trends.

Figure 5: Basic discourse frequency of pseudoclefts in contemporary written (LOB/FLOB) and spoken (SBC) English. Occurrences per 1 million words (cf. Figure 1).



Figure 6: Relative frequency of pseudoclefts (compared to predicational copular constructions); Relative frequency of unmodified pseudoclefts (compared to modified ones); Proportion of pseudoclefts with 'do' or 'happen'. Contemporary written English (FLOB) compared to spoken English (SBC) (cf. Figures 2 and 4).



The same is reflected in the set of high-frequency verbs occurring in spoken pseudoclefts, as seen in Table 8.

1980s (spoken)	
DO	55
HAPPEN	17
say	6
BE	5
be funny	3
be good	2
get [me]	2
remember	2
talk about	2

Table 8: Most frequent wh-clause predicates in spoken discourse (Santa Barbara Corpus)

Table 8 shows a continuation of the trends we have observed in the development of written pseudoclefts above. Not only have *do* and *happen* come to dominate the verb spectrum, but another semantically general verb is in fourth place: the verb *be*. An example is given in (22), from a conversation about computers:

(22) What it is is some sort of slow 486, that will go into a 386 motherboard and work. (SBC corpus)

We will return to the significance of this verb in the discussion in Section 4.

3. Cross-linguistic comparison: English, Swedish and German pseudoclefts

We now address our second research question. Are cross-linguistic differences in pseudoclefts idiosyncratic and largely language-specific, or are they the outcome of a particular construction's progression along a general grammaticalization path? We apply the insights gained from the history of English pseudoclefts in a cross-linguistic comparison of English pseudoclefts with those of two closely related languages, German and Swedish. Because both German and Swedish have only "rudimentary" pseudoclefts (cf. Section 1), we can test whether the diachronic stages identified for English are more generally applicable indicators of grammaticalization. To the extent that our historical observations have cross-linguistic validity, a "rudimentary" pseudocleft should exhibit properties associated with English pseudoclefts at an earlier developmental stage. Specifically, we predict that (i) German and Swedish pseudoclefts constructions should consistently score lower than English on the quantitative measures of grammaticalization, and (ii) to the extent that German and Swedish pseudoclefts themselves are at different developmental stages, our measures should enable us to rank them relative to each other.

To start out, we need to clarify our operational definition of pseudoclefts in German and Swedish. Starting with German, it has been pointed out that German pseudoclefts can include a headless relative clause, as in English, or a headed *das was* 'that which' clause (e.g. Weinert 1995).

 (24) <u>Das was</u> wir also jetzt immer eigentlich bekämpfen müssen in uns ist einfach das Anthropomorphisieren.
 'What we have to fight now is the temptation to think in anthropomophic terms.'

(both examles FREIBURG corpus)

Moreover, at least in spoken German a variant exists in which the relative clause has a pronominal antecedent in the focus phrase, as in (25).

(25) Was uns andererseits wieder an Benn erregt, und was uns an Benn so anzieht, das ist die Gleichzeitigkeit von Dichter und Kritiker.
 <u>'What</u> excites us about Benn on the other hand, and what attracts us to Benn, (that) is the simultaneity of poet and critic.'

(FREIBURG corpus)

Our data include clear examples of each of these variants in a specificational function, as illustrated in (23) - (25). Therefore, we took the structures in (24) and (25) to be pseudoclefts wherever their use was specificational (and not predicational). To exclude them would not only be a purely form-based decision, but also an English-centric one. An *a priori* restriction to headless relatives is contradicted by highly grammaticalized pseudoclefts with headed initial relative clauses, as well as pronominal antecedents, such as the French pseudocleft.

(26) <u>Ce que</u> je me méfie <u>c'</u>est que les gens disent on n'a pas de problème.
 'What makes me suspicious is that there are people saying we don't have a problem.'

(Roubaud 2000: 163, underlining added, our translation)

Coming to Swedish, we find an even greater variety of relative clause types in pseudoclefts. Besides headless *vad* ('what') clauses there exists a major headed variant, *det som* 'that which' clauses, which combines a pronoun with the general relativizer *som*. Moreover, other combinations of these elements occur in usage, including *det vad* (lit. 'that what'), *vad som* (lit. 'what which') and *det vad som* (lit. 'that what which'). We did not exclude any of these variants *a priori*, for the same reasons given above.

Our sources of German and Swedish usage data are four late 20th century corpora, two each for Swedish and German, spoken and written discourse. The written data are taken from two 1 million-word corpora which are exactly comparable to the LOB and FLOB corpora because they were constructed according to the same sampling principles: the *Stockholm Umeå Corpus* (Ejerhed et al. 2006) and the *HAMBURG* corpus (Hilpert 2004). Our two spoken language corpora are the *Göteborg University spoken language corpus*

Corpus			Date of composition / recording	No. of texts / speech events	No. of words total	No of pseudo- clefts
HAMBURG	German	written	2004	664	~1,000,000	32
FREIBURG	German	spoken	1960-1974	221	593,335	63
SUC	Swedish	written	1990s	500	~1,000,000	84
GÖTEBORG	Swedish	spoken	1990s	3,107	1,416,248	210

Table 9: Corpora of late 20th century written and spoken German and Swedish

3.1. Discourse frequency

We replicated the full set of analyses of Section 2 for the German and Swedish data using the same criteria. In terms of discourse frequency, we find a consistent patterning

ENG > SWE > GER

in both basic text frequency and relative frequency compared to predicative copular constructions with referential *wh*-clause subjects, as shown in Figures 7 and 8.







Figure 8. Relative discourse frequency (specificational vs. predicational constructions)

The lack of a clear difference between English and Swedish in the relative frequency of written pseudoclefts in Figure 8 stands out. Whether this is a theoretically significant finding is not clear since it is not consistent with the basic frequency difference seen in Figure 7.

3.2. Modification of the *wh*-clause

Additional modifiers in the *wh*-clause are extremely common in German. Examples (24) and (25) illustrate this very clearly. Note the sequence *jetzt immer eigentlich* (lit. 'now always actually') in example (24) which is not untypical in this respect. Table 10 breaks down the different categories, which largely coincide with those found in English. Table 11 shows the corresponding modifiers found in Swedish, where modification is not as frequent as in German.

Comparison	Was mir <u>viel mehr</u> auffiel
Exceptional degree	Was mich <u>besonders</u> gefreut hat
Spatio-temporal deixis	Was <u>da</u> zu sehen ist Was wir <u>jetzt</u> brauchen
Epistemic modality	Was <u>sicher</u> nicht stimmt
Anaphoric so	Was mich <u>so</u> verwunderte
Other anaphor	Was ich <u>damit</u> meine
Temporal adverbs	Was man <u>dann</u> bekommt
Addition	Was ich hier <u>noch</u> sagen möchte Was <u>auch</u> fehlt

Table 10. Types of modifiers found in the relative clause of German pseudoclefts

Comparison	Vad vi gör åt det <u>mer</u>
Exceptional degree	Det som går upp <u>reellt</u>
Spatio-temporal deixis	Det som <u>sen</u> hände
Focus particle verkligen	Vad som <u>verkligen</u> oroade mig
Epistemic modality	Vad som <u>kan</u> hända
Anaphoric så	Det som är <u>så</u> synd
Temporal adverbs	Det som <u>fortfarande</u> skiljer det
Addition	Vad som syns <u>också</u> här

Table 11. Types of modifiers found in the relative clause of Swedish pseudoclefts

Figure 9 shows that the rate of unmodified pseudoclefts is consistently lowest in German, and that we find the same ranking ENG > SWE > GER for spoken discourse. Interestingly, there is no difference between English and Swedish in the written data here. It appears that in writing, Swedish pseudoclefts have already reached the ceiling at ~60% which we saw for English (cf. Section 2).

Figure 9. Proportion of unmodified pseudoclefts



3.3. Wh-clause predicates

Coming to the predicates occurring in the wh-clause, we see the same pattern. Table 12 gives the most common predicates in German pseudoclefts. The reason for the sparsity of

the data is the low discourse frequency of pseudoclefts in German overall. Very few predicates occur more than once.

German spoken		German written	
wichtig sein 'be important'	5	wichtig sein 'be important'	2
sehen 'see'	5	erwähnen 'mention'	2
bedauern 'regret'	2	bleiben 'remain'	2
sagen 'say'	2		
verwunden 'puzzle, surprise'	2		

Note that in German evaluative predicates predominate ('be important' 'regret', 'puzzle, surprise') but that perception and utterance verbs ('see', 'say' 'mention') are well established. Conspicuously absent among the top frequency predicates are the verbs 'do' and 'happen'.

Table 13: Most common pseudocleft predicates in spoken and written Swedish

Swedish spoken		Swedish written	
göra 'do'	20	<i>göra</i> 'do'	5
hända 'happen'	15	handla om 'be concerned with'	5
säga 'say'	9	hända 'happen'	4
mena 'mean'	8	vara kvar 'be left, remain	3
tycka 'think'	6	utmärka 'distinguish'	3
se 'see'	6		

In Swedish, the general verbs *göra* 'do' and *hända* 'happen' are frequent in both spoken and written data. Other than that, the most common predicates include utterance verbs like 'say', 'mean', and 'think' (in the sense of expressing an opinion) and perception verbs ('see', 'distinguish').

Figure 10 provides a quantitative comparison of the role of the verbs 'do and 'happen' in all three languages. While these two verbs are almost completely absent in German writing, and rare in spoken discourse, they seem to be well established in Swedish, and, at least in writing, as frequently employed as in English. However, our Swedish data show no use of 'be' in pseudoclefts (cf. the English example [22] above).

Figure 10. Proportion of the verbs 'do' and 'happen' (combined) out of all pseudocleft predicates



4. Discussion and conclusion

In answer to our first research question, we can now state that pseudoclefts do not come into existence in full fledged form, but are the result of a gradual development following motivated, measurable stages. At the same time, this does not invalidate Harris and Campbell's (1995) characterization of cleft constructions as "easily added to grammars". After all, a construction type that requires only 300 years – or five generations of speakers – to grammaticalize to the degree that the English pseudocleft has, can probably be called fairly "readily available" as syntactic constructions go. And there is no doubt that the reason for this relatively rapid growth lies in the availability of the components parts, relative clauses and copular clauses.

What is mainly required, then, is the "bleaching" of the pragmatic constraints originally associated with these components as part of the new construction, or, as we have described it, the generalization of the construction's presuppositional structure. The pragmatic requirements of the earliest English pseudoclefts were maximally restrictive, allowing the construction to be used only where the presupposition expressed in the *wh*-clause was particularly easy to construct on the basis of the discourse context. This was followed by a gradual process of pragmatic weakening, reflected in the decreasing frequency with which speakers insert into the *wh*-clause overt markers which flesh out the relation of the *wh*-clause proposition (and, by extension, the focused constituent) to the preceding discourse or otherwise mark the *wh*-clause proposition as relevant. The same weakening is also seen in the changing spectrum of *wh*-clause predicates, starting

with a highly restricted set of overtly relational predicates and eventually including more abstract ones.

Among these predicates, the semantically general verbs *do*, *happen*, and *be* provide a clear window on the process of generalization. As we have seen, these verbs enter the construction in a certain order, reflecting their degree of semantic schematicity.

(27)	a.	'do'	dynamic event with participant specified	(What we did)
	b.	'happen'	dynamic event, no participant specified	(What happened)
	c.	'be'	any event or state of affairs	(What it was \dots)

Why do 'do', 'happen', and 'be' become available in the order of (27a-c)? One would predict this order if, as we have seen, the presupposed proposition in pseudoclefts is originally more contextually dependent and needs to echo more clearly established aspects of the discourse. To do this, it must be (relatively) lexically rich. The difference between 'do' and 'happen' is that the former requires the expression of the main participant of an event (the doer), while the latter simply projects a dynamic event. Finally, 'be' is the most schematic in meaning as it contains no restriction to particular event types at all.

The driving force behind the progressive pragmatic extension to an ever greater number of presuppositional situations is the use of the construction in contexts which require some degree of pragmatic accommodation. This confirms Lambrecht's (1994) suggestion that the pragmatic accommodation of presuppositional structures may become conventionalized and grammaticalized. The motivation for the grammaticalization of pseudoclefts thus provides a nice illustration of the reason why grammaticalization is unidirectional. As the construction becomes conventionally associated with a certain presuppositional situation, so much so that certain presuppositional situations are preferentially expressed by means of the cleft, speakers will no longer feel that the alternative, canonical sentence construction adequately captures this situation.

It is not difficult see what that the end result of this process has to be, viz. obligatorification of the cleft construction as the basic clause type. Here we come full circle with the typological accounts of languages with morphological focus marking systems mentioned in the introduction. For example, one of the languages discussed by Heine and Reh (1984: 171) is Somali, whose focus marking system is so highly grammaticalized that the pragmatic differentiation of presupposition and focus is obligatory for all main clauses. From a typological perspective, then, the diachronic weakening of the presuppositional structure of focus constructions is old news. Dik (1997: 325ff) uses the term *demarking* to describe the process whereby "FCs [focus constructions], in particular clefts, may lose their contrastive force and are then reduced to a presentative function."⁵ What we believe to have done in this paper is to show how

⁵ The idea of the progressive weakening of the discourse requirements of the construction is also brought up by Ball (1994) in connection with the issue of so-called "informative presupposition" *it*-clefts. Interestingly, Ball rejects it as a factor in the diachronic development of this cleft type. This shows that it remains to be worked out to what extent our findings on pseudoclefts carry over to other cleft categories,

these typological concerns and the micro-concerns of information structure analysts working within the context of a particular languages are connected, and can mutually inform each other.

One obvious benefit of a unified view of the grammaticalization and synchronic discourse function of pseudoclefts can be seen in the way in which the diachronic picture helps make sense of cross-linguistic differences. We have shown that the diachronic measures are by and large in line with the cross-linguistic ones, especially with respect to the two most different languages (in terms of theis pseudoclefts), English and German. That is, the constraints which were responsible for the grammaticalization of pseudoclefts to their present form in English are the same as those which "hold back" the pseudocleft in German. This suggests that the discourse constraints on pseudoclefts in individual languages are not as unpredictably language-particular as one might have thought. They are to a surprising extent derivable from a general grammaticalization continuum on which a construction is defined by its particular cut-off point. Our account thereby gives substance to intuitive labels like "rudimentary" when applied to less grammaticalized cleft constructions.

To illustrate the explanatory power of a grammaticalization perspective on pseudoclefts, we conclude by briefly discussing the results of Weinert's (1995) contrastive analysis of English and German cleft constructions. Weinert approaches the constructions strictly from the perspective of synchronic discourse pragmatics. In her discussion of the discourse use of German and English pseudoclefts she notes that

"there are no WH clefts [in German] with the equivalents of DO and HAPPEN, suggesting that the general topic introducing and explanatory function is not so central. Instead we find a variation not so common in English. This is the use of WH clefts to expand on topics, or to introduce a new topic where the focusing function [of the pseudocleft] is used to stress the speaker's desire to raise the topic itself, rather than to merely focus on the content. The former is indicated by the use of expressions such as NOCH, SONST NOCH, ZUSÄTZLICH, meaning 'in addition' ..." (362)

Without the background of the present paper, the discourse functions of the German pseudocleft construction identified by Weinert in the above quotation must appear as language-particular, stylistic choices, which could have turned out to be different. However, every one of these functions falls out from the more general constraint on German pseudoclefts which we have argued for in this paper, viz. the restrictiveness of its presuppositional structure, which is to be expected from a pseudocleft at an early stage of grammaticalization.

especially focus-initial (and thus, presupposition-final) ones. It may turn out that these don't yield as neat a picture, which would not be unexpected given that synchronically, too, pseudoclefts are the most well behaved cleft type in information structure terms (Hedberg & Fadden 2007).

We can motivate each point of contrast she mentions. First, together with the absence of the German equivalents of 'do' and 'happen' in pseudoclefts, the specific uses which English speakers make of these verbs in the construction (the "general topic introducing and explanatory function") are of course absent in German. Second, the "topicexpanding" (rather than topic introducing) function follows directly from the fact that the wh-clause of German pseudoclefts has to contain propositions which are easier to accommodate (compared to English). It is no wonder, then, that speakers use the construction for small shifts within a general topic rather than full-scale topic changes. The former require less accommodating work on the part of the hearer because, instead of taking for granted that a new topic is suddenly relevant, they only need to orient to a different aspect of the same topic. The frequent use of the adverbs noch, sonst noch, and zusätzlich 'also, in addition, furthermore' is predictable because these expressions link of the *wh*-clause presupposition to the prior discourse. But, as we have seen in Section 3, they constitute only one of several classes of presupposition-inducing modifiers frequently employed in German pseudoclefts. Weinert's third and last point of contrast is somewhat less clear to us, but we would suggest the following. In those cases where speakers of German do use the pseudocleft for a general change of topic, this move must appear more disruptive, as it is a less conventionalized and less easily accommodated function. Therefore, it is easy to get the impression that such a move reflects in the first instance "the speaker's desire to raise the topic itself" and only secondarily her intention to also say something about that new topic. In English, where speakers routinely accommodate a greater range of presuppositional situations, the raising of a new topic using a pseudocleft attracts less attention to itself.

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1. Introduction

1.1. Background

In a companion paper (Givón 2006) I suggested that the diachronic rise of complex verb phrases, and eventually clause-union, proceeds through the following general steps, in order:

(1) General diachronic trend of complex-VP formation:

- (a) *Parataxis*: The two clauses are packed under separate intonation contours.
- (b) Syntaxis: The two clauses condensed under a single intonation contours.
- (c) Lexis: The two verbs co-lexicalize into a single word. [FN 1]

I further suggested that this general trend overrides the considerable typological variation found in the diachrony of complex VPs, so that both major typological pathways in (2) below still conform to the general trend suggested in (1) above

(2) Two main pathways to clause union:

- (a) the clause-chaining pathway
- (b) the nominalized V-COMP pathway

In this paper I hope to redeem a promissory note I inserted in the early work--that the diachronic rise of of relative clauses follows the same the general trend (1), regardless of structural type.

In an earlier foray into the typology of REL-clauses (Givón 1990, 2001), I did not pay enough attention to the more general **syntactic** trends in the genesis of REL-clause. While outlining an essentially diachronically-oriented typology of REL-clauses, (7-8 main types), I focused on the source--and grammaticalization pathway-- of the morphemes used to indicate ('recover') the cars-role of the missing co-referent argument inside the REL-clause (see also Heine and Kouteva 2007). This yielded a fairly coherent functional-synchronic typology, but in retrospect it seems that I could have posited higher typological distinction that would have divided the 7-8 types into fewer mega-types. In this paper I would like to investigate the feasibility of a more comprehensive typological approach to the diachrony of REL-clauses.

1.2. Reconstruction methods

A note is perhaps in order concerning the methodology most commonly used in diachronic reconstruction of syntax. There are three useful methods for reconstructing historical syntactic development:

(i) The study of historical records of contiguous developmental stages;

(iii) The study of synchronic variation of co-existing related constructions;

(iii) Doing internal reconstruction by studying surviving 'relic' clues.

Of these, method (i) is of course reliable, but the historical records often skip crucial intermediate stages & variants. They are, typically, edited written records, whereas diachronic change takes place, overwhelmingly, in the spoken register. More to the point, in many languages such records do not exist. Method (ii) is the sweetest for elucidating the detailed mechanisms of change. And it is sweeter yet when combined with (i). But you've got to catch the language at the right stage, and this is largely a game of chance. Method (iii) is bold, speculative and theory dependent (Givón 2000). It should be practiced with care, but should not be shunned, for often it is the only one available. In this paper I have attempted to avail myself of all three, relying more heavily--of necessity--on a patchwork of (ii) and (iii).

2. From clause-chaining ('conjunction') to embedding

In earlier discussion, I labeled this pathway, found in serial-verb languages all over the world, the "non-embedding strategy". This was clearly an imprecise characterization. More accurately, the early paratactic stage of this pathway involves two (or more) clause in a chain, each under its own intonation contour. But in almost all the serial-verb languages that employ this strategy, one already finds the co-existing syntactic ('condensed', 'embedded') variant, where the REL-clause falls under the same intonation contour as the main clause. And in many cases no reordering or restructuring is done, beyond the change of intonation.

I will illustrate this diachronic route to embedded REL-clauses first with examples from Bambara (Mendeic; Niger-Congo). The data is originally due to Charles Bird (1968) and Ibrahima Coulibaly (i.p.c.). Consider first the paratactic, unembedded variants, where the demonstrative *min* 'that' modifies the co-referent noun inside the would-be REL-clause (3a-e). One could consider *min* now the REL-clause maker, but it is still used in the language as a demonstrative modifier or anaphoric/cataphoric pronoun, and its position in the clause is still compatible with the original use:

(3) a. Unembedded, pre-posed (SUBJ-rel, OBJ-main):

cε min ye muru san, n ye o ye. man REL PAST knife buy I PAST him see 'The man *who* bought the knife, I saw him'. (Hist.: '*That* man bought the knife, I saw him'.)

b. Unembedded, post-posed (SUBJ-rel, OBJ-main):

n ye o ye, cε min ye muru san. I PAST him see man REL PAST knife buy 'I saw him, the man *who* bought the knife'. (Hist.: 'I saw him, *that* man bought the knife'.)

c. Unembedded, pre-posed (OBJ-rel, OBJ-main):

n ye so **min** ye, $c\epsilon$ be o dy θ . I PAST house **REL** see man PROG **it** build 'The house *that* I saw, the man is building it'. (Hist.: 'I saw that house, the man is building it'.)

d. Unembedded, post-posed (OBJ-rel, OBJ-main):

c ϵ be o dy θ , n ye so min ye. man PROG it build I PAST house **REL** see 'The man is building it, the house *that* I saw'. (Hist.: 'The man is building it, I saw *that* house'.)

e. Unembedded, extraposed:

cε ye muru san, n ye **min** ye. man PAST knife buy I PAST **REL** see 'The man bought the knife, *that one* I saw'. ('Hist.: 'The man bought the knife, I saw that one (the knife)'.)

No reordering of elements occurs in such unembedded 'REL-clauses. Both the anaphoric pronoun *o* ('s/he', 'it') and the demonstrative *min* ('that') are used the way they are used in normal clause-chaining discourse. But Bambara can place both clauses under a joint intonation contour, in a configuration that is clearly an early form of embedding. This relativization strategy is much less common (Bird 1968), and it involves placing the entire 'relative' clause at the location inside the main clause where the head-noun should have been (Bird 1968):

(4) a. Simple (main) clause:

n ye c**ɛ** ye. I PAST man see 'I saw the man'.

b. With REL-clause:

n ye c ϵ min [Ø] ye muru san ye. I PAST man **REL** PAST knife buy see 'I saw the man *who* bought the knife'. (Hist.: 'I [,] *that* man bought the knife [,] saw'.)

Finally, in some configurations, and with the anaphoric pronoun omitted under the merged intonation contour, the old chained structure looks more and more like a truly embedded one. Thus, the transition from (5b) to (5c) below involves no re-ordering, just merging of the intonation contours and dropping the anaphoric (Bird 1968):

(5) a. Simple (main) clause:

cε ye muru san. man PAST knife buy 'The man bought the knife'.

b. Chained (paratactic) configuration::

n ye cε min ye, o ye muru san. I PAST man **REL** see he PAST knife buy 'The man *that* I saw, he bought the knife'. (Hist.: 'I saw *that* man, he bought the knife'.)

b. With REL-clause:

n ye c ϵ min ye [Ø] ye muru san. I PAST man **REL** see PAST knife buy 'The man *that* I saw bought the knife'. (Hist.: 'I saw that man [,] [he] bought the knife'.)

A similar pattern of relativization is found in Supyire (Senufu; Niger-Congo), another clause-chaining, verb-serializing language (Carlson 1994). An erstwhile demonstrative pronoun has become the generalized REL-clause suffix, while a full-size demonstrative pronoun is often use inside the REL-clause, as in Bambara. Thus, (with tone-marking not shown):

(6) a. SUBJ REL-clause:

Nani **nge-mu** u a pa-ge, mii a nye man **DEM-REL** he PERF come **REL** I PERF see 'The man who came, I saw (him)'

b. **OBJ REL-clause**:

Nani **nge-mu** mii a nye-**ge**, u a pa man **DEM-REL** I PERF see-REL he PERF come 'The man I saw, he came'

One REL-clause type, which Carlson (1994; pp. 513-514) calls 'semi-embedded', represents the beginning of a syntactic--embedded--pattern:

- (7) a. Ka pi i bage e u a titige-ke, and they NARR house.DEF in he PERF descend-REL 'Then they the house in which he had descended,
 - b. ka pi i **kuru** cyee mii na and they NARR **that** show me to then they showed *that-one* to me'.

In (7a), a chunk of the main clause ('Then they...') is given before the pre-posed REL-clause. That chunk is then recapitulated in the full main clause in (7b), where the co-referent noun is marked with an emphatic resumptive pronoun.

Another language with a remarkably similar and well-known clause-chaining source of REL-clauses is Hittite (Justus 1973, 1976). The examples cited below are taken from Robert (2006). In Old Hittite, both paratactic clauses are marked by a conjunction:

- (8) a. **nu ku**-it LUGAL-uš teez-zi, **nu** apaa-at karap-zi **CONJ REL**-ACC king–NOM say-3s **CONJ** that-ACC luzzi do-3s 'Whatever the king says, that the luzzi shall perform'.
 - b. ku-u-ša-ta-**ma** ku-it píddaa-i, **na**-aš-kan šameen-zi bride-price-PTC-CONJ REL-ACC give-3s CONJ-he-PTC forfeit-3s 'What(ever) bride-price he gave, he forfeits (it)'.

The conjunction may be dropped from the first clause, yielding a more emphatic focus:

(9) **ku**-iš pa-apreez-zi, **nu** apaa-aš-pat gín ku.babbar paa-i REL-NOM be-impure-3s **CONJ** that-one-NOM-PRT shekel/ACC silver give-3s 'Whoever is impure, *that very man* shall give (three?) silver shekels'.

And the second conjunctions may be dropped too:

(10) pa-apreez-zi **ku**-iš, 3 gín ku.babbar paa-i be-impure-3s **REL**-NOM three shekel silver pay-3s 'The one who is impure, (he) pay three silver shekels'.

The case-marked *ku*- inside the REL clause is quite analogous to the Bambara *min* and was probably a demonstrative determiner, used naturally as a demonstrative pronoun (see German dada further below).

One pre-posed paratactic REL-clause may be followed by more than one main ('resumptive') clause, in a typical clause-chaining pattern (Robert 2006):

- (11) a. lu-meš Ubaru, lu-aš **ku**-iš lugal-wa-aš pé-ra-an eeš-zi, men-NOM Ubaru man-NOM **REL**-NOM king-GEN in-front be-3s 'Men of Ubaru, whatever man *that* is in front of the king,
 - b. **ne** šaraa ţieę-enzi, **CONJ** upward step-3p they step forward,
 - c. **nu** aappa tie-nzi, **CONJ** backward step-3p then (they) step backward,
 - d. **ne** araanda. **CONJ** stand.3p and then (they) stand'.

To drive home how typical a clause-chaining pattern this is, consider the following example from Chuave (Gorokan, East Highlands, Papua-New Guinea), a clause-chaining serial-verb language par 4excellence. In this language, all presuppositional clauses, including restrictive REL-clauses, are nominalized, and could only come at the chain-initial position (Thurman 1978):

- (12) a. gan moi-n-g-u-a, child be-he-**NOM**-him-PERF 'The child who is here,
 - b. Gomia tei awi d-i. Gomia there send leave-IMPF send (him) away to Gomia'.

What Robert (2006) argues about the presence vs. absence of the conjunction in Hittite, and its connection to the diachronic evolution of Hittite REL-clauses, is worth citing:

"...The distinction between sentences with both [conjunctions] and sentences with neither points to a structural distinction between adjoined [paratactic] and embedded [syntactic] relative clauses. After Old Hittite, it is no longer necessary for the resumptive [main] clause to include either both resumption [explicit anaphoric pronouns] and conjunction..." (2006, p. 17).

Robert notes that there is a strong association between the presence of a conjunction in the main ('resumptive') clause and the presence of an explicit anaphoric ('resumptive') pronoun there. While we have no documented indication of the intonation contours of the clauses, **[FN 2]** it is reasonable to suggest that what Robert (2006) describes is a drift from an old *paratactic clause-chaining* pattern, with the main ('resumptive') clause marked by both a conjunction and an anaphoric ('resumptive') pronoun, to a later *syntactic-embedded* pattern, where both the conjunction and pronoun are dispensed with. And I think it is a safe bet that the intonation contours merged in the process, this being, universally, the earliest mark of embedding.

One may as well note, lastly, that the clause-chaining source for REL-clauses is universal, and can be found--with a discerning eye for informal oral discourse--in just about any spoken language. As an example, consider the following exchange between a mother and her 2 yr. 9 months-old daughter. At this early age, the child produces not a single bona-fide adult-like REL-clauses (Diessel 2005), and her mother produces virtually none either during her conversations with her daughter. But the paratactic precursor is already there, often spread across two-person turns, as in (Nina, CHILDES data-base; see Givón 2008):

(13)	MOT	: They both are wearing earr	rings.		
		And what else is this dolly	wearing?		
	NIN:	A blouse like that one .			
		Louise gave me that one.	(p.	42,	Nina-III transcripts)

The use of the demonstrative pronoun ('that one') by Nina is reminiscent of paratactic RELclauses in Bambara and Hittite. The communicative goal, given clearly in the context and negotiated over successive-adult-child turns, is that of *identifying a referent by citing an event, here past, in which it was a participant*, the standard communicative motivation for using restrictive RELclauses. But the construction is spread *paratactically* over two adjacent turns and three intonational clauses. In tightly-edited written English, a single person would have restored the ellipsis and merge the mother's and daughter's contributions into:

(14) She is wearing a blouse like *the one Louise gave me*.

4. From parenthetical to non-restrictive to embedded REL-clauses

The second clear parataxis-to-syntaxis pathway that yields embedded REL-clause is clearly illustrated in the extant synchronic variation in present-day German. While this construction is rather old, **[FN 3]** all its intermediate precursor are still preserved as synchronic variants. Its genesis may be thus reconstructed as follows:

- (i) The Y-movement construction, with case-marked stressed demonstrative pronoun, is still extant.
- (ii) It was inserted post-nominally as an 'after-thought', with an intonation break, thus yielding a non-restrictive REL-clause.
- (iii) The intonation contours were then merged and the demonstrative de-stressed, yielding a restrictive REL-clause.

As a schematic illustration, consider (Theo Vennemann, Charlotte Zahn, Christa Toedter and Tania Kouteva, i.p.c.; see also Borgert and Nyhan 1976):

(15) a. . Simple clause:

Martin hatdemManndasBuch gegebenM.hasthe/DATmanthe/ACCbook given'Martin gave the book to the man'.

b. Y-movement clause-NOM:

DER hat das Buch dem Mann gegeben **THAT/NOM** has the/ACC book the/DAT man given '**THAT one** gave the book to the man'.

c. Y-movement clause-ACC:

DAShat Martin demManngegebenTHAT/ACChas Martinthe/DATmangiven'THAT oneMartingave to the Man'.

d. Y-movement-DAT:

DEM hat Martin das Buch gegeben THAT/DAT has Martin the/ACC book given **'To THAT one** Martin gave the book'.

(16) Non-restrictive (parenthetical) REL-clauses:

a. Nominative:

Ich kenne die Frau, **DIE** hat dem Mann das Buch gegeben. I know the woman, **THAT/NOM** has the/DAT man the/ACC book given 'I know the woman, **the one** who gave the book to the man'.

(Hist.: 'I know the woman. THAT one gave the book to the man').

b. Accusative:

Ich kenne das Buch, **DAS** hat Martin dem Mann gegeben. I know the book, **THAT/ACC** has Martin the/DAT man given 'I know the book, **the one that** Martin gave to the man'. (Hist.: 'I know the book. **THAT one** Martin gave to the man').

c. Dative:

Ich kenne den Mann, **DEM** hat Martin das Buch gegeben. I know the/ACC man, **THAT/DAT** has Martin the/ACC book given 'I know the man, **the one that** Martin gave the book to'. (Hist.: 'I know the man. **THAT one** Martin gave the book to').

By removing the intonation break (and thus is spoken language, the conservative comma), de-stressing the demonstrative pronoun, and a minor adjustment to a non-contrastive word-order, the set of non-restrictive REL-clauses turn into restrictive ones. Respectively (I ignore here the fact that in written German a comma must separate even restrictive REL-clauses, no doubt a relic of the non-restrictive pattern):

(17) Restrictive REL-clauses:

a. Nominative:

Ich kenne die Frau **die** dem Mann das Buch gegeben hat.

I know the woman that/NOM the/DAT man the/ACC book given has

'I know the woman **who** gave the book to the man'.

b. Accusative:

Ich kenne das Buch **das** Martin dem Mann gegeben hat.

- I know the book **that/ACC** Martin the/DAT man given has
- I know the book **that** Martin gave to the man'.

c. Dative:

Ich kenne den Mann dem	Martin das	Buch gegeben hat
-------------------------------	------------	------------------

- I know the/ACC man that/DAT Martin the/ACC book given has
- 'I know the man to whom Martin gave the book'.

Essentially the same parthway is described in other Germanic languages, such as Old Norse and Old English (Heine and Kouteva 2007, ch. 5). In other languages, this pattern in whole or part may be used to augment an existing REL-clause structure. Thus for example, in spoken informal Israeli Hebrew, one finds the following demonstrative-marked headless REL-clauses invading the regular Rel-clause paradigm:

(18) a. Standard OBJ REL-clause:

Ha-'ish **she**-pagash-ti 'oto 'etmol... the-man **RE**L-met-1s him yesterday 'the man I met yesterday...'

b. Standard headless OBJ REL-clause: zé she-pagash-ti 'oto 'etmol...

DEM REL-met-1s him yesterday 'the one I met yesterday...'

c. **Standard non-restrictive OBJ REL-clause**: ha-'ish, **zé she**-pagash-ti 'oti 'etmol,.... the-man DEM REL-met-1s him yesterday 'the man, the one I met yesterday,...'

 d. Non-standard condensation to restrictive OBJ REL-clause: ha'ish ze-she-pagash-ti 'oto 'etmol.... the-man DEM-REL-met-1s him yesterday 'the man I met yesterday...'

As in German, the demonstrative is de-stressed when the non-restrictive (paratactic) REL-clause (18c) is condensed into the restrictive (syntactic) REL-clause (19d). So while the source of the parenthetical clause is different, the condensation pattern—the essence of this pathway--from parenthetical non-restrictive to restrictive--is the same.

The naturalness of selecting the clause-type to be used as the parenthetical (non-restrictive) portion of the paratactic construction is, roughly, that it must *topicalize* the preceding co-referent ('head') noun. The Y-movement used in Germanic languages is certainly such a construction (Givón, 2001, ch. 15). The headless REL-clause of Hebrew carries the same topicalizing function (as do all REL-clauses).

The use of the stressed demonstrative is almost entirely predicted from the conflation of two necessary attribute of such constructions:

(i) The co-referent element has to be *anaphoric*.

(ii) The co-referent element has to be *contrastive/emphatic*.

The stressed demonstrative is rather well suited for this function (Linde 1979), so it is not an accident that it is distributed widely across the typological chasm, in the clause-chaining and verb-serializing Bambara and Hittite, as in the more embedding and nominalizing German and Hebrew. The only languages it is less-likely to be found are zero-anaphora languages like Japanese.

4. Are nominalized REL-clauses a separate diachronic pathway?

In many language families--Turkic, Carribean, Bodic (Tibeto-Burman), No. Uto-Aztecan, Sumerian, to cite only a few--all subordinate clauses are nominalized, at least historically. Such structures may re-acquire finite properties over time (Givón 1994; Watters 1998), but the morphology retains, for a long time, the telltale marks--clear fossil evidence--of the earlier nominalized status. The question now is: Can the process that created such structure to begin with be shown to conform to our parataxis-to-syntaxis prediction? And does it represent a distinct mega-channel in the genesis of embedded REL-clauses?

I will illustrate how such a pathway can be reconstructed by citing the nominalized RELclauses of Ute (Numic, No. Uto-Aztecan). Ute marks consistently the case-distinction subject (nominative) vs. non-subject (object, genitive, oblique). The verb in subject REL-clauses is marked with the subject nominalizing suffix $-t\pi$. The verb in object REL-clauses is marked with the nonsubject nominalizing suffix -na, and the subject then appears in the *genitive* case. In indirect-object REL-clauses, the subordinator $p\pi$ - carries the relevant post-position. Thus (Givón 1980):

(19) a. Main clause:

mamach*i* tupʉych-i tʉka'na-pʉ-**vwan** wacʉ-ka woman/SUBJ rock-OBJ table-OBJ-**on** put-PERF 'The woman put the rock on the table'.

mamachi'ut#p#ych-it#ka'na-p#-vwanwac#-ka-t(u)...woman/SUBJthe rock-OBJtable-OBJ-onput-PERF-NOM'the woman who put the rock on the table...'(Hist.: 'the woman putter of rock on the table...')

c. Non-restrictive REL-clause: SUBJ:

d. Restrictive REL-clause:OBJ:

t#p#y-ch*i* 'ur mamachi t#ka'na-p#-vwan wac#-ka-n(a)... rock/SUBJ the woman-GEN table-OBJ-on put-PERF-NOM 'the rock that the woman put on the table...' (Hist.: 'the rock of the woman's putting on the table,...')

e. Non-restrictive REL-clause: OBJ:

t#p#y-ch*i* 'ur, ('uru) mamachi t#ka'na-p#-vwan wac#-ka-n(a),... rock/SUBJ the (that/OBJ) woman-GEN table-OBJ-on put-PERF-NOM 'the rock, (that one) that the woman put on the table,...' (Hist.: 'the rock, (that) of the woman's putting on the table,...')

f. Restrictive REL-clause: Indirect OBJ

tæka'na-р*н* 'ur **pæ**-vwan mamach-i tæpæy-ci wacæ-ka-**n**(**a**)... table-SUBJ the **REL**-on woman-**GEN** rock-OBJ put-ANT-**NOM** 'the table on which the woman put a rock...' (Hist.: 'the table of the woman's putting the rock on'...')

g. Non-restrictive REL-clause: Indirect OBJ

tæka'na-ри 'ur, ('uru) **pæ**-vwan mamach-i tæpæy-ci wacæ-ka-**n**(a),... table-SUBJ the, (that/OBL) **REL**-on woman-**GEN** rock-OBJ put-ANT-**NOM** 'the table, (that one) on which the woman put a rock,...' (Hist.: 'the table, (that) of the woman's putting the rock on,...')

Of the two nominalizing markers on the verb, the subject nominalized -tu is still used synchronically to mark lexical subject nominalizations. In combination with the old passive/perfect marker -ka-, it can also be used to mark some direct-object (technically subject-of-passive) nominalization. Thus (Givón 1980, 1988):

(20) a. Main clause:

ta'wach*i* 'u po'o-mi man/SUBJ the write-HAB 'The man writes '.

b. Subject nominalization:

'ú ta'wach*i* pΘ'Θ-mi-**t**(**u**) 'ura'-'ay that/SUBJ man/SUBJ write-HAB-**NOM** be-PRES 'That man is a writer.

c. Object (subject-of-passive) nominalization:

'ích-'ara po'o-kwa- **t***μ* 'ura-'ay this/SUBJ-be write-PASS-**NOM** be-PRES 'This is a book'.

The Ute REL-clause data fits our scenario of parataxis-to-syntaxis rather snugly. The non-restrictive REL-clauses still function synchronically as nominalized clauses, as in:

(21) a. **Subject**:

'ú tʉpʉychi tʉka'na-pʉ-vwan wacʉ-ka-t(ʉ) tuguvu-n 'ura-'ay that/SUBJ) rock/OBJ table-OBJ-on put-PERF-NOM friend-my be-PRES 'That one who put the rock on the table is my friend'. (Hist.: 'That [putter-of-the-rock-on-the-table] is my friend'.

b. **Object**:

'uru mamachi t#ka'na-p#-vwan wac#-ka-n(a) tupuych 'ura'ay that/OBJ woman/GEN table-OBJ-on put-PERF-NOM rock be-PRES 'What the woman put on the table is a rock'. (Hist.: 'That [the-woman's-putting-on-the-table] is a rock'.)

c. Indirect object:

'uru **pu**-vwan mamachi tʉpʉy-ci wacʉ-ka-n(a),... that/OBL) **REL**-on woman/**GEN** rock-OBJ put-ANT-**NOM** 'That (thing) on which the woman put a rock is a table' (Hist.: 'That [the-woman's-putting-the-rock-on] is a table').

Just as in German or Hebrew, all it takes in Ute to move from non-restrictive (paratactic) to restrictive (syntactic/embedded) REL-clause is the merger of intonation contours. We have just subsumed the nominalized REL-clause pattern, at least in principle, under our second parataxis-to-syntaxis diachronic pathway--from non-restrictive to restrictive REL-clause.

In a nominalizing language, the etymological source of the nominalizers may perhaps shed some light on the evolution of nominalized REL-clauses. In general, nominalizers are most commonly derived from *head nouns* in noun compounds. This is, for example, the etymology of the nominalizing suffix in English 'free-*dom*' (Old Gothic *tuom* 'judgement') or 'child-*hood*' (Old Gothic *heituz* 'quality'). In Lhasa Tibetan, for example, four nominalizing suffixes are used in relativization: -*mkhan* is used for actor; -*sa* for the locative (and, by extension, dative-benefactive); -*yag* (the 'default' suffix) for the patient and instrumental (in the non-perfective), and -*pa* for nonactor or patient (in the perfective).

In lexical nominalizations in Tibetan, *-mkhan* (historically 'teacher' or 'expert') is used in many actor derivations, and *-sa* (historically 'earth', 'ground', and by extension 'place') in locative derivations. Thus (Delancey 1988):

(22) a. Actor/subject derivation:

s'i'n-**mkhan** 'carpenter' wood-expert

b. Place derivation:

yod-**sa** 'place of residence' live-place

Much like 'free-*dom*' and 'child-*hood*' in English, these noun suffixes('nominal classifiers') originated as the head nouns in noun compounds. . The use of these suffixes in Tibetan relativization can be seen in (Mazoudon 1978; DeLancey 1988):

(23) a. Actor REL-clause:

stag gsod-**mkhan** mi... tiger kill-**NOM** man 'the man who killed the tiger...' (Hist.: 'the tiger kill-**expert** man...')

b. Locative REL-clause:

kho sdod-**sa**-'i khan'.pa... he/ABS live-**NOM**-GEN house 'the house where he lives...' (Hist.: 'his living-**place** house...')

c. Instrument REL-clause:

kho-s stag gsod-**yag**-gi mem.da... he-ERG tiger kill-**NOM**-GEN gun 'the gun with which he killed the tiger...' (Hist.: 'his tiger killing-**tool** gun...'/)

d. Patient REL-clause: bsad-pa-'i kho-s he-ERG kill-NOM-GEN tiger

'the tiger that he killed...' (hist.: 'his killing-victim(?) tiger...')

stag...

A very similar 4-way division of lexical nominalizations that are then used in REL-clause formation is described in Yaqui (No. Uto-Aztecan) by Álvarez-González (2007), with the divisions being subject/agent, generalized non-subject, object/patient and locative.

What the Tibetan data above suggest, I think, is that there is no binding correlation between the nominalization case-recoverability strategy and the non-restrictive paratactic pathway to embedded REL-clauses. Tibetan is a rather classical clause-chaining SOV language. What is more, like related languages in the Bodic region, and like many other clause-chaining languages, chainmedial clauses in Tibetan are typically nominalized (i.e. non-finite; Givón 2001, ch. 18). A clausechaining source of restrictive REL-clauses is thus very likely here. What is more, the pre-nominal position of Tibetan REL-clauses makes the non-restrictive pathway to embedded REL-clauses much less plausible, given that non-restrictive REL-clauses are parenthetical after-thought devices that most commonly follow the head noun--regardless of word-order type.

In this connection, I would like to raise some questions about the genesis of Japanese RELclauses. REL-clauses in Japanese are traditionally characterized, as with many zero-anaphora languages, as a zero-marking strategy, where the missing co-referent argument in the REL-clause is left unmarked, and its case-role is then presumably computed from event/verb-type and what arguments are present or missing. Historically, restrictive REL-clauses in Japanese were marked with a nominalizer on the verb, one that was distinct from the chain-medial 'con-verb' marker. Thus (Shibatani 2007; i.p.c.):

(24) a. Finite, chain-final:

mizu nagar-**u**. water flow-FIN 'Water flows'

b. Non-finite, chain-medial: mizu nagar-e...

water flow-MED 'Water flows and...'

c. Nominalized clause: mizu-**no** nagar-**u-ru** water-GEN flow-FIN-NOM 'the water's flow(ing)'

d. Old nominalized restrictive REL-clause:

[nagar-**u-ru**] mizu... flow-FIN-NOM water 'water that flows'; 'flowing water'

e. Modern unmarked restrictive-REL clause:

[onna-ni tegami-o kaita] otoko-wa Kobe-ni ikimashita. woman-DAT letter-OBJ wrote man-TOP Kobe-LOC went 'The man who wrote the letter to the woman went to Kobe'.

But what was the paratactic source, if any, of the restrictive REL-clause in Japanese? Its prenominal position precludes a non-restrictive source. And indeed, a parenthetic non-restrictive (REL-) clause may be constructed in Japanese--following the head noun. But Shibatani (i.p.c.) also notes that (24e) above may also be interpreted as non-restrictive, as in (Shibatani, i.p.c.):

(25) **POST-nominal non-restrictive REL-clause**:

(Boku-ga) Taroo-ni atta, tokolo-de (kare-wa) onna-ni tegami-o kaita (I-SUBJ) Taroo-DAT saw [linker] (he-TOP) woman-DAT letter-OBJ sent 'I saw Taro, who (by the way) sent a letter to the woman'.

A similar situation, may be seen in Mandarin (Sino-Tibetan; Li and Thompson 1981) and Lahu (Tibeto-Burman; Matisoff 1982). In the former, restrictive REL-clauses are pre-nominal and marked with a nominalizer, while post- nominal clauses of at least two distinct functions are not nominalized. In the latter, both the pre-nominal and post-nominal REL-clauses are historically nominalized. Since the pre-nominal REL-clauses could not come from a non-restrictive source, do they come from another paratactic source? From clause-chaining?

The situation seen in Chuave (and many other New-Guinea Highlands languages; see (12) above) has some bearing on this issue. In this language, REL-clauses, like other subordinate clauses, are nominalized and must appear chain-initial--thus technically pre-posed vis-avis both the main clause and the head noun. But they are still paratactic, and make sense only in the context of the clause-chaining system. We will discuss this problem directly below.

5. Word-order typology and the diachronic source of REL-clauses

In light of the discussion above, it would be useful to examine briefly the pre-nominal restrictive REL-clauses of Mandarin Chinese and similar languages. In earlier discussion, I have tended to interpret the pre-nominal position of the REL-clause in Mandarin, an otherwise rigid SVO language with characteristic SE Asia clause-chaining and verb serialization, as a relic of earlier SOV syntax of the Tibetan type. Restrictive REL-clauses in Mandarin are marked with the clause-final nominalizer suffix *-de* (Li and Thomson 1981):

(26) a. Subject nominalization:

mài qìche **de** dàbàn dou shì hâo rén sell car **NOM** majority all be good person 'Car sellers are mostly good people.

b. Object nominalization:

mài gêi Lîsì de shì zuì guì de
sell to L. NOM be most expensive NOM
'What is sold to Lisi is the most expensive'.

c. Subject REL-clause:

jintian yíng **de** rén yùnqì hâo today win **NOM** person luck good 'The people who won today had good luck'.

d. Object REL-clause:

jintian yíng **de** qián fù fáng-zu today win **NOM** money pay house-rent 'The money (we) won today goes to pay the house rent'.

There is another type of Rel-clause in Mandarin, however, the so-called 'descriptive clause' (Li and Thompson 1981). It is post-nominal, and is used in presentative constructions with REFindefinite head noun. It's origin from clause-chaining is transparent, involving just the merger of two intonation contours (Charles Li, i.p.c.):

(27) a. Paratactic clause-chain source:

wo you yi-ge meimei, xihuan kan dianyin I have one-CL sister like see movie 'I have a sister, [she] likes to see to see movies'.

b. Syntactic presentative with post-nominal REL-clause:

wo you yi-ge meimei xihuan kan dianyin I have one-CL sister like see movie 'I have a sister who likes to see movies'.

The functional equivalent of non-restrictive REL-clauses also exists in Mandarin. It is postnominal (or post-main-clause, if wholly unembedded), and is structurally indistinguishable from the chained-clause pattern in (27a) (Charles Li, i.p.c.).. Given that both clauses are equally asserted (rather than presupposed), and given the zero-anaphora of Mandarin, this pattern is indeed predictable.

In Lahu, a clause-chaining, verb-serializing SOV Tibeto-Burman language, a *pre-posed* nominalized clause, marked with the clause-final nominalizer *-ve*, can function in two capacities. With an intonation break between the two clauses (parataxis), the construction is interpreted as a V-complement, as in (28a-i) below. Without the intonation break, it is interpreted as a *pre-nominal* restrictive REL-clause, as in (28a-ii).

But another pattern also exists in Lahu, where the nominalized clause, still pre-posed, has the following two functions: With the inter-clausal intonation break (parataxis), the nominalized construction is interpreted as an ADV-clause, as in (28b-i). Without the intonation break, it is interpreted as a *post-nominal* restrictive REL-clause, as in (28b-ii), given that the head noun originally belongs to the second clause in the paratactic sequence. Thus compare (Matisoff 1972; tone marking omitted):

(28) a. Pre-head REL-clause: (Matisoff 1972:253)

te-qha-le-lo shi-ve (,) a-pi-qu shi-e-yo
whole- village-CO know-NOM (,) old-lady die-AWAY-DECL
(i) V-COMP: 'What the whole village knows is, that the old woman has died'.
(ii) REL-clause: 'The woman [who the who village knew] has died'.

b. Post-head REL-clause: (Matisoff 1972:254)

shui-c3 ma-mu-ve (,) ka' thu ba ph3-O tree NEG-high-NOM (,) even chop throw may-EMPH ADV-clause: 'Even though the trees are not high, you may chop (them) down' REL-clause: 'You may chop down even the trees [that are not high]'.

Either way, the paratactic source of the restrictive REL-clause is fairly transparent.

One may now suggest that the pre-nominal position of the restrictive REL-clause in Mandarin (SVO), as in Lahu (SOV), has nothing to do with word-order typology. Both pre-posed and post-posed REL-clauses are possible in both languages, and both arise from paratactic patterns compatible with the clause-chaining typology. And the Tibetan nominalized pre-nominal REL-clauses probably arise through the same diachronic pathway as those of Mandarin and Lahu.

Likewise, one may suggest that nominalized REL-clauses in Ute, a fairly classical SOV language till recently, are post-nominal not in violation of Greenbergian universals, but because they arose through the non-restrictive ('parenthetical') paratactic channel. And this channel is equally available to German during a largely VO (or free word order) typology. Nominalization as a case-recoverability strategy thus correlate neither word-order type nor with the paratactic source of restrictive REL-clause. It distributes orthogonally to these two features.

Whether the pre-nominal REL-clauses of Japanese conform to the Mandarin-Lahu diachronic scenario remains to be investigated. But one may easily suggest a variant paratactic alternative (Matt Shibatani i.p.c.), where the nominalized REL-clause may either precede or follow the head noun:

(29) a. **Post-nominal**: That woman, the bread-baker, is my aunt.b. **Pre-nominal**, The bread-baker, that woman, is my aunt.

This paratactic pattern is, fundamentally, indistinguishable from the a non-restrictive one.

A by-product of this discussion is, I think, that the oft-cited Greenbergian correlation between SOV word-order and pre-nominal REL-clauses is a typological accident, due to the high correlation between the SOV order and clause-chaining. And this correlation is, in turn, due to the high synchronic--and most likely also diachronic (Givón 1979, ch. 7)--prevalence of the SOV word-order, often with its peculiar clause-chaining type, whereby chain-medial clauses are nominalized or less finite, and subordinate clauses are often pre-posed to the chain-initial position (Givón 2001, ch. 18).

6. Cleft and WH-questions

Cleft constructions are said to have a REL-clause tucked under the same intonation contour, following a contrasted (stressed) noun (Schachter 1971). But in many languages the data exist to suggest that this syntactic construction is a condensation of an earlier paratactic one, where the REL-clause was packaged under a separate intonation contour. What is more, in some languages the same can be show for WH-questions. As an illustration of both patterns, consider Kihungan (Bantu; Takizala 1972; Givón 2001, ch. 15):

(30) a. Main clause:

Kipes **ka**-swiimin kit K. **3s**-buy-PAST chair 'Kipes bought a chair'.

b. Restrictive REL-clause:

kit ki **a**-swiim-in Kipes... chair DEM **3s/REL**-buy-PAST K. 'the chair that Kipes bought...'

c. Non-restrictive REL-clause:

kit, ki **a**-swiim-in Kipes... chair DEM **3s/REL**-buy-PAST K. 'the chair, the one that Kipes bought...'

c. Syntactic cleft:

kwe **kít** ki **a**-swiim-in Kipes be **chair** DEM **3s/REL**-buy-PAST K. 'It's a CHAIR that Kipes bought'.

- d. Paratactic (non-restrictive) cleft: kwe kít, (kiim) ki a-swiim-in Kipes be chair thing DEM 3s/REI-buy-PAST K. 'It's a CHAIR, (the thing) that Kipes bought'.
- e. Syntactic WH-question:
 (kwe) kí (ki) a-swiim-in Kipes?
 (be) what (DEM) 3s/REL-buy-PAST K.
 'What did Kipes buy?'
 (Lit.: '(It's) WHAT (that) Kipes bought?')

f. Paratactic (non-restrictive) WH-question:

kwe kí, (kiim) ki a-swiim-in Kipes? be what (thing) DEM 3s/REL-buy-LAST K. 'It's WHAT, (the thing) that Kipes bought?'

Presumably, Kihungan already had a restrictive REL-clause construction before recruiting it to fashion cleft and WH-question constructions. In a way, however, the parataxis-to-syntaxis trajectory of the latter two recapitulate the presumed diachronic trajectory of REL-clauses.

7. WH pronouns in Rel-clauses

One type of relativization strategy has yet to be discussed, the use of WH pronouns to signal the case-role of the co-referent argument inside the REL-clause. In English, some of those can only appear as 'headless' constructions, and some may be subsumed under 'adverbials'. Thus:

The woman who left
What they found there was
The woman whom he chose
The woman to whom he talked
The house where he lived
The reason why she couldn't do it
The year when he died
How he did it was by

As Heine and Kouteva (2007) note, this relativization strategy has a protracted history, with the immediate antecedent being probably **WH-question complements** of cognition-perceptionutterance verbs, a construction that exhibits a considerable semantic overlap with REL-clauses. Most of C-P-U verbs take a nominal argument, perhaps even historically before they took a clausal complement; so that a considerably semantic overlap between the V-complement and a REL-clause meanings is possible, one that could serve as the *analogical bridge* for spreading the pattern. Thus consider:

	verb complement	REL-clause
(32)	 a. She didn't know who did it. b. He couldn't think where it was. c. Then she saw how to solve it. d. She never asked him why he left. 	She didn't know the person who did it. He couldn't think of the place where it was. Then she saw the way how to solve it. He never told her the reason why he left.

The plausibility of such a diachronic change is enhanced by the observation that almost all languages have WH-verb complements, but only a small subset of languages have WH relative pronouns. And further, no language that has the latter doesn't have the former. Thus:

"if WH relative pronoun, then WH verb complement",

a classical diachronic/typological one-way-conditional implication. But how did a WH-question get embedded in such V0complement?

The most likely answer is that the precursor must have been paratactic, with the complement being a *bona fide* **question speech-act**, as in:

- (33) a. Do you know? Who did it?
 - b. Think! Where is it?
 - c. Did you see it? How did they solve it?
 - d. Did you ask him? Why did he leave?

Similar paratactic construction are seen in child acquisition of WH-complements, where they are spread across consecutive child-adult or adult-child turns, such as e.g. (Givón 2008):

(34)	a. Who broke it?	c. I don't know.
	b. I don't know.	d. Who did it?

The paratactic source of the complex construction thus may thus pertain not to the target construction, but rather to its precursor in a *grammaticalization chain* (Heine 1992).

Quite a few languages, lastly, must have embarked on this process but then stopped in midparadigm, using only one WH-pronoun as the subordinator for all REL-clauses--invariably the *locative* 'where', as in Modern Greek *pou*, spoken Southern German *wo*, or Krio *we* in Krio.

7. Some tentative conclusions

Of the 7-8 major relativization strategies listed earlier (Givón 2001), I have suggested here that at least five:

(i) The non-embedding strategy (Bambara, Supyire, Hittite)

- (ii) The zero-anaphora strategy (Mandarin, Lau, Japanese)
- (iii) The case-marked demonstrative-pronoun strategy (German)
- (iv) The nominalizing strategy (Ute, Tibetan, Mandarin, Lahu)
- (v) The WH-pronoun strategy (English)

plausibly fit into one of the three *paratactic mega-pathways* that give rise to embedded RELclauses: The *clause-chaining pathway* (Bambara, Supyire, Hittite, Mandarin, Lahu), *the nonrestrictive* (*parenthetical*) *pathway* (German, Ute, Japanese, Tibetan), or the *WH-question paratactic pathway* (English), and often into more than one. One more type, the Philippine verb-coding strategy (vi), has probably risen from a nominalized source to begin with, and may thus parallel Ute or Japanese (Shibatani 2007). Since both Philippine languages and Ute have post-nominal REL-clauses, it is perhaps more likely that the paratactic of the Philippine REL-clause was the nonrestrictive one.

Another case-role recoverability type, the Hebrew resumptive-anaphoric pronoun strategy (vii), has a long history that goes back to a nominalized source (Givón 1991). The use of simple anaphoric pronouns in Hebrew relativization, combined with the post-nominal position of REL-clauses, are both compatible with the non-restrictive (parenthetical) paratactic source.**[FN 4]**

There is obviously a lot more to be done here, and more corroborative evidence to consider. But all three major pathways that emerge out of the typological data seem to follow, as in the case of the clause-union, the parataxis-to-syntaxis scenario. The fact that at the onset, the syntacticization of REL-clauses, just like clause-union, involves a mere adjustment--and merger--of intonation contours (Mithun 2006, 2007a, 2007b) is consistent with known patterns of early grammaticalization. But a gentle signal of grammaticalization does not mean the absence of all signals.[**FN 5**]

A final point concerns some cognitive correlates of the two developmental steps I have posited at the start:

(i) From paratactic to syntactic complexity.

(ii) From syntactic to lexical/morphological complexity.

In the heydays of Generative Semantics, and before Shibatani's (1972) paper on the semantics of causatives, both packaging steps were considered trivial, a matter of mere surface structure. Causative clause-union was a prime example cited by proponents of GS:

(35) a. Paratactic:	She let him, and he went.
b. Syntactic:	She let him go.
c. Co-lexicalized:	She let-go of him.

The processing speed of lexical words (35c) is ca. 250 msecs/word, relying heavily on automated ('spreading') activation of semantic networks. The processing speed of a single syntactic clauses(35b) is ca. 1-2 secs/clause. And the processing speed of two chained clauses (35a) is at least twice that in real discourse context. The level of semantic complexity varies only in subtle ways from (35a) to (35b) to (35c), but the processing speed surely does. The two steps of 'condensation', involve increased processing speed and automaticity. Whether this is the primary driving motivation or merely an unintended consequence remains to be seen.[**FN 6**] Still, the rise of hierarchic structure is, in general, part of the mechanism of rising automaticity.

Footnotes

*

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1

Lexis within the condensed complex clause can lead, eventually to the rise of new lexical words. In the case of complex VPs (head verb plus a COMP clause), the product is new lexical verbs. In the case of complex NPs (head noun plus a REL-clause), the product is new lexical nouns. 2

The original Hittite text marked no intonation-relevant punctuation, which was added to them by various more modern transcribers and editors.

3

Luther's translation of the bible, ca. 1500's, has the same REL-clause structure in Modern German. This structure may date back to 1,000 or even 800 AD.

4

In Biblical Hebrew, the later finite relativization pattern with the generalized REL-subordinator *'asher* was preceded by an earlier layer of nominalized REL-clauses (Givón 1991a). The etymology of *'asher* may go back to *'athar* 'place' (Hetzron, in personal communication). If so, there may have been a spreading of the pattern from a nominalized locative REL-clause to the entire case paradigm, a phenomenon also attested in spoken Greek (*pou* 'where'), spoken Southern German (*wo* 'where') and Krio (*we* 'where').

5

In a recent paper, Everett (2005) has asserted that his Amazonian language, Piraha, has no embedded clauses. In support he cites Piraha clause-chaining constructions that 'function as' RELclause, very much like Bambara, Supyire, Hittite, Mandarin or Lahu, but are not embedded. Everett suggests that all such clauses are separated by an intonation break from their main clause. As further support for his claim of non-embedding, he cites other clause-chaining serial-verb languages (Pawley 1987; Matisoff 1969). At face value, this seems to be an early stage of grammaticalization (Givón 1991b, 2006; Mithun 2006, 2007a, 2007b). Only a text-distribution study of intonation contours would tell whether Piraha has already advanced beyond the earliest paratactic stage, like Bambara, or has not.

6

Two companion studies of child acquisition of complex constructions (Givón 2008a, 2008b) seem to suggest that the primary motivation for the rise of V-complement construction is communicative rather than cognitive. The subsequent condensation into hierarchic structure, and the presumed increase in automaticity, are thus a secondary development, perhaps even an 'epiphenomenon'.
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MULTIPLE ROUTES TO CLAUSE UNION: THE DIACHRONY OF COMPLEX VERB PHRASES

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1. Introduction

This paper proceeds with two main premises in mind, both of which, for better or worse, I have always been inclined to take for granted:

- (i) The phenomenon of complex predicates is better viewed in the broader context of syntactic complexity; more specifically, of **syntactically-complex clauses** and **cognitively-complex events**.
- (ii) A synchronic typology, of whatever syntactic domain, can only make full sense from a **diachronic perspective**; that is, as a typology of the diachronic pathways that gave rise to the attested synchronic types within the domain.

In the course of trying to show that both my premises are eminently sensible, and that they are indeed applicable to the more-narrowly construed topic of complex predicates, I will first outline the two main diachronic sources of complex clauses--thus the two main pathways to clause union--verb-phrase embedding ('complementation') and clause chaining. For each of the two, I will suggest, the syntactic properties of the resultant ('synchronic') complex clause are in large part predictable from its diachronic source.

Once the two main diachronic pathways to syntactic complexity have been established, I will turn to consider a number of well-known types of complex clauses that may or may not fit under the main two-way typology. To the extent possible, I will try to determine whether, and to what extent, the plethora of known types fits within the proposed two-way diachronic typology, and whether the latter needs to be expanded and/or enriched in order to accommodate those extra types.

Along the way it will become necessary to treat one typological parameter that often intersects with a predictive typology of complex clauses--finiteness. I this connection, I will first describe the extreme typological contrast between languages in which all non-main clauses are **non-finite** (or less finite), and languages that have only finite clauses. The latter, according to some, have no embedded clauses. Or perhaps put a better way, they have **less grammaticalized** subordinate clauses. While there are many example of both extreme types, most languages tend to fall somewhere in the middle.

The term 'complex clause', much like 'complex event', begs for some explanation, however cursory. Following an earlier discussion (Givón 1991), I will suggest that a good point of departure could be to assume that:

(1) **Preliminary definition of complex clauses**:

- a. A single clause, whether simple or complex, must at the very least fall under a single intonation contour.
- b. A complex clause must, at the very least, contain multiple lexical predicates.

Both of the tentative definitions in (1) are to be taken as one-way ('if--, then--') conditional implications, which leaves the door open to at least two types of exceptions; respectively:

(2) Systematic exceptions to the definitions in (1):

- a. Syntactic units that fall under a single intonation contour but are not clauses; such as e.g. short **predicate-less interjections**. **[FN 1]**
- b. Multi-predicate clauses under a single intonation contour that are nevertheless not complex single clauses, since no clause-union in involved; such as e.g. **embedded relative clauses**.

One should note, lastly, that my sense of the term 'clause union' is in essence diachronic, so that the two main diachronic pathways that yield complex clauses are, from my perspective, the two main routes to clause union. **[FN 2]**

2. Some preliminaries

2.1. Grammaticalization, co-lexicalization and clause union

Clause union has been traditionally discussed almost exclusively within the context of morphological causativization, but is in fact a much broader phenomenon. Semantically first, a wide range of syntactic-semantic configurations can be the diachronic precursors to clause-union.

The semantic common denominator to all types of clause-union is either the **grammaticalization** or **co-lexicalization** of (at least) one predicate in the two precursor clauses to be merged. In cases where clause union arises from an embedded VP complement (Type A), if the main verb grammaticalizes or co-lexicalizes semantically, it also tends to grammaticalize or co-lexicalize syntactically, and thus to become an affix on the complement verb.[**FN 3**] In cases where complexity arises from clause chaining (Type B), full clause union tends to occur less frequently, even if cognitively-semantically the precursor configuration is the very same as in type (A) and the two events are cognitively merged into a complex single event.

Some of the more common semantic configurations that serve as precursors to clauseunion are illustrated in (3) below. Their great semantic diversity also illustrates the fact that the very same syntactic type of complex clause may arise due to diverse functional motivations.

(3) a. Causativization: (co-lexicalization)
She let-go of his hand
b. Tense-aspect-modal auxiliaries: (grammaticalization)
He will-eat the apple
They have-eaten their supper
c. Evidentials: (grammaticalization)
They say she's quitting
I hear she's quitting
Suppose she quits?
d. Directionals: (grammaticalization) [FN 4]
em tromwey sospan I-go
she threw.away pot PRED-go
'She threw the saucepan away'
e. Cognate object: (grammaticalization)
She made a left turn
f. Ideophone: (co-lexicalization)
It went kapow!
g. Resultative verb construction: (co-lexicalization)
She shot him dead.
h. Co-verb constructions: (grammaticalization, co-lexicalization) [FN 5
liri-ma nga- ya -naggi munybaban
swim-ASP I-go-PAST other.side
'I swam to the other side'

The reason why clause union has always appeared so conspicuous in morphological causative constructions (3a) is first because morphological causatives involve full clause union, including co-lexicalization of the precursor verbs. And second, because the causative main verb in such constructions is transitive, and thus takes an object (the manipulee). When the complement verb is also transitive, competition ensues for the object GR in the merged clause, between the manipulee of the main verb and the patient of the complement. **[FN 6]** And thus, the topic of GR integration is broached.

2.2. Functional and structural dimensions of clause union

2.2.1. Event integration and clause union: The Complementation scale

Perhaps the best illustration of the functional and structural properties of clause union, and how the two run in parallel (isomorphism), is the complementation scale found in VP-embedding languages such as English (Givón 1980a; 2001 ch. 12). At the top of the scale one finds morphological causatives with maximal clause-union and co-lexicalization. As the bottom are the complements of cognition, perception and utterance verbs, falling under a separate intonation contours. The transition between the two extreme is gradual both semantically and syntactically.

(4) The complementation scale:

Semantic scale of verbs	syntax of COMP-clause
a. She let-go of the knife	CO-LEXICALIZED COMP
b. She made him shave c. She let him go home d. She had him arrested	BARE-STEM COMP
e. She caused him to switch jobs f. She told him to leave g. She asked him to leave h. She allowed him to leave I. She wanted him to leave j. She'd like him to leave	INFINITIVE COMP
k. She'd like for him to leave	FOR-TO COMP
 l. She suggested that he leave m. She wished that he would leave n. She agreed that he should leave 	SUBJUNCTIVE COMP
o. She knew that he had left p. She said that he might leave later	INDIR. QUOTE COMP.
q. She said: "He will leave later"	DIR. QUOTE COMP.

The semantic gradation of event integration in (4) is indeed fine, but may nonetheless be subsumed under three major features:

(5) Main semantic features of even integration:

- (I) Referential integration: The sharing of referents between the two events
- (ii) Temporal integration: Simultaneity or direct temporal adjacency of the two events
- (iii) Spatial integration: The sharing of the same location between the two events

Other widely-discussed features, such as successful (vs. intended) causation, intentional (vs. accidental) causation or direct (vs. indirect) causation, are relevant primarily because they imply, directly or indirectly, either co-temporality or co-spatiality of the two events (Givón 2001, ch. 12)

Syntactically, the seven syntactic forms of English complements in (4) also represent a fine gradation, which is made possible by the interaction of the following structural features:

(6) Main syntactic devices that code clause union:

- a. Expression of the co-referent argument: zero vs. presence
- b. Grammatical relations: And integrated single set vs. two distinct sets
- c. Adjacency of the two verbs: co-lexicalization vs. separation
- d. Finite verb morphology: presence vs. absence on the complement verb
- e. Adjacency of the two clauses: presence vs. absence of a complementizer
- f. Intonation contours: Joint vs. separate

2.2.2. Finiteness

Even a cursory look at the complementation scale (4) and the structural devices used to affect clause-union (6) would show a strong involvement of finiteness, provided one recognizes finiteness a feature of the whole clauses rather than just the verb. Thus, the most merged complement clause at the top of scale (4) have zero subjects (4a), no independent main-clause-like set of GRs (4b), co-lexicalized verbs (4c), and non-finite verb morphology (4d), all prominent features of clausal non-finiteness.

Finiteness--and especially its converse, non-finiteness--is best illustrated in VPembedding, nominalizing languages, subordinate clauses are often fully or partially nominalized.

2.2.2.1. Finiteness and nominalization

As a syntactic (rather than merely morphological) process, nominalization may be characterized as:

(7) Nominalization as a syntactic process:

Nominalization is the process via which a finite **verbal clause**,--either in its entirety or only a subject-less **verb phrase**--is converted into a less-finite **noun phrase**.

A verbal clause is nominalized most commonly when it occupies a prototypical nominal position/function--subject, direct object, indirect object or nominal predicate--within another clause. The syntactic complexity of NPs arising through nominalization most commonly reflects the structure of their precursor verbal clause.

Within the nominalized NP, the erstwhile verb assumes the syntactic role of **head noun**, while other clausal constituents--subjects, objects, verbal complements or adverbs--assume the roles of various **modifiers**. Nominalization is thus best described as a **syntactic adjustment** from the finite verbal-clause prototype to the nominal (NP) prototype (Hopper and Thompson 1984; Givón 2001, ch. 2). The major components of such adjustment, at the full extreme, are:

(8) Adjustment from the prototype finite verbal clause to the prototype noun phrase:

- a. The verb becomes a *head noun*
- b. The verb acquires nominal morphology
- c. Loss of *tense-aspect-modal* marking
- d. Loss of pronominal agreement marking
- e. The subject and/or object assume genitive case-marking
- f. Determiners may be added.
- g. Adverbs are converted into adjectives

A simple example will illustrate the general pattern emerging out of (8), contrast the finite clause (9a) below with its nominalized version (9b):

(9) a. Finite verbal clause:

She **knew** mathematics extensively

b. Non-finite nominalized clause:

Her extensive **knowledge** of mathematics

It is of course hardly an accident that finiteness has been treated traditionally as a property of verbs, since many of its salient features (8a,b,c,d) indeed pertain to the verb. But the rest of the features (8e,f,g) pertain to other constituents of the clause. Finiteness is thus fundamentally an aggregate grammatical feature of clauses. Its converse, non-finiteness, is thus an aggregate grammatical feature of NPs derived–historically or transformationally, depending on one's theoretical perspective--from verbal clauses. **[FN 8]**

The same tradition also treats finiteness as a discrete, either-or feature. But since the finite prototype (or its converse) is patently an aggregate of many features, finiteness must be at least in principle a matter of degree. This has been already seen in the complementation scale in (4). Another illustration of this gradation may be seen in (10) below:

(10) Scalarity of finiteness:

least finite

- a. Her good **knowledge** of math [helped a lot]
- b. Her **knowing** math well [helped]
- c. For her to know math so well [surely helped]
- d. She wanted to know math well.
- e. Having known math well since highschool, she...
- f. Knowing math as well as she did, she...
- g. He wished that she **would know** math better.
- h. Had she studied harder, she would have known math better.
- I. She knew math well.

most finite

2.2.2.2.. Nominalizing vs. finite languages

The broadest cross-language typological distinction in finiteness is the seeming chasm between extreme nominalizing and extreme finite languages. In the first type, all subordinate clauses are, at least historically, nominalized. Only main clauses display fully finite structure. In the second, no clause-type is nominalized, and all clause-types are thus fully finite. We will illustrate the two extreme types in order.

(A) Extreme nominalizing (embedding) languages

While most languages can nominalize clauses at least to some extent, some languages practice nominalization to the extreme, so that all their non-main clauses are nominalized to some degree, and are thus non-finite. Tibeto-Burman (Watters 1998), Turkic, Carib (Gildea 1998), Quechuan (Weber 1996), Gorokan languages of the Papuan Highlands (Thurman 1978) or No. Uto-Aztecan are conspicuous examples of this type. I will illustrate this extreme type with data from Ute (Uto-Aztecan). The three most conspicuous telltale signs of clause nominalization in Ute are:

- •genitive case-marking on the subject
- •nominal suffix on the verb
- •object case-marking on the entire clause

Compare first the finite verbal clause (11a) with its various nominalized counterpart (Givón 1980b, 1993):**[FN 9]**

(11) a. Finite clause:

ta'wach 'u yoghovuch-I pakha-qa-'u man/SUBJ DEF/SUBJ coyote-OBJ kill-PERF-he/him 'The man killed the coyote'

b. Nominalized clause as a main-clausal argument:

ta'wach-I 'uway yoghov#ch-I pakha-qa-na-y man-GEN DET/GEN coyote-OBJ kill-PERF-NOM-OBJ ka-'áy-wa-t 'ura-'ay NEG-good-NEG-NOM be-IMM 'It was bad that the man killed the coyote' (Lit.: '*The man's killing (of) the coyote* was bad')

c. Complement of cognition verb:

mamach 'u pucucugwa-p#ga woman/SUBJ DEF/SUBJ know-REM ta'wach-I 'uway yoghov#ch-I pakha-p#ga-na-y man-GEN DET/GEN coyote-OBJ kill-REM-NOM-OBJ 'The woman knew that the man (had) killed the coyote' (Lit.: 'The woman knew the man's killing (of) the coyote')

d. Object REL-clause:

yoghovuch 'u [ta'wach-I 'uwáy pakha-pʉga-na]... coyote/SUBJ DEF/SUBJ [man-GEN DET/GEN kill-REM-NOM] 'the coyote that the man killed...' (Lit.: 'The coyote *of the man's killing*...')

e. Subject REL-clause:

ta'wach 'u [yoghov#ch-I pakha-qa-t]... man/SUBJ DEF/SUBJ [coyote-OBJ kill-PERF-**NOM**] 'The man *who killed the coyote*...' [Lit.: The *coyote-killer* man]

f. Complement of modality verb:

na'acich yoghovuch-I pakha-vaa-ch 'ásti'i-p#gay-'u girl/SUBJ coyote-OBJ/GEN kill-IRR-NOM want-REM-she 'The girl wanted *to kill the coyote* '

g. Complement of manipulation verb:

mamachna'acich-Iyoghovuch-Ipakha-vaa-kumáy-p#gawoman/SUBJgirl-OBJcoyote-OBJ/GENkill-IRR-NOM/DStell-REM'the woman told the girlto kill the coyote 'tell-REM

h. 'If'/'when'-ADV clause:

ta'wach-I 'uwa-y kani-naagh y#ga-khw,... man-GEN DEF-GEN house-in enter-SUB 'When the man entered/enters the house...' (Lit.: '(upon) the man's entering the house,...)

(B) . Extreme finite (non-embedding) languages

At the other end of the typological chasm one finds languages in which all clause types are finite, including, in some languages, even lexical nominalizations. Iroquois (Mithun 1991), So. Arawak and Athabaskan languages are conspicuous examples of this type. But many serial-verb

Consider first verb complements in Tolowa, which are all finite with, tense-aspect-modality and pronominal affixes matching the prototype main-clause pattern (Bommelyn 1997; Bommelyn and Givón 1998):

(12) a. Main clause (IMPERF):

nn-tu-sh-'í 2s-TH-1s-observe 'I observe you'

b. Main clause (PERF):

nn-tee-s-ii-'íָ-' 2s-TH-PERF-1s-observe-PERF 'I observed you'

c. V-complement (implicative, IMPERF):

nn-tu-sh-'í xa-sh-tł-sri 2s-THM-1s-observe INCEP-1s-L-do 'I begin to observe you' (Lit. 'I begin-do I observe you')

d. V-complement (implicative, PERF):

nn-tee-s-ii-'í-' xaa-gh-íi-ł-sri 2s-TH-PERF-1s-observe-PERF INCEP-PERF-1s-L-make/PERF 'I began to observe you') (Lit.: 'I began-did I observed you')

e. V-complement (non-implicative, IMPERF):

nn-tu-sh-'í '-uu-sh-tł-te 2s-TH-1s-observe TH-DES-1s-L-want 'I want to observe you' (Lit.: 'I want I observe you')

f. V-complement (non-implicative, PERF-IMPERF):

nn-tu-sh-'í 'aa-w-íi-l-te 2s-TH-1s-observe TH-DES/PERF-1s-L-want 'I wanted to observe you (but maybe didn't)' (Lit.: 'I wanted I observe you')

g. V-complement (non-implicative, PERF-PERF): nn-tee-s-ii-'í-' 'aa-w-íi-ł-te 2s-TH-PERF-1s-observe-PERF TH-DES/PERF-1s-L-want 'I wanted to observe you (and did)' (Lit.: I wanted I observed you')

While some restrictions constrain the distribution of aspectual-modal combinations in (12), complement clauses display the very same finite structure of main clauses.

Relative clauses in Tolowa are just as finite, involving no subordinating morpheme but mere juxtaposition (Valenzuela 1996; L. Bommelyn, i.p.c.):

(13) a. Main clause:

tr'ąąxe 0-s-ii-ts'ums woman 3s-PERF-1s-kiss 'I kissed the woman'

b. Main clause:

tr'ąąxe te-s-0-ch'a woman TH-PERF-3s-leave 'The woman left'

c. SUBJ EL-clause:

tr'ąąxe [0-s-ii-ts'#ms] te-s-ch'a woman [3s-PERF-1s-kiss] TH-PERF-leave 'The woman *I kissed* left' (Lit.: 'I kissed the woman she left')

d. Main clause:

Tr'ąąxe ch'usne yu-s-0-ts'ums woman man TR-PERF-3s-kiss 'The woman kissed the man'

e. OBJ REL-clause:

Ch'#sne [Tr'ąąxe y#-s-0-ts'#ms] te-s-ch'a man [woman TR-PERF-3s-kiss] TH-PERF-away 'The man *the woman kissed* left' (Lit.: The man kissed the woman and left')

Adverbial clauses are just as finite; and often the adverbial subordinator itself is historically a finite serial-verbal construction (Hennesy 1996; L. Bommelyn i.p.c.):

(14) daach'#stłna-'#n' naa-s-ee-ya, ch'ąą-[n]-t'a' nąą-[n]-n#-sh-ch'a store-to MOV-PERF-1s-go AWAY-REV-fly/PERF MOV-REV-PERF-1s-go.away 'After I went to the store, I came back (home)' (Lit.: 'I went to the store, flying back I came bac')

The extreme finiteness of Tolowa syntax is most conspicuously underscored by its lexical nominalizations, which display full finite structure. Only in some agent nominalizations does one find an (optional) nominalizing suffix. And if the verb is transitive, the now-extinct old antipassive ('impersonal object') prefix is used. Thus (Givón 2000):

- (15) a. **ch'**-u-ł-ch'ak-**ne AP**-CON-L-pinch-**NOM** 'hawk' ('he pinches things')
 - b. k'waạ'n'-**ch'**-uu-le' ON-**AP**-CON-stick 'mosquito' ('he sticks something on')

In object/patient nominalization, the passive ('impersonal subject') prefix is used:

- (16) a. t**æ-d-**k'æsh TH-**D**-pull 'bow' ('one pulls it')
 - b. ye'-na-y-**d**-tr'ush under-MOV-TR-**D**-wear 'underwear' ('one wears it under')
 - c. tu-**d**-ł-xut TH-**D**-L-gulp 'water' ('one gulps it')

And in oblique nominalizations of three-argument verbs, both the passive and antipassive prefixes can be used:

(17) a. m**#i**-**ch'#**-**d**-**i**-ts'a's WITH-**AP-D**-L-whip 'whip' ('one whips things with it')

- b. m**i**'-**ch'#**-gh**#**-**d**-ł-t'e'sr IN-**AP**-PERF-**D**-L-write 'book' ('one wrote things in it')
- c. k'w#t-gee-na-'-d-'a ON-UP-MOV-AP-D-say 'altar' ('one says things (prayers) on it')

3. Two diachronic routes to clause-union

3.1. Preamble

In this section we will examine the two main diachronic pathways to clause-union. The first one involves the embedding of a clause into the verb phrase as a **verb complement**, whereby both main and complement clause now fall under a single intonation contour. Here the complement-clause event is treated analogically as a **nominal object** of the main clause. This 'syntactic metaphor' is not just a convenient simile, but is supported by the fact that in all languages the verbs that take embedded complements--'see', 'hear', 'feel'; 'want', 'finish', 'start'; 'make', 'tell', 'know', 'remember', 'say'--also, overwhelmingly, take nominal objects. On occasion one may even find the hybrid transitional constructions where both complements appear in the same clause (Givón 1991b; see section 6 below).

The second pathway involves the condensation of a **clause chain** into a single serial-verb clause. Here the resultant complex event is treated analogically as a **clausal conjunction**.

What I hope to show here, among other things, is that the first type leads to a much more complete clause union, including co-lexicalization and the integration of GRs into a coherent single set. In the second type, the resultant serial-verb clauses often displays only partial clause-union.

Four typological caveats need to be noted at this point:

(i) Under some syntactic conditions--most conspicuously when the two (or more) verbs are adjacent and morphologically unmarked--complete clause-union may be achieved in serial-verb clauses.

(ii) The distinction between a nominalizing vs. finite language does not always coincide 100% with the distinction between embedding vs. serializing languages, respectively. There is indeed a substantial correlation between the two features, but it is not absolute.

(iii) A language may be predominantly embedding or serializing, but still have some construction of the opposite type.

(iv) Finally, the syntactic differences between the two major types of clause union need not imply parallel semantic differences in event integration (as suggested by Pawley 1976/1980, 1987). Rather, these synchronic differences are mere syntactic consequences of the different diachronic pathways.

3.2. Clause-union in equi-subject (SS) configurations

3.2.1. Verb adjacency and co-lexicalization

(A) VP-embedding languages

As noted earlier above, clause union in equi-subject (SS) configurations is the main diachronic venue of grammaticalized T-A-M markers (see (3b)), directionals (3d,h), cognate object constructions(3e), ideophone clauses (3f), resultative clauses (3g) and co-verb constructions (3h). In VP-embedding languages, complements in such a configuration are treated analogically as nominal objects of the transitive main verb. The main verb in such configuration retains the finite inflections, such as tense-aspect-modality and pronominal affixes. The complement verb is either partially or fully nominalized, exhibiting less-finite or non-finite morphology. When full clause union occurs, the grammaticalized main verb contributes all its finite marking to the co-lexicalized compound verb.

In both VO and OV languages, SS-complementation places the complement verb directly adjacent to the main verb, thus facilitating co-lexicalization and full clause-union. Thus compare the VO complementation pattern of English (18a) with the OV pattern of Ute (18b):

(18) Equi-subject (SS) clause-union in embedding languages:



Mary **finished** [0] **reading** the book

b. Ute (OV) (Givón 1980b):



'Mary finished reading the book'

When the main verb ('finish') grammaticalizes as a perfect(I've) aspect, it becomes --at least initially--a finite auxiliary that remains, morpho-syntactically, the main verb of the complex two-verb clause. This is the case in English (18a). Eventually, if that auxiliary grammaticalizes fully, it becomes a prefix on the complement verb in a VO language, or a suffix in an OV language. With cliticization, the erstwhile auxiliary now brings along all its finite morphology to the complex main verb, as is the case in the Ute example (18b).

(B) Serial-verb languages

In serial-verb languages, two major factors conspire against complete clause-union. First, the precursor chained structure quite often prevents verb adjacency, scattering object nominals between verbs. One or more of the verbs in the clause may grammaticalize or co-lexicalize semantically, but it is not adjacent to another verb. As an illustration of this, compare the SS-complementation of the embedding languages in (18a,b) above with the serial-verb languages Saramaccan (VO) and Supyire (OV) in (19a,b) below:

(19) Equi-subject (SS) clause-union in serial-verb languages:

S

SUBJ VP VP [S]

V OBJ SUBJ VP

V

a bi-**fefi** di-wosu [0] **kaba** he TNS-**paint** the-house **finish** 'He finished painting the house' (Hist.: 'He painted the house and finished')

b. Supyire (OV) (Carlson 1994):

S SUBJ VP VP [S]

SUBJ VP

PERF V PERF OBJ V

maa [0] ' **nura** [0] à u-kuntunu-sEEge **wwu** and (she) PERF **return** (she) PERF her-monkey-skin **take** '...and she again took her monkey-skin...' (Hist.: '...and she returned and took her monkey-skin...')

When 'finish' in (19a) and 'return' in (19b) grammaticalize as aspect markers, they often have no adjacent main verb to cliticize to.

3.2.2. Finiteness gradients and grammaticalization

A second factor that conspires to subvert full clause union in that of lack of clear finiteness gradients among the verbs in the serial clause. As noted above, the syntactic configuration that gives rise to clause-union in VP-embedding languages is structured by analogy with the V-OBJ configuration of the simple clause. In such constructions, the main verb retains all finite verbal features, while the complement verb is nominalized, non-finite or less-finite. When clause-union occurs in this syntactic configuration, the grammaticalized main verb--now co-lexicalized with the complement verb--contributes all its finite inflections to the new complex lexical verb. As an illustration of this, consider the Spanish auxiliaries, as in:

- (20) a. **se-lo-**est-**amos** explicando **DAT/3s-ACC/3sm-**be-**1p** explain/PART 'We are explaining it to him/her'
 - b. se-la-h-an dado DAT/3s-ACC/3sf-have-3p give/PART 'They have given it to her/him'

In serial-verb languages, quite often the verbs in the precursor chain are of equal finiteness. When such a chain condenses into a single serial clause, the verbs in it likewise do not diverge in finiteness. What is more, even in languages where finite verbal morphology had consolidated on a single verb in the precursor chain--and thus on single verb in the resulting serial clause--that most-finite verb could just easily be either the one that is de-semanticized and grammaticalized, or the one that retains its initial lexical-semantic function. As an example consider Miskitu (OV), where the grammaticalized verb may be the finite chain-final/clause-final one, as in 'go' in (21a), or the non-finite chain-medial/clause-medial one, as in 'join' in (21b) (Hale 1991):

- (21) a. Baha usus-ka pali-i wa-n that buzzard-CNS fly-INF go-PAST/3
 'That buzzard flew away' (Hist.: 'The buzzard flying, it went'
 - b. Yang nani ulta kum maki-i bangwh-I s-na
 1 PL house one build-INF join-INF be-1
 'We are building a house together'
 (Hist.: 'We building a house, joining, we are'

In Akan (Benue-Kwa; Niger-Congo), the verbs in the precursor chain or the condensed serial clause may be of equal finiteness, as in (22a). Or the grammaticalized verb may be non-finite (22b). Thus (Osam 1997):

- (22) a. Kofi soa-a adaka-no ko-o skuul Kofi carry-PAST box-the go-**PAST** school 'Kofi carried the box **to** school'
 - b. Kofi **de** abaa-no hwe-e abofra-no Kofi **take** stick-the whip-PAST child-the 'Kofi whipped the child **with** the stick'

The conflation of both factors--verb dispersal and lack of consolidated single locus of finite morphology--renders clause-union in -serial-verb languages much more problematic, as compared to embedding languages.

3.3. Clause-union in switch-subject (DS) configurations

(A) VP-embedding languages

Switch-subject (DS) clause union involves a family of broadly causative or resultative constructions, where the subject/agent of the complement verb is co-referent with the object/manipulee of the main verb. These structures are broadly patterned on DS-complementation of manipulation verbs such as 'make', 'cause', 'force' or 'let'. In VP-embedding languages, finite marking again gravitates to the main verb, leaving the complement verb nominalized, non-finite or less-finite. In an OV language, the main causative verb in DS complementation of this type always winds up adjacent to the complement verb. This makes co-lexicalization and full clause-union only a matter of time--provided the main verb is high enough on the complementation scale, as is the case with the causative construction in Ute (Givón 1980b):



The syntactic structure in (23) is probably too abstract or 'historical', since full clause-union and co-lexicalization leaves us a complex bi-transitive verb with two objects--one the causee, the other the patient of 'fry'. A more realistic synchronic structure is thus:

(24)

SUBJ

S

OBJ OBJ V

VP

mamach ta'wach-i tukuavi **cíira-ti**-kyay-'u woman/SUBJ man-OBJ meat/OBJ **fry-CAUS**-ANT-3sAN 'The woman made the man fry the meat'

In a VO languages such as English, it appears first that there is no automatic verb adjacency in DS-complementation, since the object of the main verb intervenes between the two verbs:

(25) S SUBJ VP V OBJ COMP [S] SUBJ VP V OBJ

Mary made John [0] cook the-meat

Over time, however, a VO languages can affect predicate raising and co-lexicalization in such a construction, as in Spanish: [FN 9]

(26) María se-la-hizo comer la manzana a Juan Mary him-it-make/PRET/3s eat/INF the apple DAT John 'Mary made John eat the apple'

(B) Serial-verb languages

Here again, serial-verb languages come short of full clause- union. Because of the dispersal of verbs among objects, such languages often fail to achieve full co-lexicalization (6c). Their objects often cluster with their respective verbs as distinct VPs, so that several objects in the serial clause may bear the same GR--each to its own verb (6b) (Osam 1997). And finite morphology often fails to concentrate in a single verb (6d).

The only structural device serializing languages use consistently to indicate clause integration is the most universal and iconic one--intonation; so that the multi-verb serial clause falls under a unified intonation contour, with neither pause nor a subordinator (6f).

Thus, consider the serial resultative (DS) constructions in:

(27) a. Akan (VO; Osam 1997):

Esi yi-i tam-no fi-i pon-no-don Esi take-**PAST** cloth-the leave-**PAST** table-the-on 'Esi took the cloth <u>off</u> the table' (Hist.: 'Esi took the cloth and **it** left the table')

b. Miskitu (OV; Hale 1991): Yang truk-kum atk-ri wa-n I truck-a sell-DS/1 go-PAST/3 'I sold the truck away' (Hist.: 'I sold the truck and it went away')

c. Tok Pisin (VO; Givón 1991):
...em layt nau paya i-kamap...
she light now fire PRED-come.up
'...She lights the fire...'
(Hist.: 'She lights the fire and it comes up')

d. Tok Pisin (VO; Givón 1991):
...em tromwey sospan i-go...
she threw.away saucepan PRED-go
'She threw the saucepan away'
(Hist.: 'She threw the saucepan and it went away')

e. Kalam (OV; Givón 1991):
...mon d-angiy-ek yin-ip...
wood take-light-PAST/SEQ/DS/3s burn-PERF/3s
'...She lights the wood...'
(Hist.: 'She takes and lights the wood and it burns')

In all these examples, the object of the first verb is semantically the subject of the second. Often the old switch-reference morphology of the precursor chain is left intact in the serial clause (27b,e) above. But, by all available syntactic tests for GRs, the semantic 'subject' of the second clause is a grammatical **object** in the serial clause.

The same also applies to bona-fide causative constructions in serial-verb languages, as in:

(28) a. **Supyire** (Carlson 1994):

mii à u **karima** à ngukuu **lyi** I PERF him **force** PERF chicken **eat** 'I forced him to eat the chicken' (Hist.: 'I forced him and <u>he</u> ate the chicken')

b. Ijo (Williamson 1965):
woni u mie-ni indi die-mi
we him make-ASP fish share-ASP
'We made him share the fish'
(Hist.: 'We made him and he shared the fish')

c. Ijo (Williamson 1965): ari u mie mu-mi
I him make go-ASP
'I chased him away'
(Hist.: 'I chased him and he went')

4. The transfer of finite morphology from chains to serial clauses

The morpho-syntactic properties of the serial clauses are often imported wholesale from its precursor clause chain. If one catches the condensation early enough in the process, the only syntactic difference between chain and serial clause is their intonational packaging--separate clausal contours vs. a single-clause contour, respectively.

In Akan clause chains, in most tense-aspects all verbs are equally finite and carry the same tense-aspect marker. This feature is transferred intact to the condensed serial clause:

(29) a. Clause-chain:

Araba to-**o**, dwow, nyen-n, kyew-**e** Araba buy-**PAST** yam fry-**PAST** sell-**PAST** 'Araba bought yam, fried it and sold it'

B. Serial-V clause:

Kofi yi-i tam-no fi-i pon-no-do Kofi take-**PAST** cloth-the leave-**PAST** table-the-on 'Kofi took the cloth off the table' (Hist.: Kofi took the cloth, and it left the table')

If the clause-chaining system has chain-medial switch-reference morphology, the entire system may be transferred from the chain to the serial clause. Thus in Miskitu, the participial/infinitive suffix serves as a chain-medial SS marker, and the finite past suffix as a chain-medial DS marker, as in (Hale 1991):

(30) a. Participle suffix as chain-medial SS marker:

Yang ulta-ra dim-i kauhw-ri I house-in enter-INF/SS fall-PAST/1 'I entered the house and fell'

b. Participle suffix as clause-medial SS maker:

Baha usus-ka pali-i w-an That vulture-CS fly-INF/SS go-PAST/3 'The vulture flew away'

c. Past suffix as chain-medial DS marker:

Witin sula-kum kaik-**an** plap-an he deer-one see-**PAST/3/DS** run-PAST/3 'He saw the deer and it ran'

d. **Past suffix as clause-medial DS marker**: Witin sula yab-**an** plap-an he deer make-**PAST/3/DS** run-PAST/3 'He made the deer run'

Substantial re-analysis of the verbal morphology, between clause-chains and serial clauses, can of course occur and is indeed predictable given enough time-gap from the onset of clauseunion. Thus for example, in Kalam (Papua-New Guinea) an extensive chain-medial verb morphology signals cataphoric SS vs. DS and simultaneous vs. sequential distinctions, as well as various tense-aspect-modal categories (see Pawley 1966, 1976/1980, 1987). In most serial clauses, most of the clause-medial verbs are stripped of all such morphology. Thus (Givón 1991):

(31) a. Chain-medial DS-SS morphology:

...kikaruk am-nak-nin, nuk kimb-iy, mon kamb-ak yupiri-sap... Chicken go-IPAST/s3-SIM/DS she leave-SS wood heap-the carry-PERS/3s '...the chicken having escaped, she leaves and carries a heap of wood...'

b.

...mon tip-pang kom moch g-ip... wood chop-break roll crush do-**PERF/3s** '...he cuts-chops-rolls-crushes the wood...'

Only in few complex serial clauses in Kalam has the SS/DS morphology been integrated into the structure of the complex clause, as in (Givón 1991)::

(32) a. SS complements of modality verbs:

...nying man-**ning** gi-sap... water fill-**IRR/SS** do-PRES/3s '...she intends to fill it with water...' (Hist.: 'She intends and fills it with water')

b. DS complements of causative verbs:

'...mon d-angiy-ek yin-imb...
Wood take-light- RPAST/3s/SEQ/DS burn-PERF/3s...
'...she lights the wood...'
(Hist.: 'She takes-lights the wood and it burns')

5. Other known types of complex predicates

Having established the broad context for the diachronic rise of complex clauses, and thus also for a big chunk of the diachronic rise of complex-hierarchic syntactic structures, **[FN 10]** we are now in the position to survey some of the better-known types of 'complex predicates'.

5.1. Clearly serial

We have already surveyed this type extensively above. What we will note briefly here is the recruitment of serial verbs for the coding of **argument structure**; that is, **case-marking.** This pattern can be seen in many Kwa (Benue-Congo, Niger-Congo) languages, as in (Givón 1975):

(33) a. iywi awa utsi ikuboy took door shut'the boy shut the door'	(patient; Yatye)		
b. mo fi ade ge naka I took machete cut wood 'I cut the wood with the machete'	(instrument; Yoruba)		
c. o fi ogbon ge igi he took cleverness cut tree 'he cleverly cut the tree'	(manner; Yoruba)		
d. mo so fun o I say give you 'I said to you'	(dative; Yoruba)		
e. nam utom emi ni mi do work this give me 'Do this work for me!'	(benefactive; Efik)		
 f. o gbara gaa ahya he ran go market 'He ran to the market' 	(allative; Igbo)		

This use of serial verbs is extremely wide-spread, and the semantics of the small group of verbs that partake in this function is highly universal and indeed striking: 'take' (PAT, INSTR, MANN), 'give' (DAT, BEN), 'go' (ALL) and 'come' (ABL). These are, of course, members of a slightly larger set of **'the usual suspects'** that are repeatedly implicated in various types of grammaticalization. Thus for example, the set 'take/have', 'be/stay/sit', 'finish', 'start, 'want', 'go' and 'come' is most prominent in the grammaticalization of tense-aspect-modality.

For the purpose of the discussion here, it is important to remember that the morpho-syntax of case-marking serial verbs owes its structure largely to its diachronic precursor, the clause-chain. This is particularly striking in terms of the incomplete grammaticalization of such verbs, which often retain older formal verbal properties in spite of their new grammaticalized function (Osam 1997).

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This is particularly striking when one compares these case-marking serial verb with the very same functional development in an embedding/nominalizing language, where grammaticalization of the erstwhile verbs is much more complete. For example, Ute derives all locative case-markers from historically-still-traceable precursor verbs. But these erstwhile verbs cliticize as noun suffixes, are in most cases phonologically reduced, and carry no discernible residue of verbal properties. Thus (Givón 1996):

post-position	source verb
-va/-pa 'at'	-paa 'pass (through)' (morphologically defective; old)
-kwa 'to'	-kwa 'go to' (morphologically defective; old)
-chux 'to' (an. obj.)'	-chugwa 'meet (an. obj.)'
-tux 'to' (inan. obj)	-tugwa 'go to'
-mana 'from'	-mana 'leave'
-caw 'Toward'	-cawi 'come to'
-naagh 'in'	-naagha 'enter'
-tarux 'on (top)'	-tarugwa 'climb'
-pa'agh 'on (top)'	-pa'agha 'ascend'
-tuvwa 'down'	-tuvwa 'descend'
-ruk 'under'	-rukwa 'descend'
-yaakwi 'down into'	-yaakwi 'descend into'
-paw 'down'	-pawi 'descend'

(34) **De-verbal Ute post-positions**:

5.2. Clearly embedded

In this section I will review three well-known multi-predicate constructions, suggesting that in each case their structural properties point to a reasonably clear VP-embedding diachronic source.

5.2.1. Cognate object constructions

Cognate object constructions, as they are known in English, are a type of multi-predicate clause. In such constructions, a member of a relatively small group of highly de-semanticized **'light' verbs** carries the finite verbal morphology. Such a main verb may be followed by a nominalized verb, an adjective, an adverb, or even an ideophonic exclamation. The group of 'light' verbs that partake in this construction is small and contained a predictable selection of **'the usual suspects'**. In contrast, the nominalized **'heavy' verbs** that follow contain much of the semantic weight of the construction, and are much more numerous. As a brief illustration, consider:

- (35) a. **Give**: give speech/talk/lecture/demonstration/performance; give a hint, give it a thought, give a kiss, give a signal, give a break, give chase, give a try, give it a shot
 - b. **Put**: put an end, put some thought into, put one's mind to, put some effort into, put a question to, put to a vote, put to flight/sleep/work/good use, put in a good word
 - c. **Make**: make a decision/effort/attempt/try/decision/error/ suggestion/mistake/promise/pass; made a turn/ circle/top/start; make do without, make haste, make believe, make the grade, make good time, make eyes at, make a joke, make sense
 - d. Pay: pay attention, pay heed, pay ones respect, pay a visit
 - e. Throw: throw a fit/party/question/suggestion/curve
 - f. **Take**: take an oath/break/leap/plunge/turn/look/leak/crap/ risk; take heart, take stock of, take time to, take care of, take sick, take effect, take a stand
 - g. **Have**: have a feast/ball/party/cry/laugh/doubt/idea/pity; have a problem, have a second thought have lunch, have a meeting
 - h. Get: get busy/mad/sad/happy/wild/corny/old/young (etc.); get going, get on in years, get along with, get to the point
 - i. **Do**: do justice to, do...out of, do good, do injury, do a disservice, do a service, do a favor, do a show, do a song, do without
 - j. Go: go nuts/mad/hungry, go well with, go too far, go fifty-fifty on the deal, go dutch, go to a lot of trouble, go against the grain, go back on one's word, go off like a rocket, go kapow!, go bang!, go
 - k. **Come**: come clean/loose/true; come to an understanding, come into blows, come to a halt, come along, come to think/believe/understand/know/realize
 - 1. **Stand/stay**: stand accused/guilty/tall/corrected; stand to gain/loose, stand trial, stand to reason, stand close scrutiny; stay put/healthy/alive/active/alert/in touch
 - m. Turn/become: turn yellow/green/white/red/blue/hostile etc.
 - n. Utterance verbs: utter a cry/curse, say a prayer/blessing, cry uncle, sing the praise of

5.2.2. Ideophone constructions

An extreme case of the 'cognate-verb' construction may be found in So. Bantu languages, where hundreds of multi-predicate clauses may be built by combining a single 'light' verb--'say'/'do'-with so-called **ideophones** that carry a large variety of meaning, many manner adverbial. Many of these ideophones are etymologically related to extant verb stems. Others are perhaps onomatopoeic, and many are of undetermined origin. The 'light' verb say/do is the only finite verb in the ideophonic construction, and the ideophones themselves carry no finite verbal morphology. As a cursory illustration from Tswana, consider(Cole 1955):

- (36) a. dithupa dine ts-arobega ts-a-re kgothu kgothu stick those they-broke they-PAST-say ID ID 'the sticks broke going "snap" "snap"'
 - b. (na) a-ntse a-re na na na (he) he-walking he-say ID ID ID '(he) walking very softly'
 - c. pula e-ne entse e-re gwaa rain it-fall on.ground it-say ID 'the rain fell heavily'
 - d. ba-bo-tsaya ba-bo-re goro fafa-tse they-it-pour.out they-it-say ID on-ground 'they poured it down on the ground'
 - e. logadima lono lo-gaketse lo-**re** lai lai lightning that it-fierce it-**say** ID ID 'the lightning was fierce, flashing repeatedly'
 - f. mme rraagwe a-mo-tshwaara a-mo-**re** thusu thusu thusu kamoretlwa father his he-him-caught he-him-say ID ID ID Stick 'his father caught him and hit him swish swish swish with a stick'
 - g. yo-le a-didimala fela a-re tuu she-be she-quiet complete she-say ID 'she said nothing, keeping very quiet'

5.2.3. Co-verb constructions

In light of what was said about the last two constructions, let us consider the classical coverb construction. In Wagiman (Australia), a small group of light verbs, 45 in all, can head complex multi-predicate clauses. These verbs take the full range of finite verbal morphology, and may also stand by themselves and code states or events without any added predicates. They form a closed lexical class, and include all **'the usual suspects'** found in the serial clauses of Benue-Kwa or the cognate-verb constructions of English (italicized in (37) below). Thus (Wilson 1999): 27

(37) hit, eat, stand, come, cut, take, put, get, turn/become, burn, step on, be, become, hear, throw, spear, cry, go, bite, cook, dream, cause, name/beget, leave/go, lose, make, tell lies, have/keep, follow, sew, love oneself, fuck, chase, see, give, fear, look for, bring, tell off, sing, stay

The bulk of events/states in Wagiman are coded by combining one or more non-finite 'coverbs' with at least one 'light' verb. Semantically, a co-verbs may code an intransitive state ('be sick'), an intransitive event ('swell'), an intransitive motion ('run'), a communicative act ('talk'), a bodily function ('yawn'), a transitive event of impact ('kick') or possession ('hold'), a bi-transitive transfer event ('pour'), an environmental phenomenon ('thunder'), or a manner adverbial ('quickly'). The lexical class 'co-verb' is, as one would expect, large and wide open. In terms of finite marking, co-verbs can take one semantically-bleached 'aspectual' suffix and a number of derivational suffixes. For some illustrative examples of these constructions, consider (Wilson 1999):

- (38) a. liri-ma nga-ya-naggi munybaban swim-ASP I-go-PAST other.side 'I swam to the other side'
 - b. bewh-ma nga-bu-ni boran cross-ASP I-hit-PAST river 'I crossed the river'
 - c. guk-ga nga-ge-na gahan warri-buga? sleep-ASP I-put-PAST that child-PL 'did you put the children to sleep?'
 - d. ngarrmen lem du-ng hollow.log be/PRFV 3s/cut-PAST/PFV
 'it entered the hollow log'
 - e. gabarn-na wek-ga ga-**ra**-n quickly-ASP swallow-ASP 3s-**throw**-PAST/PFV 'he swallowed it quickly'

The suggestion that the semantically-heavy 'co-verbs' arose as embedded complements is strengthened by their pre-light-verb position, given the incipient--or at least reconstructable–OV order found in Australian language.

5.3. Complex multi-stem the verbal word

We come now to the more difficult cases, those of multiple stems that co-lexicalize to form a single verbal word. Some of these constructions may be too old to allow reconstruction of the pathway that gave them rise. But in some cases the pathway may still be transparent.

5.3.1. Pre-verbal incorporation of post-positions in Rama

In some languages, the incorporation of adpositions into the verb is a diachronically recent and still ongoing process, so that the governing mechanism can be still observed. One such case has been seen in Rama (Chibchan), as described by Craig and Hale (1987) and Craig (1991). In this language, post-positional phrases that code various indirect objects may either follow or precede the verb. When they precede it, the object noun may be zeroed out, in context of either anaphoricity or, more commonly, non-referentiality or non-topicality (antipassive).[FN 11] The remaining postposition, sitting adjacent to the verb, then cliticizes as a verbal prefix. Thus consider:

- (39) a. ngang an-tangi Juan-ya bed they-gave John-DAT 'they gave the beds to John'
 - b. ngang Juan-ya an-tangi bed John-DAT they-gave 'they gave John a bed'
 - c. Rama ya-an-tangi
 Rama DAT-they-gave
 'they gave (it/something) to some Rama person'
 - d. ngang **ya**-an-tangi bed **DAT**-they-gave 'they gave him a bed'

Many of the post-positions involved turn out to have a verbal etymology, so that ultimately their incorporation may be viewed as one type of creating a multi-predicate construction. Rama is presently a VP-embedding, mostly-OV language. But related Chibchan and Misumalpan languages show a considerable level of serial-verb constructions (Hale 1991; Young and Givón 1990). Given the strong finiteness gradient between the main verb and the incorporated ex-verbal stem, the source of the incorporated post-positions may have been pre-verbal clausal complements. But this conclusion is not absolute certain, and the construction may have arisen from clause-chaining.

5.3.2. Pre-verbal incorporated preposition in Romance and Germanic

Pre-verbal incorporated adpositions can be found all over Germanic and Romance, where prepositions have been incorporated as verb prefixes much like in Rama. This occurred, presumably, under the same typological (SOV word-order) and functional (zeroed indirect-objects, most likely non-referential/antipassive) conditions as in Rama. By way of illustration, consider the Latin-derived abstract prepositional verbs in English, all in one way or another metaphoric extension of concrete, often spatial expressions:

(40) Prepositional prefixes in Latin-derived verbs (English):

'close'	'hold'	'build'	'call'	'press	 '
in-clude ex-clude pre-clude con-clude se-clude oc-clude	main-tain ob-tain de-tain re-tain per-tain con-tain at-tain enter-tain abs-tain	con-struct de-struct in-struct ob-struct Re-struc	ex-clain de-clain re-clain pro-clai t(ure) ac-clain pro-clai dis-clain de-clain	n ex-pre n im-pr n de-pre m re-pre n com-p im op-pr n sup-p n	ess ess ess ess press ess ress
'carry' com-port ex-port im-port de-port re-port	'bend' ex-tend in-tend con-tend dis-tend at-tend	'pull' ex-tract de-tract re-tract con-tract at-tract sub-tract	'breathe' in-spire ex-spire re-spire con-spire a(d)-spire per-spire	'form' re-form in-form de-form con-form	'throw' ====================================

suggested old concrete meaning

Since the original process in Latin is old, no firm verbal etymology for the preposition may be available, although many possible connection between prepositions and old verb stem can be suggested. Still, given that old Latin was an strongly embedding and nominalizing OV language, the pre-verbal position of the incorporated prepositions suggest that this construction may have arisen initially through the VP-embedding pattern.

One may as well note that the same process of incorporation still goes on in English, but in conformance with the current VO syntax, prepositions are incorporated post-verbally, yielding the so-called verb-particle constructions, as in:

(41) Post-verbal incorporated prepositions in English

- a. The window broke
- b. The meeting broke **up** (early)
- c. Her car broke **down** (on the freeway)
- d. Her skin broke out (in a rash)
- e. He turned (and left)
- f. (So finally) he turns up (in Las Vegas)
- g. They turned **in** (for the night)
- h. It turned **out** (that she was right)
- i. She worked (hard)
- k. It worked **out** (just fine)
- l. They worked **out** (in the gym)
- m. He worked **up** a sweat
- n. They broke the furniture
- o. She broke up their engagement
- p. They broke him **in** (gradually)
- q. He broke it **down** (for them into small pieces)
- $\boldsymbol{r}\,$. He turned the key
- s. He turned the key **over** (to her)
- t. They turned her **down** (for the job)
- u. She turned **in** her report (and went home)
- v. They shut the door
- w. She shut him **up**
- x. They shut the plant **down**
- y. We shut them **out** completely (ten to nothing!)
- z. He shut the water **off**.

These 'stranded' prepositions in English, while semantically part of the verb, have not yet fully incorporated into the verb morpho-syntactically. For one thing, they still retain their lexical stress. For another, in many contexts they are not adjacent to the verb, so that the order variation V-OBJ-PREP vs. V-PREP-OBJ is functionally significant (Chen 1986). The syntactic pattern of this incorporation probably follows established Germanic pattern s (pre-verbal in the old OV Germanic dialects), and thus does not imply a direct connection to the VP-embedding pathway.

5.3.3. Incorporated objects, instruments, adverbs and verbs in No. Uto Aztecan

Object nouns, instruments and manner adverbs can incorporate into verbs. Over time, such a process may yield complex multi-stem verbal words that are on occasion also discontinuous, stranding non-lexical element between other parts of the compounded verbal word. As a quick illustration of how incorporation may over time yield complex 'bi-partite' verbs, consider No. Paiute, (Thornes 1996; Delancey 19991, 1999b):

(42) a. ka-t u -pongosa ma -tabui-na ACC-POSS-arrow hand -create-ASP '(they) hand-made their arrows'	(<i>ma</i> - 'hand')
b. t u -tama-ma o- gu -pada-na POSS-teeth-INST 3- bite -bend-ASP '(they) bend it by biting with their teeth'	(g#- 'bite')
c. i-kaazi to -noyoi my-car fist -move '(you) push my car'	(<i>to-</i> 'fist')
d. d u -gu-hani my/ASP-fire-prepare '(s/he) cooks for me'	(gu- 'fire')
e. ta -hani foot -prepare 'herd (sheep/cattle)'	(<i>ta</i> - 'foot')
f. ku-pi -suki fire-back -warm 'warm one's back at the fire'	(<i>ku</i> - 'fire', <i>pi</i> - 'back')
g. pa-ko-ma- ma'i water-face-hand- wash 'wash one's face'	(pa- 'water', ko- 'face', ma- 'hand')
h. tsa- noyoi grasp- move 'pull'	(<i>tsa</i> - 'grasp')

i. i-giki-kuba wi-ni-u (wi- 'long') my-foot-on long-step-ASP '(s/he) stepped on my foot'
j. kosso-kimaba a-tsi-kwini-ki (tsi- 'sharp') fire-beside ??-sharp-stand/pl-ASP

While many of the affixes involved are too old to determine their etymology, it is most likely that they have been derived through the incorporation--of nouns, adjectives or verbs--into formerly-simple verbs. In Ute, a related Numic language, the same pattern of pre-verbal incorporation is synchronically productive as, among other things, an antipassive device for non-referring objects or intsrumentals, a semantic pattern reminiscent of Rama and Latin/English, above. Thus (Givón 1980b):

(43) **Object-incorporation antipassive in Ute**:

'stick (the sticks) along the fire'

a. Active-transitive:

ta'wach 'u kwanach-i 'uwa-y pakhá-p#ga man/SUBJ DEF/SUBJ eagle-**OBJ/AN** DEF/**OBJ/AN** kill-REM 'The man killed the eagle'

b. Antipassive:

ta'wach 'u **kwana**-pakhá-puga man/SUBJ DEF/SUBJ **eagle**-kill-HAB 'The man killed eagles' 'The man did some eagle-killing'

Object incorporation is also used in Ute nominalizations, which have the same objectsuppressing antipassive flavor as their English counterparts:

(44) a. Agent nominalization:

ta'wach kwana-pakha-mi-t 'ura-'ay man/SUBJ eagle-kill-HAB-NOM be-IMM 'The man is an eagle-killer' (> He kills eagles in general)
b. Action (VP) nominalization: kwana-pakha-ta ka-'ay-wa-t 'ura-'ay eagle-kill-NOM NEG-good-NEG-NOM be-IMM 'Eagle-killing is bad' (> 'the killing of eagles in general')

This pre-verbal incorporation pattern is also productive in Ute with semanticallyappropriate verbs, adjectives, adverbs and instrument, as in (Givón 1980b):

- (45) a. **saku**-paghay-'way **limp**-walk-IMM 's/he limp-walks'
 - b. mama-paghay-'way
 woman-walk-IMM
 'he walks like a woman'
 - c. wii-pakha-ux-kway-'u knife-kill-ASP-REM-him/her 's/he killed him with a knife'
 - d. '**atu**-may-рыga well/good-speak-REM 's/he spoke well, eloquently'

The antipassive object-incorporation pattern requires no invocation of pathway to complexity beyond the OV order of No. Uto-Aztecan. This pattern may have been later extended, analogically, to incorporated verbs. In such extreme nominalizing, VP embedding languages, the VO-embedding pathway is strongly suggested. The bare-stem, non-finite, status of the incorporated verbs certainly conforms with this pattern.

5.3.4. Pre-verbal incorporated adverbials in Athabaskan

In Athabaskan languages, the lexical verb-sense is obtain from combinations of old verb stems with 'adverbial' prefixes. The latter may have begun their life as verbs, but then grammaticalized as post-positions and eventually incorporated into the verbal word (Underriner 1997; Givón 2000). As an illustration of many of the adverbial prefixes with a single verb, consider Tolowa Athabaskan, the oldest of these prefixes (*-na-* 'motion') can be augmented by more recent ones, many of them with clear verbal etymology (Bommelyn 1997; Givón 2000):

(46)	a. na-ł-da	's/he runs'	(-na 'move around')	
	MOV-L-run			
	b. waa-na-ł-da	's/e runs that-a-way'	(-wa 'go')	
	c. yaa-ł-da	s/he runs through (it)'	(- <i>ya</i> 'go')	
	d. daa- na-ł-da	's/he runs into (it)'	(-da 'sit/live')	
	e. k'wee-na-ł-da 's/he is running behind (it)"			
	f. tr'ee-na-ł-da	's/he runs down'		
	g. see- na-l-da	's/he runs up'		
	h. tee- na-ł-da	's/he runs under water'	1	
	i. yee-na-ł-da	's/he runs under (it)'		
	j. ch'aa-ł-m u s	's/he runs off (road)'	(- <i>ch'a</i> 'leave')	
	k. lee-na-y'-l-d	a 'we-2 run together'	(- <i>l</i> - reciprocal)	
	l. l-ch'aa-na-ł-	da 's/he runs apart'		
	m. taa- na-ł-da	's/he runs outward'	(- <i>ta</i> 'push away')	
	n. 'ee- na-ł-da	's/he runs in a circle'		
	o. k'w#t-na-ł-d	la 's/he runs upon (it)'		
	p. ts'ee-na-ł-da	'she runs out there'		
	q. gee-na-ł-da	's/he runs away'		
	r. xaa- na-ł-da	's/he begins to run'	(- <i>xa</i> ' lift up')	

The diachronic pathway through which the Athabaskan incorporation pattern arose is not, for the moment, clear. On the one hand, Athabaskan languages are extremely finite, non-nominalizing and non-embedding. But still, it is not yet clear to what extent serial-verb clauses--the intermediate stage of the condensation in the alternative pathway--can be shown in Tolowa. Since clause-chaining is a universal construction across all typologies, however, the initial stage of this pathway is, at least in principle, always available. However, Rice (2006) has recently argued that the slot in which these 'adverbial prefixes' in Athabaskan incorporate is a nominal slot, and that the incorporated ex-verbal stems have a **nominal** form. This suggests that in spite of their highly non-finite syntax, Athabaskan languages created these complex predicate constructions via the nominalization route (Type A)..

6. Final reflections

The two major diachronic pathways to clausal complexity can both lead, at least potentially, to co-lexicalization, and thus to morphologically complex verbal words. The dispersal of verbs among objects in serial clauses certainly lowers the potential for such co-lexicalization in serial-verb languages. But as the Kalam data indicate, this tendency is far from absolute. My own suspicion is that Kalam serial clauses represents a more advance diachronic stage, where serial verbs have by and large been stripped bare of their finite morphology. In contrast, the serial constructions in both the Miskitu and Akan are probably diachronically much younger, so that much of the verbal morphology found in clause chains is still found in the 'condensed' serial clauses.
35

My discussion thus far may have left the unfortunate impression that only in serializing languages (Type B) does one start initially from a two-clause parataxis, which is then condensed into a complex clasuse under a single intonation contour. In a subsequent study I intend to show that in embedding languages (Type A) too, complex clause arise through the condensation of paratactic precursors in which main and complement clause fell under separate intonation contours. In both major diachronic pathways, therefore, the process of creating complex clauses begins with two-clause parataxis, proceeds through an intermediate stage of condensation under a single intonation contour, and may end in co-lexicalization and complex words (for an extensive discussion of the latter stage, see Dahl, 2004).

The distribution of finite marking is but a methodological, heuristic tool that makes its easier to reconstruct the diachronic pathway, be it VP embedding or clause-chaining, in the absence of explicit historical records. But in the final stage of the condensation process, that of complex (colexicalized) verbal words, the telltale signs of diachrony have been largely zeroed out, so that reconstructing the diachronic pathway that led to the complex verbal word is much harder.

The two major diachronic pathways can be thus summarized schematically as in:

(47)	stage:	embedded pathway:	clause-chain pathway:
	i. paratactic source:	paratactic main+COMP	chained main+COMP
	ii. complex clause:	embedded main+COMP	serial-verb clause
	iii. complex word :	complex verbal word	complex verbal word

As a quick example of the early paratactic hybrid constructions that can lead to the eventual condensation of verb-complement complex clauses, consider V-complements in Biblical Hebrew, where this process remained endemic across a diachronic continuum spanning over 1,000 years (Givón 1991b):

- (48) a. va-yar' 'elohim 'et kol 'asher "asa ve-hine tov and saw God ACC all REL made and-lo good 'And God saw all that he had done that it was good' (Lit.: 'And God saw all that he had done, and lo it was good') [Genesis 1.31]
 - b. 'al ti-r'u-ni she-'ani sHarHoret NEG you-see-me REL-I swarthy/sf
 'Don't see me that I am swarthy'
 (Lit.: 'Don't see me, I who am swarthy') [Song of Songs, 1.6]

Similar examples of such condensation from earlier parataxis are discussed by Heine and Kuteva (forthcoming).

In the same vein, one may as well note that the one major venue to clausal complexity not discussed here, the rise of **embedded relative clauses**, also progresses through the three diachronic stages: From parataxis to embedding in the NP (Givón 1991b; 2001, ch. 14; Heine and Kuteva, forthcoming). And at least potentially, embedded REL-clause can also lexicalization, yielding nouns or names.

Lastly, note that both stages of condensation along our diachronic pathways-syntacticization (embedding) and lexicalization --are driven by functional-cognitive imperatives, and thus ultimately by **usage frequency**. This is the real significance of our list of **'the usual suspects'**, this ubiquitous small group of verbs ('closed class') whose initial usage frequency is high in all languages. These are the verbs that retain old ('irregular') forms long after those are leveled off in the rest of the verbal lexicon (Zipf 1935). These are the verb that tend to become classificatory, generic, grammaticalized, 'light' or de-semanticized, and thus become operators on other ('operand') predicates. Through whatever pathway, these high-frequency verbs tend to partake disproportionally in multi-predicate combinations that code complex events. But it is their initial semantics--general, classificatory, cognitively and communicatively central--that lends them their ubiquity.

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37

FOOTNOTES

1

An event clause in natural connected discourse need not, of course, contain an explicit lexical predicate, although when it doesn't, one is most often implicit (Chafe 1994; Givón 2002, ch. 3). 2

The term 'clause union' was used initially in the early 1970s context of Relational Grammar, in a purely synchronic sense, dependent as it was on the notion of 'syntactic transformation'. 3

This affixation of one verb to another is sometimes called 'predicate raising'.

Tok Pisin (Givón 1991a), here this is a serial-verb construction.

5

Wagiman (Wilson 1999). While recognized syntactically as a *co-verb* construction, the semantic configuration here is that of *directional*, thus akin to (3d) above.

6

Comrie (1976) has attempted to deal with this competition with a mechanical syntactic hierarchy. Both Shibatani (1976b) and Cole (1977/1984) have shown that the competition is resolved along semantic grounds.

7

The discussion of finiteness here is based on Givón (2001, vol. II), mostly on various sections of chs 11 (noun phrases), 12 (verbal complements), 14 (relative clauses) and 18 (clause chaining). 8

Most of the syntactic relations between clauses that were taken to be synchronic 'transformations' in Harris (1956) and Chomsky (1957, 1965) turn out to have at least some diachronic reality. This is analogous to Chomsky and Halle's (1968) *Sound Patterns* turning out to be, primarily, a recapitulation of the history of English phonology.

9

Since the intervening object (causee) is highly topical, often anaphoric and thus marked as verbal inflection or zero, its 'intervention' between the two verbs is often illusory. 10

The only major pathway to syntactic complexity we deliberately refrained from covering here is the one that gives rise to are NP-embedded REL-clauses. This is so because, with few exceptions, this pathway does not give rise to merged clauses. But here too, the ultimate source is parataxis. 11

A text-based functional study by Tibbitts (1995) strongly suggests the latter.

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Engines of Linguistic Complexity Brian MacWhinney, CMU

Human language is enormously complex. Some of this complexity is located within individual speakers. Each of us knows tens of thousands of words, and each of these words inhabits its own microworld of complexity. When we put these words together into sentences and discourse, still further complexities arise in the form of collocations, phrases, and grammatical relations. These patterns at the individual level become even more complex when we look at how language varies across social groups and communicative situations.

Fortunately, we are able to use the methods of sociolinguistics, diachronic linguistics, and typological analysis to track this complexity as it arises. Sorting out the patterns is hard work, but the data are rich and we have good methods for conducting this analysis. In theoretical terms, it is also fairly easy to adapt the Darwinian theory of natural selection to apply to the generation of linguistic complexity. In the traditional Darwinian framework, mutations and sexual recombination produce variations in the genotype which then lead to variations in the phenotype. Some of these variations are favored above others. Successful variations thrive and propagate, whereas unsuccessful variations disappear.

Over time, these Darwinian processes have produced enormous complexity in the basic systems supporting life (Tublitz, this volume). Respiration within the mitochondria provides a well-known illustration of this biological complexity. In respiration, glucose is oxidized to carbon dioxide, and adenosine triphosphate (ATP) is produced as a byproduct. Through a chain of catalytic reactions, including glycolysis and the Kreb's cycle, one molecule of glucose ends up producing 36 molecules of ATP. The complexity and interlocking balance of the various turns of these catalytic cycles is nothing short of amazing. It is even more amazing to realize that evolution pieced this complex system together, layer by layer, through a blind process of trial and error that extended over hundreds of millions of years.

Linguistic complexity depends upon a neural system whose structure is far more complex than that of respiration. Unlike respiration, linguistic complexity arises from both genetic engines that build complex structures in the human brain and mimetic engines (Mesoudi, Whiten, & Laland, 2006) that codify complex structures from social interaction. Both of these engines depend on variation, adaptation, and selection. For both engines, we are not interested primarily in the initial variation, but in the end structures that result from selection. Of course, we want to understand variation itself as the initial source of complexity, but we do not want to focus on the

complexity involved in the variation, but rather the complexity in the forms that are selected out for further integration into complex neurological and stored structures. In other words, we are talking about the ways in which variations become stabilized and preserved over time during both during child language learning and during the ongoing change of the language itself across time.

The fundamental challenge here is to understand the ways in which the brain provides support for the consolidation of complexity. Once we understand how the core support operates, we can then move on to study how ongoing mimetic processes make use of these core mechanisms to consolidate linguistic complexity. So, let us begin our exploration by considering the neural engines that generate and store We can begin by recognizing the importance in neural complexity, terms of the six fundamental levels of linguistic analysis: auditory phonology, articulatory phonology, lexicon, morphology, syntax, and discourse. The account provided here attributes the consolidation of linguistic complexity to mechanisms operating within each of these six However, before exploring processes and structures systems. operative on each of these six levels, we need to consider some basic issues regarding pseudo-modular organization in the brain.

Modularity and maps

It would be tempting to think of these six levels as computational modules (Fodor, 1983; Levelt, 1989; Pinker, 1997). Indeed, each of these linguistic levels is supported by uniquely adapted processors in localized brain regions. However, thinking of these processors as protected modules like those in a Java program is not in accord with what we know about the brain (Bullinaria, 2007). We know that brain regions are heavily interconnected by asymmetric bidirectional connections. These connections cannot pass symbols, as required by the digital computer. Instead neurons must communicate by depending on isotopic mapping, learned patterns of connectivity, firing synchrony, and modulation through supervisory units. Moreover, except lower organisms or the brainstems of higher organisms, it is seldom the case that a single cell is responsible for a discrete cognitive function. This is certainly true at the level of the cortex, where cells appear to operate in assemblies of thousands of neurons to achieve single cognitive goals.

Brain development in the fetus involves the migration of neurons from the germinal matrix to the periphery. During this migration, cortical areas maintain their connections to the various subcortical areas from which they differentiated. For example, within both the

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thalamus and the hippocampus, there are separate nuclei that project to separate cortical areas. Although single axons fire in a directional fashion, these larger sets of connections are bidirectional, thereby providing a system of reentrance or interaction between areas of the brain (Tucker et al, this volume). Within each of these thalamic or hippocampal nuclei there may be additional fine-grained structure that allows the subcortical area to maintain a map of the structure of the cortical area, even after it has migrated to a more distal position. The map-like nature of these connections between cortical and subcortical structures is further supplemented by map-like connections of motor and sensory areas to external sense organs and the body. In motor cortex, there is a somatotopic organization that matches up well with the actual shape of the human body. In sensory areas, cortex is organized to represent the features of the sense. For example, auditory cortex is organized in terms of frequencies, as detected by the cochlea, which is itself organized so that neighboring hair cells respond to similar frequencies. Similarly, the visual cortex is organized in patterns that maintain the position of receptors in the left or right visual field and other peripheral patterns.

This map-like organization of the brain allows areas to communicate with themselves and the body in terms of an embodied neural code that is implicit in the position of a neuron within the map. As processing moves away from the periphery, the blending of these codes increases. However, through reentrance, it is possible for the brain to reground cognitions in terms of these original body maps (Jeannerod, 1997; Schütz-Bosbach & Prinz, 2007; Wilson & Knoblich, 2006). This basic principle of map-like organization across brain areas is further supported by learning methods that function to organize local maps. One powerful way of modeling this local organization relies on the self-organizing feature maps (SOFM) of Kohonen (1990). In this model, neuron-like units are organized in two-dimensional sheets with connections to an array of input and output features. When an input feature vector is activated, units in the map also gain some activation. Through lateral inhibition, the most strongly activated unit will inhibit its neighbors, leading to a winner-take-all effect. This pattern of activity has been well documented for cortical structures. After the initial inhibition, there is then a learning phase in which the connections with the winner and its neighbors are strengthened. As a result of this learning, responses to certain patterns in the input tended to become parceled out across areas of the feature map, with this self-organized differentiation increasing over time. This type of map is a a sparse, distributed memory, since there are typically many possible features of which only a few are active for a given input.

The DevLex Model

Li, Zhao, & MacWhinney (2007) have developed a model of lexical learning based on SOFM. This model, called DevLex, uses three separate self-organizing feature maps for auditory phonology, articulatory phonology, and lexical structure. In effect, DevLex provides us with a fully implemented, neurologically grounded, empirically successful account of organization for the first three pseudo-modules in our general account of the origins of linguistic complexity.

Featural organization on the DevLex auditory map relies on the PatPho representational system which parcels out segments into an autosegmental grid. In terms of neural processing, this model assumes that initial auditory processing has yielded a set of perceptual features that are associated with specific syllables, and slots (onset, nucleus, coda) within syllables. This representational system was introduced in MacWhinney & Leinbach (1991) and most subsequent work in neural network modeling of input phonology has used this framework. The activation of segments or syllables in a self-organizing feature map is further controlled through a sequence detection mechanism that expresses the form of a word as a linear trajectory through points in the feature map. Multiple positional variants of a given segment are represented as multiple neighboring nodes in the map. Output phonology is also represented through sequence control units that activate articulatory gestures organized in a second motor feature map. Figure 1 illustrates the overall shape of DevLex.



Figure 1: The DevLex Model

The three separate maps of the DevLex model represent three of the six core linguistic modules. These modules are each located in separate brain regions, connected by axonal projections. DexLex trains these connections using Hebbian learning. However, we will see later that there is reason to believe that other processes are involved. Input phonology is in the auditory cortex of the superior temporal sulcus. Output phonology is controlled by some parts of Broca's area, along with motor cortex. The core semantic or lexical map is centered in Wernicke's area, although it is actually far more generally distributed, as we will see later.

Looking first at the control of input phonology, we know that this processing is focused in primary auditory cortex. This area, which spans Brodmann areas 41 and 42, lies in the posterior half of the superior temporal gyrus and the transverse temporal gyri or Heschl's gyri. Within this area, there are in fact multiple tonotopic maps, each of which appears to represent a different view or processing slant on the whole range of the frequency spectrum. Work with rhesus monkeys has shown that the auditory system involves three levels of auditory processing with 15 different tonotopic maps. This pattern of multiple parallel isotopically organized maps is similar to the pattern of

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multiple parallel maps found in the motor system. Like many other cortical areas, the auditory cortex is also connected to its own specific thalamic nucleus, the medial geniculate nucleus, from which it receives input.

Human auditory processing is fundamentally similar to that of other mammals and even birds. For example, the human ability to differentiate categorically between syllables with initial voiced stops that have a release time of either more or less than 40 milliseconds after the closure is also found in chinchillas (Kuhl & Miller, 1978) and Japanese quail (Lotto, Kluender, & Holt, 1997). This result and others like it suggests that the basic neural engines for auditory feature detection were consolidated prior to the evolution of hominids. Overall, input phonology functions to reduce the enormous complexity of the auditory world to a much smaller set of contrasts that can link to output phonology and lexical structure. This reduction of complexity is operative in other mammals. However, it is likely that, under the influence of linkage to a lexicon, these processes extend further and occupy additional neural machinery in humans.

In addition to an overall sharpening of the reliance on contrasts, human and primate audition must also differ in the extent to which they must rely on mechanisms for sequence detection. Although syllables can be perceived as wholes, multisyllabic words need to be encoded in ways that associate sounds with syllable position. Prosodic features, such as syllabic stress or moraic timing, can facilitate and sharpen this encoding, but it is still likely that some form of sequence detection is involved in the interfacing of auditory processing with lexical recognition. These sequence detection processes may be present in other mammals, but they are probably elaborated in humans.

Principles of Sequence Detection and Control

There has been extensive work in neuroscience on the study of neural mechanisms for sequence detection and control. Pulvermüller (2003) reviews this literature, including classic models from McCulloch & Pitts (1943), along with some new detailed proposals of his own. The simplest form of sequence detection involves a chain of direct connections. In this scheme, when unit A fires, it primes the next item in the chain, unit B. Unit B will then fire only when it receives input both from unit A and an incoming stimulus. A similar scheme can operate for motor control by allowing actions to trigger one another in sequence, as in the avalanche model of Grossberg (1978).

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Although simple chains provide a reliable solution to the sequencing problem, they can lose sensitivity, if the delay between A and B is either less than or more than the natural timing on the syntaptic connections between the two neurons. In order to avoid this type of problem, sequence detection can rely on additional mediating elements, configured in various ways. Pulvermuller's version of this mechanism includes bidirectional connections that promote reverberation within the circuit. The fact that forward sequential connections are stronger than backward ones prevents the circuit from firing in the wrong direction. When the first unit fires, it primes the sequence detection unit which then primes the second unit and then reverberation in the whole circuit. At this point, both of the items that have been detected become "visible" which means that they can then pass on information to other processing areas. However, if the second unit fires without being primed, it fails to trigger the sequence unit and activation is then suppressed.

This account applies in a parallel way for the control of output phonology. Here, The relevant mechanism includes components in the cerebellum, motor cortex, and Broca's area. We know that the final stages of speech production involve the control of mouth movements by motor cortex, as modulated by the cerebellum. The motor cortex is directly connected to the spinal cord. As a result, lesions to the motor area inevitably lead to hemiparesis or hemiplegia. The cerebellum retains somewhat more plasticity. Yamamoto et al. (2006) have shown that the cerebellum incorporates two somatotopic systems for control of motor movements of the hand. One of these systems is hard-wired to particular effectors, the second retains full plasticity to allow for the learning of patterns of controlling the first system. It is likely that a similar dual structure also operates for the control of the vocal organs. This system for controlling speech output operates on gestural plans that are unique for each lexical item. As in the case of input output gestures are triggered by the operation of phonology, sequence planning units that trace out trajectories through a feature map space.

Initial Linkage

Having surveyed the three major components of the DevLex model, we can begin to ask how this system becomes consolidated during development in ways that can support a lexical basis for linguistic complexity. First, we can consider how output phonology becomes aligned with input phonology. MacNeilage & Davis (2000) argue that the first stages of babbling are driven by a frame-context CV organization that is parallel to the organization found in the primate

lip-smacking gesture produced by a facial gesture control area in the inferior frontal gyrus. Beginning with such resources, Oller (2000) shows how the child must spend several months organizing laryngeal and oral processes to gain control of phonation. Once phonation is in place, the linkage of input and output phonology deepens through babbling, as modeled by Westermann & Miranda (2004). Patterns arise to produce clear and interesting auditory patterns, including CV and CVCV structures and a range of segment types that the child finds entertaining and rewarding. Up to nine months, this loop between input and output phonology depends little on social input. After that time, as the child pays more attention to the input, the loop becomes further structured to match the input phonology. The complexity arising from these mimetic changes is largely represented in the differences between alternative sound systems. However, the shape of these possible sound systems is still constrained by what children can represent in hearing and reproduce in articulation.

A Distributed Lexicon

Once input and output phonology are coordinated, the child can begin to link these systems to the developing lexicon. In fact, some lexical learning can begin even when only input phonology has been consolidated. However, the presence of a full resonant loop between input and output phonology facilitates the coupling of lexical learning to social interaction. Linkage of these input-output relations to a conceptual structure sets the stage for an enormous burst in linguistic complexity. Although dogs and primates can learns dozens of words, they are unable to link their lexical map to an input-output system. As a result, higher mammals cannot rely on mimetics for organizing and enriching their conceptual lexicon. Humans, on the other hand, are able to acquire a virtually limitless array of words from conversational input.

There is currently no evidence that the brain structures involved in this learning are fundamentally different from those used by the higher mammals. However, in both humans and animals, lexical representations are far more distributed that the representations of input and output phonology. The broad area of cortex at the intersection of the parietal, occipital, and temporal lobes has further access to wide areas of the whole cortex. Unlike the feature maps for input and output phonology, the core conceptual lexicon must make contact with a very diverse set of connections across the brain. Words for tools must make contact with the motor gestures and postures involved in the use of these tools. Words for fruits must make contact

with the visual properties of these flowers, including colors, shapes, and smells. Words for actions must make contact with the motor sequences, perceptual changes, and object affordances involved in these actions. The competition between alternative tools, such as *screwdriver* vs. *drill*, arises at least partly in the motor and parietal areas that control tool usage. However, the competing cell assemblies within the lower level of this hierarchy are then able to transfer activation back to higher level units in the major map that activates phonology. Figure 2 presents a sketch of how this hierarchical organization can operate within a system of self-organizing feature maps (Dittenbach, Rauber, & Merkl, 2002).



Figure 2: Hierarchical access in self-organizing feature maps

To control this hierarchical access, the brain must rely on longdistance connections between the core lexical areas and areas that flesh out the meanings involved in words. Moreover, these hierarchical connections must be structured in a way that allows for a consistent control of competition at both the local areas and the lexical core.

Consolidation of lexical patterns

This distributed, hierarchical patterning has important consequences for the consolidation of linguistic complexity. Tucker et al. (this volume) argue that ventral stream processing operates upon discrete item-based object representations that are characteristic of processing in temporal cortex. This type of item-based encoding is supported by neostriatal attentional mechanisms and hippocampal reentrant encoding processes. The hippocampus provides a compressed encoding of the distributed patterns related to a word. By maintaining resonant and reentrant reactivation of these patterns, the hippocampus can facilitate the consolidation of these traces into a new cell assembly or lexical pattern. This ventral-hippocampal system provides the basic engine for consolidating and extending linguistic complexity at the lexical level. Here the complexity involves not just the phonological form of the word, but also the diverse connections of the lexical system to many areas of the brain. Because words have become conventionalized mimetic forms, this system then functions to repeatedly consolidate variant meaningful configurations into the same phonological bucket. From this core engine, arise the linguistic complexities of radial semantic structure (Lakoff, 1987), polysemic pathways (MacWhinney, 1989), metonymy, partonomy, and homonymy (Lyons, 1977).

Underneath this linguistic complexity is a further level of psycholinguistic complexity that arises from the fact that words trigger distributed concepts through "resonance". In production, the activation of a distributed meaning pattern triggers activation of the word. In comprehension, activation of a distinct phonology triggers the distributed activation of the concept. A simple word like "hammer" is able to trigger both visual images of a hammer in the ventral "what" stream and functional images of wielding a hammer to hit a nail in the dorsal "how" stream. When we come to more complex words such as "grandfather" or "promise", the meanings involved have to be unpacked in terms of a whole set of embedded predicates, such as "the father of my father, or the father of my mother" or "tell someone that you will perform an action that you would not otherwise have done with the expectation that, if you fail to complete the action, there would be unpleasant social or interpersonal consequences and that you therefore fully intend to complete the action, even if certain barriers arise."

The solidification of complexity at the lexical level relies on this system of distributed resonance. When a complex word like "promise" is produced, it is not necessary that all elements of the chain be fully

activated in working memory. All that is necessary is that enough of the word be activated to guarantee correct lexicalization of this word as opposed to its competitors. In the case of "promise" it may that all that is necessary is the notion of saying something seriously. The pragmatic implications involved further in serious, focused participation in a conversation may not be available initially in working memory, although there are long-term, distributed links available that can call them up if needed. This is equally true for concrete terms such as "hammer", since we do not always have to think about using the claw of a hammer to pull out a nail when we hear the word "hammer." In this way, we can think of words as promissory notes or tokens that are issued in the place of the full set of concepts and stances with which they are linked.

Sequence analysis within the lexicon

In principle, it would be possible to ground a communication system on sentences or propositions compressed into single words. Polysynthetic languages such as Iroquois or Eskimo push hard in this direction with their inclusion of a wide range of moods, persons, surfaces, and aspects into a single verb-based complex. However, languages achieve this compression by relying on an additional morphological engine for the generation of complexity. The engine of morphology rests astride two basic principles in neural organization. Consider the contrast between Hungarian and English in the way they form the phrase meaning "my coat." In English, the possessive appears as a separate word preceding the noun. Variations in the phonological shape of the following noun have minimal effect on the sound of the possessive pronoun. In Hungarian, on the other hand, the suffix -om takes on the shape of either -am, -om, -em, -öm, or *m*, depending on the shape of the stem. Moreover, the stem will also change its shape, depending on the nature of the suffix.

The debate about the cognitive representation of these morphophonological patterns has raged for over three decades in psycholinguistics. The connectionists and analogists view forms such as kabátom as produced within the lexicon through interactive activation of analogic patterns. In this model, all lexical forms are produced within the lexicon, without reliance on external routes. The alternative view holds that regular morphological forms are produced by combination between stems and affixes. The third possible formulation is that of MacWhinney (1978, 1982, 1987a, 2005a) which views combinatorial forms as arising through extraction from a core analogic process. Within the framework of self-organizing feature maps. this means that a separate lexical map for affixes emerges from

a process that compares similar morphological formations. For example the comparison of *shoe* with *shoes* will lead to the extract of *s* as the initial productive form for the plural. Similarly, the comparison of *kabát* with *kabátom* leads to the extraction of *-*om as the first person possessive suffix.

This comparison and extraction method is clearly an important additional source of linguistic complexity. This same engine can work within the noun phrase or verb phrase to extract *my* from the combination *my coat*, just as *-om* is extracted from *kabátom*. Moreover, it is an engine that can work in both both directions. If the pressures of fast speech work to modify combinations such as *going to* into *gonna*, then the latter can be stored as a single form representing what was earlier a syntactic combination.

The extreme analogist view would hold that the neurological basis of complex morphology is completely interwoven with the lexical substrate in Wernicke's area at the juncture of the parietal and temporal lobes. It would view an item such as *-om* as residing on essentially the same lexical map as an item such as *kabát*. A strength of this approach is that the morphological alterations involved in the relevant combinations would be directly tuned in the connections between these forms and output phonology. However, a weakness in this approach is that it fails to capture the fact that the *-om* suffix occurs positionally after the stem. To represent this within a single net, sequence detector units would have to be built into the lexical net itself. As an association area, Wernicke's contains few assemblies that could be configured as sequence detectors.

Sequence analysis outside the lexicon

To solve this problem and to boost lexical capacity, evolution shaped a new engine that allowed lexical processing to turn over the control of morpheme combination to other areas. This "offloading" of sequence detection then freed up lexical processing to focus on the basic work of achieving intersection between associations. The modulation of the lexical sequencing was off-loaded to Broca's area in the inferior frontal gyrus (IFG). Among the various cortical areas specialized for sequence processing, this is the area that was closest to the posterior lexical areas. Although this area lies across the Sylvian fissure, it is well connected to the areas back of the Sylvian fissure both in primates (Deacon, 1988) and, presumably, the ancestors of hominids. So, there was no need to establish connectivity between the areas. In this sense, the syntactic engine was not built up from scratch. Rather, like all evolutionary advances, it is a new machine

made up of old parts. Within this new machine, there was a need to make sure that this connectivity supported effective control of lexical activation. To do this, it was important for lexical assemblies in posterior cortex to organize themselves in ways that map up with the already existent connections to IFG. Again, this is not some sudden evolutionary invention, but rather the reshaping of an old machine to serve new functions. The DevLex model shows how this topological structuring of posterior cortex is achieved through movement of lexical forms on the self-organizing feature map.

Figure 3 below illustrates the results of training the DevLex model on parental input derived from the Belfast corpus in CHILDES (MacWhinney, 2000). During this training, words that appear in similar contexts in the parental input self-organize so that they end up being located next to each other in lexical space. In other words, nouns end up next to other nouns and prepositions end up next to other prepositions. This topological self-organization provides support for reliable interactions between IFG and the posterior lexicon. In effect, the topological map is the backbone of a communication protocol between the lexicon and IFG. To understand how this protocol operates to produce complex syntactic structures, we will need to take an excursion into language acquisition theory.

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Figure 6. Word representations in GSM from learning the CHILDES parental speech. GSM identifies various grammatical categories (nouns, verbs, prepositions, and pronouns) as well as semantic categories within each of the grammatical categories.

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The map presented in Figure 3 is the result of thousands of exposures to each individual word in a thousand word input corpus. During the course of this learning, the shape of the map changes radically, particularly during the first phases of training. Figure 4 shows how the map changes its shape across the first 50, 150, 250, and 500 epochs of training.



Figure 4: Changes in the DevLex map across the first 100, 150, 250, and 500 epochs.

Item-based Patterns

In the early days of acquisitional theory, Braine (1963, 1971) explored ways of applying learning theory to the study of child language. The formulation he devised focused on the idea that function words tend to appear in fixed positions *vis a vis* content words. For example, *the* appears before nouns and the suffix *-ing* appears after verbs. Like Harris (1951), Braine analyzed these constituent structures in terms of slots that could be filled by items of a certain class. Formulating a set of 12 such rules for a small corpus of child utterances, he referred to his account as a "pivot-open" grammar, since it specified the position of pivot words vis a vis the open class. Under the influence of Chomsky's (1957) ideas about deep

structure, this model was rejected as failing to pay adequate attention to semantic patterning. Later, Braine (1976) revised his account, emphasizing the role of "groping patterns" that established links based not on lexical class, but semantic relations.

Sticking closer to Braine's original formulations, MacWhinney (1975) introduced the notion of the item-based pattern. Applying the this construct to a corpus of Hungarian, MacWhinne examined the word order of 11,077 utterances produced by two Hungarian children between the ages of 17 and 29 months. He found that between 85 and 100% of the utterances in these samples could be generated by a set of 42 item-based patterns. Some examples of these patterns in English translation are: X + too, no + X, where + X, dirty + X, and see + X. The item-based pattern model was able to achieve a remarkably close match to the child's output, because it postulates an extremely concrete set of abilities that are directly evidenced in the child's output.

MacWhinney made no general claims about a pivot or open class, focusing instead on the idea that the first syntactic patterns involve links between individual lexical items and other words with which they are prone to combine. An example of an item-based pattern is the structure *the* + *X*. This pattern states simply that the word *the* occurs before another word with which it is semantically related. In addition to these positional facts, the item-based pattern encodes the shape of the words that can occupy the slot determined by X and the nature of the semantic relation between *the* and *X*. This is to say that an item-based pattern is an predicate-argument¹ relation which encodes:

- 1. the lexical identity of the predicate,
- 1. the lexical category of the argument(s),
- 2. the sequential position of the predicate vis a vis its argument(s), and

¹ This paper uses the predicate-argument relation to describe item-based dependency patterns. This terminology is used to avoid confusions regarding the ways in which clusters inherit head features for X-bar syntax. In the noun phrase, predicates join with their heads to produce new clusters that inherit the features of the head noun. However, in verb phrases and prepositional phrases featural inheritance is driven by the predicate, not the arguments. Because of this, referring to the arguments as the head of a verb phrase would be confusing. The major danger involved in use of predicate-argument terminology for item-based patterns is the possibility that this would be interpreted as applying outside the domain of lexical combinations. Other levels of predicate-argument decomposition and combination exist throughout language and cognition and we are here only focusing on the role of the predicate-argument relation for combinations of words.

3. the semantic relation between the predicate and its argument(s).

The neural architecture that can instantiate this type of pattern is a sequence detector, located in IFG, that maintains explicit bidirectional connections to two other areas. First, the IFG sequence detector must have links to the lexicon. These links have to be directed to both the specific predicate as a lexical item and the argument slot as a general class. Second, the IFG unit must have links to the area performing sentence interpretation and binding together propositions into coherent mental models. Following Tucker et al. (this volume) and the growing theory of embodied cognition, we hypothesize that this processing occurs in the dorsal stream and involves DLPFC, orbital-frontal cortex, the dorsal corticolimbic circuits, and projections to motor and parietal areas.

Returning to the earlier example of English *my coat* and Hungarian kabátom, we can trace how these forms are processed in terms of the IFG sequence control mechanism. In English, when the child hears my *coat*, we can imagine that the bare form *coat* has already been learned. The child may see that a person is referring to a coat, but with the additional fact that this is the coat that belongs to that person. According to MacWhinney (1978), the child compares the known and unknown segments of the input my coat. In this case, the argument is recognized, but the predicate is new. The child then enters my as a new item in the lexicon, in the areas occupied by affixes and other predicates. Linked to this lexical storage is the establishment in IFG of a sequence detector related to my. The child's use of this pathway does not preclude storing my coat as a full lexical unit or "amalgam". In Hungarian, amalgam processing for kabátom is even more likely, but the child can still pull out -om as a separate suffix linked to its own IFG sequencing unit.

Generalization and Composition

Initially, the item-based pattern for *my* has a single item as the predicate and a single item as its argument. As the child hears other combinations with either English *my* or Hungarian *-om*, the argument slot begins to generalize. This generalization is supported by the fact that words that can occupy the argument slot are located in the same general area of the lexical map. In this case, the relevant words are all nouns. In fact, in the DevLex model, both positional and semantic features work together to control lexical self-organization. In this sense, feature generalization is an emergent property of growing lexical organization.

Eventually, the process of generalization begins to work on predicates as well as arguments. Because the sequence detectors for my, your, his, and its are so closely linked in lexical space, and because they operate on similar argument types, enforce the same positional pattern, and yield the same interpretations to mental models, their operation in IFG becomes more and more overlapping. At this point, we begin to see a merger of item-based patterns into feature-based patterns. What differentiates feature-based patterns from item-based patterns, is that they are no longer linked to specific lexical items, but instead apply to classes of items. In this case, the feature-based pattern is *Possessor* + *Possession*. In this way, the child slowly pieces together the 23 major grammatical dependency relations of English, as summarized in the work on the GRASP parser (Sagae, Davis, Lavie, MacWhinney, & Wintner, 2007) for the CHILDES database. In this system, predicates can attach to as many as three arguments. Item-based constructions for verbs can also include the verbs of embedded clauses as arguments. And we will see below how item-based constructions for prepositions and auxiliaries include both an endohead and an exohead.

There is a third level of argument generalization, above the levels of the item-based pattern and the feature-based pattern. This is the level of the global construction. Just as feature-based constructions emerge from a process of generalization across item-based patterns, so global constructions emerge from generalization across featurebased constructions. For example, in English, there are literally dozens of verb groups that share a common placement of the subject before the verb. Together, these constructions give support for the SV global construction in English. The SV and VO global patterns of English work together to produce prototypical SVO order (MacWhinney, Bates, & Kliegl, 1984). Other languages promote different combinations of global patterns. In Hungarian and Chinese, for example, SV, OV, and VO orders operate to express alternative varieties of object definiteness, producing SVO and SOV orders. Italian combines SV and VO patterns with secondary, but significant use of VS (Dell'Orletta, Lenci, Montemagni, & Pirrelli, 2005) to produce SVO and VSO orders. Other global patterns control the ordering of topic before comment or the tendency to associate animacy with agency.

In this section, we have discussed four levels of sequence generalization. Beginning with word pairs, the system then extracts item-based patterns, feature-based patterns, and then global patterns. The processing of all of these patterns is supported by the same underlying mechanisms for sequence detection and control. Together, we can refer to all four levels as involving "positional patterns."

In addition to this process of generalization, positional patterns can be subjected to a process called composition. Composition takes two positional patterns and hooks them up into a single larger sequence. The important consequence of composition is that it increases the proceduralized nature of syntactic processing. For example, it may be that a single complex network, looking very much like a finite state automaton, processes all variants of noun phrases. In this network, there would be an initial slot for a quantifier, followed by a determiner or possessive, then a series of adjectives, and finally the noun. The compilation of smaller patterns into larger patterns of this type can proceduralize and facilitate both listening and production.

Incremental processing and storage

Dependency grammars such as the GRASP model can be grounded neurologically on IFG pattern detectors of the type outlined here. However, by themselves, dependency relations are not enough to achieve parsing or generation of longer strings of words. Some additional recursive control mechanism is needed to allow for the embedding of the results of one sequence processor in another. Here, one can imagine two neurologically-grounded approaches. One approach would emphasize composition of X-bar structure and trees However, neurological evidence for such directly within IFG. embedded groupings of sequence processors is currently absent. Instead, current evidence suggests that areas outside of IFG are involved in the construction of larger conceptual trees from the sequential fragments detected by IFG. In accounts such as MacWhinney (1987b) or Gibson (1998), smooth processing relies on the incremental construction of interpretable units. Consider a sentence, such as my coat has a missing button. As soon as the sequence my coat is detected, the predicate is linked to its argument and the whole is then treated as a single cluster in the mental model being constructed. Mental model construction proceeds in accord with the principle of starting points introduced by MacWhinney (1977) and supported in detail by Gernsbacher (1990). The starting point of my *coat* then becomes the perspective from which the rest of the sentence is interpreted. At this point, resonant activation involves items in posterior lexical space, continued processing in IFG, and resultant model elements in dorsal processing. Next, the sequential processor takes this whole active assembly as input to the verb-based frame for This predicate has argument slots for both a possessor have. perspective and an object possessed. Even before the second slot is filled, incremental processing activates a mental model expectation for

a thing possessed. Then the phrase a missing button is processed by the two relevant sequence processors and the result then fills the second slot of the verb *has*, thereby completing the mental model of a coat that has a missing button. Of course, the model itself may generate additional associated ideas. Perhaps the button is removed in some overt way; perhaps it is seen on the floor; or perhaps there is a focus on the thread left on the coat after the button has fallen off.

The filling of argument slots in feature-based patterns is driven by a series of cues that have been studied in detail in the context of the Competition Model of MacWhinney (1987a, 1987b) with additional illustrations in McDonald, Pearlmutter, & Seidenberg (MacDonald, Pearlmutter, & Seidenberg, 1994), and O'Grady (2005). The model specifies a series of steps for the ways in which incremental processing triggers competition between constructions:

- 1. Sounds are processed as they are heard in speech.
- 2. Competition during sound processing controls activation of a current word.
- 3. Each new word activates its own item-based patterns along with related feature-based patterns (see below).
- 4. Item-based patterns then initiate tightly specified searches for slot fillers.
- 5. Slots may be filled either by single words or by whole phrases. In the latter case, the attachment is made to the head of the phrase.
- 6. To fill a slot, a word or phrase must receive support from cues for word order, prosody, affixes, or lexical class.
- 7. If several words compete for a slot, the one with the most cue support wins.

Most work the Competition Model has focused on on comprehension, which is easier to control experimentally. However, the model applies equally well as an account for sentence production. The details of the operation of this parser are controlled by the competitions between specific lexical items and the cues that support alternative assignments. Consider the case of prepositional phrase attachment. Prepositions such as on take two arguments; the endohead is the object of the preposition, the exohead is the head of the prepositional phrase (i.e. the word or phrase to which the prepositional phrase attaches). Consider the sentence the man positioned the coat on the rack. Here, the endohead of on is rack and its exohead could be either positioned or the coat. These two alternative attachment sites for the prepositional phrase are in competition with each other. For detailed examples of the step-by-step

operations of this type of processor consult MacWhinney (1987a), MacDonald, Seidenberg, & Perlmutter (1994), or O'Grady (2005).

In this model, syntax involves nothing more than the repetitive clustering of the results of basic linear detectors. Of course, not all sentences are as simple as the one chosen to illustrate the basic Often uninterpreted arguments will build up on sentence process. memory waiting for merger with their predicates. MacWhinney & Pléh (1988) suggested that the capacity of memory for uninterpreted phrases was no greater than three and Gibson (2001) and others argue for a similar limit. But all analysts agree that there must be a mechanism for storing at least two or maybe three such uninterpreted items during processing. Because of its role in the phonological loop and other memory processes, there is reason to believe that dorsolateral prefrontal cortex (DLPFC) provides the necessary store for This frontal mechanism then provides an not-yet-merged items. additional engine for the maintenance and diversification of linguistic complexity.

But can a mechanism like this really control complex syntax? Don't we need the full power of transformational grammar, or at least context-sensitive phrase structure grammars? What about empty categories, traces, indices, interfaces, and so on? Addressing questions like this is difficult, since there are often many additional suppositions. However, it is important to explain how a linear mechanism of this type can indeed compute complex structures. First, because the slots of feature-based patterns refer to whole classes of items, the power of this machine is beyond that of finite-state processors that operate only on terminal symbols. As Hausser (1992) has shown, finite state grammars that operate on category symbols are formally equivalent to phrase-structure grammars.

Second, the results of individual linear patterns can be combined or clustered through attachment in mental model space. As a result of this, the final model implicitly encodes a full X-bar structure. Third, many of the linguistic phenomena that have been used to motivate complex syntax are actually better represented through memory processes in mental models. Consider the case of the tangled dependencies by Dutch serial verbs or the English caused "respectively" construction. The fact that John and Bill ordered steak and fish, respectively can be interpreted best by a mnemonic device that establishes actual spatial positions in mental model space for John and Bill and then engages in the mental action of parceling out steak and fish to these positions in mental model space. This type of mental model processing is basic for anaphoric processing. There is no reason

not to think that it is used to process these constructions too. Of course, the problem here is that, by itself, the syntax would not yield a complete parse tree in such cases. But that is because syntax is not doing this work alone.

A Neural Basis for Mental Models

Recent work in neuroscience has benefitted from four fundamental insights, each relating to the construction of mental models. First, in the 1980s, we learned that the visual system separates processing into an image-oriented ventral stream and an action-oriented dorsal stream.² Second, we have learned from imaging work through the last decade that the brain relies on a perception-action cycle to interpret incoming messages. This cycle involves the generation of mental representations for objects in terms of the ways in which we typically act upon them. Much of this cycle is grounded on interactions that include the action-oriented processing of the dorsal stream. Third, we have learned that the brain provides specific mechanisms for mapping the body images of others onto ours. One consequences of this ability is the fact that certain "mirror neurons" controlling actions, facial gestures, and postures can fire equally strongly when the actor is the self or the other. As we are now learning, these mirror systems are just one of the various components of a general system for social cognition, that also involve temporal facial processing and amygdala and striatal areas for empathy and projection. Fourth, we have learned that the basal ganglia and hippocampus play a central role in the consolidation of memories, often driven by rewards and error minimization.

Piecing together these results, and following the lead of Tucker et al (this volume), we can see that one of the additional consequences of the dorsal-ventral dichotomy is a shift of discrete processing of

² Following the lead of Givon (1995), Hurford (2002) relates the separation of processing into the dorsal and ventral streams to the predicate-argument distinction in language. However, as Bickerton (2002) notes in his commentary to the Hurford's article, this analysis fails in two important regards. First, predicates and arguments are not "raw sensory feeds" but rather complex lexical items that can themselves involve embedded predications, as we noted earlier in our discussion of words like "promise" or "grandfather". Second Hurford's model fails to provide a method by which the brain can integrate predicates and arguments. The mechanism proposed in the current paper is not linked in any clear way to the dorsal-ventral contrast, depending instead on interactions across IFG, distributed lexical processing, and frontal mechanisms for mental model construction.

individual elements to the ventral stream and a shift of global model construction to the dorsal stream, with particular additional regulatory control from frontal areas. In recent papers, I have suggested that this frontal-dorsal system provides the neurological basis for a system that constructs dynamic mental models from linguistic input. At the core of this system is the notion of the self as actor. During sentence interpretation, this fictive self is then projected onto the role of sentence subject, and the self reenacts the image underlying the sentence. Because narrative and dialog often involve rapid shifts between agents, this system has to be able to use linguistic devices to control perspective shifting. As a result of this core dynamics, we can refer to this system as the Perspective Shift System.

This system constitutes the highest level of support for linguistic complexity. Without the mental model construction supported by this system, complex syntax would be useless. This is because the fundamental purpose of virtually all the devices of complex syntax is the marking of perspective shift. This analysis applies across all the grammatical constructions, including passivization, major relativization, clefting, pronominalization, dislocation, existentials, shift reference, split ergativity, serialization, complementation, conjunction, ellipsis, adverbialization, long-distance anaphora, reflexivization, PPattachment, and participial ambiguity. Each of these structures allows the speaker to combine, maintain, and shift perspectives in communicatively important ways. And these devices allow the listener to trace these movements of the speaker's attention across all of these shifts.

Building Mental Models

The conventional view of mental model construction focuses on the linking of predicates into a coherent propositional graph (Budiu & Anderson, 2004; Kintsch, 1998). This activity is much like the process of clause-combining that we learn in writing class. You can combine "the dog chased the bird" and "the bird flew away" to form "the dog chased the bird that flew away." All that one needs here is a grammatical device that serves to mark the fact that *the bird* plays a role in both clauses. The processing of the grammatical relations within clauses relies on the positional patterns in IFG which then activate role slots in mental model construction. The relativizer is recognized by the lexicon and triggers a the perspective shift in mental model construction. In this case, the shift moves smoothly from *bird* as the object of chased to *bird* as the subject of *flew away*. However, if the sentence is "the dog chased the bird that the bird that the girl loved" then the

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perspective shift is far more difficult, since a brand new perspective is introduced and the perspectives of both *the dog* and *the bird* must be dropped. These shifts of perspective are triggered either by syntactic patterns or by lexical devices. In each case, the child must learn how to operate on signals from the lexicon or IFG to control the correct shifting in frontal cortex. As the developmental literature amply demonstrates, the learning of this control takes many years (Franks & Connell, 1996). Later in this paper, we will explore some of these processes in further detail, since this is one of the primary loci of the consolidation of linguistic complexity.

Perspective and Gesture

The frontal-dorsal system for perspective shifting is not a recent evolutionary adaptation. Chimpanzees (Tomasello, Call, & Gluckman, 1997), dogs, and other mammals make extensive use of symbolic behaviors in social contexts. However, lacking a lexicon and positional patterns, other animals cannot organize these behaviors into recursive structures³ However, Donald (1991) and others have argued that the production of symbolic communication can rely on gestural and vocal devices that may well have been readily accessible to homo erectus. Because gestures can be formed in ways that map iconically to their referents, it is relatively easy to build up communal recognition of a gestural system. As Tucker et al. (this volume) argue, such a system would rely primarily on gestures and affordances specific to the actionoriented processes in the dorsal stream. It appears that learners of contemporary sign languages are able to use posterior lexical areas to structure a lexicon of signs, just as they use IFG in the left hemisphere to control the ordering of signs. It is possible that protosign could also have relied on these same neuronal structures for lexical organization. However, looking back two million years, it is likely that the depth of support for lexical storage and positional patterning of gesture was still very incomplete. As a result, it is likely that protosign was incompletely lexical and heavily reliant on dorsal processes for direct perspective taking and shifting.

Although sign may not have triggered full linguistic structure, it provided a fertile social bed that supported the development of further articulatory, lexical, and sequence systems. As Darwin (1872) notes,

³ Gentner, Fenn, Margolish, & Nusbaum (2006) claim that starlings demonstrate recursive processing for strings such as AAABBB. However, Corballis (2007) points out that these strings can be detected through a subitization-based counting mechanism that has been demonstrated for birds.

vocal and gestural communication coexisted as parallel streams from the beginning of human evolution. Gesture and prosody were able to keep humans engaged in protoconversations, during which the further elaboration of vocal patterns could refine and complement communication in the gestural-prosodic mode. Of course, humans are not the only primates that engage in conversation. However, as argued in MacWhinney (2005b), the shift in homo habilis to a full upright posture led to two important consequences. One was the freeing of the hands for additional conversational interaction and the other was the encouragement of full face-to-face interactions linked to full display of the hands and torso. This increasing support for gestural communication brought along with it a supportive social context for the further development of accompanying vocalizations. However, both of these modalities continue to provide important input to conversation in modern humans. Thus, we can best view the transition from a primarily gestural communication to a primarily vocal communication system as gradual, but unbroken, process (MacWhinney, 2005b) with no sudden break based on the sudden introduction of an ability to process recursion.

Digression: Accounting for Critical Periods

The vision of language processing elaborated here has interesting implications for our understanding of age-related processes in second language acquisition and bilingualism. Much current work in these fields has been shaped by the Critical Period Hypothesis (CPH), as proposed by Lenneberg (1967). According to Lenneberg, fundamental hormonal changes at puberty lead to a consolidation of brain lateralization and a loss of neuronal plasticity. Before this critical period, children can easily learn a second language to native-like proficiency. After this critical period, languages can no longer be learned in a natural way. There are now many hundreds of articles and scores of books discussing the pros and cons of this hypothesis. Although few researchers continue to accept the hypothesis as originally formulated, there is still widespread awareness of the fact that it becomes increasingly difficult to acquire a nativelike account in a second language after perhaps ages 6 or 7 (Flege, Yeni-Komshian, & Liu, 1999). Moreover, there is evidence that some forms of syntactic processing are difficult to restructure in second language learning during adulthood.

One way of understanding these age-related patterns focuses on the ways in which neuronal maps become "entrenched" over time. For example, in Figure 4 above, it was more and more difficult in the later

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epochs of learning in DevLex to produce major changes in the shape of the lexical map. Emergentist accounts of age of learning effects for L2 learning (Hernandez, Li, & MacWhinney, 2005; MacWhinney, in press) have relied on this notion of entrenchment as a simple replacement for the notion of a hormone-based critical period. However, the analysis presented here suggests that the picture is not that simple. Studies of neuronal regeneration have shown that, in fact, there is a great deal of regeneration and local rewiring in cortical areas throughout adulthood. Thus, the entrenchment we are hypothesizing for L1 cannot be due simply to the loss of local plasticity. Instead, I believe we need to look at the ways in which local areas connect to distal processing areas through axonal projections. In fact, all six of the modules we have examined are connected in this way to other areas. The problem the brain faces in learning a second language is not to reorganizing local connections, but to figure out how to restructure these inter-module connections.

Consider the case of connections between output phonology and the lexicon. Here, the lexicon must maintain somatotopic connections to areas in IFG and motor cortex that control specific phonemic or syllabic gestures. These units are organized topologically during the first two years of life so that input and output phonology are properly coupled to the contrasts of the target language. When the second language learner comes to learn a new word in L2, this new word must be connected initially to L1 output gestures. For example, when producing the Spanish word "taco" and English speaker will map the initial stop onto the aspirated /t/ of English, thereby producing a form with a decidedly foreign accent. It may well be impossible to establish new axonal connections to support this new L2 articulatory gesture. Instead, it is likely that secondary modifications are produced in IFG and motor cortex that systematically modify the English /t/ by reducing its aspiration when the area receives modulation from subcortical structures consistent with the use of Spanish. This new version of /t/ will slowly develop a status as a competitor to English /t/ in the same general region of motor cortex. Over time, the final branches of the axonal projections from the lexicon will tend to innervate this new area so that the connection between new Spanish words and Spanish output phonology will be smoother. However, this reorganization is fundamentally more difficult than that involved in restructuring forms within a local module.

These difficulties apply equally to both output phonology and positional patterns, since in both cases, there must be fine-tuning at a distance across long axonal projections. They also apply to input phonology, although in that case top-down lexical processes may tend

to mask problems with reshaping the effects of a foreign accent in auditory processing.

But, if this is true for these three modules, then why do we not see similar limitations in the learning of new L2 lexical items? This is because this learning is "parasitic" on L1 lexical forms in a way that makes the semantic range of the new words accurate enough to pass as correct. For example, the semantic range of Spanish *mesa* is close enough to that of English *table* to make them essentially equivalent for the beginning learner. A similar analysis is true for the L2 perspective shifting system and the learning of L2 methods for relying on short term storage.

Engines of Complexity

We have now finished our survey of an account of neurolinguistic processing grounded on self-organizing feature maps, sequence limbic processing mechanisms, consolidation, and topological preservation of feature map resonance across six linguistic modules. The core mechanisms of neural connectivity and firing are fundamental to all animals from molluscs to mammals. Mechanisms for sequence detection and control can also be found in both invertebrates such as insects and vertebrates such as amphibians. Systems of topographic organization can be found even in animals with no cortex. Systems controlling memory consolidation and value-based projection are found in bees. What is new in the engines supporting language are not the pieces, but the ways in which the pieces are being combined. Let us review these innovative configurations in the context of the six modules supporting language processing:

- 1. Input phonology. This system is available to all mammals. However, it is tuned during development to produce a sharpening of contrasts found in the target language (Kuhl, 1991; Werker, 1995) and central to the lexicon and the morphosyntax. This system works to reduce an enormous perceptual complexity into a much smaller set of meaningful contrasts.
- 2. Output phonology. Once linked to input phonology, this system takes control of a complex production mechanism to align with the greatly reduced contrast space of input phonology. Thus, like input phonology, this is a system that reduces complexity to simpler contrasts.
- 3. Lexicon. This system relies on hierarchically linked selforganizing feature maps to link distributed conceptual structures to phonological forms.

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- 4. Lexical Analysis. This system works to analyze input forms into predicate-argument structures. The predicates in these structures are then linked to item-based patterns in IFG and morphophonological patterns associated with affixes in the lexicon.
- 5. Syntax. This system extracts patterns in lexical sequencing. Beginning with simple word pairs, generalization moves through item-based patterns, feature-based patterns, and global patterns. These sequence detectors maintain tight links both to the lexicon and to mental model construction. These patterns can also be compiled into longer chains to improve fluency.
- 6. Discourse. The linking of syntactic patterns into mental models relies on initial storage in a frontal STM buffer. Once an item can be linked into a growing mental model, it can be released from short-term storage. The growing mental model is interpreted in terms of an ego-based system of perspective shifting.

We can now ask how these engines support linguistic complexity. One answer that has been offered by Hauser, Chomsky, & Fitch (2002)as well as Bickerton (this volume) is that linguistic complexity arises from the Merge operation of minimalist syntax. Certainly, the Merge operation is a crucial step in the construction of complex syntax. However, it is important to avoid oversimplication of this issue. In neuronal terms, the Merge operation can be decomposed into several component processes.

- 1. In sentence production, lexical items must be activated before they can fill slots in positional patterns.
- 2. In models of sentence production such as those proposed by Garrett and Levelt, the activation of words occurs in parallel or even after the activation of a syntactic frame. In any case, it is likely that relations in mental model space prime IFG positional patterns, preparing them to accept candidate lexical forms. This priming must be viewed as a separate process.
- 3. The filling of slots is governed by a process of competition. Merger cannot occur until this competition is resolved.
- 4. There must also be lateral connections between alternative, competing positional patterns. In particular, larger, more specific patterns formed from the composition of shorter patterns must inhibit the corresponding shorter patterns.
- 5. Merger produces sentence fragments that must be stored in a short-term memory buffer to permit X-bar cluster formation. This storage is not itself a part of merger and without it, merger would only succeed in processing the simplest sentences.

6. Finally, the merger that occurs on the syntactic level is not itself enough to control either recognition or production. Merger must be connected to mental model processing. By itself, a merger system would have no adaptive utility and no evolutionary advantage.

These six processes must work together to produce recursion. Without the complete set of all six, along with further support from the lexicon and social support, the full construction of grammatical complexity would not be possible.

Mimetic Processes

Our discussion so far has confined itself to the neural engines of linguistic complexity. However, without social input, these engines would produce nothing more than fuzzy and incoherent inner speech. Through the process of language learning, this neuronal substrate is molded and shaped into complex patterns that reflect those inherent in the input. Human language has the shape it does, because it must be learnable by children (Christiansen & Chater, 2008). Moreover, this learnability has been maintained now in a consistent fashion for perhaps two million years, as humans moved from one step of protogesture and protolanguage to the next, always relying on the fact that what they were producing was in good alignment with things that the next generation could learn. The close relation between the mother and the infant certainly plays a central role in this process, as mothers move their children into a linguistically profitable "zone of proximal development" through processes of imitation, recasting, scaffolding, and vocal play.

Once a child becomes an adult, the linguistic power derived from initial learning can now be turned back upon language itself. Adults can create new words, collocations, expressions, prosodies, gestures, constructions, poems, jargon, and grammatical devices. If they build these new creations upon devices that can be easily learned by others and which express interesting social goals, then these devices will spread across the language community through processes of mimetic drift, eventually producing language change. When we then come to look at the results of these processes, we can then return to our original analysis and ask how the underlying neuronal mechanisms we have surveyed functioned to incorporate this mimetic changes into the stable core of the language of the community.

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Applications of the Model

With this linkage between the brain and social processes in mind, we are now ready to consider the genesis of specific forms of linguistic complexity. Let us consider these four processes: nominalization, colexicalization, compilation, and construction formation.

(to be written -- I expect about five pages here -- sorry for the delay)

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Syntactic complexity and coordination in a verbal production task Preliminary summary of experiment results Rice Complexity Symposium, Precirc

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Abstract

The origin of syntactic complexity is not completely clear. Some degree of syntactic complexity can be seen as the natural consequence of the evolution of a rich communication system, while much cross-linguistic variation must be attributed to historical circumstance with often unclear causal factors. This study addresses the synchronic issue of why speakers elect to employ greater or lesser syntactic complexity for expressive purposes.

We examine the extent to which changing the communicative intent of the speaker affects the degree and type of reliance on syntactic complexity. Participants viewed complex human action video stimuli and were asked to respond in detail to a single question concerning either *what* had happened in the scenario they had just watched or *why* a particular event in the video had occurred. Our prediction was that responses to the *why* question would have more syntactically complex constructions than responses to the *what* question. The experimental results with these stimuli did not straightforwardly uphold the hypothesis; however, there was significant difference in the amount of coordination within intonation units between the two conditions and the types of complementation varied between conditions.

Background

How to describe complexity

One option for defining linguistic complexity is in terms of processing load: utterances that are difficult to process (either in production and comprehension) are by definition complex. Language offers speakers some options in the complexity of the utterances which they produce, although this will be constrained by certain choices of verbs and other reference needs. To the extent that speakers can choose for greater or less complex constructions, this choice may be influenced by other task demands on the attentional and processing systems.

Informational content, how much data is entailed in a given phrase, is another factor in processing. In this regard, pronouns—or even ellipsis—could be considered highly complex, yet it seems that these grammatical elements of language actually facilitate processing, by making it possible to reference words or whole phrases that are highly salient / available in memory.

It could be argued that even a single-word utterance can be complex, in that its intended and perceived meaning involves predication (child-caretaker interaction clearly exemplifies this possibility, as for example when a child says "milk," and the caretaker understands the utterance as a request and responds "Oh, do you want some milk?"). On this argument, all language is complex. But there are different kinds of complexity. The child's utterance is meaningfully complex, while the caretaker's response is more

complex in form. Descriptive linguistics recognizes a difference between simple utterances and those that are more concatenated in form, and again between concatenation and subordination. Complexity is thus relative: a two-word utterance is in a structural sense more complex than one word; conjoined phrases are more complex than a single phrase; one phrase embedded within another is still more complex.

The complexity we seek to explain is structural. Given that varying degrees of syntactic complexity can be used to represent the same event, a logical question follows as to the motivation for using more complex syntax. What causes speakers to use embedded rather than concatenated structures?

The origin of complexity

Evolutionary accounts offer explanations of the development of syntactic complexity in terms of adaptive benefit: slight processing gains can deliver a substantial advantage for quick decision-making and consequently for survival. Developmental accounts describe how verbs representing separate but frequently-connected events may move through stages of paratactic association (coordination) to syntactic complexity (subordination) to complex verb forms like complements. Grammaticalization theory accounts for the various steps in the process of morphosyntactic change, but there is no explanation for why some languages follow the predicted path while other languages do not.

Either of these explanations must remain hypothetical since we cannot gather data on language production and comprehension outside of the laboratory. Lacking from both evolution and diachrony is any data on how language is used online. Attempting to explain how complexity varies online today will help to build a model of the origin of complexity in general, since the synchronic choices behind evolutionary and diachronic change are related to online expressive demands. Therefore we start with an exploration of online language use in this study.

We investigated the conditions under which people use complex syntax (i.e., the hierarchical structures of complementation or relativization) as opposed to simple syntax (i.e., the conjoined structures of coordination, or separate clauses) to describe associated events.

Our initial intuition was that empirical characteristics of the events themselves might affect the choice: on this account, events that are closer in time or space, or events that have a high degree of shared referents, would be more likely to be described with complex clauses. An immediate difficulty arises in this regard, however, because for many common complement constructions it is difficult to develop stimuli that clearly represent separate component events—for example cognition/utterance complements like "he said the train was late", manipulation complements such as "she had him call a cab", and modality complements in the vein of "they wanted to arrive early". It is difficult to imagine, using the last example for instance, how "wanting" could be presented separately from "arriving" in an experiment using visual stimuli. Thus there is problem of lexically determined complementation; in order to describe some situations, complement structures are the only linguistic option, at least in English. Our hypothesis was that these complement-taking verbs would be more used in explanations than in descriptions.

Clearly certain genres typically demonstrate greater syntactic complexity. For example, formal written texts tend to have far more subordination than spontaneous

speech. However this reflects editing processes which are less subject to processing constraints. Since we are interested in the factors driving greater complexity in production, we focus here on the variable conditions of extemporaneous speech.

Motivations for complexity in oral narrative

We presumed that a pervasive function of complementation is evaluative. In the case of manipulation and modality complements, speakers use the main verb of the complement to explain the motivation for the action in the complement. With cognition utterance verbs, speakers express a basis for confidence in the subordinated event. We might further propose that such evaluative information will automatically be packaged this way—it may in fact be difficult or awkward to separate such information syntactically.

Because of this evaluative use of complementation, we hypothesized that speakers would use complements more often in describing a scenario if they were asked to give reasons and motivations rather than to simply give an account of events. In other words, we are looking for online motivations for speakers to increase their syntactic complexity. To test the hypothesis, we decided to present visual stimuli in the form of video clips and ask experimental participants to alternatively "describe" or "explain" what had happened in the videos they viewed.

Experiment 1: Within-subjects describe/explain Methodology

Ten video clips, each approximately one minute in length, were taken from separate episodes of the USA Network TV series <u>Monk</u>. Segments were chosen that depicted a sequence of events telling a brief coherent story in which two or three main characters were involved (brief descriptions of the ten video clips are included in Appendix A).

Fifteen experimental participants (12 female, 3 male; median age 19) were recruited from the University of Oregon Psychology & Linguistics Human Subjects pool. Participants watched the ten video clips, each approximately one minute in length. Half of the participants were given the following instructions:

You are going to watch ten video clips selected from the TV series "Monk." For the first five, after you watch each one, I'd like you to describe from memory the events as you saw them happen on the screen, so that someone listening to your description would be able to describe the same events without seeing the video.

For the second set of five, please give from memory an explanation of why the events happened the way they did, so that someone listening to your description would be able to understand how the various actions are related to each other and why the things that happened on the video took place in that way.

The other half of the participants received the same instructions, with the order reversed; i.e., these participants were asked to explain the reasons for the events in the

first set of five videos they viewed, and describe the events in the second set of five videos.

Participants viewed one video clip at a time, and then were tape-recorded as they gave an oral description or explanation of the events in the video. For the ten videos they viewed, each participant produced five "descriptions" and five "explanations." Video clips were presented in a fixed order. The fifteen participants produced ten narratives each for a total of 149 data points (75 "describe", 74 "explain"; one "explain" data point was not recorded due to equipment error).

Results

Results showed no difference between the two conditions in amount of complements, coordination, or relative clauses. The length of the narratives also did not differ between the two conditions.

				length	
describe	comp. 4.8 (.12/sec) SD=3.9	coord. 2.9 (.07/sec) SD=2.8	rel. 1.7 (.04/sec) SD=1.4	seconds 40.3	lines 7.5
explain	4.6 (.11/sec) SD=3.5	2.3 (.05/sec) SD=2.3	1.6 (.04/sec) SD=1.7	42	7.4
describe + explain	4.7 (.11/sec)	2.6 (.06/sec)	1.64 (.04/sec)	41	7.4

Table 1: Results of Experiment 1 – within subjects describe/explain

In Experiment 1, fifteen participants were asked to either "describe in detail what they had seen" or alternatively to "explain why the events happened the way they did". The prediction was that the explanatory recalls would have greater overall syntactic complexity (e.g. higher subordination: coordination) than the more purely descriptive recalls. Data analysis showed no difference in rates of complementation, coordination, or relativization between the "describe" and "explain" conditions; participants simply used more adverbial "because" clauses in the "explain" condition.

Experiment 2: between-subjects *why* vs. *what*

For the second experiment we decided that rather than asking participants to describe or explain the videos, we would ask them questions which prompted for detailed descriptions or explanations.

We hypothesized that asking questions about why a particular action was taken would point participants toward explanation, because speakers would talk about motivations and causality, requiring the use of complement-taking verbs. On the other hand, we predicted that asking about what happened would not require as many complement structures, since speakers would be talking about concrete visible actions and presumably not about the reasons the events took place. Two of the ten stimuli used in Experiment 1 were eliminated, and eight of the original ten videos were used for the experimental study.

Why condition

Fifteen experimental participants (7 female, 8 male; median age 21) were recruited from the University of Oregon Psychology & Linguistics Human Subjects pool. Participants first watched a sample video clip, then were given the following instructions:

You will be watching eight more video clips selected from the same TV series. After you watch each one, I will ask you a question about why something happened in the video. Please give a full and complete explanation in answer to the question, in other words, several sentences, connections between various events, rather than simply the immediate cause. For example, for the sample video, if the question was "Why does Monk use a handkerchief to hold onto Kevin's pants?" you wouldn't want to say it's just because Monk has OCD. You need to talk about the multiple things that are going on, such as

Kevin's need to look into the house the need not to touch the floor the need for a counterweight Monk's fear of germs etc.

Participants viewed one video clip at a time, then were asked one question about the video they had just viewed, and tape-recorded as they produced an oral response to the question.

What condition

Fifteen experimental participants (9 female, 6 male; median age 19) were recruited from the University of Oregon Psychology & Linguistics Human Subjects pool. Participants first watched a sample video clip, then were given the following instructions:

You will be watching eight more video clips selected from the same TV series. After you watch each one, I will ask you a question about what happened in the video. Please give a full and complete description in answer to the question, in other words, several sentences rather than simply an undetailed response. For example, for the sample video, if the question was "What does Kevin do in the process of getting the pencil?" you wouldn't want to say just that he gets it with the shovel. You need to talk about the multiple things that you saw, such as

Kevin's having Monk hold his pocket his leaning into the house reaching for the chair getting the shovel using the shovel to scoop up the pencil etc.

Participants viewed one video clip at a time, then were asked one question about the video they had just viewed, and tape-recorded as they produced an oral response to the question (*why* and *what* questions are included with the video descriptions in Appendix A).

Results

For each speech passage produced, we determined the length of the response in seconds. We also counted the number of transcribed lines for each response as a secondary comparative measure in case rate of speech differed greatly between participants. For each response, coordinate, complement, and relative clauses were marked and counted.

Speech passages were divided into phrasal units as the basic processing element. These are considered an indication of planned speech units, hence mental association, in addition to and possibly more reliable than lexical than lexical coordinators like *and*, *but*, and *or*, which are often used as discourse markers to show narrative continuation rather than syntactic connection. In other words, without knowing the intonational packaging it is impossible to tell from transcripts whether *and* marks coordinate clauses, since coordination joins syntactically complete expressions. Complementation constructions, on the other hand, can span across intonation contours, because the first part is clearly incomplete and awaits the completion in the second. There may well be long-term planning across boundaries, but this is difficult to measure and not necessarily consistent.

Therefore, coordination was described as clauses connected by *and*, *but*, *or*, or \emptyset . but verbs were counted as coordinated only if they fell under the same intonation contour. Complementation was determined syntactically – in other words, even if the complement construction occurred across the boundary between intonation contours. Relativization was also determined syntactically.

We did not count clauses from meta-cognition or commentary– i.e., "I guess he was having lunch" does not count as complex for purposes of describing/explaining the action of the video. "Monk thought there was another snake" does count as complex, because it describes what is going on in the video. The verb *like* used for quotation was counted as cognition/utterance complementation.

Complement types

We further analyzed complement clauses by classifying them into six groups:

- 1. **Speech**—describing speech or semiotics (examples include *she yells at Monk to help, he pointed out that he saw she's saying 'he's gonna get me!'*.
- 2. **Cognition**—describing mental activity (examples: *he knew how to do it, he couldn't figure out how to move it.*
- 3. **Manipulation**—describing the use of someone or something to accomplish a task (examples: *he got the ferris wheel to move, he used his legs to press the door shut.*
- 4. **Modality**—describing attempt, intent, obligation, ability, or possibility (examples: *he tried to climb on, he wants to know*.
- 5. **Aspect**—describing inception, termination, continuation, success, or failure (examples: *it ends up breaking, he started to back out*.
- 6. **Other**—where the subordinated clause describes intent (examples: *he climbed up to prevent the guy from getting her, he reached to grab the cloth.*

Fifteen participants who answered one *why* question after viewing each video produced eight narratives each for a total of 120 data points. Fifteen participants who answered one *what* question after viewing each video produced eight narratives each for a total of 120 data points. Results are shown in Figure 2.

	comp.	coord.	rel.	sec	lines
total	286	86	96	2766	481
mean	2.38	.72	.80	23	4
	SD=1.56	SD=0.85	SD=0.94	SD=7.93	SD=1.43
<i>what</i> questions n=120 productions (15 participants, 8 videos)					
1	comp.	coord.	rel.	sec	lines
total	305	158	90	2932	460
mean	2.54	1.32	.75	24.4	3.8
	SD=2.21	SD=1.22	SD=1.00	SD=12.1	SD=1.85
Table 2: Results of second experiment – between subjects why vs. what					

why questions n=120 productions (15 participants, 8 videos)

One-tailed T-tests were conducted on the complementation and relativization data, since the difference between conditions was in the predicted direction (more complex syntax in the *why* condition). A two-tailed T-test was conducted on the coordination data, since difference between conditions was not predicted. Anovas were run for all three measures comparing *why* vs. *what* responses. These analytic measures showed a slightly higher rate in the *why* condition of complementation (T-test P=.41, single factor ANOVA P=.8) and relativization (T-test P=.14, single factor ANOVA P=.5), while coordination was greater in the *what* condition, with the difference being highly significant (T-test P=.001, single factor ANOVA P<.001).

Although the overall frequency of complements was not significantly different between conditions, the types of complements used by speakers varied noticeably between the *what* and *why* conditions. See Figure 1.



Figure 1: Comparison of complementation types in Experiment 2

Discussion

Our hypothesis that people will use more complex syntax when asked to explain an event than when simply describing was not supported, and thus must be rejected for tasks such as this experiment. The rate of complementation in online speech appears, at least in these tasks, to be fairly consistent. However, the use of complementation does vary with expressive purposes. Participants answering why questions are far more likely to use complements of cognition than those answering what questions.

There was no cognitive loading beyond the task of giving descriptions / explanations; participants were just talking, concentrating only on what they said. Reporting observed events is a common, low-effort task. Based on these results, we might propose that the rate of complementation is stable in speech, possibly because of cognitive constraints on how much embedded information can be processed in a given unit of time. In other words, people typically embed at a rate near their current production capacity. It may well be that in (frequent) situations where the language production system is sharing cognitive resources with other processes that greater differentiation of complexity would emerge.

Surprisingly, however, the amount of coordination varied between conditions in Experiment 2, without affecting the rate of production of complements and relative clauses. This increase of coordination effectively places more clauses within the phrasal unit. Multi-clausal intonation contours in the *what* condition could be interpreted as reflecting a conceptual grouping of events.

A notable difference between the two experiments was the length of response given by participants. In the first experiment, where they were asked to either describe or explain the events that took place in the video, the average response length was 41 seconds. In the second experiment, where participants responded to a specific question about the video, it was 23 seconds, despite specific instructions to answer at length. It seems that participants interpreted Experiment 1 to require a narrative, and Experiment 2 to require a brief and fairly specific answer; as if the first were open-ended and the second a test question. The rate of complementation and relativization was fairly stable between the two experiments despite the large difference in response length. The rate of coordination, however, was more variable, being similar in Experiment 1 and the *what* condition of Experiment 2, while being much lower in the *why* condition of Experiment 2.

Response length

	Ave. response length		Ave. no. of associated clauses per response			
	Sec.	Lines	Complement	Coordinate	Relative	
Exp1 overall	23	4	2.4 (.11/sec)	0.3 (.014/sec)	0.5 (.024/sec)	
Exp2 overall	41	7.44	4.7 (.11/sec)	2.6 (.06/sec)	1.64 (.04/sec)	

Complex	structures
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(means)	P n=15	P n=15	P n=30	E n=15	E n=15
	describe	explain	total	why	what
comp./sec	.12 SD=.060	.11 SD=.058	.11	.106 SD=.065	.103 SD=.083
coord./sec	.07 SD=.052	.05 SD=.046	.06	.029 SD=.035	.055 SD=.048
rel./sec	.04 SD=.041	.04 SD=.035	.04	.035 SD=.044	.031 SD=.042
Table 3: Cor	nparison of Exp	periments 1 and	12		

Syntactic complexity and coordination in a verbal production task

Appendix A: Description of stimuli, why and what questions

Ball—Monk and a woman are in the office of a sports agent, who is talking on the phone. Monk takes out a tissue and wipes a basketball in a display case. The agent gets off the phone quickly and tells Monk to stop, explaining the "stain" on the ball is Michael Jordan's autograph. Monk proposes that Michael could sign the ball again and the agent sarcastically agrees; Monk says he is relieved and the woman grimaces.

Why does the woman look disgusted when Monk says he is so relieved? What does Monk do with the tissue?

Car—Two men hand Monk the keys to a car parked at a curb. Monk takes the keys and goes to the driver's side of the car, but climbs first into the back seat of the car, then into the driver's seat, while the woman with him gets in the passenger seat. He maneuvers with difficulty out of the parking space while other drivers honk. There is a crash; the car has crashed into a light pole. Monk tells the woman that she told him to turn, so he turned.

Why did Monk crash into the light pole at the end? What did Monk do with the car?

Dog—Monk is running through the aisles of a store that is closed. A Doberman is chasing him. He goes into a customer service booth, lies on the floor, and holds the swinging door closed with his feet. He looks around, grabs a phone, and dials. The scene cuts to a restaurant where a man and woman are eating. The woman's phone rings; she answers but there is no response, only barking. The man listens and then says "let's go." They hurriedly leave the restaurant.

Why did the man and woman leave the restaurant in a hurry? What did Monk do to escape the dog?

Ferris wheel—A woman is in the seat of a ferris wheel; a man is climbing toward her on the bars of the ride. Monk is at the controls of the ferris wheel, pushing buttons. The woman shouts at Monk to get her down. The wheel starts moving, Monk pulls a lever out of the controls, and finally jumps up onto the ferris wheel.

Why does Monk jump onto the ferris wheel? What does Monk do at the ferris wheel?

Leaning—Monk and another man stand in the doorway of a house. They open the door and nobody is home. The other man asks Monk to hold the pocket of his pants and act as a counterweight so he can lean into the house and look around without touching the floor. He can't reach a pencil on the sofa, so grabs a shovel outside the door and uses it to get the pencil. Monk pulls him back. (used as example for experiment) Sandwich—Monk is in the break room of a store. He takes a bag lunch from a refrigerator. Two coworkers are trying to get candy out of a vending machine. A woman comes in and tells the two to get back to work. The two others make some comments about the woman to Monk. He opens his sandwich and finds that a bite has been taken out of it, and he throws it down. (not used in experiment)

Roof—Monk and another man look out an upper-story window; Monk points out a red rag on the chimney of the building. The other man climbs out onto the roof with Monk cautioning him to be careful. The man gets the rag, and Monk asks him to look for footprints, which he sees, and then climbs back to the room where he says that the rag is evidence.

Why are Monk and Manny looking for footprints on the roof? What did Manny do on the roof?

Room—Monk is in a nursing home room. He examines the furniture, walls, etc and questions a nurse about the occupant of the room and whether anything has been moved. A police officer is talking on a cell phone in the background describing what Monk is doing. He asks Monk to give an opinion, and Monk states that the man was murdered. The police officer seems surprised.

Why was the captain surprised that Monk said the old man was murdered? What did Monk look at while investigating the old man's room?

Snake—Monk and a police officer are inside a house. The officer is putting a snake back into a cage while Monk acts panicky. When the snake is back and the lid closed, Monk examines the snakes, saying there is a feeding schedule for Curly, Larry, and Moe. He looks closely, shouts, then climbs onto the table. The officer runs into the room and asks what he's doing. Monk replies that there are only two snakes in the cage; one must be loose.

Why did Monk jump up on the table? What did the captain do with the snakes?

Tie—A woman is talking to a man on a park bench, while Monk leans over them. The man says they have no proof; Monk stands up and holding his tie, speaks toward it, saying "come and get him." There is no response. Monk runs toward a white van parked nearby and opens the back doors. He asks the policemen inside why they didn't arrest the man; they respond that they heard nothing, and ask what happened to a stain on his tie. He responds that he finally got it out; they look dismayed.

Why were the agents inside the van upset? What did you see Monk do with his tie?

Appendix B: Sample responses

What Condition: What did Monk do with the car?

B16—Alright, it starts out with Monk taking, a pair of keys from a man, on a sidewalk, / and then he walks around the front of the car, / and he sits in the back seat, / and then closes it and opens the door again I believe, and, goes to the front seat where he's driving, / and he sticks his head out the window, / and, tries to back up and hits a car and it makes a noise, / but he drives away anyway and sticks his hand out the window to kinda wave people away, / they're honking, and then, / uh, he hits, uh, I think it's a light post, on, the right side of the car. / And gets out and is very frustrated. (38 sec)

B17—Monk got in the wrong door of the car, in the back seat, instead of the front seat; / he, then, reversed into another car, / and then kept going, / and the alarm was going off, / then he, swerved in, to the middle of the street, while another car was coming, and they honked at him, / and then he kept going, / and then, ran into, a pole. (25 sec)

B18—Monk got in the back seat first cause he was distracted, / and then he got into the driver's seat, / and he, backed up, / and, since he was nervous, it seems like he, wasn't paying attention and he backed up into a car behind him, / and then, continued to drive off, and cut off traffic, / and then, he drove into a pole. (24 sec)

B19—So, Monk got the keys from the guys standing on the curb, / and first he went to the back seat instead of getting into the driver's seat, / and completely closed the door and then got into the driver's seat, / and, s- proceeded to try to pull into traffic, it took him a few minutes, / he looked backwards, / and it sounded like he kinda backed into a car but I'm not really sure if he actually did, / and then he pulled out into traffic and cut somebody off because they honked the horn, / and then, he, ended up crashing into a light pole. (32 sec)

Why condition: Why did Monk crash into the light pole at the end? B1—It appears that Monk, does not know how to drive, or he wouldn't have gotten into the back seat of the car to begin with, / and in pulling out, he was very jerky, and, as he said to the woman, um, that she had told him to make the turn. / And so he followed her directions. (21 sec)

B2—Monk crashed into the light pole because he was so frazzled from what was going on, / he was trying to play it really cool, / um, getting out of that parking spot, cause he thought it was a really good spot, / and, um, he got stressed out, / and, that girl told him to turn, and supposedly he turned, / and, he was just listening to other people I guess. (23 sec)

B3—He crashed into the light pole because, uh, he was listening to the lady's instructions, / and it didn't look like he had, ever like driven a car before, / because, first when he gets into the wrong seat and, gets in the back seat of the car, instead of the driver's seat; / so, uh, it looked like he had little experience of driving cars, / so, uh, he didn't know when to turn right. (23 sec)

B4—Uh Monk crashes into the light pole – light, pole, at the end, because he, uh doesn't seem to be able to drive very well or be very sure of himself. (12 sec)

"Cognitive and Neural Underpinnings of Syntactic Complexity"

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For almost half a century, researchers in psycholinguistics have been interested in the relation between syntactic processing of sentences and domain-general cognitive processes (Miller & Chomsky, 1963). The question was initially addressed on linguistic and philosophical grounds (Fodor, 1988) and tackled soon thereafter by behavioral and neuropsychological experiments (Caplan & Waters, 1999; Miyake, Carpenter, & Just, 1994). Over the last two decades, the emergence of neuroimaging techniques has provided a wealth of information about the relation between language processing and domain-general resources (Grodzinsky & Friederici, 2006; Kaan & Swaab, 2002). A comprehensive review of this literature is beyond the scope of the current paper. Instead, I will focus on the processing of relative clauses.

It is well established that some embedded sentences are more taxing to process than others. In particular, people have a harder time understanding object-extracted relative (OR) clauses than understanding subject-extracted relative (SR) clauses, as demonstrated by the following example:

OR: The reporter that the senator attacked admitted the mistake

SR: The reporter that attacked the senator admitted the mistake

OR clauses have a *non-canonical word order* (object-verb-subject), requiring listeners to reorganize the sequential order of a sentence so that it matches its syntax. In these clauses, the perceptual location of the critical phrase is non-adjacent to its semantic interpretation. Therefore, its processing requires a *syntactic movement* (aka grammatical transformation) across another element. Some researchers have argued that this additional syntactic operation is at the core of what makes OR clauses more difficult to process. A prominent theory of this kind is the Trace-

Deletion Hypothesis (Grodzinsky, 2006). Proponents of this view further argue that *syntactic movement* has its biological substrate in the left frontal cortex, a claim consistent with some aphasia and neuroimaging data (Ben-Shachar, Hendler, Kahn, Ben-Bashat, & Grodzinsky, 2003).

In contrast, other researchers have explained the increased processing cost of OR clauses by appealing to 'syntactic complexity.' *Syntactic complexity* theories differ from each other regarding how complexity is defined. Some are explicit in their definition and provide a metric of complexity that can be use to test predictions (Gibson, 1998; Halford, Wilson, & Phillips, 1998). Others leave the concept of *complexity* undefined and focus instead on the experimental conditions that lead to increased complexity (Caplan, Alpert, & Waters, 1998; Carpenter, Miyake, & Just, 1994; Friederici, Fiebach, Schlesewsky, Bornkessel, & von Cramon, 2006). Theories of *syntactic complexity* also vary from each other on how general are the resources used in syntactic processing. Some theories posit the existence of a limited-capacity memory devoted exclusively to the processing of syntactic relations (Caplan et al., 1998; R. Lewis, 1996). Others argue that syntactic complexity taps onto cognitive resources that are shared with other non-linguistic complex tasks (Andrews, Birney, & Halford, 2006; Larkin & Burns, 1977; Miyake et al., 1994).

According to syntactic complexity theories, OR clauses are said to be more difficult to process than SR clauses for many reasons, including the following ones:

1. OR clauses pose a larger *storage cost* than SR clauses. This is because partially analyzed clauses need to be stored in short-term memory until their completions are available. In other words, the first noun phrase (*the reporter*) has to be retained in working memory until the verb (*attacked*) is encountered, at which point syntactic and thematic integration can occur. Once the information is integrated, it becomes part of the text meaning and of the long-term memory representation of that sentence. However, until it is integrated it needs to be held in working memory.

- 2. OR clauses yield more syntactic *ambiguity*, as more than one syntactic structure is applicable at the beginning of the sentence. For example, instead of "the reporter the senator attacked admitted the error" one could say "the reporter the senator … and the president disagreed." Comprehension is improved when ambiguity is eliminated by adding the pronoun 'whom', as in "the reporter whom the senator…" (Hakes & Foss, 1970).
- 3. OR clauses pose a larger demand for *syntactic integration*. In OR clauses there is a longer distance between dependents (reporter, attacked) and as additional words are processed, the activation level of the initial element decays¹. Therefore more resources are required for the reactivation of the initial element at the time of integration.
- 4. OR clauses require *perspective shifts* and therefore pose a larger *thematic integration* cost (MacWhinney & Pleh, 1988). In sentences with OR clauses, the first noun plays two different thematic roles. In our example, 'the reporter' starts as the *subject* of the main clause, shifts to being the *object* of the attack in the relative clause, and goes back to being the *subject* 'who admitted the error' at the end of the sentence. Such perspective shifts during sentence processing mean that the two competing representations have to be coordinated. Comprehension is enhanced when the first noun is an inanimate object, as in "the rock the kid touched was hot" (Hakes, 1972). In such cases, there is no bias toward interpreting the initial noun as a subject; therefore switching to an 'object' representation becomes easier.

¹ According to some theories of syntactic complexity, the distance between dependents is determined not so much by the total number of words to be processed before integration, but rather by the number of new discourse structures (Gibson, 1998). Each time a new discourse referent occurs cognitive resources have to be deployed to include it in the discourse environment. In contrast, when the *new* referent is already part of the discourse environment (e.g., indexal pronouns), OR clauses become easy to process (e.g., the book *you* bought...).

It may be useful to compare the processing of syntactic complexity to Executive Function processes, which play a prominent role in theories of working memory, consciousness, and willful action. In most of these theories, one of the properties of executive function is its domaingenerality. Although the taxonomy of executive function is itself a matter of controversy, executive functions are thought to contribute to:

- a. *manipulating* representations in working memory -as opposed to merely storing them.
- b. coordinating ambiguous or conflicting information.
- c. *switching* one's mindset to facilitate the interpretation or implementation of new rules for guiding behavior.

From the point of view of a cognitive neuroscientist who specializes in executive function but knows much less about psycholinguistics, the similarities between *syntactic complexity* of relative clauses and *executive function* seem, at first sight, quite compelling. On the other hand, these similarities may stem from comparing two very broad and ill-defined concepts, rather than from a genuine conceptual overlap. Thus, the remainder of this chapter is devoted to comparing the properties of *syntactic complexity* of relative clauses and *executive function*, in an attempt to systematically uncover their possible relation. For this, I will analyze the anatomical overlap between processing syntactic complexity and executive function tasks, with a focus on the frontal cortex. I will also explore the conceptual similarities between tasks that tap syntactic complexity and tasks that tap cognitive complexity in non-syntactic tasks, also touching on the role that syntactic complexity plays in reasoning about the mind (i.e., folk psychology).²

 $^{^{2}}$ I will end by summarizing how these three sections provide evidence for the close functional relation between syntactic complexity and general cognitive function.

Part 1. A. Neuroimaging of syntactic complexity

This is not an exhaustive review of the neurology of syntactic complexity but rather a review more limited in scope. From an anatomical standpoint, this review focuses on the inferior gyrus of the frontal cortex, an area that has been implicated in both the processing of syntactic complexity and the processing of many executive function tasks. As a measure of syntactic complexity, the review focuses on the comparison between OR and SR clauses. From a methodological standpoint, the review focuses on neuroimaging research (fMRI, ERP) with only a brief mention of neuropsychological data.

<u>fMRI studies</u>. To assess the neural substrates of syntactic complexity, neuroimaging studies have often compared object-extracted and subject-extracted relative clauses. This comparison has consistently shown left hemisphere activation of frontal and temporal areas (Caplan et al., 1998; M. A. Just, Carpenter, Keller, Eddy, & Thulborn, 1996). In the frontal lobe, the activation is centered in the inferior-frontal gyrus (IFG) particularly in its pars opercularis (Broadmann Area 44) and its pars triangularis (BA 45).³ Sometimes these areas are referred to as Broca's area, but I will refrain from using this label, as its anatomical boundaries remain elusive and its use is bound to create confusion (Lindenberg, Fangerau, & Seitz, 2007).⁴ Activation of IFG is consistent with neuropsychological evidence showing that lesion to IFG area reduces comprehension of embedded clauses with non-canonical word order (Friederici, 2002).

³ In the temporal lobe, the activation is center in the posterior superior temporal gyrus (BA 21/22).

⁴ Many studies refer to 'Broca's area' without a clear definition of its anatomical boundaries. Even in studies that do define the boundaries, there is significant variability on what those boundaries are. Part of the reason is that the macroscopic features are not reliable landmarks for its cytoarchitectonic borders (Amunts et al., 1999). To further complicate matters, lesions to 'Broca's area' are neither necessary nor sufficient for the syntactic deficits observed in Broca's aphasia (Dick et al., 2001).

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OR clauses differ from SR clauses in terms of syntactic operations, as the canonical word order needs to be reconstructed in the former but not the latter. Thus, one can be tempted to attribute the IFG activation to the extra syntactic processing that OR clauses demand. However, OR and SR clauses also differ in other respects such as the amount of effort involved in information processing. In other words, syntax complexity is confounded with non-syntactic cognitive processes, such as working memory.

To disentangle the contribution of syntax and non-syntactic processes, a useful approach is to include a 'cognitive' factor to the experimental design, and explore whether it interacts with syntactic complexity. The assumption is that computations carried out by overlapping neural substrates will interact. Therefore, the cognitive factor included in the design is usually one known to elicit IFG activation.

Reading low-frequency words causes more activation of left IFG than reading high frequency words.⁵ This raises the question of whether the effect of syntactic complexity in IFG will be modulated by word-frequency. To address this question, OR and SR sentences with high-frequency or low-frequency words were created in a factorial design (Keller, Carpenter, & Just,

⁵ Left IFG activation by low frequency-words may be due to lexical selection, as low-frequency words demand more intense filtering of distracting lures (Badre & Wagner, 2007; Thompson-Schill, D'Esposito, Aguirre, & Farah, 1997). Increased IFG activation by low frequency words may also stem from phonological recoding. For example, IFG is activated by reading pseudo-words (i.e., English-like words absent meaning), a task that requires grapheme-to-phoneme conversion but does not require lexical retrieval. There might even be some amount of anatomical segregation in parts of the IFG between these two mechanisms (Fiebach, Friederici, Muller, & von Cramon, 2002; Poldrack et al., 1999).

2001). As in previous studies, left IFG showed greater activation for the processing of OR clauses than for the processing of SR clauses, and greater activation for low-frequency words than for sentences with high-frequency words. More importantly, there was an interaction between these two main effects: the effect of syntactic complexity on IFG was evident only for sentences of low-frequency words. These findings point to a common anatomical substrate for the processing of syntactic complexity and the processing of non-syntactic operations such as phonological recoding and/or lexical selection.

Other fMRI studies have used the factorial design to provide evidence that IFG is not the locus of syntactic movement *per se*, but rather it supports aspects of working memory. In one such study, syntactic complexity was varied independently from working memory in German indirect wh- questions (Fiebach, Schlesewsky, Lohmann, von Cramon, & Friederici, 2005). Object-initial questions were compared to subject-initial questions with the same working memory demands. This comparison did not reveal IFG activation, despite the larger syntactic integration cost posed by object-initial questions. Sentences with non-canonical word order in which the verb was dislocated from its canonical position over a relatively long distance were compared to sentences with a shorter dislocation. These two types of sentences had the same syntactic integration cost but different working memory load. Those with larger working memory load did cause larger IFG activation (BA 44).

In a study of OR vs. SR clause processing, whether the disambiguation occurred early or late within a clause was systematically varied (Fiebach, Vos, & Friederici, 2004). This early-versuslate manipulation was intended as a manipulation of working memory load. Based on a different measure of working memory capacity, subjects were classified as having high- or low- working memory span. OR clauses caused greater IFG activation than SR clauses, consistent with previous findings. More importantly, the effect of syntactic complexity was dependent on the

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working memory demands. More specifically, increased IFG activation by syntactically complex sentences was evident only for participants in the low WM span group while reading sentences that demanded most WM (i.e., in which disambiguation occurred late in the clause). In other words, it seems that working memory demands were the main cause of IFG activation.

In sum, there is substantial evidence to argue that IFG is not recruited exclusively for the syntactic reconstruction of canonical word order but rather is implicated in working memory or processing load. As just described, IFG activation by syntactic complexity is modulated by sentence ambiguity, lexical retrieval, and other memory demands.

Mechanisms underlying IFG activation in OR clause processing. In subject-relative clauses, syntax helps to integrate nouns with verbs: once the information is integrated, it becomes part of the long-term memory representation of that sentence. In contrast, in the object-relative clause the partially processed but incomplete syntactic dependencies need to be maintain in working memory. Based on this analysis, working memory differences should begin with the occurrence of the second noun-phrase in the object-relative clause (e.g., 'the senator who the reporter attacked denied the charges'). On the other hand, it is at the end of the object-extracted relative clause that syntactic and thematic integrations occur. The verb of the OR clause resolves the ambiguity and allows assigning the roles of 'who did what to whom'. If the cost of OR clause processing stems from these syntactic and thematic integrations, the IFG activation should start near the end of the OR clause. These two hypotheses are not necessarily incompatible: it is possible that the IFG activation is driven both by working memory demands and integration costs. Unfortunately, fMRI studies are unable to assess these alternative hypotheses because in fMRI studies the hemodynamic response lags the neuronal response by several seconds, making it impossible to test which part of the sentence is triggering the activation.

This limitation can be overcome by methods using online measures such as gaze duration

(Holmes & O'Regan, 1981; Traxler, Williams, Blozis, & Morris, 2005), word-by-word reading (Gibson, Desmet, Grodner, Watson, & Ko, 2005), and pupil diameter (Marcel A. Just & Carpenter, 1993). Studies using these methodologies indicate that the point of greatest effort is at the end of the object-relative clause, when thematic roles are assigned (i.e., when it is decided who did what to whom). Although useful as online measures of performance, these methodologies do not allow direct comparisons with brain activation. This limitation is overcome by event-related potentials (ERPs), as online electrophysiological measures of sentence processing can be correlated with fMRI activation. Although ERPs' spatial resolution is not as good as that of fMRI, its temporal resolution is much superior. Thus, the methodological strengths of the two techniques complement each other very well.

ERP studies provide support for the *working memory* hypothesis. The electrophysiological response to the OR clause begins to diverge from the SR clause at the appearance of the second noun (the senator) which marks the beginning of a differential working memory load between OR and SR sentences (King & Kutas, 1995). This divergence occurs in left anterior sites (i.e., frontal lobe) and is similar to the effect found when working memory load is increased in other types of sentences (Kluender & Kutas, 1993). Furthermore, the left anterior negativity is also found when comparing SR clauses to unembedded sentences, consistent with the increased memory demands of embedded sentences. Interestingly, the laterality of the OR effect occurs only for reading material; auditory presentation elicits a bilateral effect instead (Muller, King, & Kutas, 1997). Thus it seems likely that phonological recoding may contribute as a possible modulator of this effect. Finally, ERP studies also support the *integration* hypothesis. In fact, the largest ERP difference between OR and SR does occur at the end of the OR clause, when the main clause verb is first displayed (King & Kutas, 1995).

Evidence for Syntactic Specificity in left IFG activation. According to the literature

reviewed so far, IFG activation while processing OR clauses is mediated by non-linguistic cognitive processes such as working memory and perspective taking. However, some studies argue otherwise. One fMRI study assessed activation under different levels of (a) syntax complexity and (b) speech rate (Peelle, McMillan, Moore, Grossman, & Wingfield, 2004). It compared OR clauses to SR clauses; speech speed was systematically manipulated. Syntax complexity activated left IFG across all presentation rates. Fast presentation rate elicited medio-frontal activation usually activated by effortful tasks. More importantly, speech rate did not modulate the level of activation due to syntax complexity. This lack of interaction is at odds with the behavioral data in the same task showing that the cost of increased syntax complexity is modulated by speech presentation rate, with larger error rates for OR sentences at faster speech rates.

A second study showed activation in left frontal cortex independent of a variety of factors that were manipulated to increase demands (Ben-Shachar et al., 2003). These results have sometimes been interpreted as evidence for a core network of brain regions that supports grammatical processes and includes IFG and postero-lateral temporal cortex (Cooke et al., 2006). Additional brain regions are thought to be engaged as required by extra cognitive demands. It is unclear how best to reconcile these findings and those showing interaction.

Part 1. B. Neuroimaging Executive Function

'Executive Function' is an umbrella term for a wide range of functions that contribute to working memory, consciousness, and willful action. A central goal in cognitive science has been to describe how those functions relate to each other and to other cognitive systems (Miyake, Friedman, Emerson, Witzki, & Howerter, 2000). Cognitive neuroscience has joined the enterprise by exploring whether the same brain areas, most notably in the frontal cortex, are

recruited for different aspects of executive control. Although there is not yet a definitive taxonomy of executive function, there is general agreement that a central place should be given to the following abilities:

a. manipulating mental representations in working memory

- b. coordinating ambiguous or conflicting information
- c. switching mental sets

Some of the experimental paradigms developed over the years aim to explore a single executive function and fractionate it into its more basic subcomponents. Other paradigms aim to relate executive function to other cognitive systems, such as working memory (Baddeley, 1992) and visuospatial attention (Fernandez-Duque & Posner, 2001). In such latter cases, 'executive function' is conceptualized as a component of the cognitive system in question. Finally, executive processes are sometimes involved in tasks designed to study some other function. For example, the ability to ignore distractors is an executive function that modulates performance in lexical decision tasks.

Given the central role that verbal working memory seems to play in syntactic complexity, I start by reviewing executive function as part of working memory capacity. This requires a brief description of Working Memory (WM) as a system that allows people to actively *maintain* and *manipulate* information. One of most influential models of WM is the one proposed by Baddeley (Baddeley, 1992). That model poses the existence of a system for *maintaining* verbal information known as the phonological loop, a system for *maintaining* visual information, and a central executive system for *manipulating* the information.

<u>Simple storage of verbal information in working memory</u>: For functioning in everyday life, it is absolutely necessary to be able to maintain information after it ceases to be perceptually available. Otherwise, we would be unable to hold a phone number in mind or to

understand any sentence more than a few words long. This simple storage of information is dependent on the phonological loop. Presumably, this is the aspect of WM that is tapped by lengthening the distance between syntactic dependencies.

Neuropsychological and neuroimaging evidence shows that the phonological loop is lateralized to the left hemisphere and is further subdivided into a subvocal rehearsal process and a passive storage of phonological information. A recent meta-analysis has confirmed that simple storage of verbal information in working memory activates IFG and that such activation is lateralized to the left hemisphere (Wager & Smith, 2003). Left IFG is also active during rhyming judgment tasks and other phonological tasks, consistent with a close functional relation between verbal working memory and silent speech (Paulesu, Frith, & Frackowiak, 1993; Poldrack et al., 1999).

This raises the possibility that increased left IFG activation in response to OR clauses may be due to increased phonological rehearsal. According to this hypothesis, increased complexity would bias participants toward sounding their words out. If this hypothesis is correct, the left IFG activation by OR clauses should disappear under conditions that prevent silent speech (i.e, articulatory suppression). However, some of the evidence suggests otherwise: left IFG activation by OR clauses occurs even when participants read the sentences while uttering an unrelated word every second, aimed at suppressing silent speech (Caplan, Alpert, Waters, & Olivieri, 2000). Nonetheless, there is some neuropsychological evidence in favor of the hypothesis. For example, comprehension of OR clauses is impaired in patients whose clinical symptoms include effortful speech and dysarthria. One such example is patients with progressive non-fluent aphasia, a type of dementia with brain atrophy most pronounced in left lateral frontal cortex (Grossman & Moore, 2005).

<u>Manipulating information in verbal working memory.</u> As suggested by the label *working* memory, people are able not only to store information but also to manipulate and reorganize it. Such ability correlates with individual differences in reasoning, planning, and other intelligent behavior (Kane & Engle, 2002). The ability to manipulate information in WM has been tested with several different paradigms.

In the *n*-back task, letters are presented one at time separated from each other by a delay of 2 seconds. For each letter, the participant has to decide whether it matches the letter presented *n* stimuli back. As an example, imagine that in a 2-back task you see the following letter sequence: G, T, L, B, L. Upon seeing the first L, you should report it does not match the reference letter G, that is, the letter that occurred two trials back. As soon as this decision is made, you have to update the information, replacing G for T as the reference letter.

Although some studies report IFG activation in the 2-back task, it seems likely that such activation is due to increased verbal rehearsal rather than to working memory updating. In support of this interpretation, silent rehearsal tasks cause as much left IFG as 2-back tasks (Awh et al., 1996). This is consistent with the findings from a recent metaanalysis showing that working memory updating does *not* increase left IFG activation relative to the activation in the simple storage condition (Wager & Smith, 2003). In the few studies in which *updating* does activate IFG, the effect is lateralized to the *right* hemisphere. In sum, it seems that left IFG activation is due to *rehearsal* rather than *updating*, at least as far as the n-back task is concerned.

In the *alphabetization* task, a sequence of letters is presented followed by a delay. During the delay, the participant has to organize the letters in alphabetical order. When the probe appears, the subject reports its location in the alphabetical order. The *alphabetization* condition is compared to a *storage* condition in which the letters have to be retained in the order they are presented. Both conditions equally activate IFG, consistent with a rehearsal interpretation. The

alphabetization condition uniquely activates more dorsal areas of the frontal cortex, such as area 9 and area 46. Thus, working memory manipulation appears to depend on neighboring areas of IFG, rather than IFG proper (D'Esposito, Postle, Ballard, & Lease, 1999).

The Operation Span task assesses the ability to maintain words in memory while solving math problems. In this dual-task paradigm, a sequence of words is presented one at a time, each paired with a math equation. The task requires holding certain information in mind while doing something else. Performance in the Operation Span task correlates with individual differences in reasoning and general fluid intelligence (Engle, Tuholski, Laughlin, & Conway, 1999). Activation is more anterior than for syntactic complexity tasks and lateralized to the right hemisphere. It includes BA 10, 46, and 47 (Wager & Smith, 2003).

Summary of WM activation and its relation to syntactic complexity. The literature provides support for a common anatomical substrate for syntactic complexity and some aspects of working memory, but not others. On the one hand, there is firm evidence in favor of left IFG activation for subvocal rehearsal and for syntactic complexity. This is consistent with the view that OR clauses require maintaining more information in working memory for longer time. On the other hand, there is less evidence of overlap between syntactic complexity and manipulation of information in working memory. Although syntax complexity and WM *manipulation* both activate lateral frontal cortex, the precise areas of activation are mostly non-overlapping. However, it remains a possibility that overlap exists with other executive functions. I discuss this possibility next.

<u>Coordinating</u> ambiguous or conflicting information. Objects in the environment have many attributes; they have color, shape, motion, size, function, location in space, meaning, etc. For any given task, only a few of those attributes are relevant. Effective information processing requires, among other things, the ability to adequately select which information to process and

which to ignore. For example, when picking an apple it is useful to know its size and location, but it is not necessary to know its color. However, color information may become useful when deciding whether to eat the apple, as color will cue the eater to any rotten parts as well as to the flavor she should expect.

The above example illustrates some of the difficulties confronting an agent as she processes a multi-attribute stimulus. On the one hand, some of the perceptually salient attributes carry information that should be ignored because they are useless or even harmful to performance. On the other hand, those same attributes may become relevant at some later point in time. This variability requires that the agent be flexible when deciding how to allocate her attention. In cognitive psychology, the filtering of salient information has been studied under the banner of *conflict resolution*. The flexible allocation of attention to different dimension has been studied under the banner of *set switching*.⁶

Conflict Resolution in perceptual tasks. The prime example of conflict resolution is the Stroop task, in which subjects are instructed to respond based on a certain stimulus dimension (e.g., hue) while ignoring some other information (e.g., word meaning). When information from the distracting dimension is incongruent with the target dimension (e.g., the word RED in green ink), conflict arises (Bush, Luu, & Posner, 2000). Its resolution depends on subjects' ability to ignore the irrelevant information, which in turn requires keeping in mind the correct mindset (i.e., 'respond to hue'). This version of the task is sometimes referred to as the 'verbal' Stroop. Other Stroop-like tasks require the filtering of non-verbal information. The spatial-compatibility task, for example, requires participants to ignore the stimulus location and respond instead based on stimulus shape. The 'flanker task' requires responding to the center target while ignoring

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⁶ Sometimes both are referred to as 'selective attention', a label that highlights that these processes are voluntary, effortful, and require the deployment of domain-general resources.

distractors on the sides (Fan, Flombaum, McCandliss, Thomas, & Posner, 2003).

Performance in the verbal Stroop task is impaired following lesion to left IFG (Hamilton & Martin, 2005) and neuroimaging studies show left lateralized IFG activation for incongruent trials (RED in green ink) (Derrfuss, Brass, Neumann, & von Cramon, 2005). The left lateralization of these effects is specific to verbal material: conflict in a non-verbal flanker task activates *right* IFG (Hazeltine, Poldrack, & Gabrieli, 2000), and lesion to left IFG does *not* impair performance in the non-verbal spatial-compatibility task (Hamilton & Martin, 2005).

<u>Conflict Resolution in Working Memory tasks.</u> In the Stroop and Stroop-like tasks, the filtered information is perceptually available. In contrast, other tasks require the filtering or inhibition of memory representations. Such tasks are relevant to our discussion of syntactic complexity because interpreting a sentence based on new information does require suppressing the no longer relevant interpretation.

One task requiring inhibition of memory representation is the proactive interference task. In this task, a few words (or letters) are presented one per second, immediately followed by a probe. The participant reports whether the probe matches one of the items she just saw. Nomatch trials can be further divided based on probe familiarity: a probe is said to be familiar if it appeared as an item in the preceding trial. Familiar probes in non-match trials lead to slower and less accurate responses. In those trials, there is conflict between the familiarity of the probe and its absence in short-term memory set. High conflict trials activate left IFG (Brodmann area 45); this activation is triggered by the probe onset, which suggests that it is related to conflict resolution (Postle, Brush, & Nick, 2004). Consistent with this interpretation, performance in high conflict trials is impaired following left IFG lesion (Hamilton & Martin, 2005). Impairment can also be triggered in healthy adults by temporally inactivating left IFG with the use of repeated transcranial magnetic stimulation (Feredoes, Tononi, & Postle, 2006).

Conflict resolution in semantic memory tasks When trying to retrieve a word from memory, it is necessary to filter out distractors semantically related to the target. For example, imagine that you are shown a picture of a pencil and asked to name its function. The first word that will come to mind is 'pencil', rather than the correct answer. Or imagine you are shown a picture of an ox and asked to name which animal it is. In this case, a more prototypical member of the category – e.g., 'cow' - may to come to mind. As these examples illustrate, correct performance in these tasks require suppressing the tendency to use the most salient response. Neuropsychological and neuroimaging studies indicate that left IFG plays an important role in such inhibition (Kan & Thompson-Schill, 2004).

<u>Switching mental sets.</u> When processing multidimensional stimuli, attention is allocated selectively to a particular dimension. However, the focus of attention can be shifted voluntarily to a different stimulus dimension, or even to a different task. For example, a person who had previously been responding based on stimulus color (red, blue) can begin to respond based on stimulus shape (triangle, square). Switching requires selecting the new mental set ('respond to shape') and inhibiting the old one ('respond to color'). It also requires the activation of specific rules ('if red, press left'). These two components of set switching are dissociable in the brain: *Set selection* activates lateral and medial prefrontal cortex, while *rule activation* activates mostly the intra-parietal sulcus (Derrfuss et al., 2005; Wager, Jonides, & Smith, 2006).

A recent meta-analysis found that set switching tasks and verbal Stroop tasks cause overlapping activation in the posterior part of the left IFG (Derrfuss, Brass, & von Cramon, 2004). In switch trials, this area - known as the inferior frontal junction- becomes active even before the appearance of the target (Brass & von Cramon, 2002). This is consistent with a role in *set selection,* as behavioral studies have found that *rule activation* requires a perceptually available target (Monsell, 2003). Furthermore, neuroimaging studies show activation of this

brain area at the start of a block of trials, once participants are instructed to get ready for the task (i.e., to adopt the appropriate mindset) (Dosenbach et al., 2006). The set selection is likely to involve the maintenance of task-relevant information, probably in verbal format. Such maintenance of task-relevant information is a process akin to *selective attention*, the mental highlighting of some stimulus property for the benefit of preferred processing and conscious awareness.

One fMRI study provides striking evidence that the left lateralization of set switching is related to verbal processing. In this study, overlapping face/word stimuli were displayed and participants either performed a gender task on the face (male/female) or a syllable-counting task on the word (two syllables or not). Every four trials, a cue signaled participants to continue the same task or switch to the other task. Left IFG was activated when performing the word task and right IFG was activated when performing the face task. More importantly, those effects were larger for switch trials than for repeat trials (Yeung, Nystrom, Aronson, & Cohen, 2006). In other words, the IFG activation was larger for the trials that required more attention.

Neuropsychological studies have further shown that lesions in the left hemisphere impair performance in *switch* trials (U. Mayr, Diedrichsen, Ivry, & Keele, 2006). Besides causing increased *local* switch cost (the cost in switch trials), left lateral frontal lesions also lead to increase *global* switch costs. Global switch costs refer to slow responses to no-switch trials in blocks with bi-dimensional stimuli, relative to blocks with uni-dimensional stimuli. When the relevance of each dimension alternates every few trials, the irrelevant dimension becomes salient, and more attention is needed to filter it out. If this explanation is correct, we should find that subjects who are least effective at *set selection* are more exposed to the irrelevant dimension and therefore have more conflict to resolve. Neuroimaging studies in normal subjects support this prediction: participants who perform poorly in *switch* trials show increased activation in some

conflict resolution areas of the frontal lobe (superior and middle frontal gyri) (Wager et al., 2006).

Besides being the *source* of selective attention in some verbal switching tasks, parts of left IFG are also the *target* of selective attention. For example, when participants have to attend to syntax (e.g., plausibility judgment task), the processing of OR clauses trigger larger IFG activation than when syntax is not task relevant (e.g., detecting the presence of a pseudo-word) (Chen, West, Waters, & Caplan, 2006).

<u>Coordinating information in relative clauses: A role for conflict resolution and set</u> switching.

In explaining differences between OR and SR clauses, studies of syntactic complexity often appeal to concepts such as 'working memory' or 'cognitive load'. The strength of those explanations lies on a detailed description of what the terms mean and how they relate to syntactic processing. This has been done with some success for some aspects of working memory (R. L. Lewis, Vasishth, & Van Dyke, 2006; Caplan & Waters, 1999). In contrast, less is known about the conditions under which conflict resolution and set switching would contribute to syntactic processing (Novick, Trueswell, & Thompson Schill, 2005). Some likely candidates are mentioned next.

Conflict resolution and switching of mindset are likely more involved in the processing of OR clauses than in the processing of SR clauses. One reason for this is that OR clauses are more ambiguous: in OR clauses, the lexical semantics often do not converge with the default syntactic order. Consider the following two sentences:

(a) the girl the boy kicked was big.

(b) the ball the boy kicked was big.

These are two OR clause sentences, but 'a' is harder to understand than sentence 'b'. The reason for this is that 'girl' is an animate noun. Based on semantic knowledge, the reader builds the expectation that the animate noun will be the agent of the action. Furthermore, in the English language it is very infrequent for an animate noun to be followed by an OR clause (Fox & Thompson, 1990). Thus, the expectation based on distributional statistics agrees with the expectation based on lexical semantics, namely that following an animate noun the clause will be a SR. In OR clauses, this expectation needs to be overcome, a process that requires conflict resolution.

Consistent with this account, OR sentences in which the first noun is animate elicit greater left IFG activation than OR sentences in which the first noun is inanimate (such as 'b' above) (Caplan, Chen, & Waters, <u>in press</u>). It is likely that the activation is elicited at the end of the relative clause. OR sentences require the rapid processing of adjacent verbs, increasing the chances that role assignments for the two clauses will overlap in time. Such temporal overlap is bound to create conflict, as the same noun has to be assigned two different roles (patient of the relative clause, agent of the main clause). This conflict will be greater in the OR sentence with an animate noun in the main clause because in that case there is a stronger expectation that is being violated.

ERPs on these types of sentences using a word-by-word reading paradigm reveal that the animacy effect is elicited in part by the relative clause verb, and in part by the main clause verb (Weckerly & Kutas, 1999). The relative clause verb elicits an effect that is centered in centro-parietal sites, with a scalp topography and time course similar to the P600 component. It is probably the neural marker of the mismatch between the incoming stimulus and the current
mental set, or possibly a marker of working memory update (*Coulson, King, & Kutas, 1998*).⁷ The second ERP component is elicited by the main clause verb. It is a left anterior negativity (LAN) that occurs in the 200-500 ms window after stimulus onset. Its location is consistent with IFG activation, and its time course and scalp topography are almost identical to those obtained by comparing OR clauses to SR clauses (see p. 10). Interestingly, the LAN effect is obtained only in participants whose sentence comprehension is good. It would be interesting to explore whether the effect correlates with conflict resolution, set switching, or both.

Support for the claim that conflict resolution is related to syntactic complexity also comes from the observation that OR clauses with indexal pronouns are easy to process. Consider the following two examples:

a. The reporter the senator attacked admitted the error.

b. The reporter you attacked admitted the error.

Sentence (a) is harder to understand than sentence (b). A likely interpretation is that in (a) the embedded subject (the senator) is a new referent in the discourse while in (b) the embedded subject (the pronoun 'you') is already part of the discourse, at least implicitly. According to one of the more prominent theories of syntactic complexity, the presence of a new discourse referent makes more difficult the integration (attacked-reporter) because processing new discourse information demands working memory capacity (Gibson, 1998). As a consequence, access to the main clause noun becomes more difficult and so does the noun-verb integration. The difficulty in accessing the noun is probably due to retrieval interference,

⁷ The functional significance of the P600 is a matter of debate. Some researchers argue that it is a general-purpose process related to the updating of information in working memory. In support of this view, the P600 has a scalp distribution similar to that of another ERP component associated with memory updating, the P3b (Coulson, King, & Kutas, 1998). Others argue that the P600 is caused by the syntactic reanalysis that occurs whenever the parser fails to find a meaningful parse (Friederici, 2002). Consistent with this interpretation, the P600 is triggered by syntactic violation and by sentences with correct but non-preferred structure, such as OR sentences and garden-path sentences.

although other factors may also come into play (R. L. Lewis, Vasishth, & Van Dyke, 2006; Van Dyke & McElree, 2006). To overcome that interference, conflict resolution needs to be applied.

Conflict resolution may also explain why processing OR clauses is more difficult when the noun phrases are similar (Gordon, Hendrick, & Johnson, 2001). Consider the following two OR clauses:

(a) the actor that the director thanked worked in many hit movies before 1980

(b) the actor that Fay thanked worked in many hit movies before 1980

Sentence 'a' is harder to understand than sentence 'b', and participants in a word-by-word reading paradigm slow down at the moment of thematic integration (i.e., when processing the verbs of sentence 'a'). In (a) the embedded noun phrase (the director) is similar to the matrix noun phrase (the actor). In (b) the embedded noun phrase is a proper name (Fay) and thus it is less similar and probably causes less interference. Once again, it is at the moment of retrieval that such interference is likely to occur (R. L. Lewis, Vasishth, & Van Dyke, 2006; Van Dyke & McElree, 2006). Consistent with this view, eye tracking studies show that the similarity effect first appears at the moment of processing the verbs (Gordon, Hendrick, Johnson, & Lee, 2006).

Finally, set switching may help explain the pauses that occur during speech production of relative clauses. According to a prominent view, intonational boundaries are the result of *resource processing demands* on language production (Watson & Gibson, 2006). This 'cognitive load' interpretation argues that pauses are due to effortful processing (i.e., executive functions). The claim is that intonational boundaries "provide the speaker with time to (a) plan the properties of upcoming linguistic structure and (b) recover from expending resources after producing complex linguistic structure" (pp. 1045-1046) (Watson, Breen, & Gibson, 2006). According to this cognitive load hypothesis, intonational boundaries should be most likely to

occur before *and* after long constituents because these locations are likely points for planning and recovery (Watson et al., 2006).

A further prediction would be that intonational boundaries will be most likely for sentences with large set switching demands. Testing this latter prediction might be difficult, as syntactic complexity and set switching are often confounded. Thus, a goal for future research should be to develop experimental sentence comprehension and speech production designs that vary set switching independently from syntactic complexity. Another approach would be to appeal to individual differences, and test whether intonational boundaries are more likely in participants whose set switching skills are below-average. This approach could also be extended to clinical populations that show impairment in these domains. One such group is Parkinson Disease (PD) patients. PD patients are impaired at set switching in both motor and perceptual tasks (Hayes, Davidson, Keele, & Rafal, 1998). They also have difficulty understanding OR clauses and other syntactically complex sentences. In PD, the deficit in set switching, as well as the deficit in syntactic complexity, is ameliorated by dopamine treatment (Grossman et al., 2001; Hayes et al., 1998). Many patients go on and off medication as part of their treatment, a regimen that could offer a rare opportunity to explore the chemical mechanisms underlying syntactic complexity and/or set switching. More generally, PD may prove to be a useful model for testing how executive functions and syntactic complexity interact in the brain. The frontal-striatal loop is a circuit that includes parts of the cerebral cortex as well as sub-cortical structures such as the basal ganglia. This loop is involved in many aspects of behavior, including working memory (Koelsch et al., 2008; McNab & Klingberg, 2008) and set switching (Crinion et al., 2006), as well as learning (Packard & Knowlton, 2002), reasoning (Goel, Gold, Kapur, & Houle, 1997), motor control, and other functions. The hallmark of PD is a dysfunction of this frontal-striatal loop due to partial depletion of the neurotransmitter dopamine. PD deficit in syntactic

complexity, such as OR clause comprehension, correlates with deficits in executive tasks such as the Stroop task (Grossman, Lee, Morris, Stern, & Hurtig, 2002) and set switching tasks (Hochstadt, Nakano, Lieberman, & Friedman, 2006).⁸

The effects of syntactic complexity and working memory maintenance in PD were explored in an fMRI study using a factorial design (Grossman et al., 2003). Type of relative clause (OR, SR) was used to manipulate syntactic complexity, and length of noun-gap linkage (short-distance dependency, long-distance dependency) was used to manipulate memory storage. In healthy adults, both cortical and sub-cortical components of the loop were recruited by syntactically complex sentences with high memory demand. In PD, those sentences only activated the cortical component (left IFG), failing to activate the subcortical component (striatum). These results are consistent with IFG playing a compensatory role to the subcortical dysfunction. It is unclear whether the compensatory effect is on memory or conflict resolution.

Conceptual Similarities between tasks of syntactic and non-syntactic complexity

The reviewed literature on IFG activity shows commonalities between syntactic complexity and some aspects of working memory and executive function. However, to argue that the syntactic and non-syntactic domains are functionally related it is also important to seek commonalities at other levels of analysis. One promising approach is to compare tasks of syntactic complexity to tasks that share a similar structure, or require a similar set of computations. Tasks of *reasoning* and *intelligence* seem likely candidates. I discuss those next. <u>Transitive inference task.</u> Consider the following scenario:

⁸ Another factor that may contribute to poor sentence comprehension is PD's slow information processing, as revealed by abnormally late effects of lexical priming in this group.

Premise 1: Mary is taller than Joan.

Premise 2: Joan is taller than Emma.

Conclusion: Therefore, Mary is taller than Emma.

This type of reasoning is relatively easy. If after reading the two premises you were asked who is tallest, you probably would have no difficulty answering "Mary". Now, let's switch the order of the premises:

Premise 2: Mike is taller than Joe.

Premise 1: Ed is taller than Mike.

Conclusion: Therefore, Ed is taller than Joe.

This slight modification makes the second example much more difficult to process. Why? In trying to answer this question, it is worth pointing out that performance in the transitive inference task is correlated with OR clause comprehension (Andrews et al., 2006). Remarkably, the correlation remains significant after controlling for performance in SR clause comprehension, and for performance in a variant of the Operation Span task. This raises the possibility that a common factor underlies performance in OR clause comprehension and transitive inference reasoning.

The factor, it has been proposed, is *relational complexity* or number of related dimensions that need to be considered *simultaneously* (Andrews et al., 2006). In the transitive reasoning task, the goal is to rank each person by height, based on relative height information. In the first example, the relations between names can be processed sequentially. This segmentation reduces the task complexity: by the time the second relation is being processed, the first one is already solved. In contrast, in the second example both relations need to be considered simultaneously. In other words, the relational complexity of the task is increased, and so its difficulty.

The processing of SR and OR clauses lends itself to a similar analysis. In this case, the goal is thematic role assignment ('who did what to whom'). Thematic role assignment, which is central to sentence comprehension, requires processing the relation between nouns and verbs. In the SR clause, those relations can be processed sequentially; propositions can be processed one at a time. In contrast, in the OR clause segmentation is more difficult because the verbs, which are needed for assigning the roles, are concentrated at the end of the sentence. Consistent with this interpretation, the largest processing cost in OR sentences occurs at the moment that the verbs are displayed. This is the moment when noun-verb relations are extracted.

Re-describing relative clauses in terms of relational complexity should allow researchers to entrench syntactic complexity into cognitive literature that includes reasoning and problem solving (Halford & Andrews, 2004; Halford et al., 1998). For example, the maximum number of relations that can be processed simultaneously is four, according to estimates based experimental research⁹. There is a developmental progression to this maximum capacity (Andrews & Halford, 2002). It would be interesting to explore whether the developmental trajectory of *relative complexity* coincides with the developmental trajectory of relative clause use (Diessel, this issue).

<u>Matrix tasks</u>: When seen through the prism of relational complexity, matrix tasks share a resemblance to the transitive inference task just described. The best known example of this type of task is Raven's Progressive Matrix (RPM), developed in 1938 as a measure of nonverbal intelligence. Over the years, the original version of the task has been adapted to accommodate different populations and methodologies (Carpenter, Just, & Shell, 1990).

⁹ The relational complexity of a task can be lowered by segmentation and by conceptual chunking, both of which are important aspects of expertise. *Segmentation* entails breaking tasks into less complex steps that can be processed serially. *Conceptual chunking* is the recoding of concepts into less complex relations. For example, 'distance over time' can be recoded as 'speed'. Although useful in reducing complexity, conceptual chunking entails a loss of relational information.

In a version of the task adapted for neuroimaging, a 3 x 3 matrix of figures is displayed with the bottom right figure missing (Christoff et al., 2001). Participants have to infer the missing figure and select it from among a set of options. The complexity of the problem is based on the number of dimensions that relate figures to each other. For example, a 1-relational problem would vary in only one dimension (e.g., size). In one such problem, the figures might decline in size from left to right. A 2-relational problem would add a second dimension of change (e.g., shade). In this example, besides getting smaller from left to right the figures would also get darker from top to bottom. Solving a 1-relational problem requires evaluating only one dimension, while solving a 2-relational problem requires the simultaneous evaluation of two dimensions. In this sense, the RPM is conceptually similar to the transitive inference task, and to the processing of relative clauses. A comparison of 2-relational vs. 1-relational problems show activation of several brain areas, including anterior part of the left frontal cortex (area 10), posterior part of the IFG (area 44) and sub-cortical parts of the fronto-striatal loop (e.g., basal ganglia) (Christoff et al., 2001; Kroger et al., 2002). ¹⁰

Sequential vs. Coordinated Change detection:¹¹ This task is conceptually similar to the other tasks described in this section (Ulrich Mayr, Kliegl, & Krampe, 1996). One of its conditions allows the process to be carried out sequentially, while the other condition requires simultaneous evaluation of two dimensions.

In each trial of this task, two panels are displayed side by side. Each panel has four figures. Within a panel, the figures could differ from each other in size, shape, inside shading, or outside shading. In the sequential condition, the second panel has the identical arrangement except for one figure which varies in one dimension (e.g., shape). The goal is to find that odd

¹⁰ The IFG activation is related to the increased difficulty that is associated with more complex trials. In contrast, area 10 of the frontal lobe is specifically activated by relational complexity being active even in 2-relational trials in which the response was quick and accurate.

¹¹ Tom: should I delete this task? I worry that it may feel too much like a laundry list.

item (i.e., local change). Task difficulty can be manipulated by increasing the number of figures per panel, thus increasing the number of items that need to be searched.

Task difficulty can also be manipulated by adding a global change. This involves changing one dimension in all the figures of the second panel, such as removing the inside shading. The goal in this condition remains the same as before: find the odd item (the one with a local change). However, participants in this condition need to take into consideration the global change. They have to retain that information in working memory and integrate it when deciding whether the item they are looking at is the target or not. This coordinated complexity is more detrimental to older adults than the task difficulty brought about by increasing the number of figures in the displays (sequential).

Coordinative complexity has also been explored in mental arithmetic (Verhaeghen, Kliegl, & Mayr, 1997). In the sequential condition of this task, participants performed additions and subtractions, for example answering a problem such as (8-3+4-1+2 = ?). Coordinative complexity was induced by including bracketing to the problem, for example '[(8-3) + 4] –(1 + 2) = ?'. Difficulty was manipulated independently of complexity by varying the number of operations to be performed (5, 10). Once again, coordinative complexity was disproportionately affected in older adults.

The coordinative process in these tasks seems akin to the process that occurs in the comprehension of OR clauses. This raises the question of whether coordinative complexity measured this way would predict OR clause comprehension.

<u>Dimensional Change Card Sort Task</u> (DCCS) This task has been used successfully in the developmental literature to explore the development of executive functions (P. D. Zelazo, 2006). Children are asked to sort cards into two piles according to an explicitly stated rule, such as "Play the color game: if it's red, it goes here [to the left], if it is blue it goes here [to the right]".

After several trials the rules change and children are explicitly told to sort based on a dimension that until then was irrelevant (e.g., 'Now you will play the shape game: if it is a rabbit it goes here [left], if it is a boat it goes here [right]'). At the age of 3, most children are incapable of switching, even though they are able to verbalize the new rule if asked to do so. At the age of 5, most children are capable of performing the task.

These findings have been interpreted in the context of a theory of cognitive complexity and control, which poses that rules are embedded in a hierarchical structure (Philip David Zelazo & Frye, 1998). Application of the first-order rules ('if red, left', 'if blue, right'; 'if rabbit, left', 'if boat, right) is contingent on which higher order rule ('sort by color', 'sort by shape') is active based on the instructions. Although 3-year old children are capable of implementing two firstorder rules, it is not until the age of five that they can coordinate them in an embedded structure.

The embedded structure of the DCCS task raises the interesting question of whether it can be performed by people whose language seems not to include embedding, such as the Piraha (*Everett*, xxx). Said differently, the DCCS may be a good proxy for assessing the use of embedded structures and rules in speakers of that language. An advantage of the task is the simplicity of its instructions, which can be illustrated without words.

<u>The ramp task¹²</u>: This task has been used to explore the development of causal reasoning (*Frye, Zelazo, Palfai, 1995*). Children are presented with a ramp that has two holes at the top in which a marble could be placed and two holes at the bottom from the marble could roll out. Which hole the marble rolls out from depends on the ramp configuration. In one configuration, the marble rolls out from the hole in same side it was placed (e.g., left, left). In the other configuration, it rolls out from the opposite side (e.g., left, right). Although the mechanism is hidden from view by an opaque lid, there is a light that correctly indicates which configuration

¹² Tom: should I delete this task? I worry that it may feel too much like a laundry list.

the ramp is on. The instruction correctly informs the child about this (e.g., "remember, the light is on, so the marble will roll across"). Three-year olds are capable of learning one rule, but they fail to switch rules. By the age of 5, children are nearly perfect in their causal predictions.

The ramp task has a similar structure to the DCCS task and not surprisingly, performance in the two tasks is correlated even after age is partialled out. It would be of interest to explore the relation between the two tasks and comprehension of syntactic complexity. In the ramp task the inference is about a physical event. However, performance in this task correlates with tasks in which the inference is about mental events (theory of mind).

<u>The appearance / reality task</u>: This task explores children's inferences about mental states. Children are shown a picture of a white bird covered by a blue filter, and asked to report its color. After the child reports that the bird is 'blue', the experimenter removes the filter to reveal that the true color of the bird is white. The experimenter covers the bird with the filter again, and asks three questions: (a) what color the bird looked like (*appearance* question), (b) what color the bird really is (*reality* question), and (c) what color the subject had thought the bird was before the filter was removed (*false-belief* question). Three-year olds tend to offer the same answer to all three questions, revealing a difficulty in realizing that mental states can differ from reality.

<u>False Belief task:</u> In this task, subjects are asked to predict the behavior of a character who holds a mistaken belief about the state of the world. In the classic story, Maxi puts his chocolate in the cupboard and goes outside to play. While he's gone, his mother moves the chocolate to the drawer. Subjects are asked to predict where Maxi will look for his chocolate upon his return (Wimmer & Perner, 1983).

The second-order false-belief task is a more complex version of the same task. It requires subjects to infer the thoughts of a character who holds a mistaken belief about another character's knowledge. In this version of the task, for example, Maxi comes back inside and,

unbeknownst to his mother, sees her move his chocolate. Subjects are asked to predict where the mother–who does not know of Maxi's updated knowledge—will think he will look for his chocolate. Children do not succeed in this task until the age of five or six (*Sullivan, Zaitchik, & Tager-Flusberg, 1994*).

For the purpose of this chapter, the appearance /reality and the false-belief task are relevant in that they require the coordination of two different yet truthful statements about the very same object (e.g., bird's color; chocolate's location). Thus, these tasks require flexibility in perspective taking. Something similar may be required for grasping that a noun phrase can be both the subject of the main clause verb and the object of the relative clause verb.

Turning the tables: does reasoning require syntactic complexity?

So far the review has focused on the roles conflict resolution and set switching may play in explaining syntactic complexity. However, it also seems likely that language would play an important role in human reasoning (*Polk & Newell, 1995*). More specifically, syntactic complexity may serve as an instrument for reasoning in certain domains. For example, the claim has been made that reasoning about mental states (theory of mind) is not possible in the absence of the syntax of complementation (*deVilliers, chapter*).

The syntax of complementation is found with verbs of communication as in 'she said the table was big' and with some mental state verbs as in 'Maxi *thinks* the chocolate is in the cupboard". Embedded complement sentences allow for propositions that do not match reality. In other words, the truth value of the sentence is independent of the truth value of the clause: even if the chocolate is not in the cupboard, the sentence will hold true provided that Maxi *believes* the chocolate is in the cupboard.

Thus, acquiring the syntax of complementation may provide children with an important tool to understand beliefs. In support of this view, children's performance in the false-belief task

is predicted by their understanding of sentences of communication (She said that ..), even after factoring out age and intelligence (*deVilliers*, 2000). Furthermore, mental state concepts that do not require a sentence complement (e.g., she *wanted* a cookie) are grasped earlier in development than those that do require syntax of complementation (*Reference*). On the other hand, the developmental trajectory of these concepts does not always follow the linguistic constraints. Across languages, complement structure may be necessary for statements about beliefs but not about desires (as in English), for beliefs and desires (as in German), or for neither belief nor desires (Chinese). Nevertheless, children learning each of these three languages all understand and talk about desires significantly earlier than beliefs (*Tardif and Wellman, 2000; Perner et al., 2005*).

If syntax of complementation and theory of mind reasoning are overlapping functions, we should find overlapping neural activations. However, the pattern of neuronal activity in false belief tasks is quite different from the pattern observed in syntactic complexity (*Saxe*). Given that, to date, all neuroimaging studies of theory of mind have been performed in adults, it remains to be seen whether the lack of neuronal overlap is also observed in children or instead is the end product in adulthood. The latter possibility would help reconcile the developmental evidence with the neurological studies that show that false belief performance is spared in some aphasic patients (*Apperly, 2006, soc Neurosc*). The syntax of complementation may be critical for theory of mind development but not for adult performance.

Summary. The paper will end with a summary of the material cover and whatever great ideas people might volunteer at the symposioum.

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Two Pathways of Grammatical Evolution

Östen Dahl (Very rough draft, January 2008)

In the paper "Toward A Diachronic Typology Of Relative Clauses", distributed to the participants of this symposium, Tom Givón suggests three stages¹ that characterize the diachronic rise of both complex verb phrases and relative clauses, and presumably of various other grammatical phenomena:

(1)

- (a) Parataxis: two separate intonation contours.
- (b) Syntaxis: one single intonation contour.
- (c) *Lexis*: co-lexicalization into a single word.

At the end of the paper, he reformulates this in terms of "two developmental steps":

(2)

- (i) From paratactic to syntactic complexity.
- (ii) From syntactic to lexical/morphological complexity.

An earlier version of the same ideas was presented already in Givón (1979: 213-214) where he speaks of "processes by which loose, paratactic, PRAGMATIC discourse structures develop – over time – into tight, GRAMMATICALIZED syntactic structures", which, however, are said to erode over time "via processes of MORPHOLOGIZATION and LEXICALIZATION". With the caveat that "the principles motivating the erosion of syntax are not necessarily identical to those that motivate its rise", Givón argues that "we are dealing with cyclic waves that may be characterized roughly as:"

(3) discourse \rightarrow syntax \rightarrow morphology \rightarrow morphophonemics \rightarrow zero

However, in fact, the two first steps in this cycle, he says, "are often COUPLED (i.e. occur simultaneously)", and later in the paper (94) he strengthens this to say that "in almost every case where loose, paratactic structure is condensed historically into tight, syntactic structure, the condensation involves the simultaneous rise of grammatical morphology to better code the emergent syntax". This is an important observation, and I shall devote the rest of this paper to discuss the place of the development of what Givón here calls "grammatical morphology" to the schema (1).

In the study of grammaticalization processes, it is often suggested that grammatical forms undergo a development which can be summarized as follows (Dahl (2004: 106):

(4) free > periphrastic > affixal > fusional

This schema has its roots in the 18th century and was originally thought as characterizing languages as wholes rather than individual grammatical markers. (4) is

¹ Actually, Givón says "general steps", not "stages", but this is not consistent with how he uses the word "step" later in the paper, where "step" refers to the transitions between the three elements of (1) rather than the elements themselves.

reminiscent of (3), although it focuses on grammatical markers rather than constructions. (Recall that the original understanding of grammaticalization is as the process which turns lexical words into grammatical formatives.) It may be in place to compare briefly the characteristics of the evolution of constructions and grammatical markers, respectively.

For both constructions and grammatical markers, the changes that they undergo over time affect grammatical complexity in various ways. Givón and others have stressed the central place of condensation in grammatical evolution. Basically, condensation involves moving a certain amount of structure from a higher hierarchical level to a lower one, which usually means that the structure in question has to be squeezed into a tighter spot, so to speak: two phonological phrases are replaced by one, or a phrase is squeezed into a a word. This can be applied to a whole construction, but may also affect just one grammatical marker and the word next to it, as when a negation morpheme cliticizes to a verb or an auxiliary. But there are also other changes, which I have subsumed under the rubric "growth of non-linearity" (Dahl (2004: Chapter 3)), and which are particularly important in the evolution of grammatical marking, and are partly covered by the last step in (4), the one from 'affixal" to "fusional". Non-linearity can be defined as everything that cannot be described in terms of the concatenation of mutually independent units ("the rosary ideal", or if you like, the Item-and-Arrangement model). For instance, inflectional morphology can be non-linear because (i) the choice of an affix depends on the identity of the stem; (ii) one surface unit represents several underlying units (portmanteau morphs); (iii) the borders between units is blurred (fusion); (iv) stems undergo unpredictable changes from one form to another or even are wholly replaced (suppletion); (v) markings are prosodic, affecting the whole word rather than just one segment. These developments are obviously not independent from condensation in the sense that they are more likely to take place in tight units but are not reducible to it. The rise of non-linearity fairly clearly involves an increase in the complexity of the grammatical system although it does not necessarily involve the addition of extra structure -- the number of surface units may even be reduced.

There are quite dramatic differences between human languages as to the amount of non-linearity in their grammars, in particular with respect to the size and character of the inflectional component. Also crucially, this variation appears to be correlated with the socio-history or "ecology" of the language, in that non-linearity tends to be reduced in high-contact languages, in particular creoles. Thus, in the recent debate on whether "creole grammars are the simplest in the world" (McWhorter (2001)), the complexity under discussion has largely been of the kind that can be subsumed under non-linearity.

Non-linearity is often seen as dysfunctional and as "historical junk", i.e. the accidental results of "blind" diachronic processes ("erosion"). Arguably, however, nonlinearity may have processual advantages, but I won't go into that question here. But I want to make a point that is discussed in more detail in Dahl (2004): the rise of inflectional morphology is not adequately characterized as a result of "erosion", for several reasons. The first one is that erosion is a bad metaphor for phonological changes that come about when an element is squeezed into a tighter slot or given a less prominent position in the structure, as this change is adaptive rather than the result of random entropy-increasing processes -- I have suggested that "trimming" is a better word for an element being reduced to make it fit better into the space allotted for it. The second reason is that the rise of inflectional morphology also can involve the creation of new abstract structure. Thus, previously unrelated forms can by various processes come to be understood as belonging to the same paradigm, most clearly perhaps in the case of suppletion, or the absence of a grammatical marking can come to be understood as meaningful (Bybee et al. (1994: 294-295)).

Inflectional systems also tend to have a number of quite specific properties that set them off from other parts of the language system. I argue in Dahl (2004, Chapter 9), that these can be seen as consonant with a description according to the "Word-and-Paradigm" model, in which word forms are seen as the manifestations of a lexeme and an unordered set of morphological properties. Thus, inflectional systems tend to involve closed sets of possible forms, arrangeable in paradigms, formally, *n*dimensional matrices (where *n* is a small finite number corresponding to the number of inflectional categories). Among other things, this excludes recursivity (Matthews (1991: 213-214) and multiple meaning-bearing appearances of the same morpheme; it also entails that the order of elements is not by itself meaningful (typically the position of inflectional morphemes in a word is rigidly fixed).

Although inflectional systems are set off from the rest of the language system by their properties, as I just said, they interact quite intimately with other components, notably the syntax and the lexicon. Grammatical gender is a paragon example. In gender systems like the ones well-known from many European languages, gender is a lexical feature of nouns and an inflectional feature of adjectives and pronouns, which agree with nouns in gender given that they have certain syntactic relations to them. In fact, if we take a definition like that of Hockett (1958: 231), "Genders are classes of nouns reflected in the behavior of associated words", gender does presuppose syntax, although its direct manifestation is in morphology.

Given this intimate relationship between inflectional morphology and syntax, it is no wonder that the genesis of inflection takes part within the development of syntactic constructions, as Givón argued in his 1979 paper. Obviously, however, even if inflectional morphology often arises at or immediately after the transition from "parataxis" to "syntaxis", new inflections can also develop a long time after the syntactic structures have been stabilized as such. For instance, it is well known that definite articles commonly develop out of demonstrative pronouns, but even if there are languages in which combinations of demonstratives and nouns are looser than in, say, English, and it is possible that constructions of the looser type could serve as a diachronic source for tighter ones, there is to my knowledge no evidence of such developments in the languages where definite articles have developed and been morphologized.

Summing up so far, we see that inflectional morphology arises at Givón's Stage 2, "Syntaxis", together with syntactic constructions, with which it is intimately connected. The question now arises, what happens to inflections in Stage 3, "Lexis"? A priori, anything could happen: inflectional complexity may continue to grow, it may stay the same, or it may be reduced or go to zero. If inflectional complexity were a simple function of the tightness of a construction, we would expect the first to be the case. However, in fact, it seems that the growth of inflectional complexity and the development of tighter, "co-lexicalized" constructions in fact have a rather strong negative correlation, and that there is in fact evidence for speaking of two separate pathways of development.

I shall use the phenomenon of differential object marking to illustrate what I have said. Cf. the following example from Southern Ute (Givón (1995: 189)):

(5) Southern Ute

(a)
kwana-ci 'uway paqa-puga
eagle-AN/OBJ DEF/OBJ kill-REM
'He killed the eagle'
(b)
kwana-paqa-puga
eagle-kill-REM
'He did some eagle-killing' or 'He killed eagles'

In (5)(a), there is an object noun phrase *kwana-ci* '*uway*, which contains both a casemarking suffix *-ci* and a determiner '*uway*.² In (5)(b), there is no independent object noun phrase, rather the stem *kwana* 'eagle' shows up as an incorporated part of the verb. With respect to the way the direct object is realized, (5)(a) could be said to be a typical representative of "Syntaxis", whereas (5)(b) exemplifies "Lexis", more specifically the well-known phenomenon of noun incorporation. What we can note is that the object in 5b is not connected with any type of grammatical marking.

In fact, the Southern Ute sentences represent a very general pattern, in which direct objects are differentiated in such a way that high-referentiality objects get full grammatical marking while low-referentiality objects get reduced or no marking, with variation in how the two groups of NPs are delimited. Thus, in Turkish, accusative case-marking can be omitted with indefinite direct objects:

(6) Turkish

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(a)
Ayşe balıği tutuyor.
A. fish.ACC catch.PRS.3SG
'Ayşe is catching the fish.'
(b)
Ayşe balık tutuyor.
A. fish catch.PRS.3SG
'Ayşe is catching fish.' (Nilsson (1985: 24))
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Such zero-marked noun phrases are restricted to the position immediately before the verb (which is sentence-final in Turkish), a fact that could be interpreted as indicating

 $^{^2}$ Strictly speaking, 'uway is a "remote-invisible" demonstrative which here functions as a definite article (Givón & Southern Ute Tribe (1980: 55)).

that (6)(b) represents a tighter construction than (6)(a), even if it has not reached the stage of full incorporation.

These facts are of course well-known, and I could cite many similar examples. What I want to focus on here, though, is the fact that the tighter constructions 5b and (6)(b) contain no grammatical markings pertaining to the direct object. In other words, at least for these cases, it looks as if whereas the step from "Parataxis" to "Syntaxis" is connected with the rise of inflectional morphology, the further step from "Syntaxis" to "Lexis" shows the opposite tendency: inflectional morphology disappears. This pattern is not restricted to direct object marking but appears to be quite general. For instance, in some Scandinavian vernaculars, attributive adjectives are frequently incorporated (this is obligatory if the noun phrase is definite), and then do not display the agreement markers found in the syntactic construction, as in the following Elfdalian examples:

(7)

(a)

gambler kaller old-PL.M.NOM man-PL.NOM 'old men'

(b)

gamt-kaller old-man.PL.NOM 'old men'

We may then suggest that inflectional morphology is essentially a phenomenon of the "Syntaxis" stage, and thus even more intimately connected to syntax. The question now is what kind of diachrony is behind this. Again, there are alternatives: either the processes that take structures from the "Syntaxis" to the "Lexis" stage involve reduction of grammatical markings, or, structures that are thus condensated are the ones that do not contain any grammatical markings.

If we return to direct object marking, it seems to me that the second alternative is the most likely one in most cases. In many languages with differential object marking, the source of the grammatical morpheme that marks high-referentiality objects is fairly transparent, for instance, Spanish *a*, which has the original meaning 'to' and has expanded first to be a marker of indirect objects and then to animate direct objects. Inanimate direct objects, on the other hand, which represent the low-referentiality type in Spanish, have been unmarked since the breakdown of the Latin case system. A process that fused the latter with verbs to create structures analogous to that in 5b would not have to involve any reduction of grammatical marking. It can be argued that the factors that disfavour grammatical marking of direct objects are the same that favour a tightening of the link between direct object and verb. In general, it seems that high-referentiality noun phrases are resistant to incorporation.

However, it seems that at least some reduction of inflections does take place in the transition from "Syntaxis" to "Lexis". It is not uncommon for incorporated stems to be

reduced ((7)(b) is a case in point), so it is no wonder that inflectional elements can also be affected by the same processes. Croft & Deligianni (ms.) argue that constructions with preposed adjectives are in many languages "tighter" than those with postposed adjectives in the same languages, and in some Romance languages, reduced forms of preposed adjectives are found. Thus, in the Italian expression *il bel paese* 'the beautiful country', the absence of the usual masculine singular adjective ending -o in *bel* 'beautiful country' can hardly be explained in any other way than as the result of phonetic reduction.

There are a number of further problems here. It does appear to be if not universal so at least normal for incorporation to apply only to a subset of all direct objects, and the properties of that subset are similar from language to language. Thus, only some transitive VPs are condensated as to make their way into the tighter "Lexis" stage. But if one starts considering why this is the case, it becomes fairly obvious that the direct objects that are candidates for being incorporated must be in some sense or other more "tightly" connected to their verbs than those that are not, and that must be the case even in languages where incorporation has not taken place. That is, if there must be some difference between the verb phrases kill the eagle and killing eagles in a language like English that makes it possible to explain why only counterparts of the latter are plausible candidates for incorporation. So maybe expressions in languages have some kind of inherent "tightness", or inversely, their components have an inherent degree of independence from each other. If we take a standard case of the transition from "Parataxis" to "Syntaxis" -- the development from topic-comment to subject-predicate constructions, it is fairly obvious that there is a difference between these two types in their inherent degree of condensation, which relates to differences in the discourse role of topics and subjects. So what happens when a topic-comment construction is condensated to a subject-predicate construction is that the former extends its domain of use to cases with a higher degree of inherent tightness (this is an example of what I call "pattern spread" in Dahl (2004) and undergoes changes that are conditioned by this increase (which is what I call "pattern adaptation"). It is less clear that such a description applies to the development of object noun incorporation, since in those cases, it is hard to see that there is any change in inherent tightness.

The differentiation of transitive verb phrases in a language such as southern Ute into one "syntactic" and one "lexical" construction, where only the first one involves overt object marking, suggests that thinking of "Syntaxis" and "Lexis" as two consecutive stages is at least partly misleading. In the case of direct object marking, we could equally well speak of two alternative pathways. Given a construction that combines two lexical elements A and B, grammatical development can lead to results of two different kinds: either A and B coalesce into one word, or they remain separate but grammatical markers develop that eventually may fuse with either A or B. Thus, in the first case, the construction unequivocally moves to the "Lexis" stage, in the second, it remains at "Syntaxis". On the other hand, both cases involve the development of morphological complexity. So if we look at Givón's original developmental scale in (3), what we have to say is that the first is wholly at the morphology stage while the second is both syntax and morphology -- and of course Givón notes that the first two steps of his schema can take place simultaneously. But here is a further complication. If syntax and morphology arise at the same time, where does then that morphology come from? Does that mean that there is an immediate jump from the "discourse" or "Parataxis" stage to the morphological stage? Well, if we look closer at things, we can see that this is not in fact the case. Suppose, for instance, we have a development of the following kind, which would give rise to object marking on the verb:

(8)

Parataxis Syntaxis I know him, John → I-know-him John 'I know John'

What we see here is that it is a simplification to say that the construction to the left of the arrow is at the "Parataxis" stage -- it is really only at the top level we have a relationship that can be called paratactic, since the (so-called) right-dislocation construction joins a dislocated noun phrase with a regular transitive sentence, which must be said to be at the "Syntaxis" stage -- and this is in fact crucial to the further development, given that the object pronoun in the dislocated construction and its components may have reached different degrees of condensation, and that it is the combination of these degrees that conditions the following step in the development, which involves on the one hand a step from "Parataxis" to "Syntaxis" at the level of the whole construction, and a step from "Syntaxis" to inflectional morphology with regard to the relationship between the object pronoun and the verb.

Similarly, noun incorporation occurs in progressive constructions in some West Germanic languages, like the following example:

(9) German (regional)

IchbinamEis-essen.Ibe.PRS.3SGat_DEF.DAT.M.SGice-cream_eating'I am eating ice-cream.'

Here, the construction as a whole is still periphrastic, and thus at a syntactic stage, but the object-verb relationship is encoded at the "Lexis" level.

Some conclusions:

Inflectional morphology is intimately connected with Givón's "Syntaxis" stage not only in that it arises together with it but also in that it is essentially restricted to it. It appears that inflectional marking is a characteristic of medium tightness -- inflections characterize elements that are neither too loosely nor to tightly integrated into a construction.

We should probably replace Givón's schemata in (2) and (4) with something like the following

(10)

(a) paratactic constructions \rightarrow syntactic constructions

(b) syntactic constructions \rightarrow inflectionally marked words (c) syntactic constructions \rightarrow morphologically complex words

with the addition that when a development according to (a) affects a construction C, it may also involve developments according to (b) and (c) which affect the component expressions of C.

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On the origins of serial verb constructions in Kalam, or, What are clauses good for?

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1. What are clauses good for?*¹

In 1975 I attended a mind-stretching course on language taught by George Grace at the University of Hawaii. In this course and in two later books (Grace 1981, 1987) he reminded us that human languages have evolved as devices for saying things.*² He commented that linguists in general, preoccupied with formal structures, had paid little direct attention to the question of what is entailed in saying something. This seemingly innocuous question requires us to ask about how the brain works in making sense of the world, how speakers turn perceptions and thoughts into linguistic expressions, and (among other things) how they connect these expressions with the minds of their audience. In the 1970s most linguists were content to leave such concerns to philosophers and psychologists. *³

The core ingredient in saying something is specifying a conceptual event or situation (Grace uses 'event' as a cover term for both). Following Greenberg (1959), Grace observed that only human languages can analytically specify events, saying, e.g., who did what with whom and to whom, when and where. In order to be seen as saying something, however, the speaker must also (a) contextualise the expression for the audience, e.g. by connecting it to the previous discourse or to assumed shared knowledge, (b) give it a modality (as assertion, question, negation, contingency, etc.), and (c) take responsibility for the expression (as its author or sayer, in contrast, e.g. to reading a passage from a book).

The quintessential linguistic device for constructing a sketch of a single conceptual event is, of course, the independent clause or simple sentence. The prototypical clause has a single verb that represents the action or state. (For the moment I will leave aside the problematic nature of event segmentation and simply assume that each lexical verb in an utterance represents a separate conceptual event or sub-event,)*⁴ Multi-clause constructions, by contrast, are used to construct more complex propositions.

Grace's observations set me thinking about the relation between clauses and events in Kalam, a language I had worked on for some years, and which belongs to the large (400 member) Trans New Guinea (TNG) family.*⁵ Kalam has clause-like constructions that depart quite sharply from the one lexical verb per clause prototype. In narrative speech it is quite common to find a serial verb construction (SVC) that contains several lexical verbs strung together under a single intonation contour with very little other material in the clause. Example (1) contains such a construction with seven verbs. (Here and in later examples, verb roots and their glosses appear in bold face. In multi-clause examples, successive clauses are distinguished as i, ii, etc. Usually each clause begins on a separate line.)*⁶

(1)	am	mab	pu-wk	d	ap	agl	kn- la-k.
	go	wood	hit-break.up	get	come	ignite	sleep-3PL-PAST

A fairly literal English translation of (1) would occupy several clauses: 'They went and gathered firewood and brought it, made a fire and slept.' (*mab* has the senses 'tree', 'wood', 'firewood' and 'fire'.) A free translation might say simply, 'They gathered firewood for the night', where the act of gathering can, in context, be understood as implying the other activities typically associated with this.

In example (2), clauses (ii) and (ii) both contain eight verb roots, if we exclude the iteration of one verb, \mathbf{g} 'do'.

(2)	Ι	<i>kayn ak ney awsek am-ub</i> , dog the he alone go -PERF.3SG the (hunting) dog, he goes out alone,
	ii.	<i>ăn ak ognap wtsek d ap tan d ap yap</i> day the some pursuing get come ascend get come descend
		ggsuw-p,dobite-PERF.3SGsome days he goes about chasing all over the place and makes kills,
	iii.	<i>ăn ak ognap wt-sek d ap tan d ap yap</i> day the some pursuing get come ascend get come descend
		g g met $n\eta$ - l , do do not find-SS.PRIOR some days after chasing (animals) back and forth and not having caught any,
	iv.	<i>adkd katp ow-p.</i> urning.back (adv.) house come -PERF.3SG

The type of construction represented in (1) and (2ii,iii) is referred to here as a 'narrative serial verb construction'. There is in principle no limit to the number of uninflected verbs that can occur in a narrative SVC. (In practice – if we exclude iteration of verb roots to show repetition or continuity – the limit seems to be about nine or ten.)

he comes back home.' (KHT ch.19, #28)

Many languages that lack SVCs have ways of accommodating an extra verb or predicate phrase within a syntactic frame that is more or less clause-like, e.g. as secondary predicates or embedded small clauses. *⁷ But not many languages allow four or five verbs, let alone nine or ten, in a clause. How did such constructions arise? Why would anyone want to squeeze a report specifying each of a long sequence of events into a single clause frame? Are these constructions really single clauses?

In addressing these questions this paper will compare the forms and functions of four kinds of Kalam constructions that depict sequences of events – one multi-clause and three

single-clause constructions. I will draw on a considerable body of published work on this language. More generally, I will ask whether the Kalam material provides evidence bearing on Givón's (1979) proposal there are diachronic processes of syntacticization that follow a sequence of condensation:

discourse \rightarrow syntax \rightarrow morphology/lexicon \rightarrow morphophonemics \rightarrow zero

by which loose, paratactic, "pragmatic" discourse structures develop – over time – into tight, grammaticalized syntactic structures. For each one of these processes one could prepare a balance sheet of communicative gains and communicative losses. The principles which control the balance of gain and loss here are, presumably, what we are investigating. (Givón 1979:208).

Before we examine the Kalam data something needs to be said about how to measure 'syntactic complexity'. A standard measure is by depth of constituent structure – the more levels or intermediate nodes the greater the complexity, with particular weight given to the embedding of clause-like constituents inside phrases. However, one might also view the complexity of a particular construction in terms of how much brainwork is required to process the information in it, either as an encoder or decoder. (It needs to be kept in mind that in information theory the amount of 'information' carried by an item is measured by the number of possible choices facing the encoder or decoder.)

Let me refer here to just a few of a number of studies that have looked at syntactic complexity in terms of mental processing costs. Discussion of an experimental study of Kalam that does the same can be found in section 3.1.

Drawing on data from the Pear Stories narratives and conversational transcripts, Wallace Chafe has for many years argued that when speakers encode different sized units of information they make use of different kinds of consciousness or levels of attention (Chafe 1979, 1980, 1987, 1994). He distinguishes a 'focus of consciousness', a short-lived concentrated focusing of attention, from 'peripheral' or 'semi-active consciousness', where information is held in the mind but is not in focus. During a single focus of consciousness a speaker can encode a limited amount of information, typically one new 'idea unit' representing an event or state. The focus typically occurs in a pause of less than a half a second before a short burst of fluent speech. Such fluent bursts have a mean of about six words in length, typically fall under a single intonation contour and often correspond to a clause. Leaving aside memorized clause sequences, it seems that the simple (single verb) clause is a unit that encompasses roughly the amount of information that can easily be organized and encoded in a single, planning act.

A broadly similar proposal was made by Givón (1975, 1984), who argued that "the majority of sentences/clauses in connected discourse will have only one chunk – be it nominal, predicate (verb or adjective) or adverbial word/phrase – under the scope of asserted new information. All other elements in the clause will tend to be topical, background or presupposed old information" (1984:258). Du Bois (1987) put forward evidence that

speakers, when encoding connected discourse, generally avoid more than one new argument per clause.

Chafe suggests that severe constraints on the amount of new information that can be held in the mind in a moment of active consciousness reflect a limitation in the evolution of the mammalian mind. "Our powers of remembering and imagining have far outstripped those of other creatures. But this development has failed to include any increase in the capacity of active consciousness... We are capable of thinking grand and complicated thoughts, but we can still focus our active consciousness on only very small parts of them at one time" (1994:140).

By contrast, 'scanning a center of interest' is an extended process in which a certain range of related information held in 'peripheral' or 'semi-active' consciousness is explored and organized. It is typically associated with a break of more than a second in the speaker's discourse flow. The linguistic outcome is often an extended sentence, made up of a sequence of discrete bursts of speech, each representing a different idea unit, strung together to describe, say, a single episode or scene.

The long, paragraph-like macro-sentences one often finds in narrative speech result from the mind scanning a center of interest. Here the speaker holds several bits of information in mind at a less active level of consciousness and attempts to activate them, one by one. But speakers don't know exactly how things are going to turn out and, not surprisingly, the results are not always completely coherent, from a grammatical or semantic standpoint.

In the mid 1970s Frances Syder and I independently came to quite similar conclusions about how clauses and multi-clause sentences are encoded, while transcribing a corpus of conversational English speech (Pawley and Syder 1975, 1983, 2000), though without proposing the evolutionary underpinnings that Chafe puts forward. We observed that single independent clauses, of up to about eight words, are typically uttered as bursts of fluent speech, under a single intonation contour. In contrast, conjoined clauses are typically spoken as a series of intonation units, separated by (often short) pauses. And when speakers commit themselves to a more complex sentence frame, where two or more clauses are highly integrated, and the lexical strings are novel, they often end up in a tangle. We concluded (a) that it is possible to encode the full lexical detail of short clauses in a single planning act, because this detail approximately matches the amount of information humans can activate and hold in their working memory and (b) that speakers cannot, in a single planning act, encode novel lexical combinations across independent clause boundaries. We referred to the latter limitation as 'the one clause at a time constraint'.*⁸

We also addressed the paradox that in order to have nativelike fluency in a language like a native one must be able to produce many multi-clause sequences as fluent chunks, in apparent contradiction to the one-clause-at-a-time constraint. The explanation seems to be that multi-clause fluent sequences include large chunks that are memorized, so that the parts of these chunks do not represent new information. We concluded, for this and other reasons, that nativelike fluency in a language depends to a large degree on having memorized a large body of clause-sized constructions whose lexical content is completely or partly specified.

2. Notes on Kalam grammar

Let us now turn to the Kalam material. This section outlines some features of Kalam grammar relevant to the discussion that follows.*⁹

2.1 Word classes

Of the major parts of speech – nouns, verbs, verb adjuncts, adverbs, adjectives and locatives – verbs and verb adjuncts are of particular relevance here.

Verbs are the only part of speech to carry inflectional suffixes marking tense, aspect or mood, subject person-and-number, and anticipatory switch reference. Verb roots are a small, closed class with about 130 members. There are no morphological processes for deriving new verb stems. However, the stock of verb roots is augmented by several classes of multi-word predicates, including verb adjunct constructions and serial verb constructions.

Verb adjuncts are words (either free form roots or derived words) that occur only as the partner of one verb root, or a few verb roots, with which they form a complex predicate, called a **verb adjunct construction** (VAC), e.g. <u>suk</u> **ag**- (laughing **say**) 'to laugh', <u>klend</u> **am**-(crawling **go**) 'to crawl', <u>gadal badal</u> **g**- (higgledy-piggledy **do**) 'place things higgledy-piggledy or criss-crossed'. (In these examples <u>verb adjuncts</u> and their literal <u>glosses</u> are underlined.) VACs form an open class of predicates with several hundred recorded members, often translatable by a single verb in English. In VACs the verb root serves as a classifier, marking the event as being of a certain general type. The verb adjunct specifies the subtype or specifies an associated activity to that depicted by the verb root. A VAC can occur as a predicate by itself or it can fill a verb slot in a serial verb construction.

2.2 Verbal clauses

A verbal clause consists minimally of an inflected verb. In transitive clauses the unmarked order of major constituents is Subject Object Verb. If there is a secondary object it usually precedes the primary object, as in (3).

(3) An np moni ñ-a-k?
who you money give-3SG-PAST
'Who gave you money?'

Arguments already established in the discourse or otherwise recoverable from the speech context are usually omitted.

Only one inflected verb is allowed in a clause. Verbal clauses are classified according to the kind of inflected verb that is the head or obligatory element. A clause headed by an **independent verb** can stand alone as a complete sentence. Independent verbs carry suffixes marking subject person-and-number and tense/aspect/mood with *absolute* reference (i.e. deictic reference with respect to the speech situation). A clause headed by a **coordinate**-

dependent verb (see 2.3) cannot form a complete sentence but must occur in a coordinate relationship with an independent clause. (However, dependent clauses sometimes occur alone when the context allows missing material to be inferred.)

2.3 Chaining of coordinate-dependent (medial) clauses

Coordinate-dependent verbs (often called **medial verbs** in descriptions of Trans New Guinea languages) are dependent on the final clause in a sentence for a full interpretation of their tense-aspect and subject reference. They carry suffixes marking subject and tense reference *relative to* the next verb: whether the verb has the same subject (SS) as the next verb or a different subject (DS), and whether the event denoted by the verb is prior to, simultaneous with or future to that of the following verb. However, in other respects they are coordinate with, rather than subordinate to the final verb, hence the name 'coordinate-dependent', used by Foley and Olson (1985).

The most common suffixes marking same subject and relative tense are -l 'SS:prior', -lg 'SS:simultaneous' and -ng 'SS-future'. The basic forms of the different subject markers are -e 'DS:prior' and $-kn\eta$ 'DS:simultaneous'. A coordinate-dependent verb marked for change of subject in the next verb carries a separate suffix marking the person-and-number of its own subject, e.g. kn-na- $kn\eta$ (sleep-2SG-DS:simultaneous) 'while you were sleeping (someone else did...)'.

It is common for a long chain of medial (coordinate-dependent) clauses, marked for same subject and relative tense, to precede an independent clause. Sometimes such chains number more than 15 clauses. In example (4), clauses ii-ix constitute a chaining construction within the larger construction consisting of clauses i-x. A non-final intonation juncture (written here as a comma) must occur after each coordinate-dependent clause except the final one, that which immediately precedes the independent clause. Because zero anaphora is the norm for established subjects and objects it often the case in such chains that clause after clause consists just of an inflected verb, as in clauses v-ix.

- (4) i. ... *aps-basd=yad* **md-***elgp-al* won ok, grandmo.-grandfa.=my **live-**PASTHAB-3PL time that '...at the time when my grandparents were alive,
 - ii. kmn=nen gos nη-l,
 game=after thought perceive-SS.PRIOR go-SS.PRIOR having planned to go after game mammals,
 iii. am-l, go-SS.PRIOR having gone out,
 - iv. *kmn* tap nb ogok ti ti d-l, game food like those what what **obtain-SS.PRIOR** having gathered various plants for (cooking with) game mammals,

v.	ad	ñb- l,	vi.	kn- l,
	cook	eat-SS.PRIOR		sleep.SS.PRIOR
	having	g cooked and eaten them,		having camped out overnight,

vii. *am-l,* go.SS.PRIOR having gone out,

viii. *ap-l,* **come**-SS.PRIOR having come back,

ix. *g-elgp-al ak*, **do**-PASTHAB-3PL topic those (things) they used to do,

x. *mñi* ag-ngab-in.
now say-FUT-1SG
I am now going to talk about.'

'I'm now going to describe how, in the time of my grandparents, when people planned to hunt game mammals, they would go out and gather certain plants and cook them in stone ovens and eat them, and sleep out (in the forest), and after going out and coming back (to camp) they would do these things.'

2.4 Embedding

Kalam freely allows clauses to be embedded as sentential complements, as in (5), and in relative clauses.

(5) Yad [tumuk ag-p] nη-b-in
 1SG thunder say-PERF.3SG perceive-PERF-1SG
 'I heard thunder' (lit. approximately, 'I heard thunder speak'. One cannot say 'I heard thunder', with a simple nominal as object.)

Arguably, the entire sequence of clauses i-x of (4) above is the complement of the final verb ag-ngay-n 'I will speak (about)'.

2.5 Serial verb constructions

The predicate of a serial verb construction (SVC) in Kalam has as its nucleus a verb series, in which one or more bare verb roots precede an inflected verb root without any intervening conjunctions, as in (1), (2 ii, iii) and (4 v) above and in (6) below.

(6) Am d aw-an!
go get come-2SG.IMP
'Fetch (it)! (lit. 'Go get (it) and come!')

All SVCs have a number of characteristics, grammatical, semantic and phonological, that support the view that they belong to a single clause.

Only the final verb in the series is marked for tense/aspect/mood. This marker has scope over all the verbs in the SCV. All the verbs in the SCV share the same overt subject; this can be represented lexically only once and only the final verb in the series can carry a subject-marking suffix. Only one object NP can occur and this is shared by all transitive

verbs in the SVC. Only one negator can occur. In most kinds of SVC it has scope over the whole verb series.

The verb series is almost always uttered without internal pause and within a single intonation contour. The shortness of Kalam verb roots is an advantage. Verb roots are mostly monosyllabic and some consist of a single consonant. Thus the sequence of eight verb roots, *wik d ap tan d ap yap g-* (**rub get come ascend get come descend do**), meaning 'massage s.o., rub. s.t. all over', consists of just six syllables and takes no longer to say than *excommunicated* or *indefatigably*. Even including nominal and adverbial constituents, narrative SCVs seldom exceed 15 syllables and can comfortably be fitted into a single intonation contour.

2.6 Canonical vs grammaticalized SVCs

There are several types of SVCs. It is useful to make a first division between **canonical** and **grammaticalized SVCs**. $*^{10}$

In a canonical SVC each verb root has a lexical meaning and denotes a distinct conceptual (sub-)event in the event sequence denoted by the clause. To the extent that the events represented in a SVC are temporally discrete, their order matches the temporal order of the verbs that represent them. All the events are of roughly equal semantic importance, i.e. none are subordinate to another.

In a grammaticalised SVC the final verb in the series, while it carries the TAM and subject-marking inflections, takes on a 'grammatical' meaning that is distinct from the meaning(s) it has when it stands alone as a lexical verb. For example, the ditransitive verb **n** 'give, transfer, connect' serves as a dative marker. An intransitive verb, *md* 'stay, exist, live', has been recruited as an emphatic continuative marker. At least six transitive verb roots have been recruited as emphatic completive markers. The six verbs, with some of their most common lexical senses, are **ask** 'avoid, abandon, leave', **d** 'hold, get, control, stop', **ju** 'withdraw, extract', **l** 'put, become stable', **tk** 'sever, interrupt', and **yok** 'move away, displace'. Each verb in its completive function tends to co-occur with a different set of verbs from the others. A full account of the uses of grammaticalized verbs would require a separate paper. A fairly detailed treatment is given in Lane (2007).

Some of the main features common to SVCs are further illustrated by each of the three clauses in (7). Clause i contains a canonical verb series. Clauses ii and iii each contains a verb series with a grammaticalized final verb (**d**- marks completive with reference to the actor having finished, **l**- marks the object as being completely affected by the action).

- (7) i. Ami... taw tb tk-l, mother step cut sever-SS.PRIOR
 'My mother... having stamped on and closed off (the entrance to the bandicoots' burrow),
 - ii. <u>tug</u> tb tk d-e-k,... holding.in.hand cut sever finish-3SG-PAST
took hold of them (one by one) and closed off (the entrance)

iii. *mey pak l-a-k mamd ak,...* thus **kill finish**-3SG-PAST five that and in this way killed all five,...' (*KHT* ch. 10, #21)

3. Types of canonical SVCs

A fairly clear distinction can be made between two types of canonical SVC: **compact** and **narrative**.*¹¹

3.1 Compact SVCs

Compact SVCs contain two or more lexical verb roots that form a single tight-knit predicate, as in (7i,ii) above and (8):

(8) *Kaj tb lak-eb-al.*pig cut split-PRES.PROG.3PL
'They are butchering pigs.' (lit. cutting them up by splitting, i.e. making a (first) longitudinal cut)

The verbs in a compact SVC denote sub-events that are close-spaced in time and typically connected in a causal chain. In some cases the connections people make between the constituent sub-events are probably grounded in innate perceptions of observed happenings. In other cases the connections depend on culture-specific knowledge of customary behavior.

Syntactically, a compact SVC is a nuclear layer predicate in the sense of Foley and Van Valin (1984) and Foley and Olson (1985). No non-verb elements can be inserted between verb roots (other than verb adjuncts, which count as part of a verb). Compact SVCs have the 'macro-event property' defined by Bohnemeyer et al. (2007): temporal operators, such as tense markers and temporal adverbs, have scope over all sub-events in the construction.

Compact SVCs fall into many types according to their particular semantic and grammatical makeup. Just a few types will be illustrated here (a fuller account appears in Pawley, in press a). It is important to note that each type represents a productive pattern. For example, the verb series in (8) represents a productive formula in which V1, *tb* 'cut, chop', combines with V2, a verb of result, where V2 can be, e.g. *blok* 'distribute', *kluk* 'gouge, hollow out', *pag* 'break, snap', *sak* 'chip, break off a fragment', *tk* 'sever', *wk* 'break apart, shatter', *yk* 'open', *yok* 'move away'.

For each of the types exemplified in (9)-(12) below the productive patterns are defined by the accompanying notes.

(9) Verb series denoting resultative or change of state events

In the simplest case, resultative SVCs contain just two verbs: V1 is transitive and specifies an activity performed by an agent, usually forceful contact. V2 is intransitive and specifies a change of state or a movement undergone by an affected entity. The conventional meaning derived from the sequence is that the state or movement is the result of the first event. The overt subject of a resultative SVC is always the agent of V1. The logical subject of V2 is not represented.

pak cg-	(strike adhere)	'stick s.th. on, cause s.th. to adhere'
pak wk-	(strike shattered)	'knock s.th. to bits, shatter s.th'
pak sug-	(strike extinguished)	'put out (a fire)'
pug sug-	(blow extinguished)	'blow out (a flame)'
puηl ask-	(pierce open)	'prise s.th. open'
puŋl lak-	(pierce split)	'split s.th by wedging or levering'
taw pag yok-	(step.on broken displace	b) 'break s.th. off by stepping on it'
tb kluk yok-	(cut gouge displace)	'gouge s.th. out'

(10) Verb series denoting testing or discovering events

An activity verb or verbs precedes the generic verb of perception and cognition, $n\eta$ 'perceive, be conscious, aware, see, hear, feel, smell, know, etc'.

ag nη-	(say perceive)	'ask, enquire, ask for, request'			
ар пղ-	(come perceive)	'visit s.o., come and see s.o.'			
ay nη-	(put perceive)	'try to fit s.th., try s.th. on (e.g. clothing)'			
d nη-	(touch perceive)	'feel s.th. by touching (deliberately)'			
ñb nŋ-	(consume perceive)	'taste s.th.'			
թսղլ ող-	(pierce perceive)	'probe, test by poking'			
tag nŋ-	(travel perceive)	'sightsee, travel and see'			
taw tag nŋ-	(tread walk.about pe	lk.about perceive) 'test (ground, branch, etc.) by treading'			

(11) Verb series denoting transfer/connection events

A transitive verb precedes the generic verb of transfer, \tilde{n} 'give, connect, etc.', which denotes transfer of the referent of the affected object of V1 to the recipient of V2.

ag ñ-	(say transfer)	'tell s.th. to s.o.'
d jak ñ-	(get stand connect)	'stand s.th. against a place'
d ñ-	(get transfer)	'give s.th. personally, hand s.th. to s.o.'
g ñ-	(do transfer)	'fit s.th. in position, connect to s.th.'
ju ñ-	(withdraw transfer)	'return s.th. to its owner, give back'

ñag ñ-	(shoot transfer)	'fasten s.th., pass s.th. through and
		connect it (in sewing, buttoning)'
tk ñ-	(write transfer)	'write s.o. (a letter)'

(12) Verb series denoting transporting events

A verb of manipulation, usually d 'hold, handle, touch, get, have, control' combines with one or more verbs of locomotion.

d ap-	(get come)	'bring s.th.'				
d am-	(get go)	'take s.th.'				
d am yok-	(get go move.away)	'get rid of s.th, take s.th. away'				
d ap tan-	(get come ascend)	'bring s.th. up, fill s.th.'				
d ap tan jak-	(get come rise reach) 'bring s.th. to the top, fill s.th. up'				
d ap tan d ap yap-	(hold come ascend hold come descend)					
	'move s.th. up and do	wn, or 'move s.th. back and forth'				

Some compact SVCs consist of a compact SVC plus another verb, or another compact SVC. For instance, the last verb series in (12) is a compact SVC that itself consists of two compact SVCs, *d ap tan* + *d ap yap*, whose order can be reversed.

Why do the Kalam have compact SVCs? An answer was proposed by Givón (1990, 1991), who carried out an experiment investigating the cognitive processing of different kinds of verb sequences in three languages spoken in Papua New Guinea: Kalam, Tairora, a very distant relative of Kalam spoken in the Eastern Highlands Province, and Tok Pisin, a creole whose grammar and semantics has been heavily influenced by Austronesian and Papuan languages of Melanesia.

A six minute action film was shown to speakers of each language. Each subject was asked to provide two narratives describing what happened in the film, one spoken 'on-line' (during a second viewing of the film), one '(immediate) post-view'. Three types of constructions were compared where successive verbs have different degrees of contiguity and grammatical integration: independent clauses, coordinate-dependent clauses, and serial verb sequences. Kalam makes heavy use of SVCs, Tairora moderate use and Tok Pisin much less use. Kalam and Tairora both make extensive use of clause-chaining constructions, using coordinate-dependent verbs, but Tok Pisin does not have this type of construction.

The hypothesis predicted that speakers will pause most often after an independent verb (not highly integrated with the next verb), less often after a coordinate-dependent verb (middling degree of integration) and least often after a serial verb (where the verbs are part of the same predicate phrase).

The hypothesis was strongly confirmed. Kalam narrators paused between the verbs in a serial verb construction only in about 4 to 5% of cases, similar to the hesitation rate within single words. They paused much more often at boundaries between coordinate-dependent clauses (about 23-32% in on-line narratives and about 48-60% post-view narratives) and consistently paused after independent clauses (81% on-line and 71% post-view). Although

Kalam speakers used far more SVCs than speakers of the other two languages, all three languages displayed similar overall patterns of pause probabilities, with inter-clause transitions showing a much higher rate of pausing than transitions between verbs in a SVC. Givón commented that:

In terms of temporal packaging, serial-verb clauses, on the one hand, and prototypical main/finite clauses, on the other, behave as two extreme points on this scale: the former as co-lexical stems (or grammatical morphemes) within a clause; the latter as full-fledged independent clauses. However, chain-medial verbs exhibit pause probabilities and adjacency probabilities somewhere between the two extreme poles. (Givón 1990:49)

He concluded that serial verbs in Kalam and Tairora are consistently co-lexicalized (or in a minority of cases, co-grammaticalized) because they "display pause probabilities that fall within the range of lexical words" (1990:48). The main function of SVCs in Kalam, he said, is to augment the small stock of verb roots. That is to say, SVCs serve to encode conceptual events that are usually denoted by single verbs in languages with large open verb classes.

I think Givón's conclusions are valid for compact SVCs and grammaticalized SVCs. As we shall see, they do not fit so well with narrative SVCs.^{*12} Plainly many compact SVCs have meanings similar to English simple causative verbs and to certain kinds of phrasal verbs. Upwards of 500 compact verb series have been recorded and all are included in the dictionary of Kalam (Pawley and Bulmer 2003) on the grounds that they are standardized expressions.

A number of compact SVCs show morphological fusion in progress, where phonological reduction has blurred morpheme boundaries, e.g. in the following pairs the second form is now the conventional one: *tk pag* (sever break) 'break s.t. in two' > *tpag*-, *pk pag* (hit change.form/break) 'bend forcefully, break or damage with a blow' > *ppag*, and *pk wk* (hit break.up) 'smash up, pound to pieces' > *puwk*.

How did compact SVCs arise? It is reasonable to argue that, long ago, they developed by clause union. But unlike narrative SVCs (as we shall see), compact SVCs are not readily paraphrasable by chaining constructions. Take the verb series *tb wk* (cut break.up) 'cut to bits, chop up'. One can say:

using a same subject chaining construction but this means 'Having cut (the) pumpkin, I then broke it up'. This implies a sequence of two distinct events, clearly separated in time, without a clear causal connection. The causal connection can be achieved by a two clause sequence which is marked for change of subject:

(14) Bangay tb-e-n-k, wk-a-k. pumpkin cut-DS.PRIOR-1SG-PAST break.up- 3SG-PAST This translates as 'I chopped the pumpkin and it broke up' or 'When I chopped the pumpkin it broke up'. However, such a two clause construction is not a natural way of expressing a direct causal connection, for the same reason as the English translations are not, perhaps because they separate the two events too sharply. Thus, it is difficult to argue that particular compact SVCs and chaining constructions are near functional equivalents in contemporary Kalam.

When did compact SVCs originate? Such constructions are present in many branches of TNG and likely were present in the common ancestor of the family, which was probably spoken between six and ten millennia ago. While no one has done a systematic comparison of particular semantic patterns in compact SVCs, it is clear that there are some close correspondences across different branches of TNG, indicating certain patterns must have been stable for several millennia.

3.2 The structure of narrative SVCs

We can now take a closer look at narrative SVCs, which have a much more complex syntactic and semantic structure than compact SVCs. As their name suggests, narrative SVCs tell a short story, or parts of a story, in highly compressed form. The semantic links between events in such constructions differ from the direct causal chain and force dynamic links that characterize the event structure of many compact SVCs. The kinds of things that are mentioned in a narrative SVC, and their order, reflect conventions for telling a well-formed narrative.

In a well-known paper on spoken narratives in English, Labov (1973:363) identifies the following major components of narratives:

- 1. Abstract. Announces the story and indicates what it is about.
- 2. Orientation. Identifies the initial context, e.g. time, place and participants.
- 3. Complicating action. Answers the question: What happened?
- 4. Resolution. Reveals the outcome of the complicating action.
- 5. Coda. Summary remark signaling that the narrative is finished.

Narratives may be complex, with two or more minimal narratives, or episodes, occurring within a larger story. A well-formed account of a single episode must at least describe the complicating action and the resolution, the other components being optional. Kalam narratives show similar functional parts to English narratives. The account may be spread over many clauses or be compressed into two or three clauses or even into a single clause, by the use of narrative SVCs.

Narratives reporting collecting expeditions

The distinctive features of Kalam narrative SVCs may be illustrated by examining a class of narratives that are richly represented in our corpus: successful collecting expeditions, such as getting firewood, fetching water, picking fruit, gathering leafy greens, hunting for wild mammals on the ground or in trees, and collecting pandanus leaves to make mats or for thatching.

Collecting expeditions represent a particular sort of purposeful activity, where there is both an immediate objective and an ultimate objective. Whether carried out by humans, nutstoring squirrels, nesting sparrows or nectar-gathering bees, successful collecting expeditions have four main stages: one or more actors (i) go forth in search of something, (ii) obtain it, (iii) carry the goods to a convenient place and (iv) process or otherwise dispose of them.

A well-formed minimal report of a successful collecting expedition in Kalam reflects this pattern. The main elements in such a report can be summarized as follows.

Major constituents of reports of successful collecting episodes

1	2	3	4	5
MOVEMENT	COLLECTING	TRANSPORT	PROCESSING/	CODA
TO SCENE OF		TO SCENE OF	DISPOSAL	
COLLECTING		PROCESSING		

Stages 1-3 each describes elements of complicating action. Stage 4 describes the resolution, telling how the goods were processed or disposed of (e.g. cooked and eaten, preserved by smoking, stored, divided up, or traded). Occasionally there is a fifth stage, that closes off the episode by saying, e.g. that the actor(s) slept or came home. For each stage, speakers can choose to say what happened in more or less detail. Thus, some episodes are given extended treatment, while others are compressed into a few clauses or even into a single clause.

A narrative SVC reporting a collecting episode is defined as any SVC that contains two or more of stages 1-5. Predictably, there are no recorded cases of 1+3 and 1+4; these would be ill-formed because stages 2 and 3 describe pivotal event(s) in the complicating action and cannot be omitted from a report. But the corpus contains SVCs consisting of stages 1-2, 1-3, 1-4, 1-5, 2-3, 2-4, 3-4 and 4-5. Example (1) contains stages 1-5.

Example (15) is about gathering $\tilde{n}epek$ herbs. Clause i contains the gathering stage, the transport stage, and the first event in the processing stage, cooking. However, the second event in this stage, eating, occurs in clause ii and the coda is given in iii.

- nb tk d ad-1. (15) i. ognap ksen (stages 2-4) ap pick thus get come cook-SS.PRIOR sometimes new "...sometimes they would gather and bring fresh ones (*ñepek* herbs) and having cooked (them),
 - ii. *ñb-l,* (stage 4) iii. *kn-elgp-al.* (stage 5) eat.SS.PRIOR sleep-PAST.HAB-PL and eaten (them), they would sleep.' (*FPKF* #17)

All narrative SVCs have a deeper constituent structure than compact SVCs. A maximal SVC reporting a collecting episode can be analyzed as containing five small verb phrases (VPs), each representing one stage in the episode. The boundary between each small VP is potentially a boundary between separate clauses in a chaining construction. Most often the verb series representing one stage of a narrative SVC is a compact SVC but more complex series sometimes occur. For example, the formulaic string *d ap tan* + *d ap yap* (get come ascend + get come descend) 'go back and forth, go up and down', which may occur in stage 1 or stage 3, itself consists of two compact SVCs.

At the next level up, stages 2, 3 and 4 (collecting, transport and processing) form a constituent coordinate with stage 1 (movement to the collecting site) and with stage 5 phrase (the coda, usually sleeping or return home). The verbs in stages 2-4 share the same object NP (the thing collected). They can fall under the scope of a single adverbial modifier, independently of 1. Finally the entire SVC forms a constituent, a large VP or predicate phrase, coordinate with the subject. Thus, the constituent structure of the highly recurrent lexical string in (16) is as follows:

Narrative SVCs differ from compact SVCs in that the verbs need not be contiguous. Four kinds of non-verbal elements can intervene in certain positions, marking boundaries between the stages or small VPs. First, an object NP can (and often does) follow the Stage 1 verb(s) denoting movement to the scene of collecting. This can be seen in (17) and (18), as well as in (1) and (21).

(17)nb kas ogok tk <u>dad</u> *ap-l*,... (stages 1-3) am pick leaves such these carrying come-SS:PRIOR go (they) go and pick such leaves and having brought them back,..." (*KHT* ch. 10, #113)

Second, locative adjuncts can intervene. A locative adjunct to a stage 2 verb or verb series, as well as an object NP, can separate this from stage 1 material, as in (18).

(18)Nev am okok kmn-nen dad ap-1.... gtag tag pak travel travel kill carrying comes/he around game-after go SS:PRIOR 'She used to go and walk about killing and bringing back game mammals,...' (KHT ch 10, #35)

Alternatively, a locative adjunct to a stage 4 verb or verb series can occur after stage 3, as is the case in (19), in which the broad leaves of a spinach-like herb, *bep*, are gathered and put into an oven pit.

(19) ... mj bep tk d ap nb okyaŋ yok-l,... (stages 2-4)
leaf spinach pick get come place below throw-SS:PRIOR
'... having picked and brought bep leaves and thrown (them) below (into an oven pit),...' (*KHT* ch. 1, #72)

Thirdly, an adverbial modifier can occur between the stage 1 verb(s) and the following verbs. In such cases the scope of the modifier may be over the whole SVC or just over the verb(s) that follow the modifier. In (20) (not a collecting narrative) it is probable that the speaker intended *kasek* 'quickly' to modify only the final verb.

(20) i	maj-wog	0	gok g	ym-e-l,	
	sweet.potato	-garden tl	nese do	plant-DS:PRIOR-3PL	
	' after the	y had mao	de these sw	eet potato gardens,	
ii	(kupyak)	ap	kasek	ñb -e-k	(stages 3-4)
	(rat)	come	quickly	eat-DS:PRIOR:3SG-PAST	

(the rat) came and soon ate (there).'

Fourthly, a negative clitic may precede the final verb in a narrative SVC. In compact SVCs the negative clitic must precede the entire verb series and it always has scope over the entire series. In narrative SVCs there are more options. First, the non-emphatic negator *ma*-can precede the entire verb series and have scope over it. Second, *ma*- can precede the final verb in the series but have scope over the whole series. Third, *ma*-, or the emphatic negator *met*, can precede the final verb in the series, but have scope only over that verb, as in (6iii) above.

(*KHT* ch. 13, #68)

Where do narrative SVCs fit in a typology of SVCs? There is no simple answer because there are many subtypes of narrative with subtly different characteristics.

Narrative SVCs with an uninterrupted verb series, even those containing eight or ten verb roots, are almost invariably spoken under a single intonation contour. When the verb series is discontinuous short pauses are somewhat more frequent, and are most likely to occur after a stage 1 VP that is followed by a heavy locative and/or heavy object phrase. In such cases, the likely reason for the pause is that there is new information in the non-verbal constituents and the encoder has to pay close attention to these. Compare English single-verb clauses with heavy complements or modifier phrases, which often exhibit internal pauses (Chafe 1987, 1994).

Some narrative SVCs qualify as nuclear layer constructions in Foley and Olson's typology (the verbs are contiguous, and share all arguments and peripheral phrases). In other cases, the verbs are contiguous but the stage 1 VP appears to be joined to the other VPs at the core layer (it shares the subject but not the direct object), as is the case in (21) and (22). This type also counts as a single clause in terms of Foley and Olson's criteria. In (21) a hunting episode is spread over two clauses. Stages 1-3 are represented in clause i while stage 4, cooking and eating, is represented in ii. The object of the stage 2 and 3 verbs occurs clause-initially in i, preceding the stage 1 verb, an indication that it is topicalized.

(21) i. ...kmn am pak dad ap-l, (stages 1-3) kill carrying ...game:mammal come-SS.PRIOR go '... having gone and killed and brought game mammals, ii. ad ñb-l katp seŋ ognl,.... (stage 4) eat-SS.PRIOR house old:site those cook they cooked and ate them at those old house sites,...' (KHT Intro, #8)

In (22) the object NP is omitted, having been established earlier in the narrative.

(22) Bin pataj ogok am yg pak <u>dad</u> ap-elgp-al... (stages 1-3) woman young these go dig kill <u>carrying</u> come-PAST.HAB-3PL
'Young women used to go and dig up and kill and bring back (these bush rats)...' (*KHT* ch. 13, #29)

In a small minority of narrative SVCs, one VP appears to be joined to the rest at the peripheral layer (cases where the scope of a locative adjunct or an adverbial modifier, or a negator is restricted to just one of the VPs), and this type Foley and Olson would treat as a two clauses. However, rather than dichotomising, I think it makes more sense to see different constructions as occupying different points on a continuum or scale, as being more or less like prototypical clauses.

3.3. How and why did narrative SVCs develop?

There can be little doubt that narrative SVCs developed by clause union, as stripped down paraphrases of clause chains. Syntactically and semantically, the closest relatives of narrative SVCs are same subject clause-chaining constructions, in which the speaker uses a string of medial verbs to report a sequence of acts performed by the same actor. Comment has already been made on the close parallels between information packed into the separate stages, or little VPs, of a narrative SVC and information packed into separate clauses of same subject chaining constructions.

Same subject (or same topic) clause chaining is extremely widespread across subgroups of TNG languages (Roberts 1997) and was presumably present in the common ancestor of the family. However, it seems that while many TNG languages have narrative SVCs of a sort, few show the degree of elaboration found in Kalam and its close relative, Kobon (Davies 1981), and presumably this elaboration was an innovation of the common ancestor of this subgroup. It seems that certain formal characteristics of the language ancestral to Kalam and Kobon provided conditions favorable to the compression of elaborate verb series into a clause-like construction. One such characteristic is that zero anaphora was then, as now, the norm for subjects and objects, allowing verb roots to be juxtaposed. A second is that the most common verb roots were short, mostly monosyllabic, and some consisted of a consonant alone, so that (as was noted earlier) a sequence of eight verb stems might occupy just six syllables.

But the question remains: Why would speakers wish to cram several discrete stages of a narrative into a single clause? What is to be gained by such compression?

There appear to be two kinds of gains, both having to do with packaging information for a fast ride. The first has to do with choices in way of telling a story, in choosing how much detail to provide. Same actor chaining constructions are preferred when speakers want to individuate particular events in a narrative, whether merely to emphasize the temporal discreteness of the stages, or to elaborate on details. Narrative SVCs are preferred when speakers do not want to individuate the stages. In narrative SVCs individual events in the sequence are mentioned but in the most minimal way, with little or no use of what Labov (1973) calls evaluative devices – such as voice modulations, adverbial intensifiers and descriptive phrases – to add detail and drama to the bare bones of the reported actions. Of course, speakers narrating a particular episode can use a mixture of strategies, using single verb clauses for some stages and narrative SVCs for others.

The second gain, related to the first, is in economy of processing. The predicate phrase in a narrative SVCs is represented by speech formulas whose lexical content is stored in the long-term memory and which can be retrieved as an automatic chain. Significantly a minority of same subject clause-chaining sequences correspond, unit for unit, to narrative SVCs: those that conform to the formula for a well-formed minimal narrative. And it is very probable that these are also the mostly frequently same subject clause chains.

One measure of the rigidity of narrative SVCs is the fact that, speakers often recount a whole episode, with all its sub-events, even when the main point being made relates to just one sub-event in the sequence. This apparent transgression of the Gricean principle of economy can be seen both in narrative SVCs and in clause chaining constructions. Consider (23):

- (23) i. As nb-ak yg pak d ap ñb-l, (stages 2-4) small.mammal like-this dig kill get come eat-SS.PRIOR
 'After digging up killing bringing (home) and eating this kind of animal,
 - ii. b mnek wog ksen ma-a-b-al.
 man next.day garden new not-go-PERF-3PL
 men don't go into newly planted gardens for the next few days.'

It is only the act of killing this kind of animal that makes a man ritually dangerous to crops. The other four sub-events represented in clause i (the mode of capture, transport, cooking and eating of the animal) are not strictly relevant to the point the narrator is making. Thus, an idiomatic English translation would simply say 'After killing this kind of animal, men don't enter newly planted gardens...'

In such cases, why do speakers bother to mention the superfluous sub-events? There appear to be two possible answers: (i) because convention requires it –without these details the event report would seem incomplete, (ii) because the formula for the whole event sequence is stored in the long term memory and it is just as easy, or easier to retrieve the whole sequence than to pick out the salient sub-event.

But a construction can be formulaic and still be multi-clausal. The sole advantage of using a one clause formula over a two or three clause formula to express the same information appears to be that the former takes less time and can more easily be uttered under a single intonation contour. This advantage was evidently enough for the ancestors of the Kalam and Kobon to develop narrative SVCs.

It seems, then, that the clause frame is a natural target for encoders. While the norm is for clauses to contain just a single lexical verb, speakers will find ways and means of compressing frequently used multiclause expressions into a single clause construction. In this respect Kalam narrative SVCs are testament to human ingenuity and to the power of 'chunking'. They show that, given the right phonological, semantic and syntactic preconditions, it is possible to stretch a clause structure to accommodate eight or ten verbs. But such complex expressions can be uttered as fluent units only because they are learnt as formulae, and do not need to be constructed bit by bit.

4. Conclusion: Kalam and the cycle of syntacticization

We have compared various Kalam constructions that depict event sequences, with an eye to their functional and diachronic relationships. Is there evidence here for the thesis that loose, paratactic structures develop into tighter syntactic structures and then into lexicalized or grammaticalized units? The Kalam material did not include strictly paratactic discourse so it does not bear on this part of the thesis. However it did include same subject clause-chaining constructions, two kinds of lexical SVCs, and grammaticalized SVCs.

The short answer is that there is much in the Kalam material that is consistent with the thesis that, over, time, speakers find ways and means of compressing highly recurrent multiclause expressions into single clause expressions, that particular verb series come to have the status of lexical items and that some verbs take on grammatical functions. Jonathan Lane, whose recent book presents the most thorough account of Kalam SVCs, has neatly summed up the diachronic tendencies exhibited by these constructions. I can do no better than cite his remarks:

Certain sequences of events tend to be coded in SVCs, in large part to marry speed of articulation with the requirements of Kalam discourse. Verb order is

initially iconic with the order of events coded, recapitulating the most typical patterns of interclausal discourse. Once events get coded in SVCs, iconicity of another kind takes over. The close association of events coded by the verbs is reinforced by, among other things, the physical closeness of the stems themselves. Contiguity of stems, and the absence of morphological markers within SVCs, allows reinterpretation of the relation between stems... From coding independent events they move to being dependent on each other in some way. One manifestation of this is for the stems to become part of a larger lexical unit This has happened with resultative compounds, and with complex verbs of motion. The end point of this process is phonological fusion into a single word. Alternately, one stem can end up modifying the other. Essentially, one stem will begin to act as a grammatical marker. In Kalam SVCs, this correlates highly with SVC-final position. Hence discourse can be seen as being sucked inexorably into SVCs, and, through SVCs, into the lexicon or into the grammatical system. (Lane 2007:135)

NOTES

1. I am grateful to the Wenner-Gren Foundation, the University of Auckland and the University of Papua New Guinea for supporting my fieldwork on Kalam, in various spells between 1963 and 1993.

2. A few years later I read another mind-stretching book, *On Understanding Grammar*, by Tom Givón (1979), where, among other things, he explored the implications of viewing grammar as a processing strategy. While Givón argued that the structure of languages is shaped by many other forces beyond the need to describe events, he acknowledged plays a key role in language played by the clause, as a level that deals with the specification of events and states.

3. Among the linguists who in the 1970s were concerned with several of these issues were Dwight Bolinger, Wallace Chafe, Tom Givón, Koenraad Kuiper, Pim Levelt and Diana Van Lancker. The field has broadened greatly in more recent times, as the discussion in Chafe (1994) and Wray (2003) indicates.

4. There is a large literature on the event structure of verbs, much of it treating English, and to a lesser extent, Romance and Germanic languages, and Hebrew. See, for example, Bohnemeyer et al. 2007, Croft 1990, Dowty 1979, Jackendoff 1990, Levin and Rapaport-Hovav 1995, 1996, Parsons 1990 and Talmy 2000. For a debate about event structure in Kalam see Givón (1990, 1991) and Pawley (1987, in press b).

5. Kalam is spoken by about 20,000 people living around the junction of the Bismarck and Schrader Ranges, Madang Province, Papua New Guinea. There are two main dialects, Etp and Ti, which show considerable differences in morphological forms and lexicon. Examples cited here are from the Ti dialect as spoken at Gobnem in the Upper Kaironk Valley. The main source of examples cited here is an extensive collection of tape-recordings and texts on Kalam traditional knowledge and use of animals and plants in the Ti dialect by Ian Saem Majnep and his collaborators, chiefly Majnep and Bulmer (1983, 1990, n.d.) and Majnep and Pawley (n.d.).

There is a fairly extensive literature on Kalam linguistics. The most detailed study of serial verb constructions is Lane (2007), but see also Givón (1990, 1991), Pawley (in press a, b), Pawley and Lane (1998). Other works on Kalam grammar and lexicon include Pawley (1966, 1987, 1993, in press b), Pawley et al. (2000), and Pawley and Bulmer (2003).

6. The following abbreviations are used in glossing Kalam examples and in identifying sources of texts.

DS different Subject (from following verb)

DUR	durative					
FPKF	Some food plants of our Kalam forest (Majnep and Bulmer 1983)					
FUT	future					
IMP	imperative					
KHT	Kalam hunting traditions (Majnep and Bulmer 1990)					
KPL	Kalam plant lore (Majnep and Pawley. n.d.)					
Obj	object (case)					
PL	plural					
PAST	remote past (yesterday or earlier)					
PERF	perfect (denotes present perfect, present habitual and today's past)					
PASTHAI	3 past habitual					
PRIOR	prior to (the event denoted by following verb)					
PRESPRC	OG present progressive					
SG	singular					
SS	same subject (as following verb)					
VP	verb phrase					
1,2 3	1^{st} , 2^{nd} , 3^{rd} person					
_	morpheme boundary within a phonological word					
=	clitic boundary within a phonological word					

7. Ross (1975) referred to this integrative process as 'clause-crunching' and discussed a number of examples from English. There is a considerable literature on various kinds of clause-crunching, Givon (1980) on types of clausal complements and Alsina et al. (1997) on types of complex predicates being just two examples.

8. Although extensive research on the role of hesitation phenomena in speech production was carried out by experimental psychologists in the 1950s, 60 and early 70s (parts of it reviewed in Goldman-Eisler 1968 and Rochester 1973), Syder and I were unable to find that in that literature any proposals similar to the one-clause-at-a-time hypothesis.

9. In most respects Kalam's morphological and syntactic patterns are typical of the Trans New Guinea (TNG) family. However, it allows more elaborate serial verb constructions than most TNG languages.

10. There are other kinds of non-canonical SVCs, which will not be discussed here. Some of these are described in Lane (2007) and Pawley (in press a).

11. The distinction between compact or narrative SVCs is usually clear but there are some cases that have claims to be treated as both. The distinction is similar to (though not identical to) that made between 'component serialization' and 'narrative serialization by van Staden and Reesink (in press). Narrative SCVs very like those of Kalam appear in Kalam's closest

relative, Kobon (Davies 1981). Broadly similar constructions appear in some other New Guinea languages (e.g. Bruce 1988, Heeschen 2001, Farr 1999). This kind of SVC has variously been called *condensed narrative* (Heeschen 2001), *narrative* (van Staden and Reesink in press), *episodic* (Farr 1999, Pawley 1987) and *multi-scene* (Lane 2007, Pawley and Lane 1998).

12. It can be argued that one function of narrative SVCs is to make up for Kalam's lack of verbs that represent scripted event sequences, such as 'hunt', 'gather', 'fetch', etc. However, the event structure of some SVCs is considerably more complex than any single verb in English.

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Defining Complexity: Historical Reconstruction and Nyulnyulan Subordination

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Abstract

I use data from subordination strategies in Nyulnyulan languages (Non-Pama-Nyungan, Northern Australia) in order to investigate various alternative means of defining and quantifying 'complexity'. While Edmonds (1999) defines 48 distinct types of complexity (concentrating on social and natural sciences), in this paper I concentrate on three facets of complexity: descriptive complexity, ontological complexity, and parsimony in reconstruction. While historical linguists tend to maximise parsimony, in Nyulnyulan languages the minimisation of one aspect of complexity necessarily adds complication elsewhere, and it therefore serves as an appropriate case study of the interdependencies between ontology, syntactic modelling, and language change.

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1 Introduction

We find the notion of complexity, in various forms, throughout the history of research on Australian languages. We find it more often in the early history of language documentation in its converse of simplicity, although even today in Australia we find language attitudes which simultaneously treat indigenous languages as too simple to survive in the modern world, yet too complex for outsiders to study. Even in 1980, Dixon (1980:§1.2) felt the need to disabuse potential readers of the simplicity of Australian languages. Such claims perhaps persist in the widespread notion that Australian languages do not exhibit embedded clauses (for a review of these ideas see, for example, Nordlinger 2006).

I begin with this point because it shows the importance of considering simplicity and complexity in a wider context. Both complexity and simplicity are relative terms, of course; what one researcher may regard as *simple* will be treated by another as *complex* depending on their level of experience and degree of familiarity with the concept. Linguistic complexity is also theorydependent; for example, serial verb constructions are complex (and problematic) structures in a syntactic theory that has a strong version of the lexicality hypothesis (see, for example Di Sciullo and Williams 1987),¹ however in a theory where complexity is defined in terms of degree of embedding, they are less complex than subordinate clauses.

In this paper, I use historical reconstruction of subordination strategies in Nyulnyulan languages in order to explore theoretical issues in the definition and use of complexity in language change. I begin with a discussion of definitions of complexity more explicit, especially as they relate to historical reconstruction. After all, we cannot evaluate an idea such as complexity without teasing apart the many different ways in which a time like complexity could apply to the data. I then give three case studies of subordination strategies in Bardi and the other Nyulnyulan language. I argue that grammaticalisation theory itself relies on notions of complexity in other areas of the field of linguistics and that we cannot consider complexity in grammar without also being explicit about what our theories lead us to consider as a complex answer to a question.

2 Defining complexity in (historical) linguistics

The term "complexity" itself is ambiguous between at least three senses.² ONTOLOGICAL COM-PLEXITY is a measure of the inherent nature of the item under study. Ontological complexity, assuming that all aspects of a system are knowable, is static. That is, a measure of ontological complexity does not change according to the way an item is described. This contrasts with

¹Lexicality is a good area to illustrate arguments of complexity, since it represents one area where we can clearly see the trade-offs in different areas (maximising complexity of the lexicon and parsimony in syntax, versus a less restricted theory of syntax...

 $^{^{2}}$ Edmonds (1999) found 48 distinct definitions of the term in the natural and social sciences, and even within linguistics, there appears some overlap in the terms used. Here, however, I concentrate on 3 senses in which the term 'complex' may be used, depending on what it contrasts with.

SEMIOTIC COMPLEXITY, which refers to the "self-complexity of the models which were made to represent reality" (Csányi 1989:15). A type of semiotic complexity is Gell-Mann's (1994) "effective complexity" (see also Dahl 2004:25ff), which is a measure of the complexity of the internal structure of an item.

Complexity is a relative term, not an absolute one (as discussed above), so we should note that items can only be defined as complex with respect to other items.

Finally, we should distinguish local complexity from global complexity. A structure may be locally simple but globally complex, as is for example a single nonbranching node within a tree, or it may be locally complex but globally simple (a single terminal node is more simple than a branching node).

This is all relevant for the definition of complexity within historical linguistics and language change. If we are trying to trace the evolution of a structure within a family, and trying to make claims about its complexity, we need to be explicit about which type of complexity we are talking about, and under which scenario a given event is "more simple" or "more complex".

Therefore, if we are to evaluate a possible increase in complexity over time, such an evaluation needs to take place along several different parameters, including the following:

- (1) a measurement of the construction's effective complexity;
 - a measurement of relative complexity with respect to the reconstruction;
 - an evaluation of the role of the particular model used in defining the complexity of the structure.³

This paper is also in part a comment on Givón (2001, 2008) and the feeling that there is more to be said about increasing complexity than "hypotaxis originates in parataxis" (e.g. Givón 2001:218–219), especially when considering the available coordination and subordination strategies in a language as a whole.

Let us now consider some data.

3 Nyulnyulan subordination

3.1 Bardi and the Nyulnyulan languages: background to coordination/subordination

Bardi is a non-Pama-Nyungan, Nyulnyulan language spoken now by about 30 people on the Northern tip of the Dampier Peninsula.⁴ The total number of people identifying as Bardi is around 1000, although most Bardi people use English in all situations, except when the oldest Bardi people talk amongst themselves. No full published description of the language exists, although one is in preparation (Bowern forthcoming) and Metcalfe (1975) contains detailed in-

³For example, in a model with no recursion, a structure of the form 123123123123 is equally complex as one of the form 132321213123.

⁴This section is taken verbatim from Bowern (2008).

formation about verb morphology. There is extensive unpublished raw data on Bardi dating back to the Laves collection of the late 1920s.

All the Nyulnyulan languages exhibit extensive case marking. Case morphology is ergative/absolutive for all nouns and pronouns (there is no ergative split). The Eastern Nyulnyulan languages have an overt dative case, although this is lacking in the Western languages, where the dative has changed in meaning to a causal in Nyulnyul and Jabirr-Jabirr (cf. McGregor 2006), and has almost disappeared in Bardi. The languages also show agreement for subject, object and oblique/indirect object. Most Nyulnyulan languages only mark one of oblique and direct object at a time, although Bardi can mark both.

The Nyulnyulan languages are all non-configurational and (as far as I can tell from the sources available to me) make use of similar principles of discourse organisation. There are, however, differences in verb morphology and agreement marking. These differences form the main evidence for the subgrouping of Eastern and Western Nyulnyulan languages; there are further minor differences between the individual languages. In all Nyulnyulan languages, verbs are marked for tense and aspect, and marking is discontinuous. There is a prefix slot (which intervenes between subject person marking and subject number marking in Bardi) where distinctions are made between past, present, future and irrealis. The tense suffixes encode finer tense/aspect distinctions and include future, continuous, completive and remote past. A template of the Nyulnyulan verb is given in (2).

(2) Person – Tense – Number – Trans – Root – Tense/Aspect = IO/Poss = DO

Bardi and the other Nyulnyulan languages exhibit second position phenomena (cf. Anderson 2005), including in case marking, conjunctions and discourse clitics. Examples are given below. (3) shows a complex NP with case on the first word of the phrase. (4) shows a typical stretch of Bardi narrative with clauses linked by the clitic =gid 'then'.

- (3) [Boordiji-nim jiidid] barda jawoorr irranjirri larda-ngan.
 big-ERG whirlpool down pull.under 3-pl-give-cont=2sg underneath-ALL
 "Big whirlpools pull you down underneath [the water]." (Aklif 1999:jiidid)
- (4) [Barda=gid a-ng-arr-a-na-n=irr niiman=angarr aarli baali-ngan.] away-then 1-past-pl-trans[give]-rem.pst-cont=3pl many-REALLY fish bough.shed-ALL. [A-ng-arr-a-marra-na-na=gid=irr,] [moorrgarda=gid daag 1-past-pl-trans-cook-rem.pst-cont=then=3pl, sated=THEN sleep a-ng-irr-i-na-n.] 1-past-pl-do-rem.pst-cont.

"We used to go home with lots of fish. We used to cook them, and we used to go to sleep with a full stomach." (AY1.9-10)

3.2 Types of subordination in Nyulnyulan languages

These languages provide an excellent opportunity for examining different types of complexity because of their diversity of subordinative marking. In this paper, I concentrate on the possibility of reconstructing subordination structures. However, the first question to consider is whether Australian languages exhibit true subordination at all. See Hale (1976) for arguments using data from Warlpiri, particularly structures which translate English relative clauses; where such clauses are argued to be hypotactic (that is, embedded within a larger structure), but adjoined to the main clauses rather than strictly embedded. Nordlinger (2006) has an overview of these arguments and their treatment in Australian linguistics. She notes that subsequent authors have taken Hale's argument as meaning that Australian languages have no embedded clauses at all (something that Hale clearly does not argue).

Nyulnyulan languages have both finite and nonfinite clausal dependency structures. Furthermore, while some structures are overtly marked by morphology or sentential clitics, others have no marking. Here I consider both conjunction and subordination. The constructions found in Bardi are listed below:

- (5) a. =b(a), a Wackernagel clitic which primarily translates relative clauses; see (11) and §3.3;
 - b. =*min*, =*gid*, =(*j*)*amb*, =(*g*)*arra*, =*gorror* "if"; Wackernagel clitics which mark clausal dependencies, but not necessarily subordination (see (27) and §3.5);
 - c. Words which introduce new clauses which are dependent in discourse on a previous clause, including *ginyinggon, ginyinggarra, ginyinggo* (all roughly "and then"), and, in the Laves corpus (1920s) only, *ranana* "straightaway".
 - d. Case markers, including the purposive *-ngan* "for, in order to" and the semblative *-marr* "when" (with finite or non-finite clauses; see e.g. (24))
 - e. Verb morphology; the simultaneous action marker *-j* "while Xing" (included in this list for completeness but not further discussed);
 - f. Apposition; null marking (for causes, reasons, simultaneous action, or sequential or consecutive actions; see §3.6).

Nyulnyulan relative clauses are heterogenous. In Bardi, they are marked by -b(a), a morpheme which has no cognates in the rest of Nyulnyulan.⁵ In Warrwa, they are marked by a morpheme *-jarr*, which is a verbal suffix that appears in the verb before the agreement markers (in Bardi it marks topic chaining; see below). In both cases there are problems in considering such clauses as embedded. However, they are not paratactic either; there is a dependency (for example, evidence from intonation and word order interleaving strongly indicates that they are

⁵It probably appears fossilised in *anggaba* "who" (only Bardi has a distinction between 'who' and 'what'; other Nyulnyulan languages have a cognate of Bardi *anggi* 'what' in both meanings).

a single clause).⁶

In what follows, I consider four facets of dependent clauses in Bardi and Nyulnyulan:

- (6) Bardi relative clauses and their status as embedded or adjoined (see §3.3);
 - the etymological history of *-jarr-* clauses (not listed as a dependency strategy in (5) above but relevant nonetheless; see §3.4);
 - the etymology of case marking as a subordination device (see §3.5) and its outcomes in Bardi;
 - the status of null marking in clauses (see §3.6).

3.3 Bardi relative clauses

To illustrate the problem of defining hypotaxis in Bardi, let us consider relative clauses. Relative clauses in Bardi, as mentioned above, are marked by the morpheme =b(a). The absence of lenition of /b/ to /w/ or \emptyset would suggest that this morpheme is a clitic rather than an affix, although the point is not crucial here and this test is not entirely straightforward, as a few items which are clearly clitics also undergo lenition. =b(a) is affixed to the first word of the dependent clause which usually (but not exclusively) appears immediately following the relativised noun. If the word to which =b(a) is attached ends in a consonant and the following word begins with a vowel, the clitic may be optionally resyllabified as the onset of the initial syllable of the following word.

- (7) Aamba [malarr-b i-na-m-bi-na=jin garrgoyi] diird man wife-REL 3-TRANS-PST-hit.w.hand-PST=3sg.poss'r completely run.away *i-n-joo-noo*.
 3-TRANS-do/say-REM.PST
 "The man who hit his wife ran away."
- (8) Aamba [diirdi-b i-n-joo-noo barda] i-na-m-boo-noo boolooman.
 man run.away 3-TRANS-do/say-REM.PST off 3-TRANS-PST-hit-REM.PST bullock
 "The man who ran away killed a bullock." (AKL.F4)

There are a couple of things to note about the sentences in (7) - (8). The first is that in all such cases, there is obligatory coreference between an argument in the main clause and an argument in the subordinate clause. Most examples involve subject relativisation, however examples of other grammatical relations are also found, in both main clause and relativised clause. A few examples are given below:

(9) Aarli [i-na-marra-na=ba=jirr] joord=amba n-inga.
fish 3-TRANS-cook-REM.PST=REL=3PL.IO J=THUS 3-name
"The fish which he cooked for them is called joordoo.

⁶McGregor (1994a:35ff) and elsewhere treats this type of clause as subordination, although he notes that parataxis is seldom discussed in descriptions of dependencies in Australian languages.

(10) Aamba nga-n-jalali-n-j [yandilybara=b i-na-moogar-in-j.]
 man 1-TRANS-stare.at-CONT.-SEQ boat=REL 3-TRANS-make-CONT-SEQ
 "I was watching the man who/as he made the boat." (AKL.F4)

The example in (10) illustrates an important point about relative clauses in Australian languages in general. They almost never fulfil the sole function of relative clauses. Rather, they are often used to translate simultaneous or subsequent actions, sometimes consecutive actions, and sometimes they function more like switch reference markers (as is the case in Diyari (Austin 1981); see Nordlinger (2006) for a survey of Australia more generally). This heterogeneity of function is part of Hale's (1976) argument that such clauses are adjoined to the main clause rather than strictly dependent on the noun. That is, the grammatically-marked relationship in such clauses is one of relations between events, rather than a strict marking of particular participants (see, e.g. Hale 1976:79).⁷

The sentences in (11) - (12) would also appear to point to an adjoined analysis. In (11), for example, the antecedent of the 'relative' clause *boogoonb inin* is *ginyinggi ngaarri* 'that devil'; we might want to analyze this as a case of switch reference, or translate more loosely along the lines of 'the *ngaarri* devil saw me, the one which lives in the mangroves'. However, note that *ginyinggi ngaarri* is not marked for ergative case. If this were an instance of clause chaining we would not expect the ergative to be omitted. However, we do regularly find the ergative dropped from the antecedents of relative clauses (see further Bowern (to appear) for the relevant data⁸).

- (11) Ginyinggi ngaarri injalij=jarrngayoo[boogoon=b inin].3MINdevil3-TR-(PST)-see-MID.PERF-1MIN.DO inside-REL3-sit-CONT.'The spirit, which lives inside [the mangroves], saw me.'(Metcalfe 1975:37)
- (12) Garrma jagoord anja mayalgarran [booroo=b later return 2.FUT-TR-do/say-FUT afternoon time-REL anjalajan] [nyoonoo=mb nganggan boogoon].
 2.FUT-TR-see-FUT=1min.IO here-THUS 1-FUT-be-CONT inside 'When you come back in the afternoon, you'll see me there inside.'

Another problem with the 'adjoined' relative clause analysis is that there some examples of sentences which appear to have intertwined 'subordinate' clauses.⁹ That is, constituents within the clauses are not clausebound. Consider (13) from the Laves corpus:

⁷Hale (1976) notes that in Warlpiri the NP-relative interpretation of such clauses applies when there is a coreferential argument, and the T-relative interpretation when no arguments are shared between clauses. In Bardi, -b(a) is not used if there are no shared arguments: there are other dependency markers used in such cases. However, relatives are still ambiguous between NP-relatives and T-relatives.

⁸Ergative-marked subjects may be the antecedents of relative clauses, however such sentences are very rare in my corpus and are strongly dispreferred in elicitation.

⁹Nordlinger (2006:6) points out that while the majority of Australianists have interpreted Hale's (1976) claim about adjunction as a claim that Warlpiri does not have syntactic imbedding, Hale consistently refers to such clauses as subordinate. Hale (1976:85, (22)) assumes a structure [S REL]_S.

(13) Guyarra [arra irrmunggun] ingarrjimbina nyunu ingarramarnirr aambanim malgin
2 NEG know die here put man-ERG in secret nyini irr.
here 3AUG
'They didn't know that two [men] had died and a man had been put there hidden.' (Laves n.d.:103/72)

The phrase *guyarra* 'two' is the subject of *ingarrjimbina*, but *arra irrmunggun* is the main clause. Therefore either *guyarra* has raised out of the subordinate clause, or it is the object of *irrmunggun*, and the sentence should more literally be translated 'they didn't know the two, [that] they had died', although this is rather unlikely, as *irrmunggun* does not usually take a nominal complement. It is not even a verb: it is a noun meaning something like 'knowledge'. We have the same potential problem with (11) above; if the relative clause is part of the NP, either it has been extraposed or the phrase is discontinuous. Discontinuities *are* found in noun phrases in Nyulnyulan languages, but the conditions under which it is used are not directly comparable to those in Warlpiri. It is much more restricted. (And note, incidentally, that Warlpiri discontinuities are clause-bound.)

In summary, Bardi relative clauses have a number of features of adjunction rather than embedded subordination. However, in either case, we have cases where constituents do not appear to be clause bound. Clausal embedding of this type is rare in Australia (although not unknown¹⁰). The etymology of this construction is unclear in Nyulnyulan languages. It may be tempting to assume one of Givón's (2008) pathways, such as clause chaining > embedding. However, we have no evidence for this within the language. The argument would be purely one from parsimony (that is, given such a strategy is claimed for languages elsewhere, it is most parsimonious to assume the same diachronic pathway here rather than multiplying entities).

3.4 jarr-marking

A different type of problem in Nyulnyulan subordination can be found in the analysis of words which contain the morpheme *-jarr*-. It is found in both Eastern and Western Nyulnyulan languages. It is found in all of the eastern languages, where it is either a general subordinator (as in Yawuru), a marker of relative clauses (as in Warrwa, where it functions somewhat like Bardi =b(a)), or it has additional functions in Nyikina which Stokes (1982:322ff) finds difficult to gloss (she uses the term "diffuseness"). It appears to be absent from Nyulnyul and Jabirr-Jabirr.¹¹ In Bardi, these forms are not used in subordination at all, but rather mark topic chaining. Examples from the individual languages follow.¹²

¹⁰Many of Nordlinger's (2006) examples of Wambaya centre-embedding are single non-finite verbs. In this case, it is difficult to tell whether such items are really embedded clauses, or whether they are really nominals. (This is an issue for further study, not a claim that Nordlinger is incorrect.)

 $^{^{11}}$ There is not enough data for Nimanburru to determine how subordinate clauses are formed in that language.

¹²Pace Givón (2008:2), there is a fourth method of reconstruction; that is, syntactic reconstruction using the comparative method; see Harris and Campbell (1995), for example.

In Warrwa (McGregor 1994b:58ff), *-jarri* ~ *-yarri* functions as a general marker of subordination, and is glossed as introducing a temporal adverbial clause which "locates the situation referred to by the main clause as subsequent to the situation referred to by the dependent clause" (as in (14)). This morpheme is also used in marking conditional clauses.

(14) ngambalany-jarri bij nganandiny ngajanu naarda.
1st:awoke-SEQ open 1sg:got my eyes
"When I woke up I opened my eyes." (McGregor 1994b:58)

The marker is argued by Capell (1952:452) to be a relative pronoun, on the basis of examples such as (15). I have retained Capell's glosses, although a more literal gloss of the complex predicate would be *die* (*gurd*) *3min-pres/pst-*do/say-PST-*jarri*.

(15) Warrwa

gandirin ŋana waːra guḍ ŋindan-**djäri**. Garndirrin -ngana waarra gurd ngindanjarri. platform -ALL take him-who-die.

'Take the man who died to the tree platform.'

Further examples from McGregor's fieldnotes show that *=jarri* in Warrwa also functions as a clausal connector. All the examples I have found (of which those in (16) are a sample) involve the conjunction of clauses which have the same subject.

(16) Warrwa

a.	nyinggan narndin - jarri -yirr narndin -yirr/ nan	ggana -yirr
	<i>jimbin/</i> inside	ocked -3PL.OBL
	'When he had grabbed them, he locked them up.'	(WM/FN: fm3;13)
b.	<i>yalkarn ngandin kung ngandin -jarri wila</i> burp I:did drink I:did -SEQ water	
	'I burped from drinking water.'	(WM/FN: fm;9,166)
c.	<i>mawu ngangariny liyan nganjalin -jarri happy I:got feel I:saw -</i> SEQ	
	'I got happy when I saw him.'	(WM/FN: fm;9,171)
d.	ngarndany -jarri -yina jina -ngana buru nganyjalany -jirr I:went -SEQ -3sgOBL his -ALL place I:saw -3plA dardarl -kurdany yuk jina sick -COMIT camp his	<i>-wili wirrin -mili</i> CC -du sick? -??
	When I got there I found them sick in bed.	(WM/FN: fm;10,78)

In Nyikina (Warrwa's closest relative), *-jarri* ~ *-yarri* has these functions, however in addition it may also mark multiplicity (all the examples given in Stokes (1982:322) involve the object

argument), or circuitous movement. In such cases, the marker is not used in subordination. Examples follow. (17) shows a subordinate use of the morpheme, whereas (18) shows a multiple argument use.¹³

(17)	Yim-bula-ny-dyarri ng-la-ba-na.						
	3sg-come-past-REL 1sg-irr-see-past						
	"If he had come, I would have seen him."					(Stokes 1982:321)	
(10)	NT 1.	,		1.	• 7		

(18) Ngam-biga-ny-dyarr-irr manydja yila.
1sg-have-past-REL-3plO many dog
"I used to have lots of dogs."

(Stokes 1982:322)

In one dialect of Nyikina, *-jarri* is seldom found; instead, the morpheme is *-ja*. I do not know if both these morphemes have the same etymology.¹⁴

In Yawuru, like in Warrwa, the morpheme is used as a subordinator, and this is its sole use in Yawuru.¹⁵ There are no constraints on subjecthood or coreference, although it seems to be the case that there is a coreferential argument in most of the examples given in Hosokawa's grammar.

(19)	Wa-ng-ga-bula- dyarri , nyamba	ı wal-a-ø-dyina	milim	ili.
	3_i -EN-FUT-come-SEQ this	2FUT-TR-give-3DAT _i	letter	
	"When he comes, give this lette	r to him."		(Hosokawa 1991:§4.4.2;(82))

(20) Yaga-rr-a-miri-dyarri nyanga-dyunu!, wa-ng-ga-rda-dyayrda birn'dany-dyi
 12"-AGM-TR-finish-SEQ this-really 3-EN-FUT-go-12"DAT stingray-DAT warli.
 meat(DAT)
 "A finish distribution of the statement of the st

"As soon as we finish all this, he will go and catch some stingray for us to eat."

(Hosokawa 1991:§10.6.2.1, (170))

Yawuru *-dyarri* marking is unusual in that there is a strong preference for the dependent clause to precede the main clause. No other Nyulnyulan language is reported as having this restriction. The examples given for Warrwa in this section, for example, demonstrate that no such order is required in that language.

¹³I suspect in the light of examples from Bardi that the number marking in Nyikina might be a red herring, however I do not have enough textual data for this language to look into it and context is not provided for the examples in Stokes (1982).

¹⁴It is possible that *-ja* is cognate with the Bardi simultaneous marker *-j*; however in Bardi the two markers are clearly unrelated functionally. If *-jarri* and *-ja* do not have the same source in Nyikina, we would have to assume that there has been some morphological conflation. There is certainly no sound change which would derive one from the other in this language.

¹⁵Hosokawa (1991:§10.6.2) suggests that this is a borrowing from the neighbouring language Karajarri, where *-nyarri* is a continuous aspect marker. However, given the cognates as a subordinate marker throughout Nyulnyulan, the different initial consonant, the different placement of the morpheme in the verb, the different functions of the affix, and the fact that verbal morphology is not easily borrowed, I do not find the assumption of borrowing very plausible, despite Karajarri and Yawuru having a long history of contact.

In Bardi, the cognate morpheme is *jarr*-, and it attaches to the direct object and oblique agreement markers. Direct object and oblique speech participant agreement clitics have two forms. (21) illustrates this with a minimal pair using the verb 'to give':¹⁶

- (21) a. *Ana=ngay oola!* 2.IMP-TR-give-FUT=1MIN.DO water 'Give me [some] water!'
 - b. Ana=jarrngay!
 2.IMP-TR-give-FUT=1MIN.DO
 'Give it to me!'

As seen from examples such as (22), in Bardi *jarr*- forms have no relative function. They do not have to occur in a dependent clause, and they do not track arguments or mark argument coreference or dependency in general (in fact, they only occur with first and second persons).

(22) *i- noo- moondoo -na -na -ng =jarrngayoo*3- TRANS- wet -cont -pst -APPL =1sg.DO
'He kept on wetting me with it.'

(Metcalfe 1975:107)

Jarr-forms (as I will call the set) are transparently related to the unmarked set of object agreement markers. Aklif (1993) says that the jarr-forms are used after stems ending in a consonant. Metcalfe (1975) argues that jarr-forms occur on stems containing an odd number of syllables. Neither of these distributions accounts for the data, as syntactic minimal pairs like (21a) and (21b) show. The distribution cannot be phonological.

There are two very common frames where the jarr-forms occur. The first place where jarrforms occur is where arguments are contrastive, such as in (23b) below. The second is where there is a third person subject and first or second person object, and the speech act participant is featured in the discourse over several clauses (that is, the object is a grammatical topic in the sense it is used in frameworks such as LFG: see, for example, Dalrymple (2001)). This is shown in example (23c).

- (23) a. Mangir inkalan=jarrngay iiganim alig ngandan. always 3-TR-visit-1MIN.DO, sickness-ERG pain 1-TR-do/say-CONT
 'She's always visiting me when I'm sick.'
 - b. Niiwandi=jarrngay, joo ngaada=jirri. tall-1MIN.DO 2MIN short-2MIN.DO
 'I'm tall, [but] you're short.'
 - c. *Marbiddynim inanggalajarrngay* bardi, gooyarr aalga M.-ERG 3MIN-TR-PST-visit=1MIN.DO yesterday 2 day *inggoodali=jarran* arra darr oolarnajan. 3-PST-lost=1MIN.IO.TOP NEG come 3-IRR-spear-PST=1.IO.

¹⁶This section closely follows Bowern (2008).

'Marbiddy came to visit yesterday, for two days I didn't know where she was, she didn't come to my place.'

The forms with =jarr- are cognate with verb forms marking relative clauses in the related languages Warrwa and Nyikina. It is not surprising that a marker with the function of introducing relative clauses, that is, one that establishes co-reference relations in syntax, should be co-opted to track and signal coreference across clauses. What is surprising, however, is that the forms are only used for speech act participants, especially since relative marking is not restricted to speech act participants in Nyikina and Warrwa. Perhaps the jarr-forms also have functions which are linked to discourse-based obviation (for which see, for example, Aissen 1997). Given the strong preference for use of these forms when a participant lower on the person hierarchy is acting on someone higher up the hierarchy, an obviation-based account is plausible. Some of the examples in Warrwa are ambiguous between the type of sentence connective that Warrwa has and the Bardi-type examples with topic marking, and could be topic chaining. I assume that such examples are the source of the reanalysis in Bardi.

In summary, there are several differences between Bardi-type jarr-marking and that found in the Eastern languages. In the eastern languages, jarr-marking links clauses in a more or less definite way. It works rather similarly to -b(a) marking in Bardi. In Warrwa it may link either particular participants or events, whereas in Nyikina there is an additional use in non-subordinate contexts. In none of the eastern languages is jarr-marking limited to speech act participants, in fact almost all of the examples in the grammars involve third persons. In Bardi, however, jarr-marking is not used in any of these functions. Rather, it tracks speech act participants in grammatically marked discourse functions.

Theoretically, there are several plausible pathways of change which would allow us to derive these results. We could imagine a pathway of change where a general subordinate clause marker became associated with 'linking' participants between clauses [that is, as an adjoined relative clause marker], then restricted to chaining topics before being further restricted to use with speech act participants through the rise of obviation. However, we could also imagine the reverse scenario: that is, a marker which tracked obviation and speech act participants through discourse could be grammaticalised as a marker of relative clauses [which further specify information about particular participants], and then extended to a more general function once the basis for obviation was lost. Topic chaining in discourse through grammatical agreement marking is quite rare, and of creation which is only marked on speech act participants seems to be unique to Bardi. Therefore any historical solution is likely to have few (if any) parallels in other languages.

If we assume universal pathways of discourse > syntax > morphology, that could give us an answer (cf. Givón 2008). Givón's (2008) hierarchy is parsimonious, and historical linguistics has long made use of Occam's razor in historical reconstruction, whether through internal reconstruction or through the use of the comparative method. However, in this case we have no particular reason to assume one solution is more parsimonious than the other. Moreover, we have no particular reason to assume that language change is itself parsimonious (see also analogous arguments for biological phylogenetic work by Sober 1991).

3.5 Nyulnyulan case marking and 'subordination'

My next case study within Nyulnyulan takes up this question of discourse leading to syntax or vice versa. Nyulnyulan languages have structures which look superficially similar to embedding in other languages, in particular what are called XCOMP structures in LFG (Bresnan 2001). Such constructions make use of case marking. They are the preferred method of forming subordinate clauses in Nyulnyul. They also found in Bardi, although they're much less common. In such constructions, there is a finite matrix clause. There is a further clause, which is either finite or non-finite (depending on the language) which is marked for case. The marker appears either on the verb or on the first constituent of the clause.¹⁷

(24) Bardi

Bijorr-o i-n-alinygarna-n [wirr-ngan m-arrmi-n]. there-ABL 3-tr-try-cont lift-PURP GER-rise-GER

'From there, he tried to rise up (into the sky)'.

(AKL:fieldnotes)

In this sentence, there is a matrix verb *inalinygaman* 'he tried', which is finite, and another verb *marrmin*, in a nonfinite form (which I have argued is a gerund). There is argument coreference (that is, the subject argument of the finite verb is the same as the notional subject of the nonfinite verb). There is also overt marking of the dependency between the two clauses, in this case by the purposive case marker *-ngan*.¹⁸

Similar constructions are found in all Nyulnyulan languages. The most common cases used are the semblative, the proprietive, the ablative, and the locative. (25) gives examples from Nyulnyul (McGregor 1994a, 1996). However, in these languages, the verbs are usually finite. Nyulnyul does have gerund marking, but they tend not to be used in these constructions.

(25) -uk 'Locative'

- a. *imbulkubulkum indam-uk=ngay* it.swelled he.hit-loc-me 'It swelled where he hit me.'
- b. *ingalk majikarr walk injarrjarr-uk*she.cried sunset sun it.stood up-loc
 'She cried from sunset to sunrise.' lit: 'She cried at sunset, to the sun's rising.'

¹⁷Which distribution applies in each language is difficult to determine, since all the examples from Nyulnyul and Warrwa have the verb in initial position in the embedded clause. Either distribution may be possible there.
¹⁸Case marking in these languages occurs once per phrase, as a suffix to the first word of the phrase.

Case marking as a marker of finite subordinate clauses is also found in Yawuru. Here is an example with the dative. Again, the verb is finite.

(26) Dyubagi kayukayu+ nga-na-ngama bulkar-gun, [wanydyi tobacco(ABS) soft+ 1-TR-AUX(put(FUT)) ashes-LOC soon nga-na-ga-lurra-yi].
1-TR-FUT-burn-DAT(PURP)
I'll mix the chewing tobacco leaves with ashes (lit. "making tobacco soft in ashes") so that I can later enjoy the hot taste of it. (lit. "so that I will burn [it]") (Hosokawa 1991:1067,ex176)

I have not recorded clauses of this type – that is, with case-marked finite verbs – in Bardi, although it is not certain that they do not exist. However, given how common they are in other Nyulnyulan languages, their absence from my Bardi corpus is striking. Instead, Bardi uses either non-finite clauses or finite clauses introduced by a 'linker' such as *ginyinggo, ginyinggon, ginyinggarra* 'then' or a Wackernagel clitic. Etymologically, such items are case-marked third person singular pronouns. (27) and (28) are examples.

- (27) Booroo nganjalagal=joogarra, boogoon=jamb goorrinkal.
 look 1-TR-see-REC.PST=2AUG.IO inside=THUS 2-AUG-sit-REC.PST
 '[When] I looked around for you, I saw you inside.' (or, "I looked around for you, that's why I saw you inside.")
- Birarr ingirrinin rawin ingarraman. Anyjimadan booroongan=jirr. Ginyinggo behind 3pl.do-pst go.as.group 3pl.put-pst back camp-all=3pl.poss'r. Then oorany joonk innyana arnbanjarr ingilirrmanijirr. woman run 3sg-catch-pst sing.out.in.fright 3sg-call.out-pst=3pl.Obl
 "They went behind, travelling as a group. They went back to camp. Then a woman ran off and called out to them in fright." (L81.27)¹⁹

Forms such as *=jamb*, *=min* and *ginyinggo* are unlikely to be markers of strict subordination, since they mark their clause as being related in some way to the discourse before it, but not specifically to the preceding clause. They require a preceding narrative, but not necessarily coreferential arguments.²⁰

These clause chainers have a number of forms, including apparently ablative and locative case marked forms, as well as *ginyinggarra*; (-)*garra* is a common temporal marker in the other Nyulnyulan languages but it is not otherwise found in Bardi except in fossilised phrases.²¹ In the other languages, *-karra* or *-karr* has a subordinating function.

¹⁹*Arnbanjarr* is a mysterious form; it looks like it is cognate with the subordinator *jarri* discussed above; however this is otherwise unknown in Bardi. The sentence is from a text from the 1920s.

 $^{^{20}}$ =*jamb* is perhaps the most syntax-like of these particles in that it appears to be able to precede or follow a clause that it has some sort of relation to. However, it is unclear if this is a coercion effect of elicitation.

²¹An example is *garra garra garra garra*, which is a type of elliptical for stuff that happens in a narrative. e.g. < X did something>, garra garra garra (X kept on doing it, e.g. they kept on walking), < then they did something else>.

The facts from Bardi lead us to a problem. On the one hand, we could assume that the Bardi structures originate from a paratactic structure, as implied by 'universal' pathways of grammaticalisation as outlined in Givón (2008). On the other hand, we have no evidence for this type of construction anywhere else in Nyulnyulan languages. Indeed, Australian languages seem seldom to use demonstratives as subordinate clause markers. (Yolngu is one exception that I know of; it is sporadically found elsewhere too.) Moreover, ginvinggi in Bardi is not a straightforward anaphoric pronoun. It is specifically used for reactivating lapsed topics (Bowern 2008). Finally, -karra is not used in parataxis in any other Nyulnyulan language; in Nyulnyul it marks conditional clauses, while in the Eastern Nyulnyulan languages it has an aspectual use.²² Therefore, we could either reconstruct a pathway which is widely assumed elsewhere in the world, but would be very rarely attested in these particular languages (and which would also multiply the paths needed for reconstruction within the family, because we would have to assume multiple grammaticalisation events within individual languages); or, we could assume that Bardi has fossilised this marker and turned it into a discourse chainer; in this case however it would be an example of hypotaxis > discourse dependency, and not the other way around, and therefore apparently a counterexample to Givón (2008).

3.6 Null marking

In addition to the markers discussed in §§3.4–3.5, all the Nyulnyulan languages also make extensive use of juxtaposition/apposition to mark dependencies between clauses.

I have sometimes joked that under Greenberg's SVO word order typology, Bardi's basic word order is not SVO, OVS or VSO, but V. In a text count of 171 clauses, 47% contained no argument NPs at all. It is common to go for long stretches of text with no overt markers. (29) is a short example where there is no overt subject NP.

(29) Aarlingan arr nganjinj bardi. Langar arrajana, arra fish-ALL go 1-TR-do/say-CONT-SIMUL yesterday. bait NEG-1MIN.POSS, NEG ngalinyan aarli.
1-IRR-catch-CONT fish.
'I went fishing yesterday. I didn't have any bait, [so] I didn't catch any fish.'

In textual data one frequently finds series of clauses which are clearly closely related but which show no overt markers for conjunction or subordination. In (30), for example, there are three verbs. The first two, *nganjarrga* 'I ask' (uninflected for tense) and *nganjoogaljirri* 'I said to you' are probably appositive, i.e. 'I ask(ed), I said to you ...'. The 'subordinate' clause, 'if you would give me money', also has no overt marking of subordination and could be appositive.²³

²²A morpheme *-garra* is also found in Ngumpin-Yapa languages (where it has clausal and aspectual functions) and may be a borrowing into proto-Nyulnyulan, or a wider areal feature (p.c. Ken Hale, 1999).

²³In the textual counts mentioned above, approximately 10% of the clauses could not be clearly divided and so VSV and OVO orders were also included 'as is'.

(30) Nga-n-jangarrga nga-n-joo-gal=jirri goolboo nganyji
1-TR-ask 1-TR-say-REC.PST=2MIN.TOP.DO money INTERROG *a-n-a=ngay.*2-TR-give-FUT=1MIN.DO
'I was going to ask if you would give me money.'

Frequently, the same subject is retained across clauses. In (31), for example, there are no intonation breaks between the verbs and they form a single large prosodic unit.²⁴ However, subject retention is not obligatory.

(31) Ginyinggon roowil innyana Ngarrigoonbooroo baalingan darr walk 3-TR-catch-REM.PST Ng. shade-ALL come then niimana aamba agal ambooriny Ngoolbirndi. inarnaiirri 3-TR-spear-REM.PST=3AUG.IO many and people men Ng. 'Then Ngarrigoonbooroo walked to her camp and came across many people at Ngoolbirndi.' (Laves n.d.:129/19)

These multiple verbs have many of the characteristics of discourse serialisation (see Pawley 1998, for example). They occur in a single intonation contour (although there are also examples with breaks, and examples where intonation units and syntactic units are not isomorphic). They often have the same tense/aspect/mood marking (at least in the prefixal component of the TAM marking), but I have not tested this systematically, and exceptions are found in the quoted data here. For example, (30) above would appear to show sequence of tense effects.

This construction is found in all Nyulnyulan languages. Some examples are given below for Nyulnyul, another Western Nyulnyulan language.

(32) Nyulnyul (McGregor 1996)

- a. *ingirriran=yirr, ingirrkan wanyji bur-ung* they.speared=them, they.brought.it back camp-all
 'They speared them and brought them back to camp.'
- b. nyimal kad wanaw, layib wanyji, dumbar wanyji.
 your.hand bite you.give good you.do fly you.do
 'Cut your wings so that you can fly well.' (cf, 'cut your wings, you'll fly well.')
- c. mangir ngajarrijarrin rangar-uk jan malirr arri ilajarrjarr always I.get.up early-loc my wife not she.might.get.up 'I always get up early, but my wife doesn't.'
- d. *kubimin inaw bina wamb malirr murrul baab birray jin injimb* government it.gave this man wife little baby mother his 3sg.died
 'The government gave this man and his wife a little baby whose mother was dead.'

²⁴This example was from a text transcribed in 1929 but was confirmed by current Bardi speakers. There are many such examples.

Yaruwu also has apparently 'paratactic' dependency:

- (33) Ngurru wal-a-lurra-dyaw, marlu wa-ng-ga-miri dyungku.
 more 2FUT-TR-burn-12DAT not 3-EN-FUT-finish fire(ABS)
 "Put more wood on the fire for us so that it will not go out." (Hosokawa 1991:1046,ex109)
- (34) *I-ny-dyu-nd-dyanu [nga-ng-ga-rda karda-ngarn]*.
 3-EN-say-PF-1DATi 1i-EN-FUT-go yonder-ALL
 He told me to go there. (lit. "he told me I will go there") (Hosokawa 1991:1061,ex161)
- (35) Darra+ i-ny-dyu-nda, manydya i-na-rli-nda.
 belch+ 3-EN-AUX(say)-PF many 3-TR-drink-PF
 He burps as he drank a lot. (Hosokawa 1991:1081,ex227)

Therefore, in addition to subordination with an overt marker, we also have what appears to be parataxis. However, it turns out to be rather difficult to show whether the structures are clause chaining, serialisation, zero marked discourse dependencies, or subordination proper. In favour of the serialisation analysis, at least for Bardi, is the fact that such clauses usually occur under a single intonation contour. In some Nyulnyulan languages, there are sequence of tense effects, which also point to serialisation of subordination. Moreover, in some cases the presence or absence of overt nominal material appears to be grammatically constrained. In the following Bardi sentence the noun *oorany* is not omissible:

 i. Jaarla nganjalagal *(oorany) wiliwilon inkalgal. beach(ø-loc) 1sg-trans-see-pst woman fishing 3sg-trans-visit-imperf.
 "I saw a woman on the beach, she was fishing."

However, the sentence without oorany is fine as true parataxis, with a pause between the clauses.

3.7 Summary

We can reconstruct several subordination strategies for these languages:

- jarr-marking, probably as an adjoined relative structure, which descends as:
 - topic-chaining in Bardi (not old?)
 - adjoined relatives (old)
 - general subordination
- case marking:
 - adjoined or embedded? depends on our view of argument structure in the languages more generally;
 - largely lost from Bardi; retained only in limited nonfinite clauses;
 - retained in both finite and nonfinite structures in other languages;

• zero-marked clause chaining: probably there all along, multifunctional construction; doesn't 'turn into' anything

4 Conclusions

In conclusion, let me return to a few points brought up early in this paper regarding complexity in explanation. Throughout this paper, I have relied on the idea of parsimony in reconstruction. For example, I argue that Bardi is more likely to have 'desubordinated' *karr*-marking than that the other Nyulnyulan languages have independently innovated a subordination strategy on the grounds that a single loss event is more parsimonious than multiple gain events, even if the 'gain' follows a well-known grammaticalisation pathway. However, such a view minimises global complexity at the possible expense of local complexity. Moreover, as Lass (1997) and others have observed, there is no particular reason why a language family should adhere to Occam's razor (see also Sober 1991).

The case of Nyulnyulan subordination exhibits particularly clearly the problem that minimising complexity in one area of explanation merely increases it elsewhere. Generalisations such as 'hypotaxis comes from parataxis' belie the ways that such structures arise. The complexity is more interesting. In this case, we see no overall trend towards greater complexity, and no overall movement towards syntaxis or hypotaxis from parataxis. Rather, as Dahl (2004) has pointed out in other contexts, we see changes and shifts in form and function, and these changes are governed by discourse considerations as much as emerging from it. In these languages, relative clauses are not an isolated construction but are rather multifunctional, and they remain so over any period we can reconstruct. Hendery (2007) provides further examples of multiple pathways to relative clause formation. In such cases, we might wonder whether polyfunctionality compromises participation in macro-pathways such as discourse > syntax > lexis. This requires more investigation.

Overall, there seems to be no general rise in relative complexity over the reconstructible period of the Nyulnyulan family. While we note differences within individual languages, the morphology of subordination appears to be reconstructible. Bardi has undergone the most change. It has largely lost case-marked finite subordination, and it has lost the general marker of nominal relative clauses and adverbial temporal clauses. Instead, clauses with shared arguments are ambiguous, clauses without shared arguments adverbial, but have a different marker, and the inherited subordinator marks topic chaining in speech act participants. It is hard to tell whether this is strictly more complex or not. On the one hand, there are more morphological markers and more constructions, so from a strictly effective point of view there has been a rise in complexity. On the other hand, the multiplicity of constructions results in less ambiguity in parsing, so from that point of view complexity is reduced.
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Neural plasticity: a window into the complexity of

the brain

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ABSTRACT

The ability of the human nervous system to process information, perform complicated simultaneous mental and physical tasks, and express feelings and emotions is peerless. Because of its complexity, the human brain is the seminal achievement of biological evolution on our planet. This paper focuses on one aspect of brain complexity, neural plasticity, the ability of the nervous system to alter its output in response to changing stimuli. Several examples of neuroplasticity at the molecular, cellular, systems and cognitive levels are presented, all of which have physiological and behavioral consequences. The examples presented provide a basis for the premise that neural complexity arose from the need to perform complex functions. These examples also lend support for the notion that complex adaptive functions are subdivided into separate neural pathways which are oftentimes anatomically distinct.

INTRODUCTION

"Men ought to know that from nothing else but the brain come joys, delights, laughter and sports, and sorrows, griefs, despondency, and lamentations. And by this, in an especial manner, we acquire wisdom and knowledge, and see and hear and know what are foul and what are fair, what are bad and what are good, what are sweet and what are unsavory. ... And by the same organ we become mad and delirious, and fears and terrors assail us. ...All these things we endure from the brain when it is not healthy. ...In these ways I am of the opinion that the brain exercises the greatest power in the man."

Hippocrates, On the Sacred Disease (4th Century B.C.)

The human brain is extraordinary. Its ability to detect and process sensory information, execute complex motor tasks, express emotions and feelings, communicate with others and generate a state of consciousness is without equal. We see and hear clearly in real time; we perform intricate motor behaviors; we feel pain, get angry, express joy; we converse freely; we think. Complex activities such as these are performed constantly by the brain and provide the underpinning for our existence as sentient beings.

The total number of conscious and unconscious behaviors and actions generated by the brain has not been calculated but is likely to be astoundingly large. Even more impressive is that the brain is able to vary the performance of every behavior depending on changes in internal or external conditions. For example, the precise muscular movements underlying running depend on the substrate; running on sand utilizes a slightly different pattern of leg muscle activation than running on a flat track surface (Bartlett *et al.*, 2007). Food and drink ingestion, commonly known as eating and drinking, describe ~250,000 different mouth movements (van der Bilt *et al.*,

2006). The precise body position when seated in a chair is dependent on many variables including level of exhaustion and chair shape (Shenoy & Aruin, 2007). Variations in individual behaviors, known as behavioral plasticity, are not limited only to motor movements. Responses to individual sensory inputs as well as the expression of emotions and feelings are also quite variable. The exact nature of any specific motor, sensory or emotional response depends on a combination of environmental conditions and internal motivational and physiological circumstances.

Behavioral plasticity is possible only because of the ability of the nervous system to modify its output. Minute adjustments in motor behaviors, sensory reactions, and emotional responses are mediated by numerous brain mechanisms. The term "neuroplasticity" is often used to characterize the neural adaptations that enable the central nervous system (CNS) to generate variations in individual behaviors. Neuroplasticity occurs at all levels of the nervous system including molecular, cellular, systems and cognitive levels. This paper presents an example of neuroplasticity at each of these levels. The premise underlying each example is that neural plasticity arose in each case due to the need to perform complex functions. Evidence is also presented for the notion that complex adaptive functions are frequently subdivided into separate neural pathways.

MOLECULAR PLASTICITY: EVOLUTION OF VOLTAGE-GATED SODIUM CHANNELS IN EUKARYOTES

The vast diversity of life forms on our planet is thought to have evolved from one simple organism. This means that seemingly unrelated organisms such as blue-green algae, fireflies, and orangutans are distantly related and share a common ancestor. The process of gradual divergence by which more complex organisms arose from simpler ones was first described by Charles Darwin as "descent with modification" or evolution. Evolutionary change is driven by modifications at the genetic level. Random genetic alterations occasionally generate positive adaptations that, over time, lead to new, increasingly complex species (*e.g.*, Barton, 2008). An example of a molecular level change that impacted organismal complexity is the evolution of voltage-gated sodium channels in nerve cells.

Individual nerve cells have four functional regions: dendrites, which receive an input from other neurons; the cell body, which integrates all the dendritic inputs and provides other cellular functions; the axon, which connects the input and output regions of the cell; and the terminal, which sends an output signal to the next neuron (Kandel, Schwartz & Jessell, 2000). Nerve cell inputs and outputs are usually mediated by chemical neurotransmitters. To transfer the transmitter-mediated input signal from the dendrites to the terminals, a distance of 1 meter or more in some neurons, each nerve cell converts the neurotransmitter chemical message into an electrical signal which very rapidly travels down the nerve axon to the terminal (Kandel, Schwartz & Jessell, 2000). Once the electrical signal, known as an action potential, reaches the

terminal, it is converted back into a transmitter-mediated chemical message that is released from the cell, crosses the synaptic cleft and is detected by the downstream neuron.

The action potential of a nerve cell is generated by a rapid influx of sodium ions across the cell membrane followed closely in time by an efflux of potassium ions. Sodium and potassium each pass across the cell membrane through separate, proteinaceous pores or channels that selectively pass only one type of ion. The pores passing sodium and potassium each open and close in response to changes in voltage (Hille, 1989; 2001). When the neuron is at rest, these channels are closed. However, when the voltage changes across the cell membrane, the potassium and sodium channels open, albeit with different kinetics. Because they are activated by changes in membrane voltage, these ion-passing membrane pores are known as voltage-gated sodium and voltage-gated potassium channels, respectively (Hille, 1989; 2001).

Voltage-gated sodium channels have their origin in potassium channels from prokaryotes such as bacteria (*N.B.*, prokaryotes are organisms whose cells lack a nucleus). Bacteria typically have cellular requirements for potassium but not for sodium. Consistent with their needs, bacteria do not usually express sodium channels but do contain potassium-specific channels in their membranes to allow passage of potassium ions into and/or out of the cell (Milkman, 1994). Ranganathan (1994) suggested that the primordial prokaryotic ion channel was a potassium channel with a gate on the cytoplasmic or inside face of the channel that opens or closes it. Other researchers have suggested that other types of potassium channels with a cytoplasmic gate, such as mechanosensory or cyclic-nucleotide-gated channels, may be the ancestor of all voltage sensitive channels (Jan & Jan, 1994; Anderson & Greenberg, 2001). The general consensus,

however, is that the first channels in bacteria were simple, non-voltage-gated potassium channels with a cytoplasmic gate controlling ion flow through the channel (Hille, 1989).

Voltage-activated membrane channels first appeared in single celled eukaryotes such as protozoans (*N.B.*, eukaryotes are organisms whose cells possess nuclei and other membrane bound intracellular organelles). Many protozoans express separate voltage-gated potassium and voltage-gated calcium channels (**Figure 1**; Hille, 1989; Anderson & Greenberg, 2001). The latter are used to bring calcium into the cell and as the charge carrier for electrical signaling purposes. There is good evidence supporting the notion that voltage-gated calcium channels evolved in primitive, single-celled eukaryotes after the appearance of voltage-gated potassium channels and before voltage-gated sodium channels. The use of sodium as a charge carrier to change the membrane potential of a cell did not appear in evolution until the advent of multicellularity. Sodium channels were not common until the appearance of cnidarians (*N.B.*, animal phylum with two cellular layers, stinging cells, and radial symmetry, *e.g.*, hydras and jellyfish) and are not found in higher plants, protozoa and algae (Hille, 1989). Thus, voltage-gated sodium channels did not evolve until much later.

These conclusions are supported by molecular data. Voltage-gated potassium channels in both prokaryotes and eukaryotes consist of multiple, independent subunits that associate together using weak chemical bonds to create the ion channel. The predominant class of voltage-activated potassium channels has four quite similar protein subunits (**Figure 1**). Each subunit contains 6 transmembrane spanning segments (S1-S6) plus a loop, called the P- or pore region, between segments S5 and S6 that allows the channel to be selectively permeable only to potassium.



Figure 1: Schematic drawing of voltage-gated sodium, calcium and potassium channels. Sodium and calcium voltage-gated channels consist of 4 similar domains (I-IV). Each domain is composed a single polypeptide chain with 6 α -helical, transmembrane spanning regions (1-6), a pore region (P) between α -helices 5 and 6, and voltage sensor in α -helix 4 (red). The potassium channel is a single subunit containing a single repeat of the 6 α -helices. Four of these potassium subunits assemble together to form the potassium channel. NH₂ and COOH refer to the amino (beginning) and carboxyl (end) terminals of the channel proteins (modified slightly from Kandel, Schwartz & Jessell, 2000).

Studies have determined that the voltage sensor is localized to the S4 transmembrane region of each subunit (**Figure 1;** Hille, 1989; 2001).

In contrast, voltage-gated calcium and sodium channels consist of a single protein with 4 very similar or homologous domains strung together linearly (**Figure 1**). Each domain consists of the same general architecture as that for the voltage-gated potassium subunits, *i.e.*, 6 membrane-spanning regions (S1-S6), a P-region between S5 and S6 segments, and voltage sensitive S4 segment (Goldin, 2002).

On the basis of structural and amino acid sequence data, Strong and colleagues (1993) hypothesized that the single domain, voltage-gated potassium channel subunit is likely to be the ancestral form of all voltage-gated channels. They proposed that voltage-gated calcium channels, with 4 nearly identical domains, evolved from two rounds of gene duplication during the evolution of the early prokaryotes. The first duplication produced a two-domain channel similar to domains I/III and II/IV of a voltage-gated calcium channel. Each of these two-domain channels went through another round of gene duplication to generate the first 4 domain calcium channel.

Molecular analyses of the amino acid structure of the voltage-gated sodium channel indicate that each of its four domains is more similar to its homologous domain in the voltage-gated calcium channel than to each other. These data argue in favor of the notion that voltage-gated sodium channels evolved after the double gene duplication event that created the voltage-gated calcium channel (Hille, 1989; Strong *et al.*, 1993).

These data taken together provide strong evidence that the prokaryotic potassium channel was the ancestral form of all voltage-gated ion channels. Soon after the appearance of eukaryotes, the single domain potassium channel developed voltage sensitivity followed by two rounds of gene duplication to produce the four domain, voltage-gated calcium channel. A final duplication event and alteration of ion selectivity led to the appearance of the voltage-gated sodium channel found in all invertebrate and vertebrates including humans. The advent of voltage-gated sodium channels enabled long distance, rapid signaling between cells and clearly resulted in an increase in cellular neuroplasticity and organismal complexity. The evolution of four domain, voltage-gated sodium channels in eukaryotes from single domain, non-voltage-gated potassium channels in prokaryotes is an unambiguous example of increasing biological complexity driven by evolutionary pressures.

CELLULAR NEUROPLASTICITY: FUNCTIONAL PLASTICITY IN MATURE INSECT NEURONS

Structural and functional alterations at the molecular level, as illustrated by the origin of voltage-gated sodium channels discussed in the previous section, have been a primary mechanism used repeatedly throughout evolution to increase nervous system complexity. Molecular modifications, however, are not the only means to achieve the vast neural and behavioral plasticity seen in invertebrates and vertebrates, including mammals and humans. The ability of individual cells to alter their function provides another mechanism to generate

complexity and behavioral plasticity. This section details an unusual example of a set of identified neurons that undergo a dramatic transformation at a specific point in their lifetime and assume a completely different identity and function.

Following their birth from ectodermal cells, newly born nerve cells develop into mature adult neurons with a distinctive set of biochemical, anatomical and physiological characteristics (Kandel, Schwartz & Jessell, 2000). The combination of transmitter identity, dendritic arbor shape, axonal projection pattern, biochemical profile, and electrical properties are often sufficient to differentiate a neuron from its neighbors and identify it individually.

Research on identified neurons has stimulated significant progress in cellular neurobiology. The strength of this approach lies in the ability to repeatedly analyze the same, uniquely defined neuron from different individuals of the same species. The most notable example is the squid giant axon which was used to elucidate the basic cellular properties of neurons (*e.g.*, Hodgkin & Huxley, 1952). With few notable exceptions, invertebrate preparations have provided most of the known individually identifiable neurons because of the simplified nature of their CNS. Insects have long been a favorite model system for studies on identified cells because of their rapid generation time, ease of rearing, wide repertoire of complex behaviors, and significantly fewer neurons compared to vertebrates ($\sim 10^4$ vs. $\sim 10^{11}$ cells). One insect species, the tobacco hawkmoth *Manduca sexta*, is a particularly amenable animal model system because of the wealth of information already known about its physiology, anatomy, development, endocrinology and biochemistry of its individually identifiable neurons (*e.g.*, Dai *et al.*, 2007; Duve *et al.*, 2005).

The *Manduca* nervous system follows the general plan of other arthropods (Chapman, 1991). It consists of a cephalized brain connected to a series of segmentally iterated ganglia lying along the ventral side of the body, the latter of which are collectively known as the ventral nerve cord (**Figure 2**). Each ganglion in the *Manduca* ventral nerve cord generally contains ~1000 individual nerve cell bodies that supply neural information to a single body segment. Some cells in each ganglion are motoneurons or sensory neurons and others are interneurons which interact with motor and sensory cells. A very small percentage of ganglionic neurons are neurosecretory cells, specialized nerve cells with the electrical activity of neurons and which also act like gland cells to release neurohormonal signals into the blood (Maddrell & Nordmann, 1979). One set of identified neurosecretory cells in *Manduca* are the Lateral Neurosecretory Cells (LNCs; **Figure 2**). The LNCs are four pairs of cells in each abdominal ganglion that go through a remarkable makeover during metamorphosis from caterpillar to adult moth (Tublitz, 1993).

The LNCs in caterpillars are involved in regulating cardiac activity (Prier, Hwa & Tublitz, 1994). They release a set of hormones called Cardioacceleratory Peptides at specific times during larval life (Tublitz *et al.*, 1991). For example, the CAPs are released into the blood to control heart rate during the last larval stage when the caterpillar is preparing to enter metamorphosis (Tublitz *et al.*, 1992). During the metamorphic transition from caterpillar to adult moth, the LNCs stop making the CAPs and begin to produce a different neurotransmitter, bursicon, a peptide hormone involved in tanning the skin or cuticle of the adult moth (Loi & Tublitz, 1993; Tublitz & Loi 1993). The transmitter switch from CAPs to bursicon is triggered by the insect



Figure 2: Schematic drawing of the *Manduca* nervous system in larvae and adults highlighting the Lateral Neurosecretory Cells (LNCs; in red). The *Manduca* nervous system consists of a cephalized brain plus a nerve cord with individual or fused ganglia. The nerve cord contains one subesophageal ganglion (SEG), 3 thoracic ganglia (T1-T3) and 8-9 abdominal ganglia (A1-A9) which may or may not be partially fused depending on the developmental stage.

steroid hormone 20-hydroxyecdysone, which mediates the down-regulation of CAP production and up-regulation of bursicon expression (Tublitz, 1993).

The LNCs alter other properties during metamorphosis in addition to changing its transmitter profile. The dendritic arbors of the LNCs expand their penetration of the abdominal ganglion by nearly three fold during the transformation from larva to adult (**Figure 3**; McGraw *et al.*, 1998). Physiological properties of the LNCs also change at this time. Two electrical measures, action potential threshold and input resistance, each decline significantly in the LNCs during metamorphosis (Tublitz & Prier, unpublished data). Like the transmitter switch, these other changes are triggered by 20-hydroxyecdysone. These data demonstrate that the LNCs alter their physiology, biochemistry and morphology in response to steroid hormone exposure.

The changes at the cellular level exhibited by the LNCs during metamorphosis underlie a major switch in function. As described above, the primary purpose of the LNCs in larvae is to regulate heart rate via a local release of the CAPs in the neighborhood of the heart (Tublitz *et al.*, 1993). In contrast, the same LNCs perform a very different function in adult moths, releasing the neurohormone bursicon into the blood to induce tanning of the cuticle. Thus, the LNCs act as local cardiomodulatory neurons in larvae yet serve a neurohormonal function in adults.

The plasticity exhibited by the LNCs is part of a major overhaul of the *Manduca* central nervous system during metamorphosis. Some neurons die, others arise *de novo*, and still others undergo a respecification of targets and/or function (*e.g.*, Levine, 1984; Dulcis & Levine, 2004). The LNCs fall into this latter category, changing their function from local modulator in



Figure 3. A comparison of the total extent of arborization in larval and adult lateral neurosecretory cells (LNCs) in the tobacco hawkmoth *Manduca sexta*. (A) Camera lucida drawing of the central processes of an individual LNC taken from a larva (left) and an adult (right). (B) Extent of arborization of larval and adult LNCs expressed as a percentage of the total ganglionic volume containing dendritic and axonal processes. Values are mean + S.E.M (N=5 for each data set). *The mean extent of arborization in the adult was significantly greater than that in the larva, using a one-tailed Mann-Whitney U-test, P<0.005 (taken from McGraw *et al.*, 1998).

caterpillars to neurohormonal cells in adult moths. The functional alterations seen in many *Manduca* neurons during metamorphosis correlate well with the massive changes in anatomy and behavior during this period. As the animal goes from the larva to pupa and finally to the adult, it undergoes a massive conversion from a feeding and crawling animal to one that flies and mates. The complexity of the anatomical and behavioral transition in *Manduca* is mirrored by an equally complex neural reorganization (Truman & Riddiford, 2007).

The LNCs are arguably the best examples of neuronal plasticity at the cellular level in the animal kingdom, however they are not the only neurons to exhibit significant alterations in function. Functional changes by nerve cells have been described in many organisms from invertebrates to mammals (*e.g.*, Glantzman, 2006; Kampa *et al.*, 2007; Neves *et al.*, 2008; Nikitin, 2007). Sensory cortex cells that have lost their sensory inputs due to lesions or injuries replace those inputs with other sensory signals, usually of the same sensory modality (*e.g.*, Kral & Eggermont, 2007). Motor neurons innervate another muscle when their original target muscles are removed (*e.g.*, Purves & Hadley, 1985). It is not known what percentage of neurons alter their function but the number of studies detailing cellular plasticity has certainly been on the rise. It is likely that this type of cellular neuroplasticity underlies the variation in the production of complex behaviors in many organisms.

SYSTEMS NEUROPLASTICITY: BODY PATTERNING BEHAVIOR IN CUTTLEFISH

Changes at the molecular and cellular levels explain many neurally mediated functions including sensory processing, sensorimotor integration, learning and memory, and motor behaviors. Some cases of behavioral plasticity, however, depend on groups of neurons working together as an ensemble. One example of neuroplasticity at the systems level is the neuroregulation of body patterning behavior in cephalopods molluscs, a taxonomic group that includes octopus, squid, cuttlefish and nautilus (Hanlon & Messenger, 1988). The unique combination of properties found in this group of organisms make them excellent models for studies on the neural control of behavioral plasticity at the systems level.

Of the many fascinating behaviors in cephalopods, perhaps the most remarkable is their ability to rapidly produce highly detailed coloration patterns extending across their entire body. Although body patterning behavior is exhibited by all cephalopods except for the shelled nautiloids, cuttlefish are generally thought to display the largest and most complex repertoire of patterns (Hanlon, 1982; Hanlon & Messenger, 1988; Holmes, 1940; Packard & Hochberg, 1977). Most studies on body patterning behavior have been performed on one species, the European cuttlefish *Sepia officinalis*, which like other cephalopods, are capable of adjusting their body coloration to match numerous different substrates, including many that are visually complex (**Figure 4**). *Sepia* also display specific body patterns in response to the appearance of predators, prey and conspecifics (*e.g.*, during courtship) as well as to local environmental disturbances. Many body patterns are stunningly dynamic; for example *Sepia* display a set of



Figure 4. Photograph of a juvenile European cuttlefish *Sepia officinalis* producing a camouflage pattern while resting on top of pebbles.

several dark and light transverse bands across the body that move anteriorly at 5-10 Hz, commonly known as the 'passing cloud' display (Packard & Hochberg, 1977). The complexity of these displays reflects a CNS origin, and most are visually mediated because blinded cephalopods exhibit significantly fewer body patterns (Sanders & Young, 1974). Cephalopod body patterns are generated by a suite of chromatic elements, including iridiphores, leucophores and chromatophores, the latter of which are responsible for the amazing ability of cuttlefish and other cephalopods to generate intricate displays in less than a second, much faster than any other species in the animal kingdom (Messenger, 2001).

The ability of cuttlefish and other unshelled cephalopods to generate complex patterns so quickly is due to the unique structure of their chromatophore system. A cephalopod chromatophore is a true multicellular organ (Figure 5); at its core is the chromatophore cell, a pigment-containing cell with a highly elastic plasmalemma. Attached to and radiating from each chromatophore cell are 6-20 striated muscles cells, the chromatophore muscles, which emanate from the chromatophore cell like the spokes of a bicycle wheel (Figure 5; Cloney & Florey, Contraction or relaxation of the chromatophore muscles results in expansion or 1968). retraction, respectively, of the chromatophore cell. Because chromatophore muscles produce graded contractions, many intermediate expansion states of the chromatophore cell are possible. also exhibit dynamic responses, e.g., "flickering" behavior Individual chromatophore cells produced by rapid mini-contraction/relaxation cycles of the chromatophore muscles. Ultimate control of body patterning in unshelled cephalopods lies within the CNS since most if not all chromatophore muscles are innervated by motoneurons (Reed, 1995).



Figure 5. Diagram of the ultrastructure of a retracted cephalopod chromatophore organ. The sheath cells covering the chromatophore and the muscle fibers are not shown (slightly modified from Cloney & Florey, 1968).

Like the body patterning behavior it mediates, CNS control of chromatophore activity is elaborate. Invertebrate striated muscles, unlike their vertebrate counterparts, are innervated by multiple types of motoneurons. *Sepia* chromatophore muscles receive both direct excitatory and inhibitory motor input (Loi & Tublitz, 2000). There are two different types of excitatory motoneurons, one which causes a fast contraction of the chromatophore muscles and the other which induces a slower muscular excitation. These "fast" and "slow" motoneurons are distinguished by their neurotransmitters. The fast motoneurons use the amino acid glutamate and the slow motoneurons release multiple peptides all within the FMRFamide peptide family (**Figure 6**; Loi & Tublitz, 1997; 2000). The third input to the chromatophore muscles is inhibitory, mediated by the classic biogenic amine neurotransmitter serotonin (Messenger, 2001). It is the interaction between these three different neural inputs that underlies the complex responses of individual chromatophore organs (Messenger, 2001).

Mature adult *Sepia* each contain approximately 400,000 to 1 million chromatophore organs and approximately 200,000 chromatophore motoneurons (Hanlon & Messenger, 1988; Messenger, 2001). These figures suggest that each chromatophore motoneuron controls on average about 2-5 individual chromatophore organs and innervates 12-100 chromatophore muscles. Although there is some convergence of neural information from motoneuron to chromatophore organ, the number of individual motoneurons is more than sufficient to produce the complex body patterning seen in these amazing organisms.

More information about the control of body patterning behavior has been discerned by the location and distribution of the chromatophore motoneurons within the *Sepia* CNS. The vast



Figure 6. The effect of glutamate (top panel) and the neuropeptide FMRFamide (bottom panel) on an individual *in vitro* chromatophore. A piece of skin from the fin of the cuttlefish *Sepia officinalis* was removed, pinned to a dish and immersed in sea water. A photo-optical system (Loi & Tublitz, 2000) was used to measure the expansion of an individual chromatophore. The bar above each trace indicates the period of transmitter application. Note that glutamate caused immediate expansion of the chromatophore which lasted only for the duration of its application. In contrast, the initial effect of FMRFamide was delayed and the duration of its effect was prolonged for many minutes after FRMFamide removal.

majority of chromatophore motoneurons have been localized to the anterior and posterior chromatophore lobes of the *Sepia* brain (Gaston & Tublitz, 2004). In general, the chromatophore motoneurons innervating the tentacles are found in the anterior chromatophore lobe while the posterior chromatophore lobe houses the motoneurons controlling chromatophores on the rest of the body and the fin (Boycott, 1961; Gaston & Tublitz 2004 & 2006).

Recent brain localization studies on cuttlefish fin chromatophore motoneurons suggest the presence of a somatotopic map in the posterior chromatophore lobe (Gaston & Tublitz, 2006). Somatotopy, the spatial mapping of peripheral body regions onto specific CNS regions, is a well known neural concept in vertebrates including mammals and humans (Kandel, Schwartz & Jessell, 2000). Classic examples of somatotopic mapping include the human sensory and motor cortex and retinal projections to the mammalian lateral geniculate nucleus. Although the cuttlefish data are preliminary, chromatophore motoneuron somatotopy may be present in several brain regions (Gaston & Tublitz, 2006; Tublitz, Loi & Gaston, 2006). There are several reported cases of somatotopy in invertebrate optic lobes, however this report, if confirmed, would be the first example of central somatotopic mapping in an invertebrate brain. Given that the cephalopod CNS is the most complicated and largest among the invertebrates in terms of volume and cell number (Young, 1971), it is therefore not surprising that principle of somatotopic mapping would first arise in these unshelled organisms, which require stealth, camouflage and rapid movement to avoid predation.

The size and intricacy of the cephalopod CNS provide a level of complexity and computational power previously unknown in the invertebrates. Although much is still to be

understood about the neural control of body patterning behavior, it remains the quintessential example of systems level neuroplasticity in invertebrates.

COGNITIVE NEUROPLASTICITY: THE NEURAL BASIS OF LAUGHTER AND HUMOR IN HUMANS

This paper has shown to this point how plasticity at the molecular, cellular and systems levels contributes to neural complexity. Plasticity is also a key feature of the most complicated of human brain activities such as language, learning and memory, perception, thought, and planned action. Each of these cognitive activities involves larger, interconnected networks of neurons. This section focuses on the cognitive processes and brain pathways involved in an intriguing cognitive function, humor, with a specific emphasis on laughter.

Humor is a universal aspect of the human experience (Apte, 1985). It occurs in all cultures and nearly all individuals throughout the world (Lefcourt, 2001). The Oxford English Dictionary (www.oed.com) defines humor as "that quality of action, speech or writing which excites amusement; the faculty of perceiving what is ludicrous or amusing; or of expressing it in speech, writing or other actions". It is evident that humor is a broad term encompassing anything people do or say that is perceived as amusing and which tends to make people laugh. Humor also includes the mental processes that go into creating and perceiving amusing stimuli and the physical responses involved in enjoying humor.

Like all mental and physical processes, humor is a complex series of actions taken by the brain. From detecting a humorous stimulus, to its processing and understanding, and finally to producing a response such as laughter, the brain is involved in every step. It is this final step, laughter and its underlying neural processes, that is the focus of this section.

A frequent behavioral response to a humorous stimulus is laughter. Charles Darwin noted in his 1872 book *The Expression of the Emotions in Man and Animals* that laughter is a mechanism to express a specific emotional reaction to others. Laughter is a distinctive, stereotyped pattern of vocalization that is easily recognizable and quite unmistakable (Provine & Yong, 1991). Although what is funny varies greatly, the sounds of laughter are indistinguishable across cultures. Developmentally, laughter is one of the first social vocalizations after crying emitted by human infants (McGhee, 1979). Infants first laugh in response to the behavior of others at about four months old. Cases of gelastic or laughter producing epilepsy in newborns indicate that the brain mechanisms for laughter are already present at birth (Sher & Brown, 1976). The innateness of laughter is best demonstrated in those born deaf and blind whom are reported to laugh appropriately without ever having perceived the laughter of others (Provine, 2000).

Laughter is a complex physiological response, characterized by a combination of loud oral noises, repetitive diaphragm contractions, open mouth and grimaces caused by facial muscle contractions and flushing of the skin (Ruch & Ekman, 2001). Laughter is also accompanied by a general physiological arousal including increased heart rate, production of tears, loss of strength

in the extremities and flailing body movements (Cacioppo *et al.*, 2000). All of these physiological activities are precisely controlled by the brain.

Studies of patients with brain lesions have identified two distinct functional pathways in the brain that produce smiling and laughter. One pathway produces involuntary, spontaneous and emotional laughter known as genuine laughter. The second pathway mediates forced laughter, which is voluntary and unemotional. The functional separation of these pathways has been demonstrated in several different types of studies.

Some stroke patients who are unable to voluntarily move their facial muscles (*i.e.*, volitional facial paresis), are nonetheless capable of genuine laughter. They are able smile and laugh normally in response to a humorous stimulus (Wild *et al.*, 2003). In contrast, some patients with subcortical brain lesions in the basal ganglia (**Figure 7**) are not able to exhibit spontaneous facial expressions of emotion when they feel amused but are able to smile on command (Wild *et al.*, 2003).

Additional evidence for separate pathways for voluntary and involuntary pathways comes from studies using positron emission tomography (PET), a brain imaging technique that measures changes in regional cerebral blood flow. Iwase and colleagues (2002) used PET to test responses of healthy individuals to humorous or non-humorous videos. Involuntary smiling specifically activated cortical areas such as the left anterior temporal cortex and bilateral occipitotemporal cortices involved in visual processing and integration (**Figure 7**). Limbic system areas involved in emotional reward were also activated. In contrast, voluntary, non-



Figure 7. Brain regions involved in cognitive and motor regulation of laughter (modified from Martin, 2007).

emotional smiling was correlated with greater activity in those areas of the frontal cortex involved in voluntary facial movement such as primary and supplementary motor areas (**Figure 7**).

Data from electrical brain stimulation experiments lend further support to the working hypothesis that there are separate brain pathways for voluntary and involuntary laughter. One study described a 16-year-old female patient with epilepsy who, when her supplementary motor cortex was stimulated electrically, consistently laughed even though there was no detectable visual or auditory humorous stimulus (Fried *et al.*, 1998). Her laughter was accompanied by the subjective feelings usually associated with humor such as amusement and mirth. Even more interesting was that every time she laughed due to electrical stimulation, she ascribed her laughter to a specific stimulus in the room. For example, once she claimed to be laughing because of the humorous nature of a horse photo on the wall. It must be noted that this patient's bouts of epilepsy were never accompanied by gelastic laughter.

Based on data from stroke victims, PET and fMRI brain scans, and electrical brain stimulation, it is becoming increasingly clear that the brain has two pathways for laughter that are functionally and anatomically distinct. It is reasonable to postulate that each pathway arose independently to perform its distinctive function and was maintained because it provided a selective advantage to the individual. Although the precise mechanisms and details of the networks involved in humor detection and laughter production remain to be elucidated, the presence of two separate two neural circuits for laughter provides a concrete example of the development of neural complexity at the cognitive level.

CONCLUSIONS

A fundamental tenet of modern evolutionary thought is that complex structures and life forms arose from simpler ones. Biology is rife with microscopic and macroscopic examples of this principle: for example, the origin of energy producing cellular organelles (*i.e.*, chloroplasts and mitochondria) from free-living aerobic bacteria; the advent of multicellularity from singlecelled organisms; the appearance of bird feathers from reptilian body scales; the development of the vertebrate camera eye from simple invertebrate photoreceptors; and of course, the evolution of modern day humans from our simian ancestors. The prevailing theme in each case is that these new designs arose from structures already in existence. The basic mechanism underlying this theme is that a structure originally intended to fulfill one role is slowly changed through gradual modification to become adaptive for a different role. It is by this mechanism that simple structures evolve into more complex ones. The principle of gradual adaptation is the bedrock of modern evolution.

Gradual adaptation is the force underlying evolutionary change not only in body structure but also in the form and function of the nervous system. From the simple nerve nets of cnidarians (*i.e.*, sponges, jellyfish and corals) to the complicated interactions of the central and peripheral nervous systems in insects, to the highly cephalized brain of cephalopods with functionally discrete regions, and finally to the remarkable human brain, nervous systems have developed from the simple to the highly complex over evolutionary time.

During the course of evolution, the nervous system of animals has increased in absolute size and in its number of neurons. New functions have also arisen, including the ability to alter one's own behavior in response to changing environmental or internal conditions. Known as behavioral plasticity, this function is an essential adaptation without which individual organisms would neither survive to maturity nor reproduce. All organisms from the simplest unicellular bacteria to humans are endowed with this capacity to a lesser or greater extent. Responsibility for generating variations in behavioral output lies exclusively with the nervous system and its remarkable plasticity.

This paper has presented several molecular, cellular, systems and cognitive examples of neuroplasticity underlying behavioral plasticity. Neuroplasticity arose in each case because of the necessity to perform a complex novel function. At the molecular level, voltage-gated sodium channels appeared in multicellular animals in order to coordinate responses among other cells in the organism. The need to re-specify cellular function in the nervous system of organisms with relatively few neurons is the likely reason behind the major biochemical, physiological and anatomical changes exhibited by the *Manduca* LNCs. The intricate, systems level regulation of cephalopod chromatophores arose because of the necessity to generate precise camouflage patterns and avoid prey. At the cognitive level, the two types of laughter, voluntary and involuntary, evolved to serve different functions by way of separate neural pathways. New functions in each instance resulted from the ability of the nervous system to adapt and adjust to changing environmental and internal conditions. In some cases new pathways were developed to

accommodate these changes. Neuroplasticity at the molecular, cellular, systems and cognitive levels is an essential component for behavioral flexibility and complexity in all animals.

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Neural Mechanisms of Inhibitory Specification in Cognitive and Linguistic Complexity

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1. Introduction

Complexity in grammatical clause organization provides a hierarchic organization that allows efficient constructions of meaning. To understand the scarcity of neural resources that make this efficiency important, it may be useful to examine current neuropsychological models of memory organization. That human memory capacity is limited is a fact that is often experienced in daily life, yet it may not not fully apparent from introspection alone. Experimental psychology studies have documented the limits of memory, providing an important basis for understanding not only the cognitive constraints that must be addressed by linguistic constructions, but how the emergence of these linguistic constructions allowed humans novel reasoning abilities.

We theorize that the ability to organize a complex linguistic structure such as a hierarchic clause may depend upon the capacity for what may be called inhibitory specification, in which certain meanings are isolated within working memory, such that they can be sustained and grouped within hierarchic structures. Clues to the neural mechanisms of inhibitory specification can be gained from studying the sequencing and routinization of action within the motor system, and from examining the unique properties of object memory within the ventral corticolimbic pathway.

Recent findings and theoretical models in neuropsychology have suggested that memory is achieved through specific neural systems, each of which provides unique representational properties, but also unique limitations. In addition to the traditional delineation of a procedural memory system, closely linked to the capacity for automaticity and habit formation within the motor system, there are two corticolimbic circuits that support cognitive representational memory. The first is a dorsal limbic circuit centered on the hippocampus and cingulate gyrus supporting configural memory. The second is a ventral limbic circuit centered on the amygdala and anterior temporal, insular, and orbital frontal cortex supporting item or object memory. Traditional evidence on aphasia syndromes emphasizes the importance of object memory to both expression and comprehension of language. The ventral limbic pathway's unique capabilities for specifying objects, with unique features inhibitory control, may be integral to the left hemisphere's capacity for specifying denotative semantics generally, and for creating complex linguistic constructions with the aid of grammatical conventions. Nonetheless, meaningful grammatical constructions may depend on both corticolimbic memory systems, with each one contributing unique abilities in representation and control.

To outline this theoretical approach, we begin with by considering the mechanisms of memory, and their inherent limited capacity, from the experimental psychological evidence. We then review the neural mechanisms of memory and attention that must be integrated across the multiple levels of the vertebrate neuraxis. These levels include not only neocortical networks, but the limbic-thalamic-cortical circuits that are critical to memory consolidation. We argue that

a key insight is the continuity of cognitive control with motor control, such that even complex learning can be understood as a process of action regulation. Finally, we suggest that complex grammatical structures in language are one mechanism for supporting abstract thought, in which the requirements for somatic articulation of action within the motor system arbitrate with the internal, visceral motivational control of meaning in the communication process.

2 Limited Capacities of Representation and Binding

Cognitive-experimental research on memory limitations reaches back more than 50 years, to early studies marked most notably by Miller's now famous estimation of short-term memory (STM) capacity at 7 +/- 2 chunks of information (Miller, 1956). Miller also observed that recoding of information into ever larger "chunks" is instrumental in expanding the capacity of STM, emerges naturally with experience, learning and expertise, and is ubiquitous in language. At lower levels of language processing, for example, chunking is evident in the recoding of phoneme sequences into syllables, syllables into words, and words into phrases. At a higher level, sequences of coordinated phrases can be organized into hierarchic-subordinate structures that enable the more efficient expression and comprehension of increasingly complex ideas encoded into linear discourse.

By the early 70s, the construct of STM was further refined by the introduction of working memory (WM) models (Baddeley & Hitch, 1974). Like STM, WM is characterized by capacity limitations, but here, they are distributed across both on-line storage and processing functions. One important corollary of this view is that the effective capacity of WM can be increased by efficiency of storage and/or processing components. The distinction between controlled and automatic processing (Schneider & Chein, 2003; Schneider & Shiffrin, 1977; Shiffrin & Schneider, 1977) is central here. Controlled processes tend to be slow and effortful, require attentional resources, and are deployed intentionally early in learning or in novel contexts. In contrast, automatic processes are fast, require minimal attentional resources, and are carried out in a ballistic fashion following extensive experience. Just as recoding and chunking can increase the amount of information maintained in WM, a shift to automatic processing can increase the pool of available cognitive resources. As experience in a language accrues, lower-level processing components such as word recognition, lexical access, or routine syntactic parsing become automatized, freeing up resources to be dedicated to higher level processes, such as integrating information across phrase boundaries and processing more complex relations among arguments.

A second implication of WM as both storage and processing functions is its relevance to goal-directed action. One typically doesn't just hold information in STM for later recall; one does something with that information. In other words, information is selectively maintained and manipulated in working memory in order to enhance adaptive behavior. From this perspective, WM is closely aligned with motivation and self-regulated action. An influential capacity view of attentional resources, the selection-for-action theory (Allport, 1985), posits that processing limits occur not at the level of perception and sensory selection, but out of the need to engage in coherent (usually sequential), behavioral responses – either as covert action, or internal thought. This can lead to selective, top-down enhancement of action-relevant sensory attributes (Hannus et al., 2005) and, conceivably, configural information, in order to bias their active maintenance in WM, and suggests that the contents of WM are not driven primarily by bottom-up sensory selection. Working memory thus may play an important role in the integration or binding of sensory information with action regulation.

Empirical research on the impact of memory limitations on syntactic complexity has been most extensively studied by relating individual differences in WM capacity with the comprehension of syntactically complex sentences. The reading-span task (Daneman & Carpenter, 1980) has been frequently used to assess an individual's combined WM storage and processing capacity in the language domain. King and Just (1991) demonstrated that individuals with relatively low WM capacity for language (as measured by the reading-span task) exhibited longer reading times and poorer accuracy than higher-capacity readers for complex sentences with an object-relative clause (e.g., The reporter that the senator attacked admitted the error), but they performed comparably on simpler sentences with a subject-relative clause (e.g., The reporter that attacked the senator admitted the error). Here, the more processing-intensive object-relative clause requires the reader to associate the head noun with two syntactic roles (e.g., "reporter" as subject of the main clause and object of the relative clause), whereas the subject-relative clause requires activation of only one role (that of subject) for both the main and relative clauses.

A more recent fMRI study (Prat, Keller, & Just, 2007) similarly found that low-capacity readers had slower reading times than high-capacity readers for both active-conjoined (The writer attacked the king and admitted the mistake at the meeting.) and object-relative sentences (The writer that the king attacked admitted the mistake a the meeting.). Accuracy, however, was significantly worse in low-capacity readers only for the object-relative sentences. Thus, assuming that WM capacity is the major factor in individual differences in reading capacity, slower reading times appeared able to compensate for low WM capacity when reading syntactically simple sentences, but comprehension remained impaired on syntactically complex sentences. Functional MRI results suggested that processing was both less efficient and poorly coordinated in low-capacity readers. Specifically, low-capacity readers had higher BOLD responses than high-capacity readers (particularly in frontal control, and occipital regions) suggesting they consumed more resources despite poorer performance. Functional connectivity analyses further indicated poorer synchronization among left-hemisphere language regions, including Broca's and Wernicke's areas, in low-capacity readers. The neuroimaging data may thus provide insight into mechanisms for the concept of WM, showing that low-capacity readers engaged more activity in, but less coordination among, WM-related brain areas.

In light of these and similar findings, Just and Varma (2007) proposed that working memory capacity limits may be understood in terms of resource constraints on neural activation. That is, the effective limits of working memory may reflect the capacity to recruit multiple neural regions that sustain activation of context-relevant computations or information, while at the same time coordinating communication across this dynamic network in the service of self-regulated action or thought. Although full explication of this approach is beyond the scope of this chapter, of relevance here is their 4CAPS model of sentence comprehension. Although the authors acknowledge the contribution of other brain regions, their model focuses on the respective roles of Wernicke's and Broca's areas. They propose that Wernicke's area, the "associative center," specializes in retrieving relevant, language-based associations, prior knowledge (procedural and declarative) and perceptual inputs and in configuring "designs" or templates for new language representation. Broca's area, the "structure-builder" center, then takes these loosely structured templates and their associated information (in essence the information actively maintained in WM), and builds them into recognized syntactic structures.

Finally, it may be important to keep in mind that memory capacity limits not only the number of representational elements (words, clauses) but the number of interrelations (or bindings) among those items that can be kept active in WM (Halford, Baker, McCredden, & Bain, 2005; Halford, Cowan, & Andrews, 2007). Because memory is required to maintain binding among the elements, Halford's reasoning suggests that the effective number of items active in a linguistic frame may be reduced from the "magical number" seven, down to only 3.5, on average. Binding requirements may be particularly relevant when considering capacity limitations for hierarchical-embedding. The essential cognitive work to be done in comprehending such structures is to identify the relevant constituents and establish their interrelationships (i.e., who did what to whom). In this context, it is interesting to note that a recent corpus linguistic analysis across seven European languages (Karlsson, 2007) concluded that the maximum number of center-embeddings employed is three. This is in close agreement with Halford's estimate of the number of elements and their relations that can be maintained in WM.

In summary, we propose that the relationship between working memory and syntactic processing may be associated with the need to translate a holistic relational structure--which is formulated at a global, syncretic level--into extended, linear discourse. The linear nature of linguistic expression entails that the constituent elements of this relational structure be actively maintained in working memory for integration to occur over a time delay. This may require both sustained activation of relevant processing regions and coordination of processing across those regions. Hierarchic-subordinated syntactic structures offer more efficient and elaborated articulation of such complex relations than do sequential-coordinated structures, but they increase memory demands for on-line retention and integration of multiple referents. Working memory capacity may, therefore, both enable and constrain syntactic complexity. While the ability to hold multiple referents in working memory facilitates the production and interpretation of complex sentences, inherent capacity limitations of working memory appear to place constraints on the level of complexity (e.g., number of referents, distance to resolution) that can be generated and interpreted successfully (Gibson, 1998).

3. Corticolimbic Reentrance in Consolidation

The limits on memory representation, and on the binding of information elements, may be better understood by examining the dual corticolimbic control systems that guide memory consolidation. Modern neuroanatomical studies have shown that the neocortex evolved from the limbic cortex in a nested structure (D. N. Pandya, & Seltzer, B., 1982; D. N. Pandya & Barnes, 1987; D. N. Pandya & Yeterian, 1984) in which each of four levels of neocortical differentiation emerged embedded within its predecessor. Within limbic (or paralimbic) cortex emerged the heteromodal "association" cortex, then the unimodal association cortex, and finally the modality specific sensory or motor cortex (Mesulam, 2000). One primary pattern of connectivity is between levels, with each level connecting to its adjacent, embedded or embedding, neighbor with reentrant bidirectional projections (D. N. Pandya, & Seltzer, B., 1982). The result of these several levels of interconnectivity is to create a "pathway" such that visual information, for example, is processed from primary visual areas (which receive thalamic projections) to secondary visual association cortex, to heteromodal association cortex, then to limbic cortex. In the frontal lobe, the reverse direction of network embeddedness obtains, such that actions are initially organized on a limbic base (in orbital frontal or anterior cingulate networks), and are progressively articulated through frontal heteromodal association, then premotor association, and finally primary motor cortices. For both sensation and action, the connections are reentrant in that processing is not just one-directional. For vision, for example, there are as many connections proceeding from limbic cortex out to heteromodal, to unimodal, and finally to primary visual cortex as proceed in the opposite direction.

Reentrance is particularly important in building cognitive or linguistic models, because it emphasizes the distributed nature of representations that are recreated in the multiple instantiations across the embedded networks. Reentrance describes not only the structural connectivity, but the processing that is implicit with this point-to-point connectivity. Information processing must proceed in some form, in some unknown recursive fashion, in both directions in each sensory or motor corticolimbic pathway (Tucker & Luu, 2006).

Although we do not know its neurophysiological nature, we do know the result of this reentrant and recursive corticolimbic processing. It is memory consolidation. Primate and rodent studies have shown that sensory data must be processed across all levels of the corticolimbic pathway to be consolidated in memory (Squire, 1986, 1998); disconnection of sensory and association cortex from the limbic base results in a profound deficit in consolidating new learning. Importantly, even though connectivity is broken across the corticolimbic pathway, prior memories may be accessed to guide behavior, depending on the intact connectivity of the residual networks. Although not as anatomically explicit as the animal evidence, the evidence on human amnesia is consistent with this general outline, such that specific agnosias are observed with lesions to association cortex in a given modality, and general amnesia is observed with lesions of limbic networks of the medial temporal lobe (Squire, 1986, 1998).

3.1 Thalamic Resonance of the Efferent Copy

An analysis of the nested corticolimbic networks thus provides an interesting theoretical basis for understand the levels of representation in human language (Luu & Tucker, 1998; Tucker, Frishkoff, & Luu, 2008). However, it has long been apparent that any theory of cognitive and linguistic representation based on anatomical connectivity must consider the extensive network created by thalamocortical, and corticothalamic, projections (Crosson, 1999). Recently, research into the anatomy and function of thalamic connections has suggested that most if not all of thalamic afferents (input connections) reflect copies of motor control projections to subcortical circuits (Guillery & Sherman, 2002; Sherman & Guillery, 2002). As a result, thalamocortical projections would then reflect processes of action monitoring. With extensive intrathalamic connections providing modulatory control over this bidirectional traffic, cortical control over the thalamus can be understood as a key mechanism for attentional control of behavior, and of the sensory representations that guide behavior (Guillery & Sherman, 2002; Sherman & Guillery, 2002).

3.2 Limbic-diencephalic Learning Circuits

In the mechanisms underlying the language process, both corticolimbic and corticothalamic networks must be integrated in some fashion to allow executive control of working memory, such that the elements of communication (agents, acts, objects) are both maintained in the minds of the speaker and listener and bound in meaningful linguistic patterns. One insight to this integration comes from evidence that memory is achieved by two different cortico-limbicthalamic circuits, each with a unique learning strategy. These learning strategies can be seen as different ways of optimizing the use of limited memory capacity.

Each of these circuits supports a different set of the nested corticolimbic networks. The circuit centered on the hippocampus supports the dorsal corticolimbic pathway, with its primary association cortices in the parietal regions of the posterior brain and mediodorsal regions of the frontal lobe. The circuit centered on the amygdala, pyriform cortex, and insula supports the ventral corticolimbic pathway, with its primary association cortices in the occiptotemporal regions of the posterior brain and ventrolateral regions of the frontal lobe. It is the ventral pathway that appears particularly important to inhibitory specification of meaning in language.

<u>3.2.1 Configural Representations and Context-Updating.</u> Papez (Papez, 1937) described a circuit engaging the hippocampus, posterior cingulate cortex, ventromedial thalamus, and mammalary bodies of the hypothalamus that readily sustained seizures and appeared to be important to the motivational control of behavior. Modern memory research has shown this circuit, supporting the dorsal corticolimbic pathway, to be critical to spatial memory in rodents, and very likely to configural representations in humans (Nadel, 1991).

In addition to being specialized for a holistic representation of the spatial or configural context, the dorsal circuit appears to be specialized to control learning in a unique way. Animal studies (Gabriel et al., 1983; Gabriel, Sparenborg, & Kubota, 1989) suggest that the dorsal circuit adapts gradually and more or less passively to changes in the environmental context, a process that can be described as context-updating (Luu, Flaisch, & Tucker, 2000; Luu & Tucker, 2003). This can be seen as a primitive form of associative learning, but one that is well suited to maintenance of a holistic internal model of the current perceptual and behavioral context.

<u>3.2.2 Object Representations and Sustained Focus.</u> In contrast, a second cortico-limbicdiencephalic circuit centered on the amygdala and ventrolimbic networks engages the mediodorsal thalamus and supports the item or object memory representations of the ventral pathway (Aggleton & Brown, 1999; Mishkin, 1982). Supplying input to the orbital frontal and ventral (subgenual) anterior cingulate cortex, the ventral limbic regions provide not only consolidation of object perceptions, but organization of motor control directed by this consolidation. The specific control properties of this circuit and associated networks are suggested by animal learning studies by Gabriel and his associates. These studies found that lesions of the anterior cingulate cortex impair the animal's ability to adapt rapidly to changing circumstances (Gabriel et al., 1983; Gabriel et al., 1989). The ventral pathway seems uniquely able to detect conflict or incongruity with the current context model, and then maintain a focus of attention to organize new actions required by the discrepancy (Tucker & Luu, 2007).

3.3 A Limbic Base For Consolidation

Why are these differing learning strategies manifested by different corticolimbic circuits? One answer may be functional or algorithmic, explaining the adaptive advantages of different control biases. Studies of robotic control have shown that certain cybernetic (representation and control) designs allow efficient internal guidance of action, in a feedforward fashion (Hendler, 1995). However, these designs respond poorly to unanticipated changes in the environment. Other designs incorporating feedback control are more responsive to changing action plans when events intercede, but they are poor at maintaining goal-directed actions. Because these alternate cybernetics may reuire fundamentally different neural mechanisms, mammalian evolution seems to have instantiated them in different learning circuitry.

Another answer is neurophysiological, and it comes from an analysis of the differing autonomic or bodily self-control functions carried out by the dorsal and ventral limbic networks. Neafsy and associates (Neafsey, Terreberry, Hurley, Ruit, & Frysztak, 1993) have shown that the cingulate cortex at the base of the dorsal corticolimbic pathway carries out visceromotor regulation of internal bodily functions and associated motivated behavior. Because visceromotor regulation emerges directly and reflexively from the hypothalamic and limbic monitoring of bodily states, this form of control may be the primitive basis for the feedforward learning strategy that appears integral to the more extended consolidation operations of the dorsal corticolimbic pathway.

In contrast, the insular cortex and associated ventral limbic networks appear specialized for viscerosensory regulation of internal functions and associated motivated behavior (Neafsey

et al., 1993). This basis in visceral control may be consistent with the feedback control mode integral to the ventral pathway's ability to detect discrepant events and to maintain focused attention to redirect adaptive actions.

3.4 The Visceral Basis of Semantic Memory

In examining the connectional architecture of limbic networks, we find them densely interconnected across modalities, compared to the isolated modules of somatic representation in sensory and motor cortices (D. N. Pandya & Seltzer, 1982). This suggests that limbic networks must provide the brain's most integrative representations, in contrast to the traditional view that these integrative representations are formed in "association" cortices such as lateral frontal, temporal, and parietal regions. Jason Brown (J. Brown, 1977; J. W. Brown, 1988) pointed to clinical studies of aphasia that appear consistent with this connectional evidence, indicating that whereas lesions of neocortex (including Broca's and Wernicke's areas of heteromodal association cortex) would produce comprehension and expression deficits, it is only with lesions of limbic cortex that patients suffer severe semantic deficits.

At the same time as providing a holistic level of representation, limbic cortex (parahippocampal and cingulate; periamygdalar, anterior temporal, and insular) is responsible for visceral, homeostatic and motivational, functions (Neafsey et al., 1993). The implication may be that memory consolidation within these temporal-limbic networks is both highly integrative and motivationally significant.

4. Motive and Complexity in Representational Actions

Although perhaps integrative, the diffusely interconnected representations of limbic networks are likely to be poorly differentiated. Cognition, and linguistic strucutre, formed at this level can be seen as syncretic, with multiple referential implications fused within a primitive connotative binding. To understand how more differnentiated linguistic patterns including the more traditional denotative semantics, can emerge from this elemental connectional matrix, it may be helpful to consider how actions are organized to mediate between bodily needs and environmental constraints. We propose that by understanding the mechanisms of organizing memory capacity, specifically in the context of action planning, we can gain insight into the neurocognitive process that generates, and that benefits from, grammatical complexity.

4.1 Complex Constructions in the Sensorimotor Machine

One of the first to recognize the psychological significance of the evolutionarydevelopmental order of the brain's anatomy, Hughlings Jackson emphasized that all the brain's functional circuits are linked to sensory or motor operations, such that the brain can be seen as a "great sensorimotor machine" (Jackson, 1931). At first glance, this pithy summary appears to be too simple to help students of the brain understand the complexity of its functions, including language representation and organization. However, we suggest that Hughlings Jackson's summary can be taken as a directional pointer, emphasizing that cognition does not arise ex cathedra from the vapors, but rather emerges from the body's sensorimotor, and visceral, operations. From this perspective, basic mechanisms of action regulation suggest insight into how cognitive expressions of the mind arise from more elementary neural processes.

4.2 Chunking of Action Sequences and Attentional Capacity

Actions must be sequenced to organize coherent behavior. In his analysis of the "problem of serial order" Lashley explained that the associative chaining of traditional behaviorism could not account for even elementary challenges handled by the mammalian motor system (Lashley, 1951). As a result, a representational theory is required. To understand the hierarchic structure within embedded clauses in language, it may be useful to begin with a basic analysis of how actions are grouped within clusters or chunks, which are then able to be executed with minimal demands on attentional capacity (Keele 1981; Keele & Hawkins, 1982). A similar efficiency appears to be provided by complexity in language structure, allowing not only the speaker but the listener to automatically capture nested semantic packets, thereby freeing attentional capacity for broader interpretation of the discourse and its context.

A neuropsychological analysis of action planning shows there are dual routes to sequencing actions, one in dorsal cortex and one in ventral cortex, each emerging from a different basis in the limbic system to shape action plans of the frontal lobe, and each providing a unique form of action regulation. By analyzing the limbic circuits that give rise to these cortical systems, it is possible to frame each mode of action regulation within a more general cognitive framework describing dual modes of memory consolidation. Through extending this neuropsychological analysis, we will argue that complexity in language relies on dual modes of motor control that are fundamental to organizing cognitive and linguistic structure generally.

4.3 The Visceral Basis of the Motive-Memory

Somewhere between the visceral representations of needs and motives and the somatic representations of sensory inputs and motor outputs are processes that give rise to what psy-chologists would consider higher-level cognition, including such constructs as executive control and working memory. How can we understand these processes within an action-regulation framework? Yakovlev (Yakovlev, 1948) provided a key insight when he proposed that the evolution of language can be seen as another extension of the more general evolution of motility. In primitive brains, such as that of salamanders, movement and homeostatic control are closely linked within brainstem structures, such as the tectum and tegmentum (Herrick, 1948). Actions are characterized by core, axial movements, reflecting the holistic (and undifferentiated) nature of actions and motivation. They emerge directly from internal motive processes to engage the external environmental process. For Yakovlev, the general organization of motility is a process of "exteriorization," as the internal urge is manifest in actions contacting the world. Yakovlev viewed language within this general framework of motility, thereby providing a theoretical model for understanding communication as bounded both by biological needs and the constraints of action regulation.

This organization of actions and motivation within the primitive brains of amphibians stands in contrast of course to that mammalian brains, wherein motor control spans a more complicated hierarchy that includes the neocortex. Yet, with increasing complexity in brain organization, the translation of motivational influence to action remains central to adaptive behavior. A particularly illuminating example is the seemingly inappropriate behaviors of monkeys with lesions to the amygdala, producing the Kluver-Bucy syndrome. These monkeys approach all objects without fear and react to them as if they are novel, and they also demonstrate inappropriate behaviors to peers. Pribram (Pribram, 1991) noted that this syndrome reflects the lack of visceral familiarity that usually imbues sensory experiences; without intact visceral-sensory associations, actions become not only amnestic but dysregulated. Pribram refers to the contribution of diencephalic and limbic structures as a protocritic function--holistic, undifferentiated, and motivationally relevant--that gives meaning to actions. Pribram's theory suggests how the vis-

cerosensory functions of the insula, amygadala, and associated ventral limbic networks (Neafsy, et al., 1993) may be integrated within the motive basis of action regulation.

Complementing the viscerosensory function of the ventral limbic trend is the visceromotor control integral to the dorsal limbic circuit (Neasfy et al., 1993). The unique symptoms of lesions to the dorsal limbic core of the hemisphere have long been known (Barris & Schuman, 1953). Bilateral anterior cingulate lesions result in akinetic mutism, a condition in which the patient exhibits little to no spontaneous action, and yet is able to react with coherent action and cognition when prompted. We can infer from this deficit that the dorsal limbic base of the frontal lobe is normally involved in the spontaneous, motivated direction of actions to the world.

4.4 Projectional and Feedback Modes of Action Regulation

From these dual foundations in motivated operations of memory consolidation, actions must emerge. Modern functional and anatomical analyses have suggested that these viscerosensory and visceromotor divisions of the mammalian cortex evolved from the primitive telencephalon of birds and reptiles, each division applying different control properties in the organization of action.

In addition to supporting configural cognition and memory for the spatial context of behavior (Mishkin, 1982; Aggelton & Brown, 1999), the dorsal pathway supports a projectional, feedforward mode of action, in which behavior is launched toward a goal (Goldberg, 1985) (Passingham, 1987; Shima & Tanji, 1998). Animal studies show that cells within the SMA are preferentially active (and fire several seconds before the actual movement) when actions are initiated from memory, as opposed to when they are guided by sensory input (Mushiake, et al., 1990). In humans, patients with SMA lesions can reproduce sequences of actions when they are visually cued but can not produce the same actions from memory (Halsband et al., 1993). These observations are consistent with the notion of projectional, ballistic control in the dorsal pathway for motivating and regulating action.

The ventral corticolimbic pathway evolved from the perirhinal cortex of the temporal lobe, closely connected with the insula, amygdala, and orbital frontal region (Pandya, et al., 1982). In addition to supporting representation of objects or individual items in memory (Mishkin, 1982; Aggelton & Brown, 1999), the ventral pathway supports action regulation with strong feedback control, in which sensory guidance operates to restrict the action plan to achieve the desired target (Goldberg, 1987; Passingham, 1987; Shima & Tanji, 1998). Recordings of cells from the arcuate premotor area, the ventrolateral frontal homolog of the mediodorsal SMA (Barbas & Pandya, 1986) show cells that are preferentially activated when actions are guided by visual cues (Tanji, 1987).

An important theoretical challenge is to link the cybernetic qualities (projectional vs feedback control) to the cognitive representational qualities (configural versus object control). We argue that expectancies provide the links. Expectancies can be seen as consequences of the integration of the unique cybernetics of action regulation with the essential resources of memory representation to guide the cognitive process. Both dorsal and ventral corticolimbic pathways must contribute to the formation of expectancies (Tucker & Luu, 2007). The dorsal region of the anterior cingulate cortex is particularly important to the general dorsal corticolimbic network involved in the representation of context-generated expectancies. The representation of a contextual map appears to have evolved to include the representation of reward expectancies as an integral component of the memory operation. That is, within an appropriate context, goaldirected actions can be internally generated independently of external input. This ballistic direction of action is supported by the expectancy for hedonic outcomes (Tucker & Luu, 2007). Functional neuroimaging studies show that the anterior cingulate cortex is particularly active when subjects must generate hypotheses (i.e., expectancies) about appropriate actions. In this light, akinetic mutism can be interpreted as reflecting an expectancy deficit, in that with no hedonic projection, there is no action. In everyday situations, the mediodorsal limbic-motor system appears to generate hypothesis that guide the launching and learning of appropriate actions, including communications with others.

We theorize that the cybernetics of action regulation in the dorsal and ventral pathways maintains continuity with the unique motivational base of action in each pathway. The feedforward projectional control of action in the dorsal pathway is not only guided by the cognitive representation of configural relations (with the hippocampal support of spatial memory as the iconic exemplar); it also entails an inherent motivational bias toward hedonic expectancy that is consistent with launching goal-direction actions. This integrated operation of the brain thus supports a motive-memory, not a neutral or disembodied cognitive function. As a result, it may be that in human cognition the representation of the current behavioral context within the dorsal pathway entails a positive hedonic tone to thoughts and actions.

In the ventrolateral system, the amygdala is involved in forming object (i.e., cue)-outcome associations, grounded in feedback control by viscerosensory constraints represented in insular cortex. This function supports the role of the adjacent orbitorfrontal cortex in representations of object expectancies (reward or punishment, Schoenbaum & Roesch, 2005) that guide actions. Likely, the representation of object-based expectancies provides required support for the ventrolateral prefrontal cortex involvement in rapid acquisition of arbitrary and abstract cues with actions (Bussey, Wise, & Murray, 2001). That is, with the ability to form reward and punishment expectancies for arbitrary cues, these cues can now motivate actions in a manner consistent with feedback control.

5. Aphasic Disorders of Action Plans

Aphasia syndromes provide important clues to the subcomponents of language, including the capacities required for hierarchic organization of grammatical structures. We propose that the mechanisms of language, as revealed by the aphasias, are fully interdependent with the mechanisms of action regulation (Tucker et al., 2008). The specificity of grammatical deficits with lesions to Broca's area implies that this ventral corticolimbic network, at the base of the ventrolateral frontal motor system, is critical to complexity of clause structure. Several features of the ventral pathway, including the inhibitory control of semantic objects and the capacity for automatized action sequences, are critical to language generally and complex clause structure specifically. Even more generally, the cybernetics of the ventral trend may suggest new insight into the left hemisphere specialization for language, which we view aas fundamentally a specialization of the entire hemisphere for the processing strategies of the ventral pathway (Liotti & Tucker, 1994; Tucker et al., 2008).

At the same time as we emphasize the primacy of the ventral pathway for object memory and feedback control of actions, it should be apparent that the hierarchic organization of language structure, and its interpretation, require general cognitive skills requiring multiple brain networks. We suggest that an analysis of the unique memory mechanisms of both dorsal and ventral corticolimbic pathways, integrating both anterior motor and posterior sensory controls, is necessary for a full account of the process of organizing complex linguistic patterns.

5.1 Broca's Area: Motor Planning in the Ventral Pathway

Lesions to a fairly restricted region of the brain, a few square centimeters in the caudal extent of the left inferior frontal lobe, result in deficits in language fluency. Because there are striking limitations in grammatical organization of speech, in contrast to relatively intact semantic reference, it is within Broca's area that we must find critical capacities for organizing grammatical complexity. To understand these capacities, we argue that it is necessary to appreciate the interdependence of this region of premotor (or perhaps pre-premotor) cortex with the memory capacities the left temporal lobe. These memory capacities extend the unique inhibitory cybernetics of the ventral trend to create the powerful modular structures of language.

<u>5.1.1 Inhibitory Structure and the Feedback Control of Action.</u> Within distributed neural networks such as make up the human brain, representational processes tend to engage the entire network, unless there are mechanisms for separating them. Concepts are therefore intrinsically holistic and syncretic, so that the separation of conceptual elements into chunks or packets-such as occurs with the clauses of speech--requires an active organizational mechanism. We suggest this mechanism is inhibition. To separate semantic units into interpretable bindings, the neural mechanisms of syntactic structure provide inhibitory control that is exerted by one representational unit (e.g., clause) on its associative neighbors.

In typical language production, an important result of inhibitory specification of concepts may be the differentiation of the serial order of word production, aided by the routinized conventions of grammar, and carried out in the premotor networks at the ventral base of the left frontal lobe. When grammar is expert, its conventions allow complex organizations in which inhibitory control separates the meanings of subordinate clauses from superordinate ones, allowing scarce attention and working memory to be allocated to the superordinate level. Within this process, the culturally-trained automatization of meaning units within familiar clause structures provides sufficient memory capacity to hold the full structure of the utterance for an adequate interpretation.

Lessons for the neural mechanisms producing this inhibitory specification of language may be provided by the mechanisms of action sequencing. Particularly important is the feedback form of action regulation within the ventral corticolimbic pathway. In contrast to the projectional control of the dorsomedial motor pathway, the feedback control of the ventrolateral motor pathway integrates perceptual checkpoints that are compared with the ongoing action sequence to allow sequential updates of the motor plan (Goldberg, 1985). This specification of the motor sequence requires inhibitory control that not only restricts the extent of each component of movement, but separates each component in relation to the sensory targets. To the extent that language production evolved from more generic communicative actions such as gestures (Givon, 1998), and to the extent that this evolutionary process required linguistic actions that are highly routinized, differentiated, and repeatable, it should not be surprising to find that it is specifically the ventral motor pathway and its capacity for inhibitory specification that has become the critical path for assembling intended meaning into linguistic structure.

<u>5.1.2 Automatization of Action and Object Structure.</u> With the specification of discrete actions within well-organized sequences, the ventral limbic-motor pathway is particularly suited to the development of routinized action patterns. Whereas the dorsal motor networks appear to embed actions within the episodic context that is elaborated within the configural representations of the posterior dorsal corticolimbic networks, the ventral motor networks appear to articulate more modular actions that are suited to serve as habitual patterns that can be disembedded from the immediate episodic context (Luu & Tucker, 2003; Tucker & Luu, 2007).

In this way, the automatization of action in the anterior ventral networks is similar to the formation of perceptual objects in the posterior ventral networks, and it may rely on a similar

mechanism of inhibitory specification. Objects are groupings of perceptual features that are sufficiently bound to be separated from the contextual frame. Routinized action packages are similar object representations of motor elements. It may be from the unique cybernetics of action objects the ventral pathway that the patterns of grammar evolved in Broca's and nearby networks. The patterns of grammar are automatized conventions of speech shared by a culture, allowing the members ready access to both the specific conventions and the more complex language structures that can be built on the foundation of these conventions.

<u>5.1.3 Grammatical Complexity in the Motor Pathway.</u> The position of grammatical complexity within the limbic-cortical pathway can be approached through developmental evidence. Grammar generally, and complex grammatical structure more particularly, are readily acquired by young children. But they are more difficult to acquire by second language learners after puberty, incontrast to basic lexical representations (agent, action, and object words). This differential learning capacity leads to pidgin constructions. This evidence can be interpreted to suggest that grammatical forms become rigid with the maturation of the neocortex of the motor pathways, which is relatively complete by the end of childhood.

Even more fixed within motor neocortex are the prosodic and articulatory routines that allow native speech. Whereas grammar of a second language can be learned after puberty, speaking without an accent cannot. A similar fixity appears to hold for the sensory networks of language comprehension, such that even if they learn the vocabulary of a new language rapidly, adults have great difficulty in "hearing" the unique sounds of a foreign language.

The rationale for this reasoning about differential maturation in limbic versus neocortical networks comes from studies of maturation in the primate and human brain. It has long been apparent that a major sign of maturation, the increasing myelination of cortical fibers, occurs first in sensory and motor areas (Yakovlev & Lecours, 1967). More recently, studies of cortical anatomy have suggested that limbic cortical areas retain an immature biochemical compostion well into adulthood (Barbas, 2000). The implication is that plasticity is developmentally asymmetric between visceral-limbic and somatic-neocortical networks, such that by human adolescence there is rigidity in the somatic (neocortical) domain at the same time as there remains childlike plasticity in the visceral (limbic) domain.

This neurodevelopmental perspective places grammatical complexity in an interesting position in the epistemology of human cognition. In contrast to lexical semantics, which remain plastic and dynamic into adulthood, grammar generally--and complexity specifically--become a mold for the mind, acquired automatically through experience with the culture of origin and quickly becoming resistant to later experience.

5.1.4 Left Hemisphere Specialization for the Ventral Trend. The realization of the inhibitory representational cybernetics of the ventral pathway raises interesting questions for understanding a more well-known aspect of language localization in the brain, its left-lateralization. There is an integral role of object representations within the left hemisphere's analytic cognitive capacities. This contrasts with the right hemisphere specialization for the spatial, configural concepts organized in the dorsal pathway. In light of the new understanding of dual corticolimbic representational systems, brain lateralization must be approached in a new light (Liotti & Tucker, 1994; Tucker, 2007). Not only do the right and left hemispheres' perceptual skills align differently with the dorsal and ventral trends, respectively, but their motor capacities appear to do so as well. The ideomotor apraxias that are more common after left hemisphere lesions reflect not only a generic motor dominance of the right hand, but a precision of control that is commensurate with primary engagement of the inhibitory specification of action sequences in the ventrolateral premotor networks, elaborated particularly within the left hemisphere.

Although there are of course both dorsal and ventral corticolimbic pathways within each cerebral hemisphere, there appears to be an asymmetry in the "dominance" of the archicortical (dorsal) and paleocortical (ventral) pathways within the right and left hemispheres, respectively. There may be a new way of looking at hemispheric specialization here, reflecting differential elaboration for one or the other of the corticolimbic pathways of perceptual integration, memory consolidation, and action regulation. For language, it is interesting to consider that many of the unique features that have been attributed to left hemisphere speicalization may in fact represent more fundamental mechanisms of the object representations and sequence differentiation of the ventral corticolimbic pathway.

<u>5.1.5 Restricted Spreading Activation and Object Memory.</u> In neural network models, and in neural networks, inhibitory control is critical to providing complex structures (Buzsaki, 2006). With only excitatory influences, interactions in the network are restricted to a kind of spreading activation, suitable for epileptic seizures but not for hierarchically organized neurocognitive processes.

Spreading activation has become a useful model for understanding the cognitive mechanisms of semantic memory (Meyer, Osman, Irwin, & Yantis, 1988; Schvaneveldt & Meyer, 1976). Studies of reaction time have suggested that meaning spreads quickly and automatically from one word to related words. In making a word/nonword decision, subjects are faster to name words that have been "primed" by previous words that are semantically related (Meyer et al., 1988; Schvaneveldt & Meyer, 1976). Under an operative mechanism of spreading activation, there would be multiple meanings activated during the comprehension of a sentence, such that precision of meaning requires suppression of unintended associations.

The left hemisphere may have special mechanisms for inhibitory specification of meaning, and we would argue that these mechanisms draw on the cybernetics of the ventral object memory pathway. Researchers have used right or left visual field (left or right hemisphere) presentation of prime and target words to examine whether spreading activation operates differently in the two hemispheres. Consistent with other evidence that the right hemisphere is important to comphrension of the gist or global meaning of language, some evidence has suggested that spreading activation appears to broadly and indiscriminantly in the right hemisphere (Chiarello, 1985, 1988, 2000). In contrast, the spread of meaning is more restricted in the left hemisphere (M. Beeman, 1993; M. J. Beeman, Bowden, & Gernsbacher, 2000), consistent with greater inhibitory control of related meanings that are inappropriate to the immediate linguistic context.

We speculate that these left and right hemispheric differences in spreading activation could reflect the more fundamental memory control biases of the ventral and dorsal corticolimbic pathways, respectively. With its specialization for the object memory and feedback control of the ventral limbic pathway, the left hemisphere gains a tight control over semantic structure, consistent with the inhibitory specification of actions that the ventral pathway appears to provide to motor control generally. With its specialization for the configural representation and feedforward mode of motor control of the dorsal corticolimbic pathway, the right hemisphere gains a less constrained and more holistic structure of linguistic meaning that is suited to global comprehension of discourse and the implicit semantics of humor and allegory (M. J. Beeman et al., 2000).

5.2 Wernicke's Area: Online Self-Monitoring

Lesions of the posterior left hemisphere (Wernicke's area) that lead to deficits of language comprehension do not simply impair comprehension. These lesions result in well-known expression deficits (jargon aphasia) in which grammatical form is correct, but semantic content is

disordered (Goodglass, 1993). The presence of intact grammar with Wernicke's aphasia is consistent with the argument that grammatical complexity is primarily a property of the motor preparatory networks of the frontal lobe. However, the interdependence of multiple networks in languistic self-regulation is well-illustrated by the deficits of Wernicke's aphasia. The routinized cultural packets of verb and noun clauses have little meaning when they form automatically within inferior frontal networks and yet are unconstrained by semantic self-monitoring in the posterior receptive networks.

The critical language networks of the frontal lobe are situated primarily within the ventral pathway. Similarly, those of the posterior temporal parietal (Wernicke's) area must have considerable input from the ventral object memory pathway. However, it is in interesting question of how much dorsal pathway input is integrated within Wernicke's area (Galaburda & Pandya, 1983). Just as the parietal networks (dorsal pathway) are essential to motor control, apparently through providing dynamic monitoring of on going actions (Jeannerod, Arbib, Rizzolatti, & Sakata, 1995), there may be considerable integration of configural representations from the dorsal pathway as the posterior left hemisphere guides ongoing linguistic comprehension and expression.

5.3 Transcortical Motor Aphasia: Inertia of Language Action

A definite role for dorsal pathway control in language is shown by transcortical motor aphasia in which lesions of the mediodorsal regions of the frontal lobe lead to a paucity of spontaneous speech, even in the presence of intact articulatory capacity (Freedman, Alexander, & Naeser, 1984). This form of aphasia appears similar to akinetic mutism, with the motive deficit more specific to language processes. When questioned regarding their lack of spontaneous speech, transcortical motor aphasia patients often report that nothing comes to mind. This syndrome may thus reflect an impairment in the dorsal pathway's normal contribution to the language process, which is a motivated, goal-oriented impulse to communicate. Lacking this normal feedforward extension of the visceromotor function, language is then directed only by the ventral pathway's feedback control, such that speech is absent unless feedback direction is immediately present in the form of interpersonal confrontation.

<u>5.3.1 Alien Speech.</u> Another clinical syndrome observed with lesions of the mediodorsal frontal lobe is the alien hand sign. The patient reports observing the actions of a hand, but not experiencing it as his/her own (Goldberg, Mayer, & Toglia, 1981). The implication of this disorder is that the motivational control of actions in dorsal pathway is associated with an experience of the actions as integral to the self. Certainly we would expect that the consolidation of memory, arbitrating as it does between the somatic networks of sensory and motor neocortices and the visceral networks of the limbic cortices, would result in representations with both environmental veracity and personal motive significance. However, the clinical literature shows no counterpart to the loss of felt personal significance of actions with lesions to the ventral limbic-motor pathway. Instead, patients with lesions to orbital and ventrolateral frontal cortex often show behavioral disinhibition, puerile impulsivity, and indifference to social norms, in the pseudopsychopathic syndrome (Blumer & Benson, 1975).

If language can be carried out more or less independently within the ventral pathway, but the experience of personal agency requires the participation of the dorsal pathway, it is interesting to consider the thought disorder of schizohrenia, in which internal speech is apparently divorced from the sense of personal agency, and is instead experienced as an alien intrusion into the mind (Bick & Kinsbourne, 1987).

6. Dialectical Cybernetics of Linguistic Complexity

We have theorized that there are unique neural mechanisms necessary for grammatical complexity, emergent from the capacity for inhibitory specification of objects from their embedding contexts that is achieved by the ventral limbic networks of the left hemisphere. These mechanisms appear to build upon similar capacities for inhibitory specification of discrete and serial actions within the ventrolateral regions of the frontal lobe. These are control processes, and yet they have critical implications for representation, allowing relational clauses to be bound as units, to be organized hierarchically within expressive or receptive sequences.

At the same time, however, as the cybernetics of object memories are applying inhibitory specification to differentiate and maintain clausal structure, any hierarchic organization of the semantic context must draw on multiple brain systems. Although the patient with right hemisphere damage may appear to have intact language, more careful testing shows important limitations in understanding the implicit, connotative, and contextual referents in extended discourse (Borod, 2000).

The left hemisphere's ventral frontal language networks are thus highly specialized and critical for language, but they normally operate in a balanced, perhaps dialectical, fashion, with opposing control biases at one level leading to stability at a higher level. The left frontal organization of efficient grammatical constructions is continuously monitored by posterior networks to provide constraints of meaningfulness against which the construction proceeds effectively. Verbal objects are differentiated from the embedding semantic context within the left hemisphere's ventral networks, and yet that context can be maintained on-line together with its configural implications, perhaps most clearly within the dorsal networks of the right hemisphere. More fundamentally, the motive to communicate grounds the linguistic process in an adaptive context. The representation of self and other that frames that motive may be preferentially formed within the dorsal corticolimbic pathway. In this way, the neural mechanisms of syntactic complexity can be seen as affording an efficiency of memory usage that expands conscious access to the multiple streams of information processing that contribute to social communication.

7. References

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RECURSION: CORE OF COMPLEXITY OR ARTIFACT OF ANALYSIS?

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0. Introduction

Several years ago, there appeared in the prestigious journal *Science*, which does not normally pay much attention to language, an article co-authored by Marc Hauser, Noam Chomsky and Tecumseh Fitch somewhat portentously entitled "The Faculty of Language: What Is It, Who Has It, and How Did It Evolve?" (Hauser, Chomsky & Fitch 2002, henceforth HCF) The article was placed in that section of the journal titled "Science's Compass," and it was indeed designed to give directions to us poor benighted folks who (unlike the authors of the article) had actually been laboring in the quagmire of language evolution studies for a number of years. The paper sought to derive the computational component of language (that is, what gives language its complexity) from a single process: recursion.

The paper divided language into two parts: FLN (narrow faculty of language) and FLB (broad faculty of language)

- FLB = all the parts of language either not unique to humans or human but not uniquely involved in language
- FLN = all the parts of of language uniquely human and uniquely linguistic

The working hypothesis: of the paper was that the sole content of FLN is recursion. Recursion, in turn, might well prove to be the exaptation of a faculty found in other species but used by them for non-linguistic purposes. Number, navigation, and social interaction were some of the functions suggested.

1. Some background

In order to understand where HCF is coming from, some background information is necessary.

Chomsky had for years avoided committing himself on language evolution. During the 1990s he saw the field expanding, making him irrelevant. The logic of minimalism forced him to become a player, but he needed leverage from biology to achieve a commanding position via the pages of *Science*.

Prior to 2002, he and Hauser had been on opposite sides of most issues. Hauser believed that language was on a continuum with animal communication and had emerged through natural selection. Chomsky believed language was totally distinct from animal communication and did not believe that language had been specifically selected for.

HCF represented a strategic compromise. C yielded to H on most aspects of language but preserved what was most vital to him: a unique central process for syntax, one that had not been specifically selected for **as a component of language**, thus preserving intact his claim of uniqueness and independence from natural selection over a more limited domain.

2. Defining recursion

But what exactly is recursion? More than one commentator has expressed concern over the vagueness of HCF with regard to definitions. The following are the clearest indications the paper offers:

"..[Recursion] provid[es] the capacity to generate an infinite range of expressions from a finite set of elements..."

"All approaches agree that a core property of FLN is recursion, attributed to narrow syntax in the conception just outlined. FLN takes a finite set of elements and yields a potentially infinite array of discrete expressions."

This differs from the usual definitions of recursion within a linguistic sphere of reference. Three typical examples follow.

"In fact, we can embed one sentence inside another again and again without limit, if we are so inclined! This property of syntactic rules is known as recursion." (Colin Phillips)

"In linguistics, this term refers to the fact that a sentence or phrase can contain (embed) another sentence or phrase -- much like a box within a box, or a picture of someone holding a picture. Common recursive structures include (1) subordinate clauses; e.g., He said that she left, where she left is itself a sentence; (2) relative clauses; e.g., She's the one who took the book." (Simon Levy)

"While iteration simply involves repeating an action or object an arbitrary number of times, recursion involves embedding the action or object within another instance of itself." (Anna Parker)

A feature common to all these definitions (and many others in the literature) is the insertion of something within another thing of the same kind. The resulting constructions are, of course, the major source of complexity in syntax.

Publication of HCF gave rise to two debates, which I will very briefly summarize.

3. Two pointless debates

The first debate, carried out in the pages of Cognition (Pinker and Jackendoff 2004, Fitch, Hauser and Chomsky 2005, Jackendoff and Pinker 2005), limited itself to purely definitional issues: what were the proper contents of FLN and FLB. PJ argued that many more things besides recursion should go into FLN; HCF argued that their limitation of FLN to recursion was a hypothesis not an empirical claim, and the burden of proof lay with those who would extend FLN to include other aspects of language, something they claimed PJ had failed to do.

The second debate, triggered by a sympathetic article in the New Yorker (Colapinto 2007) involved Dan Everett (Everett 2005, 2007) and a number of generativists (see e.g. Nevins, Pesetsky and Rodriguez 2007). Everett. a longtime student of the Piraha

language, claimed that Piraha had no recursion, and that therefore recursion could not form part of universal grammar (and maybe, if FLN was just recursion, then there was NO universal grammar.) His opponents insisted that he had misanalysed his data and that Piraha did indeed have recursion. Both sides entirely missed the point that while a biological capacity enables behaviors, it dos not enforce them. The absence of recursion from Piraha grammar says no more about universal grammar than the absence of prenasalized consonants or verb serialization from English grammar.

In neither debate did anyone question the status of recursion as central to FLN, let alone whether or not recursion really was a language process.

4. The birth of recursion in premature analyses

So where does the idea of recursion come from? The idea that syntax is a recursive process originated in early forms of generative grammar, but quickly came to be accepted by everyone. It seemed so self-evident that it has never yet, to my knowledge, been challenged.

The idea arose initially from the analysis in Chomsky (1957). At this time, his theory was known as "Transformational-generative grammar" and since transformations formed the most novel (and to many the most salient) aspect of it, it was widely referred to as "Transformational grammar" *tout court*. The grammar however was divided into two components, phrase structure and transformations. Phrase-structures were supplied only for simple sentences, leaving complex sentences to be built out of these by means of the transformational component. Phrase structures were derived from a series of "re-write rules", which produced strings of abstract symbols consisting of category labels, S(entence), N(oun) P(hrase). V(erb) P(hrase), N(oun), V(erb). P(reposition) etc. Rewrite rules included:

 $S \rightarrow NP VP$ $NP \rightarrow (Det) N$ $VP \rightarrow V (NP) (PP)$ $PP \rightarrow P NP$

Strings that provided descriptions of simple sentences then served as input to the transformational component.

However, for heuristic purposes the operations were frequently described as if they operated on real (surface structure) sentences. Thus "The man you saw yesterday is Harry's brother" might be described as being produced by insertion of "You saw the man yesterday" into "The man is Harry's brother" to yield "The man [you saw (the man) yesterday] is Harry's brother" with subsequent deletion of the repeated "the man".

Thus the *Syntactic Structures* model involved recursion only in the transformational component, when one prefabricated S was inserted in another prefabricated S.

However, this picture was changed radically in Chomsky (1965). The new model introduced "generalized phrase markers"; so that complex sentences were now generated directly by means of expanded rewrite rules. Consequently, recursion was no longer seen as part of the transformational component but formed a core element of phrase structure:

 $S \rightarrow NP VP$ $NP \rightarrow (Det) N (PP) (S)$ $VP \rightarrow V (NP) (PP) (S)$ (The second rule above generates relative clauses, the third generates complement clauses—in both cases referred to as "embedded" sentences.) Consequently "the man you saw yesterday is Harry's brother" would be generated from the generalized phrase-marker $_{S[NP}[Det N_{S}[NP VP]] _{VP}[V_{NP}[N_{NP}[N]]]]$ which featured one case of S within S and two cases of NP within NP.

Accordingly both S-within-S and NP-within-NP seemed to constitute clear cases of recursion. Note, however, that recursion is now deduced from a post-hoc, static description and no longer assumed to form part of any sentence-building process. This might already make recursion look dubious as a process that humans had to execute in order to evolve language. But at this point, of course, a quarter century had to elapse before linguists could even bring themselves to think about evolution.

5. Recursion lingers on while the theory marches on

Subsequent changes would make generative theory differ even more radically from its beginnings. Transformations continued to be reduced in number, being replaced by a small number of interacting principles that achieved similar results at less cost, until finally there was only one ("Move alpha"). With the arrival of the Minimalist Program, the deep-structure/surface-structure dichotomy gave way to a single structural level with two interfaces, the phonological and the semantic ("logical form"). Processes were reduced to two ("Move" and "Merge", with attempts to reduce the former to a special case of the latter). "Merge" "takes a pair of syntactic objects and replaces them by a new combined syntactic object" (Chomsky 1995, 226). Whether or not any two such objects can be merged depended on "feature-checking" (determining whether properties and dependencies of objects to be merged matched one another).

Merge seems not to have been devised as a description of how sentences are actually produced, but it could serve as such; the process of linking words with one another successively is something that a primate brain once equipped with a large lexicon should be able to do with little change beyond some additional wiring. The process is derivational not representational: that is to say it builds structures from scratch, bottom up, rather than starting with a completed string of category labels. It has no preconceived structure: the complex structures of X-bar theory, projecting triple layers of X, X-bar, XP. is abandoned. Its trees consist exclusively of binary branching: ternary branching is excluded, since nodes can have only one sister, and non-branching nodes are excluded because they cannot, by definition, result from applications of Merge.

6. Deriving complexity via Merge

Accordingly, let us derive "The man you saw yesterday is Harry's brother" via Merge:

- $saw + e \rightarrow [saw e]$ Harry's + brother $\rightarrow [Harry's brother]$
- (e represents the empty category to be interpreted as co-referential with "man")
- $[saw e] + yesterday \rightarrow [[saw e] yesterday]$
- is + [Harry's brother] \rightarrow [is [Harry's brother]]
- you + [[saw e] yesterday] \rightarrow [you [[saw e] yesterday]]
- man + [you [[saw e] yesterday]] → [man [you [[saw e] yesterday]]]
- The + [man [you [[saw e] yesterday]]] \rightarrow

[the [man [you [[saw e] yesterday]]]]

• [the [man [you [[saw e] yesterday]]]] + [is [Harry's brother]] → [[the [man [you [[saw e] yesterday]]]]] [is [Harry's brother]]]

Where's the recursion? We have constructed the sentence by means, not of a **recursive**, but of an **iterative** procedure, consisting of repeated applications of an identical process.

What is true for relative clauses is equally true for complement ckauses:

"Bill thinks that Mary said that John liked her."

• liked + her \rightarrow [liked her]

•

- John + [liked her] \rightarrow [John + [liked her]]
- that + [John + [liked her]] \rightarrow [that [John [liked her]]]
- said + [that [John [liked her]]] \rightarrow [said [that [John [liked her]]]]
- Mary + [said [that [John [liked her]]]] \rightarrow
 - [Mary [said [that [John [liked her]]]]]
 - that + [Mary [said [that [John [liked her]]]]] \rightarrow
 - [that + [Mary [said [that [John [liked her]]]]]]
- thinks + [that [Mary [said [that [John [liked her]]]]] → [thinks [that [Mary [said [that [John [liked her]]]]]]
- Bill + [thinks [that [Mary [said [that [John [liked her]]]]]] →
 [Bill [thinks [that [Mary [said [that [John [liked her]]]]]]]

Again there is no case of recursion as it is normally defined

The irony is that Chomsky is the sole person responsible both for the appearance and disappearance of recursion. His 1957 analysis, created the notion that syntax required recursion. Hs 1995 analysis removed the necessity for assuming recursion. So how is it that Chomsky in HCF is *still* proposing recursion as the central, perhaps sole content of FLN?

7. Recursion versus iteration

Let's look again at the definition of recursion in HCF

a) "..[Recursion] provid(es) the capacity to generate an infinite range of expressions from a finite set of elements..."

b) "All approaches agree that a core property of FLN is recursion, attributed to narrow syntax in the conception just outlined. FLN takes a finite set of elements and yields a potentially infinite array of discrete expressions."

It's worth noting that both definitions avoid any reference to the insertion of syntactic objects into other syntactic objects of the same class. And, as we have seen, Merge is in fact an iterative not a recursive process. Why didn't HCF bite the bullet and replace "recursion" with "iteration"?

I think the reason can only be that iteration alone cannot generate "infinite arrays of discrete expressions". Iteration of the numbers 1-9 produces no "discrete expressions" but just a string of unrelated numbers (387964421765988...) Only an additional process coupled with iteration can do this. If we add multiplication to iteration, we can indeed generate an "infinite array of finite descriptions"

 $5 \ge 7 = 35$ $35 \ge 2 = 70$ $2 \ge 9 = 18$ $18 \ge 70 = 1360$ $9 \ge 7 = 54...$ And so on, ad infinitum.

What process could one add to iteration to produce such an array in language?

The answer lies in the difference between words and numbers. Numbers have no dependencies. Each number (like an animal call, incidentally) is complete in itself and has no special relations, negative or positive, with any other number. Words, to the contrary, have dependencies. If I utter the word "leopard" in isolation, with no expressive intonation, you would know that I was making some kind of reference to an African animal, but you would not know if I was warning you about a leopard, or asking if you had seen one, or denying that there were any around, or merely listing major predators. "Leopard" has to have other words with it if it is to mean anything significant. There has, probably, to be a verb of which it is subject or object. But it cannot be the subject of just any verb; it can be subject of "run" or "kill", but not of "sing' or "rust" or "dissolve". In turn, if we started with "dissolve", its subject could not be "leopard" or "clock"; it could be "clouds" but not "cloud", since "dissolve" does not agree with singular nouns in number. Thus the dependencies of words depend on their properties, and those properties may be semantic, categorial or grammatical (most times, all three). Indeed, as shown by the feature-checking process in the minimalist program, the iterative procedure in Merge has to proceed along with the process of satisfying the requirements of the various words that are merged: (e.g. liked = Vtrans = requires object; her = 3rd pers. Fem. Sing. Acc. = possible object; liked her = predicate requiring subject; Mary = proper noun, no case = possible subject, and so on.)

8. Why Chomsky can't jettison recursion

So why didn't HCF simply say that DLN consisted of iteration plus the satisfaction of lexical requirements?

Because iteration, unlike recursion, cannot be described as a process required only by language. Iteration is a process that lies within the capacity of a wide range of species. In consequence, either (a) FLN would be void or (b) it would consist solely of a lexicon and its requirements. However, Chomsky since the beginning of his career had been wholly committed to the idea that the central part of language is syntax. His compromise with Hauser would not have worked if he had been forced to abandon the centrality of syntax. To preserve that, FLN had to be retained (thus avoiding (a)) and the content of FLN had to be syntactic not lexical (thus avoiding (b)). These goals could be achieved only by appealing to a process that was almost universally supposed to operate in syntax, recursion, even though the most recent developments in Chomsky's own theory showed that the generation of even the most complex sentences did not require it.

A fall-back position might seek to equate recursion with the Merge process. The definition of recursion in HCF seems almost designed to make such a move possible. It might be claimed that since FLN "takes a finite set of elements and yields a potentially infinite array of discrete expressions", Merge alone satisfies this definition and therefore must be recursive. But any such attempt would simply remove any real content from the term 'recursion', as well as obliterating the distinction between iteration and recursion...

9. How (and why) complexity evolved

A more rational response would be to adopt an altogether different model of language evolution. Such a model would claim that, given the kind of lexicon typical of any human language, a purely iterative process that fulfilled the requirements of that lexicon would suffice for the development of structure to whatever level of complexity the language might require. A language might, for reasons of its own, develop only a very low level of complexity, as has been claimed for Piraha, but essentially similar mechanisms would be in play, and nothing in language itself would preclude developing higher levels.

The apparent fitting of one structural element (NP or S) inside another of the same type is simply epiphenomenal, arising from the fact that (other than those imposed by individual lexical items) there are absolutely no restrictions on iterative process that generates sentences, which is also undetermined by prior applications of that process.

Goes this mean that there is no unique biological basis for language, no universal grammar? Certainly not. Following Deacon (1997), we can assert that symbolic units are unique to humans and that aspects of the lexicon are genuine universals. After all, the theta-grids of verbs appear to be universal; we know that if we meet a verb in some hitherto unknown language that translates as "sleep", it will take a single argument, while one that translates as "crush" will take two and one that translates as "tell" will take three. Other things that do not appear to require learning include the rules that determine the reference of empty categories; indeed, since these have no physically-perceptible expression, it is unclear how, even in principle, they could ever be learned. And we have as supporting evidence the fact that no other species can acquire a human language.

Clearly some kind of universal grammar is required for the production of complex sentences. But there is no real evidence that any truly recursive process need be included in that grammar. Rather than the unique content of FLN, recursion in language appears to be no more than an artifact of analysis.

10. Consequences for this conference

But if that is the case, what are the implications for what we have all been discussing? It would seem that initially at least, recursion and complexity have been seen as inextricably intertwined. According to Givon (2007), "What makes the syntactic structure of human language complex, in the sense we intend here, is the **embedding** of clauses in a **subordinate**--hierarchically lower--position inside other clauses, yielding recursive structure. That is, a node of the same type recurs under a node of the same type. With recursive **clause** nodes [S] in natural language, such embedding may be found inside a subject or object **Noun Phrase** (NP), most commonly yielding a subordinate **Relative Clause**...But embedding and thus recursivity can also occur inside the **Verb Phrase** (VP), most typically yielding a subordinate **Verb Complement**" (original emphasis)."

If, however, Merge is an iterative process, with no constraints on what can be merged (except those imposed by particular lexical items, which apply solely at each individual attachment—Merge has neither memory nor foresight) then what becomes of the widelyheld belief that sentences can be divided into three classes that can in turn be regarded as constituting three stages in three distinct areas: language acquisition, language diachrony, and language evolution

- (i) combination of words into simple clauses
- (ii) combination of clauses into concatenations of coherent chains

(iii) condensation of coordinated clauses into tight subordinations Let's consider the implications for each stage separately, then all together.

10.1 Merge and simple clauses versus No-Merge

Simple clauses are hierarchically structured. In "John left Sally", for example, "left" has to be merged with "Sally" before "John" can be merged with "left Sally". This can be shown by the fact that while material may be attached after the merger of "left" and "Sally", nothing can be attached to "left" or "Sally" before the two are attached to one another:

John occasionally left Sally John left Sally occasionally *John left occasionally Sally John without more ado left Sally *Jon left without more ado Sally

In other words, any true simple clause results from application of Merge, not from a beadlike stringing of words based solely on semantic content. The regular word order of true simple clauses is simply an epiphenomenon of the process. In other words, it is superfluous to assume the existence of any form of PS rule: "left" requires some object or person to be left. and some person or object to do the leaving, and $S \rightarrow NP VP$, $VP \rightarrow V$ NP is simply a roundabout way of describing what actually happens.

Note that in pidgins, early child speech and natural language above sentence level, Merge does not apply, although the reasons why it doesn't apply are different in all three cases. In pidgins, speakers are able to apply Merge in their own languages because they are fully aware of the requirements and dependencies of words in their own language. However, when confronted with isolated words from languages they don't know, they are lost. They may assume that the requirements and dependencies of these words are the same as those of their native language, and thus produce the substratum-influenced, literal-translation-type speech found in some (but by no means all) pidgin speakers. However, even if they choose such strategies, they cannot fully implement them, because virtually all the new items they encounter are lexical not grammatical items, and languages need to merge both types; moreover, in the early stages of a pidgin, even lexical items are sparse, there will inevitably be many gaps, and what words there are do not necessarily "come to mind" at the time needed. Thus pidgin speakers tend to produce only short, structureless utterances without any consistent word order.

Very young children, unlike slightly older children and adult pidgin speakers, may not have Merge at all. Alternatively, it is possible that they do have Merge but don't yet have enough words to merge. This is an empirical issue that needs to be resolved by careful study of the earliest stages of vocabulary growth and the matching of this growth with both the utterances they actually produce and the utterances that (with the vocabulary of any given stage) they could produce. If they don't have the right words to merge, how could they merge? That they don't is shown by typical utterances like "Mommy sock", which could mean "Mommy, please put my sock on", or "That is Mommy's sock" (typically, where words are strung together without Merge, ambiguities result that can only be resolved from context).

Natural languages lack Merge above sentence level. Why is this? A simple answer

would be "Because units above the sentences are too long." But this is obviously false: some multi-sentence paragraphs are shorter than some sentences. In fact, one long and complex sentence COULD be a multi-sentence paragraph. And this is probably the crux of the matter. The choice is stylistic. In the earliest stage of language evolution, one assumes that, lacking anything remotely like a full lexicon, No-Merge was the only option. But once Merge emerged, there were two options, and there always will be.(with consequences to be discussed in subsequent sections.) It remains, of course, true that Merge, like any iterative process (think push-ups) requires more effort than its absence and becomes more onerous on the memory the more frequently it is applied in a single series. A French author once produced a novel that consisted of a single sentence (Ndiaye 1988) but it never made the new York Times Best-Seller List.

10.2. Merge and concatenated clauses

Co-ordinate clauses are clauses that are individually constructed by Merge and then concatenated by No-Merge, the beads-on-a-string method. For adult speakers, this is often a stylistic choice.

Finally John spoke. "The tide is going out".

Finally John said (that) the tide was going out.

The question is, of course, are there languages for which it isn't a choice, and if so why? If the only syntactic process is Merge, then it becomes hard to see how there could be any developmental or physiological obstacle to applying it across the board.in all languages.

Could the choice here also be a stylistic one, reinforced by conservative tradition? After all, all that biology does for language is offer it a smorgasbord of choices. Not all languages utilize every capacity that human biology makes available, and while change from concatenation to subordination is a common diachronic development, it is far from being a unique one. As Bowern (2008) points out, "we see no overall trend towards greater complexity, and no overall movement towards syntaxis or hypotaxis from parataxis. Rather, as Dahl (2004) has pointed out in other contexts, we see changes and shifts in form and function, but ones which are governed by discourse as much as emerging from it.". Moreover, in cases where nominalizations take the place of VPembedded clauses, there must presumably have been some kind of verb to nominalize, therefore a clausal complement must have historically preceded a non-clausal one. What one sees, in other words, is just what one perceives with serial word-order: a continuous cycling within the envelope biology provides, driven by purely non-structural factors.

10.3 Merge and complex, "subordinated" structures.

Accordingly the forms found in relative clauses and complement clauses represent not the final stage in some developmental process found throughout ontogeny, phylogeny and diachrony, but rather options that lie within the scope of anyone equipped with Merge but that may or may not be selected by particular languages or particular individuals using the same language (where that language's selection allows it).

Evidence in favor of this belief comes from the acquisition of "embedded" sentences (described in Limber 1973). As Limber showed, a wide variety of such sentences (starting with non-finite complements like "I wanna eat it", including WH-headed clauses,

postverbal "that"-clauses and adverbial clauses, closing with object t relatives) all come in during the third year, most of them by the middle of that year—in other words, over a four- or five-month period. Moreover, as Limber points out, the fact that it takes the child even this long to acquire a wide range of complex sentence types has little to do with development per se and as great deal to do with the simple order in which the child acquires the kind of verb that will take sentential complements: "The fact that children use these various verbs in object-complement constructions almost immediately upon using them in any construction should not, upon reflection, be very surprising." Indeed, if the analysis of this paper is correct, this is what is predicted: as soon as the dependencies of a verb are known, Merge will be applied to it..

11. Conclusion

The consequences for the evolution of language are clear. First came words symbolic units with a definite reference, different in kind from animal calls. Then came a pidgin-like stringing together of words. Then came Merge, and once Merge was established, it was simply a question of exploiting to the full an iterative process that could be carried on without limit. The degree to which this capacity was exercised became a matter for language or individual choice.

It might be asked why, if Merge is the only process required for complex syntax, other animals that have Merge-like processes in other domains do not employ it in their communication. The answer of Hauser, Chomsky & Fitch (2002) is that such a process in other species "represents a modular system designed for a particular function (e.g. navigation) and impenetrable with respect to other systems. During evolution, [this system] may have become penetrable and domain-general...This change from domain-specific to domain-general may have been guided by particular selective pressures, unique to our evolutionary past, or as a consequence (by-product) of other kinds of neural re-organization."

A rather more plausible answer is that other species could not apply Merge to their communication because the units of their communication, in contrast with words, are holistic, symbolic, and non-referential (to speak of the "functional reference" of predator alarm calls is to ignore the fact that such calls can be translated as instructions to perform particular actions rather than as naming specific predators). Since they are the equivalent of sentences rather than words, and since each unit is situation-specific and designed less to communicate than to improve the caller's fitness, no earthly purpose would be served by concatenating them via Merge or anything else. The only surprising thing is that researchers should continue looking for syntactic precursors in other species when it should be obvious that in principle, no syntactic precursor can exist in the absence of words or word-like units. Syntax, no matter how complex, is simply a function of Lexicon plus Merge.

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