VISUAL WORD RECOGNITION

- Perceiving individual letters and words
- Phonological coding in reading
- Eye movements in reading
- Reading disorders
  - Adult acquired dyslexia
  - Developmental dyslexia
Different Orthographies:

Deep
- Logographs: Chinese characters

Shallow
- Syllabary: Japanese Kana (Kanji is logographic)
- Alphabetic: English, Spanish, Korean

Deep vs. shallow orthographies: Degree of correspondence between visual and phonological

Spanish “shallower” than English
Mid-Autumn Festival: the whole scene belongs to us hermits.
We row into the moon’s reflection and contemplate Lake Tai.
Beyond usa water and sky make a single silver colorl inside town wallsa could there ever be moonlight like this?

Fan Chengdaa 1126-1193
aru

ne ko

Japanese syllabary - Hiragana
Korean Script

• Consonants:

\( \begin{array}{cccccccc}
\text{ㄱ, ㄲ, ㅋ, ㅌ, ㄸ, ㅃ, ㅆ, ㅉ} \\
\text{kiyok, niun, tikut, riul, mium, piup, siot, iung, chiut} \\
\text{\(\text{ch}', \text{ch}', \text{k}', \text{t}', \text{p}', \text{hiut}\) }
\end{array} \)

• Vowels:

\( \begin{array}{cccccccc}
\text{ㅏ, ㅐ, ㅔ, ㅖ, ㅗ, ㅛ, ㅜ, ㅠ, ㅡ, ㅣ} \\
\text{\(\text{a, ya, eol, yeol, o, yo, u, yu, eu, ee}\) }
\end{array} \)
English: foreign, island

Spanish: mesa, cuanto
WRITTEN WORD

?

PRONUNCIATION
REGULARITY:

REGULAR WORDS - BED, DIVE, REST

IRREGULAR WORDS - SWORD, ISLAND, ONCE

WORD FREQUENCY:

HIGH - PROGRAM, ONCE

LOW - DIGNITY, CHAOS
Frequency by regularity interaction
Dual Route Model

- Letter identification
  - Visual Input
    - Lexicon
  - Phonological Output
    - Lexicon
    - Phonemes
    - articulation
- Grapheme-phoneme conversion
Evidence from neuropsychology for dual route model:

Surface dyslexia

Phonological dyslexia
Acquired Surface Dyslexia (after stroke or other brain damage):

Marshall & Newcombe, 1973; Bub et al., 1985

Word reading: Regular words > Irregular words

Nonword reading: Good performance

Word reading errors: Regularizations (tongue -> “tonn - goo”)
Surface Dyslexia

MP (Bub, Cancellier, & Kertesz, 1985)

Nonword reading:  82/86 correct (95%)

Word reading:
   regular (99%)
   irregular (68%)

Regularization errors on irregular words:
   mind -> mInd
   dough -> duff
   bead -> bed
Where is problem in lexical route?

How to test?
Surface dyslexia (Bub et al.)

Accuracy

Frequency per million

- regular
- irregular
Acquired Phonological Dyslexia

Complementary pattern:

Word reading good for both regular and irregular words
Nonword reading poor, errors are visually similar words
ML (tested in our lab - Lesch & Martin, 1998)

Regular words: 98% correct
Irregular words: 96% correct

Nonwords: 38% correct
Single letters: 9/26 correct

Nonword reading errors:
       atch -> “attach”
       meedie -> “needle”
       fank -> “flank”

Letter sounding:
         h -> “hen”, m -> “maybe”
Single Route Model - Seidenberg and McClelland

input orthography

hidden units

output phonology
Deep Dyslexia
Patient RW (from our lab)

Word reading:

<table>
<thead>
<tr>
<th>Type</th>
<th>Correct Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>HF</td>
<td>75% correct</td>
</tr>
<tr>
<td>LF</td>
<td>35% correct</td>
</tr>
<tr>
<td>Concrete</td>
<td>65% correct</td>
</tr>
<tr>
<td>Abstract</td>
<td>15% correct</td>
</tr>
</tbody>
</table>

Function words (is, are, his, the, below, of, for)
20% correct

Nonwords: 0% correct (also tended to lexicalize)
Error types:

Words:

<table>
<thead>
<tr>
<th>target</th>
<th>response</th>
</tr>
</thead>
<tbody>
<tr>
<td>semantic</td>
<td>canoe</td>
</tr>
<tr>
<td>onion</td>
<td>orange</td>
</tr>
<tr>
<td>window</td>
<td>shade</td>
</tr>
<tr>
<td>paper</td>
<td>pencil</td>
</tr>
<tr>
<td>nail</td>
<td>fingernail</td>
</tr>
<tr>
<td>ache</td>
<td>Alka Seltzer</td>
</tr>
<tr>
<td>visual</td>
<td>wish</td>
</tr>
<tr>
<td>fear</td>
<td>flag</td>
</tr>
<tr>
<td>rage</td>
<td>race</td>
</tr>
</tbody>
</table>

Nonwords:

- no response
- substitution of visually similar word (fank bank)
Dual (Triple?) Route Model

- Letter identification
  - Visual Input Lexicon
    - Semantic system
    - Phonological Output Lexicon
      - Phonemes
  - Grapheme-phoneme conversion
Dual Route Model - Seidenberg and McClelland
Developmental Dyslexia

Definition:

Reading development lags behind other academic abilities despite absence of sensory deficits. Adequate opportunity for learning to read has been provided.

Sometimes require reading level to be 2 yrs below grade level while other skills may be at grade level
“Jackie”

Case reported by Margaret Snowling (1992)

Age: 10 yrs, 10 mos
WISC IQ scale: 115, verbal 98, performance 131
Schonell Graded Word Reading Test: 8 yrs. 6 mos
Schonell Spelling test: 8 yrs. 0 mos

Subscales of WISC:
Superior performance on object assembly, block design
Impaired performance on digit span, arithmetic
Language skills

Speech halting, hesitations (describing a picture of a picnic):

“So they set out… they went…they went… I mean… and… so they had their picnic, and about an hour…no a few minutes……they….they packed up…and… got onto their bikes”

Phonological errors in picture naming:
Escalator -> exclavator
Stethoscope -> telescopic thing, st-stesesemator
Cognitive Deficit Approach

Find out how dyslexic children differ from children without reading disorder

1. Visual perceptual deficit - b/p, was -> saw confusions
Rapid visual processing deficit found in some studies, not others

   Problem: often the tests involve working with orthographic materials, dyslexics may be poorer because they have less exposure to print.

E.g., studies that have compared copying of English vs. Hebrew characters at short exposure durations have found deficit for English, not Hebrew
2. Verbal deficit

A. Verbal stm deficit
B. Slow picture naming
C. Poor phonological skills - rhyme judgments

Phonemic awareness: Debate over the importance of this. Is deficit causal or result of reading difficulty
Morais showed that non-literate adults had difficulty with phonemic segmentation

D. “fast-for-word” approach (Tallal) rapid auditory processing deficit
Individual Differences

Reading a complex skill, any component of which might be impaired

Castles and Coltheart:

Some children show a phonological dyslexic pattern (word reading better than nonword reading)

A smaller group shows surface dyslexic pattern (regular words and nonwords read relatively well, irregular words read poorly)
Case A. H.
McCloskey & Rapp (2000)

College student at prestigious university

Visual-spatial deficit:

Target

AH’s copy
Reading simple words:  88% correct

Reading Errors:

<table>
<thead>
<tr>
<th>word</th>
<th>error</th>
</tr>
</thead>
<tbody>
<tr>
<td>dog</td>
<td>hog</td>
</tr>
<tr>
<td>pen</td>
<td>den</td>
</tr>
<tr>
<td>lamp</td>
<td>lamb</td>
</tr>
<tr>
<td>snail</td>
<td>nails</td>
</tr>
<tr>
<td>chain</td>
<td>cabin</td>
</tr>
<tr>
<td>hand</td>
<td>band</td>
</tr>
<tr>
<td>nose</td>
<td>noise</td>
</tr>
<tr>
<td>church</td>
<td>cherish</td>
</tr>
<tr>
<td>apple</td>
<td>appeal</td>
</tr>
</tbody>
</table>
Knowledge-based constraint (i.e., top-down effects in reading text)

1. reading words in context much more accurate

2. reading aloud normal text, made sequencing errors much more often than controls - but where unimportant

   speed and determination -> determination and speed

3. reading sequence altered text aloud

   e.g., The horse had learned to him recognize

   RH spontaneously corrects 85% of the time, controls 24% of the time
Effect of flicker on word reading:

Steady light       Flicker

23% errors       1% errors

Opposite of prediction from fast visual processing deficit hypothesis

Transient vs. steady-state visual systems
Sentence Comprehension

Semantic vs. Syntactic Approaches

The apple that the boy ate was red.

The boy that the girl kissed had red hair.
Evidence for syntactic parsing

1. Click studies - displace perception of click to phrase boundary

   The doctor gave the patient a new prescription.

2. Probe latency - faster in same clause (Caplan, 1976)

   A. Now that artists work in oil, paintings are rare.
   B. Because acrylics are available, oil paintings are rare.

   For both, hear sentence, probe with “oil”
   Faster RT for B - where oil is in final clause.
Syntactic Parsing:

Assign syntactic structure -

Jill saw the boy with binoculars.

```
S
   /\   |
  NP  VP |
  /    /|
 N   V  NP |
 /  /   /  |
 Jill saw det N |
          /  |
            the boy |
            /   |
              N |
               |
               with binoculars
```
Jill saw the boy with binoculars.
Frazier, Rayner, & Clifton

“Garden Path Theory”

Syntax first - followed by semantic evaluation

Syntactic strategies applied without taking semantics into account

Two strategies:

Minimal attachment - assign simplest structure

Late closure - attach to current phrase
Minimal attachment -

Reduced relative clauses -

The man given the check was happy.
(The man who was given the check was happy.)

The man sent the check was happy.
(The man who was sent the check was happy.)

The man sent by the CIA was actually a double agent.
(The man who was sent by the CIA was actually a double agent.)
EYE TRACKING
gaze duration

The man given the check was happy.
430
The man who was given the check was happy.
430

The man sent the check was happy.
550
The man who was sent the check was happy.
430

The man sent by the CIA was actually a double agent.
?
The man who was sent by the CIA was actually a double agent.
430
Late Closure
(i.e., add to current phrase, don’t close phrase)

Sam teased John and his sister ….

A) every day.
B) got angry.

John and his sister - taken as one NP initially
Small garden path effect

Sarah said that John left yesterday.
Sarah will say that John left tomorrow.
Modular vs. Interactive Accounts

A. The landscape painted in the sunlight was beautiful.
(The landscape that was painted in the sunlight was beautiful.)

B. The woman painted in the sunlight was beautiful.
(The woman that was painted in the sunlight was beautiful.)

Compare times for “was” in ambiguous vs. unambiguous

Frazier et al.: predict no difference at “was”, total reading time shorter for A

Trueswell, Tanenhaus, & Garnsey (1994) find times on “was” faster for A - supports interactive account.
Support for Interactive Account

1. Plausibility of N as agent vs. theme (landscape vs. woman painted)

2. Story context:

Two men were sent to the small Middle Eastern country. One was from the CIA and the other from Army Intelligence. The man sent by the CIA was actually a double agent.

3. Verb preferences - Direct Object vs. Sentence Complement

   The girl forgot the solution was in the back of the book.   The girl believed the solution was in the back of the book.