1. The Plaut model of reading differs from that of Coltheart et al. in that the Plaut model
   a. uses a connectionist architecture and distributed representations
   b. uses a symbolic architecture and localist representations
   c. uses different route for reading nonwords and high frequency irregular words
   d. has been used to model the reading of multi-syllable words

2. The DRC model more easily accounts for phonological dyslexia
   True  False

3. According to the Shaywitz et al. neuroimaging study, dyslexic individuals show lower levels of activation in anterior brain regions involved in reading.
   True  False
Neuropsychology of Reading
Historical Background

Dejerine (1892)

Separation of reading from spoken language

Two types of disorders of written language:
Pure alexia (alexia without agraphia)
Alexia with agraphia
Left angular gyrus

Reading & writing center (l.hemis)

Visual Processing l. hemis

Visual Processing r. hemis
Alexia with agraphia

Reading & writing center (l.hemis)

Visual Processing l. hemis

Visual Processing r. hemis
Alexia without agraphia

- Reading & writing center (l.hemis)
- Visual Processing (l. hemis)
- Visual Processing (r. hemis)
Marshall & Newcombe (1973)

Information processing model
  first dual route model

Different types of acquired dyslexia:
  Surface - “partial failures” of grapheme-phoneme conversion (incense -> increase)
  Deep - mainly semantic errors
Early visual and orthographic processes

• “Visual” word forms? Abstract letter identities?
  – No disruption case change mid-saccade for normal Ss
  – Patients with poor reading, but recognize oral spelling
    • Poor at cross-case matching, good at copying, letter decision

• Orthographic lexicon - selective disruption?
  – Letter-by-letter reading?
    • Disruption in parallel processing, but
      – Effects of neighborhood size (Arguin, Fiset & Bub, 2002)
      – Semantic decision above chance with brief presentation (Coslett & Saffran, 1989)
Early orthographic processes (cont)

• Spatial position information
  – Neglect dyslexia (comb -> come, context -> concrete)
    dissociates from hemianopia and from spatial neglect
    Case of NG - neglect of “right side” of word
    irrespective of presentation format

common nommoc c
  o
  m
  m
  o
  n
Central Reading Processes

Phonological coding, semantic access
WRITTEN WORD

\[?

\]

PRONUNCIATION
English: foreign, island

Spanish: mesa, cuanto
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

Orthographic Input Lexicon

Grapheme-phoneme conversion

Phonological Output Lexicon

Phonemes

articulation
Consistency Effects
Glushko (1979)

Importance of word body consistency on naming times:

Gaze - -> g + aze       “aze” pronounced consistently

Slave - -> sl + ave     “ave” mainly consistent except for “have”
                        (cave, Dave, gave, nave, save, wave)

Pint - -> p + int       pint only word with “int” as /aInt/
                        (hint, mint, lint, tint)

RT: consistent < inconsistent regular < inconsistent irregular

Similar finding for nonwords:  tave slower than taze

Inconsistent regular problem for dual route model
Revised Dual Route Model
Coltheart, Curtis, Atkins, & Haller, 1993

Letter identification

Visual Input
Lexicon

Phonological Output
Lexicon

Grapheme-
phoneme conversion

Phonemes

articulation
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**
  - Regular
  - Irregular

- **Frequency per million**
  - > 400
  - 300-400
  - 200-300
  - 100-200
  - 50-100
  - 25-50
  - 0-25

Frequency distribution for regular and irregular words.
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”
Hypotheses about localization from lesion data
Single Route Model - Seidenberg and McClelland
Graphemes

Hidden Units

Phonemes

“z”  “ae”  “p”
Frequency x Regularity Interaction?

Acquired Dyslexia?
   Surface
   Phonological
# Deep Dyslexia

Patient RW (from our lab)

## Word reading:

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

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

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

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

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

Orthographic analysis

Orthographic Input Lexicon

Grapheme-phoneme conversion

Semantic system

Phonological Output Lexicon

Phonemes
Dual Route Model - Seidenberg and McClelland

- Input orthography
- Hidden units
- Semantics
- Hidden units
- Output phonology
- Hidden units
Can this account for acquired dyslexia?

Original model -
  poor nonword reading
  poor account of surface dyslexia

Revised model - Plaut, McClelland, Seidenberg, Patterson (1996)
  more standard mapping of orthography to phonology
  better nonword reading

  still poor fit to surface dyslexia
  fix: rely more on semantic route, helps with irregular

Problems: turns this into a dual route model
  individual differences account depends on education level
  or some unspecified source

Positives: good account of consistency
  why are there no patient with complete loss of irregular?
Other theoretical issues

• Phonological mediation in access to meaning?

• Third route or summation hypothesis?

• Locus of deficit in deep dyslexia
  – Right hemisphere hypothesis
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”

Typical case  (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. A) 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

   B) Eye movement deficit - difficulties with oculomotor control?
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)

Howard & Best (1996) - normal word reading

A smaller group shows surface dyslexic pattern (regular words and nonwords read relatively well, irregular words read poorly)

Developmental delay for second group??
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>dog</th>
<th>hog</th>
</tr>
</thead>
<tbody>
<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
Selective Attentional Dyslexia
Rayner, Murphy, Henderson & Pollatsek

40 yr old college professor, life-long reading problems

double word reading abilities normal

moving window paradigm
Attentional dyslexia

- control
- SJ
- other dyslexic

Reading rate (word/min)

- 1w
- 2w
- 3w
- full line

Window size

- 1w
- 2w
- 3w
- full line

Reading rate range: 0 to 350 words/min
Spelling
Dual (Triple?) Route Model

Acoustic/phon analysis

Phonological Input Lexicon

Phoneme-grapheme conversion

Orthographic Output Lexicon

Graphemic buffer

Semantic system

Letter/name conv.

Letter/shape conv.
Corresponding patterns in spelling

• Surface dysgraphia
• Phonological dysgraphia
• Deep dysgraphia
Issues in spelling

• Phonological mediation in spelling?
• One orthographic lexicon or two?
Phonological Mediation?

- Patients with semantic errors in oral naming, but not in written naming
- Different patterns of word class deficits in reading and spelling
  - Open class affected in oral production, function words affected in spelling

Phonology may be involved in spelling, but not necessary, at least at single word level
One orthographic lexicon?

- Original Dejerine position
- Dissociations between reading and spelling
  - How to test? Need to have deficit in reading at lexical level.
  - Findings of correspondence between reading and spelling
- Priming data