Phonological Processing and Orthographic Memory: What’s This Got to Do with Reading Success?

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The Reading Brain
(Shaywitz, 2003. *Overcoming Dyslexia*)

• Within the last decade, fMRI technology has been used in various research centers to study the neural reading process in children and adults

• The neural systems for reading are rapidly being mapped out
The Reading Brain

• Imaging studies have identified at least three neural pathways for reading:
  – One for beginning reading... slowly sounding out words
  – One for more rapid word analysis
  – Another speedier pathway for skilled reading

• As they read, good readers activate highly interconnected neural systems that encompass regions in the back and front of the left hemisphere of the brain
The Reading Brain

**Broca’s Area**
Inferior frontal gyrus: articulation/ slower word analysis region

**Parieto-temporal**
more complex word analysis

**Occipito-temporal**
Word Form Region: Records how a word looks, sounds, & what it means

**Corpus Callosum**
The Reading Brain

- When first learning to read, children primarily use the frontal brain regions to analyze and sound out words.
- After a child has correctly read a word several times (6-10), he forms an exact neural model of that specific word (word picture).

kite
The Reading Brain

• Skilled readers show the most activation in the word form (word picture) region.

• Thus... *Reading Skill* = *Reliance on word form area*

  - *Occipito-temporal WORD FORM AREA: how it looks, sounds, & what it means*

  - *Corpus Callosum*

  - *Kite*
• Internalized phonetical pattern-seeking system
• Internalized structural analysis
• Internalized automatic word-chunking
Orthography: Written Symbols

- Alphabet (26 letters - graphemes)
- Represent 44 speech sounds - phonemes
- Written/ visual
- Produced through visual memory & spelling patterns
The Reading Brain

- Study of brain activation patterns while reading revealed a glitch in the circuitry of dyslexic readers.
- Older dyslexic children show increased activation in frontal regions & over-activation in Broca’s Area, normally used for beginning reading.
- This causes them to read slower than their age peers, and less efficiently.
- They need to read a word correctly between 70-80 times before it is imprinted in the Word Form area.
The Reading Brain

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Inferior frontal gyrus
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**Occipito-temporal**
word form: how it looks, sounds, & what it means

**Orthographic Memory**

**Phonological Processing**
The 4 Simultaneous Processors

- **Context Processor**
- **Meaning Processor**
- **Orthographic Processor**
- **Phonological Processor**

Print Stimulus ↔ Speech
Recommended Assessment

• Test of Word Reading Efficiency (TOWRE) Published by Pro-Ed
• 2 Subtests: Phonemic Decoding Efficiency and Sight Word Efficiency
• Provides age and grade standard scores, grade equivalent comparison, and percentile rank
INTERVENTIONS
Phonological Processing Intervention: TEACH PHONICS

- Direct, explicit instruction that teaches the predictable structure of the English language
- Using a structured, sequential, multi-sensory approach
- Using lots of tactile/kinesthetic manipulatives
# Vowel Pattern Chart

## Syllable Types

<table>
<thead>
<tr>
<th>#1 - Closed-short</th>
<th>#2 - Open-long</th>
<th>#3 - Silent e-long</th>
</tr>
</thead>
<tbody>
<tr>
<td>Căt</td>
<td>Mē</td>
<td>Rīde</td>
</tr>
<tr>
<td>Fǐsh</td>
<td>Gō</td>
<td>Cāpe</td>
</tr>
<tr>
<td>Bũb-</td>
<td>Tā-</td>
<td>Hōpe</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>#4 - 2 Vowels</th>
<th>#5 - Bossy R</th>
<th>#6 - C+le</th>
</tr>
</thead>
<tbody>
<tr>
<td>Talkers</td>
<td>Car</td>
<td>Bũb-ble</td>
</tr>
<tr>
<td>Bōat</td>
<td>Her</td>
<td>Tā-ble</td>
</tr>
<tr>
<td>Mēat</td>
<td>Girl</td>
<td>Tur-tle</td>
</tr>
<tr>
<td>Pāil</td>
<td>Turn</td>
<td></td>
</tr>
<tr>
<td>Whiners</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>clown</td>
<td></td>
<td></td>
</tr>
<tr>
<td>few</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Predictable Vowel Patterns

- Ranges from 77-88%, better than chance
- Teaching children vowel patterns can make a difference in their fluency & comprehension

<table>
<thead>
<tr>
<th></th>
<th>Closed</th>
<th>Open</th>
<th>Silent e</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>86-89%</td>
<td>77%</td>
<td>81%</td>
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</tbody>
</table>

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<thead>
<tr>
<th></th>
<th>2 Vowels</th>
<th>Bossy R</th>
<th>C+le</th>
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<tr>
<td>Talkers</td>
<td>77%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whiners</td>
<td>---</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Teaching Strategy: Color Coding

<table>
<thead>
<tr>
<th>Digraphs</th>
<th>Vowels</th>
<th>Blends</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>sh</strong></td>
<td><strong>a, ai, ay</strong></td>
<td><strong>bl-</strong></td>
</tr>
<tr>
<td><strong>ch</strong></td>
<td><strong>e, ee, ei, ea</strong></td>
<td><strong>cr-</strong></td>
</tr>
<tr>
<td><strong>tch</strong></td>
<td><strong>i</strong></td>
<td><strong>-st-</strong></td>
</tr>
<tr>
<td><strong>th</strong></td>
<td><strong>o, oa, oe, ow</strong></td>
<td><strong>str-</strong></td>
</tr>
<tr>
<td><strong>wh</strong></td>
<td><strong>u, ue, ew</strong></td>
<td><strong>-nd</strong></td>
</tr>
<tr>
<td><strong>ph</strong></td>
<td></td>
<td><strong>-mp</strong></td>
</tr>
<tr>
<td><strong>gh</strong></td>
<td><strong>-y</strong></td>
<td><strong>etc.</strong></td>
</tr>
</tbody>
</table>

**Vowel teams**
Irregular / Orthographic Memory Sight Words

• About 12-15% of English words do not conform to the regular patterns
• Can be taught through context, repetition, multisensory techniques, learning games, etc.
• Word wall activities, word bingo, computer games, flash card review, writing in sand or sandpaper, etc.
Orthographic Memory Intervention

Sight Word Key Ring Strategy

• Use for high-frequency words
• Use for words that look similar
  - want/went/what  - saw/was  - them/then/than
• 5-7 sight words on a key ring
• Short practice drills 4-5x/day
• Remove card when students gets a word right 3 consecutive days
• Place card in review pile that will be done once/day
• Practice words in context and in phrase chunking