Morphological segmentation compensates for low reading skill, not for low orthographic transparency

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Introduction

Background:
- The contribution of morphological awareness to reading in English increases during reading acquisition (Adams 1990; Singosog et al. 2000).
- But: Reading depends on unique properties of the specific language and orthography (Nagler & Gouwani 2005).
- Morphological awareness is impaired in dyslexic readers (Schiff & Ravid, 2007).
- But: Dyslexic readers rely on morphological decomposition to compensate for the phonological impairment (Burani et al., 2008).
- Hebrew provides a unique case: 2 levels of orthographic transparency within language (diacritic marks).
- Complex derivational morphology: Semitic roots + templates.

Goals:
1. Does morphological decomposition compensate for missing phonological information in a non-transparent orthography (Unpointed Hebrew)?
2. Does morphological decomposition increase or decrease with reading acquisition?
3. Is morphological decomposition enhanced in dyslexic readers with a phonological deficit?

Methods

Participants in behavioral study:
- 21 adult typical readers, 23-34 yrs (9 males)
- 20 adult readers with dyslexia, 22-38 yrs (8 males)
- 29 typical 2nd grade children, 7-8 yrs (13 males)
- 29 typical 5th grade children, 10-11 yrs (12 males)

Participants in fMRI study:
- 22 adult typical readers, 22-34 yrs (11 males)
- 21 adult readers with dyslexia, 20-33 yrs (9 males)

Task: oral reading of single words

Baseline Task: saying “pass” to ***

Stimuli: 96 Hebrew nouns, half with two morphemes and half with one morpheme. Each word presented twice: w/o & w/ diacritics

Diacritics X Morphological complexity

<table>
<thead>
<tr>
<th>Diacritics</th>
<th>One morpheme</th>
<th>Two morphemes (root + template)</th>
</tr>
</thead>
<tbody>
<tr>
<td>With Diacritics - Pointed</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>No Diacritics - Unpointed</td>
<td>0.98</td>
<td>0.92</td>
</tr>
</tbody>
</table>

fMRI: 3.0T GE scanner; Event related design; 26 slices; TR=2000 ms; TE = 35 ms. Analysis & preprocessing: SPM12; ROI analysis Marsbar & MRlcron

Behavioral results - Children

<table>
<thead>
<tr>
<th>Grade</th>
<th>Morphological X Group</th>
<th>2nd grade</th>
<th>5th grade</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mono-morphemic</td>
<td>Bi-morphemic</td>
<td>Mono-morphemic</td>
</tr>
<tr>
<td></td>
<td>Accuracy</td>
<td>Accuracy</td>
<td>Accuracy</td>
</tr>
<tr>
<td></td>
<td>Unpointed</td>
<td>Pointed</td>
<td>Unpointed</td>
</tr>
<tr>
<td>2nd grade</td>
<td>1.00</td>
<td>0.98</td>
<td>0.94</td>
</tr>
<tr>
<td>5th grade</td>
<td>0.98</td>
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<td>0.92</td>
</tr>
</tbody>
</table>

Both groups: Morphological structure improved reading accuracy in POINTED words.

In 2nd grade: In unpointed words morphological structure interfered
- significant, marginally significant

2nd grade

5th grade

Effect of Morphology: ROI Results: Adults

Dyslexic readers show a morphological effect in unpointed words.

Conclusions

During reading acquisition
• In a language with a rich morphology, common morphemic structure is more helpful in early than in later stages of reading acquisition, and can compensate for immature lexical access.
• In contrast to the common hypothesis, morphological decomposition is most beneficial in the transparent orthography, and does not compensate for the missing phonological information in non-transparent orthography.

In adults readers
• In early stages of orthographic processing adult Hebrew readers with Dyslexia rely on morphological decomposition more than typical readers.
• Behavioral results consistent with Italian (Burani et al. 2008) French (Causals et al. 2012) and Danish (Elbro & Ambik 1998).
• In stages of phonological processing both dyslexic and typical Hebrew readers alike rely on morphological decomposition more when reading the non-transparent orthography.