The polysemy advantage in lexical access: The role of context availability and orthographic neighborhood variables

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Is the ambiguity advantage in lexical decision limited to polysemous words?

We examined polysemous English words and asked how number of senses (NOS) interacts with: Context availability, Word frequency, and Orthographic neighborhood features

Previous research has demonstrated:
- Lexical decision advantage for polysemous words (Rodd, Gazeti, and Marslen-Wilson, 2002) and words high in context availability (CA) (Tokowicz & Kroll, 2007)
- NOS and CA interact: polysemy advantage only for low context availability words (Tokowicz & Kroll, 2007), and for abstract but not concrete nouns (Jager & Cleland, 2014)
- NOS and word frequency interact: low frequency unambiguous words slowest to be recognized (Pexman et al., 2004)
- Concreteness advantage for words with higher frequency orthographic neighbors (Samson & Pillon, 2004)

Extends previous research by:
- Examining relationship of concreteness and CA
- Examining relationship of word frequency and NOS
- Controlling for orthographic neighborhood features

Predictions
- Interaction of CA and NOS: low CA/ high NOS recognized most quickly
- Interaction of word frequency and NOS: low frequency/low NOS slowest

Method

Stimuli
497 words from WordNet (Miller, 1995) Used to select for one meaning, but varying NOS (range: 1 to 35)
- 451 words for analysis

497 pseudowords, matched to words on word length, bigram frequency, and number of orthographic neighbors (Balota et al. 2007)

Participants
- Final set of 82 monolingual English speakers
- Recruited from University of Pittsburgh Psychology Subject Pool
- 18 years old or older, right-handed, normal vision

Procedure
- Visual lexical decision task
- Collected response time (RT)
- Language History Questionnaire (Tokowicz, Michael, & Kroll, 2004)

Analyses
- Linear mixed effects modeling used to examine both subject and item variance
- Critical t > 2.0 for significance (Baayen, 2008)
- Analyses used R lme4 package (Bates et al., 2014)

Model specifications (bold indicates theoretical interest; MEs of critical interactions included):
Model 1: \( \log(\text{RT}) = \text{wordRT} + \text{pretrialRT} + \text{pretrialACC} + \text{orthofreq} + \text{concreteness} + \text{orthordens} \times \text{concreteness} + \text{orthofreq} \times \text{CA} + \text{orthordens} \times \text{CA} + \text{NOS} \times \text{Concreteness} + \text{NOS} \times \text{CA} + \text{NOS} \times \text{wordfreq} + \text{Wordfreq} \times \text{concreteness} + \text{Wordfreq} \times \text{CA} + \text{CA} \times \text{Subject} + \text{Subject} \times \text{Item} \)

Results

Figure 1. Estimated effect of fixed effects of theoretical interest on lexical decision latency (ms). Bars represent 95% CI; * = significant t > 2.0.

Figure 2. Estimated lexical decision latencies for words high or low in NOS and frequency. Generated from regression equation, where low = 1 SD and high = +1 SD

Discussion
- Evidence for polysemy advantage
- But, polysemy effects qualified by an interaction with word frequency
- No effect of ambiguity for high frequency words
- Processing disadvantage for low NOS/low frequency words
- Similar to Pexman et al. (2004)
- Semantic feedback hypothesis: low frequency words take longer to identify, perhaps during this time information about meaning becomes active. Words with high NOS have greater activation/feedback. Low frequency/low NOS words don’t have as much activation/feedback, and take longer to be recognized

- We hypothesized an interaction of CA and NOS
- Found significant main effects for CA, concreteness, and NOS
- No interaction, contrary to hypotheses and previous research
- Additional control variables and significant interaction of CA × word frequency accounted for variance that past studies reporting CA × NOS interaction did not examine
- Context availability advantage persists, even when orthographic neighborhood variables controlled

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Table 1. Stimulus properties

<table>
<thead>
<tr>
<th></th>
<th>Words</th>
<th>Pseudowords</th>
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</thead>
<tbody>
<tr>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
</tr>
<tr>
<td>Length (number of letters)</td>
<td>5.87</td>
<td>1.68</td>
</tr>
<tr>
<td>Number of senses (NOS)</td>
<td>5.26</td>
<td>3.91</td>
</tr>
<tr>
<td>Orthographic neighborhood frequency</td>
<td>0.68</td>
<td>1.36</td>
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<tr>
<td>Orthographic neighborhood density</td>
<td>3.09</td>
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<tr>
<td>Summed bigram frequency</td>
<td>1.62</td>
<td>0.89</td>
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<tr>
<td>Concreteness</td>
<td>4.55</td>
<td>1.76</td>
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<tr>
<td>Context availability</td>
<td>5.84</td>
<td>0.61</td>
</tr>
<tr>
<td>Zipf word frequency</td>
<td>3.55</td>
<td>0.39</td>
</tr>
</tbody>
</table>

1 From WordNet (Miller, 1995) 2 From etalon database (Balota et al., 2007) 3 Zipf log transformation of SubtLex-US occurrence per million, ranges from 1 (low) to 7 (high), and accounts for very low frequency and unobserved words (van Heuven et al., 2015).

References