Explaining the Pseudohomophone Effect in Lexical Decision

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In a typical lexical decision task, participants are asked to categorize visually presented letter strings as either existing words or as "nonwords". The most straightforward findings in lexical decision studies are (1) that high frequency words ("house", "girl") and nonwords which are not similar to existing words ("yebe") are responded to more accurately than low frequency words ("chute", "lime") and nonwords that are similar to existing words ("baln"), and (2) that speeded conditions yield less accurate results. These findings have been succesfully modeled in ACT-R (Van Rijn & Anderson, 2003) by assuming that each trial corresponds to a single retrieval and that the retrieval latency is determined by the competitive latency equation. This model ignored phonological effects in lexical decision like the pseudohomophone effect.

The pseudohomophone effect reflects the finding that nonwords with a pronunciation equal to a word (e.g., "brane", "focks") are harder to reject than regular nonwords. Ziegler, Jacobs, and Klüppel (2001) have shown that the frequency of the baseword (e.g., "brain", "fox") influences the accuracy in visual lexical decision. This effect is in the opposite direction to what might be expected on the basis of a single-shot retrieval mechanism. Instead of showing a *higher* proportion of errors, pseudohomophones derived from high frequency basewords have a *lower* proportion of errors than pseudohomophones derived from low frequency basewords. Ziegler *et al* have suggested that this finding argues for a verification mechanism as the quick retrieval of high frequency baseword allows for a verification between probe and retrieved word. This verification mechanism cannot be easily incorporated in currently existing models of lexical decision. Ziegler *et al*'s experiment was conducted in German.

Recently, Zeelenberg, Van Rijn and Wagenmakers (in preparation) have replicated the findings of Ziegler *et al* in English, see the solid lines in Figure 1. However, if the effect is indeed explained by a verification mechanism, the correctness pattern should be mirrored in speeded conditions. That is, if a response has to be given before the verification process is finished, the retrieved high frequent basewords will induce a bias towards incorrect "word" answers. The dashed line in Figure 1 represents the speeded condition and shows indeed the opposite effect of the solid line, supporting the notion of a verification process.

We have extended the word representations that were used in the ACT-R lexical decision model as presented in Van Rijn and Anderson (2003) with phonological onset and rhyme information. In the new model, each chunk representing a word contains both a position-encoded orthographic representation and an onset/rhyme phonological representation (e.g., "brain" is represented as [b,r,a,i,n,/*br*/,/*ain*/]). When a letter string is perceived, we assume that the orthographic information leads to an automatic encoding of phonological information. This way, the letter string "brane" initiates a retrieval request of the form [b,r,a,n,e,/*br*/,/*ain*/]. The base level activation differences determine the retrieval time differences, and therefore which words are retrieved sufficiently fast enough to leave time for verification. In the speeded condition, we assume that the participants make sure that their responses are, on average, within the deadline of 500 milliseconds. Given this deadline, the time available is often insufficient time for the verification process. As the high frequent basewords will be retrieved more often than the low frequent basewords, this explains the higher proportion of errors for the high frequent basewords.

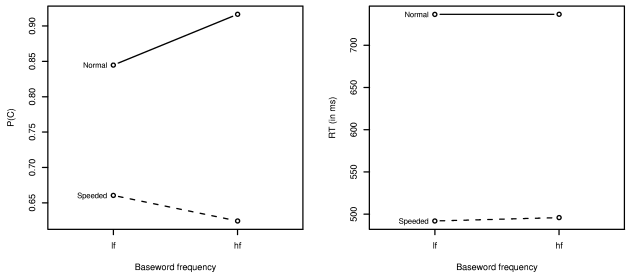

Figure 1. Reaction time and proportion correct data for pseudohomophones derived from high frequent (HF) and low frequent (LF) basewords.

References

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