What's in a word?: A sublexical effect in a lexical decision task

Chris Westbury
Lori Buchanan
Department of Psychology
P220 Biological Sciences Building
University Of Alberta
Edmonton, Alberta T6G 2E5

One of the most robust findings in the single word reading literature is that high frequency words are processed as a unitary whole. The cognitive process by which such words are read has proven to be relatively impervious to the disparate influences which can systematically affect reading of other word types, such as regularity (Andrews, 1982; Jared & Seidenberg, 1990) and pronunciation consistency (Glushko, 1979, Jared et al., 1990- but see also Jared, 1997). In this paper we present evidence that the process by which high frequency words are read can be affected by a systematic manipulation of a sublexical feature of those words. Sublexical orthographic features are of particular theoretical interest because they can be controlled in the same manner for both words and nonwords. Having such control may make it possible to make new inferences about the timing and structure of single word processing. If we can identify features that affect different sets of stimulus categories, it will be possible to infer that certain types of cognitive operations must operate only across certain types of stimuli. With a sufficient number of differential effects, inferences about which categories of words and nonwords were processed together, and for how long, may become possible. Such inferences require that several sublexical features with differentiable effects be identified. In this study we examine the role the sublexical feature of minimal bigram frequency.

We examined the effect the frequencies of two-letter pairs within letter strings (bigram frequencies) on a lexical decision task. The stimuli we used were selected on the basis of the frequency of the least-frequent bigram in each (word or nonword) letter string. We hypothesized that words with high minimal bigram frequencies would bias the word reading system towards using subprocesses specialized for high frequency words. We therefore expected faster lexical decision times among high frequency words with high minimal bigrams, and slower times among low frequency words and nonwords with high frequency minimal bigrams, as compared to stimuli closely matched on all characteristics except minimal bigram frequency.

Method/Subjects

79 native English undergraduate subjects participated.

The stimuli we used were selected from a database of 4251 words and 2946 nonwords for which we have computed a wide range of lexical and sublexical measures. The nonwords were a subset (selected for phonological consistency and length 12) from a larger set of nonwords randomly generated using pair-wise Markov chaining of the words. This stochastic computational method of generating nonwords guarantees that every nonword contains only bigrams of the same frequency as the words, and that the distribution of bigrams among the nonwords is roughly identical to the distribution among the words. The 240 stimuli used in this experiment were comprised of 30 high and low frequency words with high minimal bigram frequencies, 30 high and low frequency words with low minimal bigram frequencies, 60 nonwords with high minimal bigram frequencies, and 60 nonwords with low minimal bigram frequencies.

Results

High frequency words with high minimal bigrams are recognized more slowly (average = 596.9 msecs.) than high frequency words with low minimal bigrams (average = 576.6 msecs.). In contrast, there is no significant difference between words with high (average = 695.1 msecs) and low (average = 701.4) minimal bigrams within the low frequency category of words ($t(78) = -0.9$; $p > 0.05$). Subjects were significantly slower ($t(78)=6.84$; $p < 0.001$) in correctly classifying nonwords with low minimal bigrams (average RT = 837.1 msecs.) than they were at correctly classifying nonwords with high minimal bigrams (average RT = 804.4 msecs).

Conclusion

The reading system is sensitive to minimal bigram frequency; however, our findings were in the opposite direction of the predicted pattern. Instead of specifically facilitating lexical decision among high frequency words, a high frequency minimal bigram within a word slows down reaction times for high frequency words only. This effect of minimal bigram frequency is reversed among nonwords. Correct reaction times to nonwords are significantly faster when the nonword contains a high frequency minimal bigram.

References

Andrews, S. (1982). Phonological recoding: Is the regularity effect consistent? *Memory And Cognition, 10*, 565-575.

Glushko, R.J. (1979). *The organization and activation of orthographic knowledge in reading aloud.* Journal Of Experimental Psychology: Human Perception and Performance, 5, 674-691.

Jared, F., McRae, K., & Seidenberg, M.S. (1990). *The basis of consistency effects in word naming.* Journal of Memory and Language, 29, 687-715.

Jared, D. & Seidenberg, M. (1990). *Naming multi-syllabic words.* Journal Of Experimental Psychology: Haumn Perception & Performance, 16, 92-105.

Jared, D. (1997). *Consistency effects in high-frequency words.* Journal Of Memory And Language, 36:505-529.