Commentary on Reichle, Rayner, & Pollatsek.

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Please stop using word frequency data that are likely to be word length effects in disguise.

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Abstract

Reichle et al. claim to successfully simulate a frequency effect of 60% on skipping rate in human data, whereas the original article reports an effect of only 4%. We suspect that the deviation is due to the length of the words in the different conditions, which implies that E-Z Reader is wrong in its conception of eye guidance between words.

A computational model is as good as the data it simulates. This is why Reichle and collaborators rightly pride themselves about the good fit of the model's outcome with human data. The human data predominantly come from a reading study reported by Schilling et al. (1998) in which 30 college students read 48 sentences. According to Figure 6, the observed frequency effects in this study were roughly 70 ms for gaze duration, 30 ms for first fixation duration, and a 60% for word skipping rate. What Reichle and collaborators did not mention, is that the Schilling et al. study was originally designed to look at the word frequency effect under very controlled circumstances (i.e., with words that were matched on all other variables except for word frequency, and with sentence context that constrained the target words equally). Each participant saw a number of sentences with low frequency words (2 per million) and a number of sentences with high frequency words (141 per million). These frequencies probably

coincide with the frequency classes 1 and 5 of Figure 6 in the present target article. If we look at the data reported by Schilling et al. for these particular stimuli, we obtain a frequency effect of 67 ms for gaze duration, 35 ms for first fixation duration, but only 4% for skipping rate ("Subjects fixated on HF words 89% of the time and on LF words 93% of the time", p. 1272). That is, for this particular subset of well-controlled stimulus words in Schilling et al., the effects for gaze duration and first fixation duration agree well with the overall data used by Reichle et al., but this is not true for the skipping rate. How comes that E-Z Reader "correctly" simulates a 60% difference in skipping rate between low-frequency and high-frequency words, whereas in the human data there was only a 4% difference due to word frequency?

After a review of all previously published word skipping data, Brysbaert and Vitu (1998) concluded that the frequency effect on word skipping is 4% on average (i.e., exactly the effect reported by Schilling et al. as well), and that the effect was 9% for contextual predictability (i.e., very predictable words in a sentence are skipped on average 9% more often than unpredictable words). In addition, they observed a 60% difference due to word length: 2-letter words are skipped more than 60% of the time, whereas 10-letter words are virtually never skipped in first-pass reading. To us, these data strongly suggest that what Reichle et al. simulate in the lower part of Figure 6 is not so much a frequency effect on skipping rate but a word length effect on skipping rate. The authors themselves are clearly aware of this problem, because in Rayner, Reichle, & Pollatsek (1998, p. 256, footnote 3) they wrote: "In our modelling, to minimize the number of parameters, we did not distinguish between frequency and word length effects. Thus "frequency effects" in our model are really a combination of frequency and word length effects because the two are highly correlated in our sample of text as in printed English in general." For this reason, we were very surprised to see that in the present article they still refuse to report the data separately for word length and word frequency, even though the current model is supposed to have a mechanism to deal with the effects of the length of the parafoveal word (see Equation 1). What we ask, is that Reichle and collaborators give us a figure in which the word skipping rates of the Schilling et al. corpus are shown as a function of word length and word frequency, together with the predictions of E-Z Reader. If these provide a good fit, we will rest our case. However, we strongly suspect that the model will largely overestimate the effect of frequency and underestimate the effect of word length. For this reason, until proven wrong, we still believe that E-Z Reader is fundamentally flawed in its conception of interword behavior in general and word skipping in particular.

References

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