Prediction accuracy facilitates processing of visual word form.
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In sentence processing, word retrieval is facilitated in predictable contexts, as is evidenced from faster response times in naming and lexical decision, fewer and shorter fixations during natural reading, anticipatory eye movements in visual world experiments, and reduced N400s in ERP experiments (Schwanenflugel &Shoben, 1985; Altmann & Kamide, 1999; Federmeier & Kutas, 1999). ERP evidence has shown that predictive effects are separate from and precede contextual integration (Brother et al., 2015). The precise nature of the processes that generate predictions and the types of linguistic representations that are affected by prediction remain unclear. We designed this study to produce evidence regarding the types of representations that may be affected by prediction during language processing. In particular, we tested whether anticipatory processes pre-activate word form information in a priming paradigm.

To test whether word form information is pre-activated by anticipatory processes, we asked participants (N-198) to predict target words in a priming study followed by a lexical decision task (adapted from Brothers et al, 2015; Dave et al, 2018). Participants read lists of words comprising prime and target pairs. They were asked to actively predict the upcoming target after reading the prime word, and to perform a lexical decision task on the target. On related trials, the prime and target words had a forward association strength of .5 (*circus - CLOWN; trim - CUT*). On unrelated trials, the forward association strength was 0 (trim - *CLOWN*; circus - *CUT*). Each participant read 480 sets of word-word pairs, and 125 filler sets of word-non word pairs (*cartoon-CRECKED; detail – NELB*; to generate "no" responses) None of the words were repeated within subjects, but the same target words occurred in both related and unrelated conditions across different lists. Participants completed the experiment online via PCI Ibex. Readers were presented with the first word, followed by a 1800ms delay, during which they were asked to generate a prediction of the second word based on the meaning of the first word. Then, the second word or non-word target appeared. Subsequently, readers were asked to perform two consecutive tasks: 1) speeded lexical decision: indicate whether the target is a real word in English or not; 2) prediction: indicate whether their prediction matched the second word they saw. We compared the lexical decision RTs to the target words based on prediction accuracy and relatedness (accurately predicted related vs. unpredicted related, vs unrelated – unpredicted related words).

We subjected the RT data to linear mixed-effects models with RT as the dependent measure and fixed effects of condition. We found a significant effect of prediction accuracy (Figure 1). Lexical decisions were faster for related words when they were accurately predicted than when they were unpredicted. However, there was no difference in RT latency between the unpredicted related and the unpredicted unrelated target words, suggesting that there was no effect of semantic matching when the words were not accurately predicted.

If lexical form information is pre-activated as a consequence of successful prediction, we should observe smaller effects of lexical variables such as length for accurately predicted words compared to words that were unpredicted or unrelated. To test this, we included word length along with prediction success vs. failure in an additional LMER. We found a significant interaction of prediction accuracy and length (*b=4, SE=1.45,* $\chi^2(1) = 8.24,$ $p < .05$). When words were not predicted, we found a main effect of length (driven by very long words > 9chars; mean target length = 5 chars); this effect was not present for successfully predicted words (Figure 2).

In conclusion, we found that prediction success led to faster lexical decision times. Importantly, accurate prediction eliminated word length effects, indicating that the actual word form had been pre-activated prior to presentation of the target words. Hence, anticipation of words during language processing may operate in a similar fashion to word identification and lexical access during reading of words.
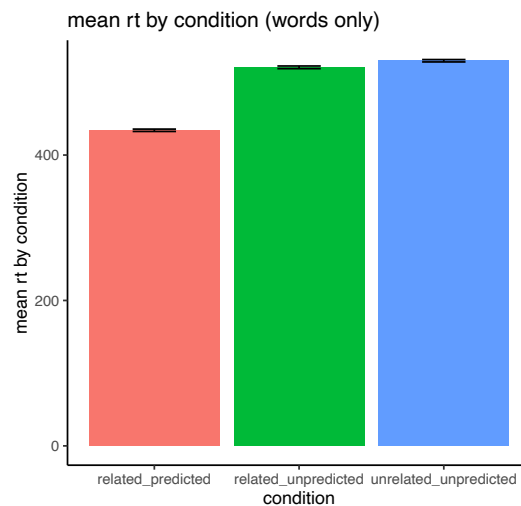
Supplemental materials

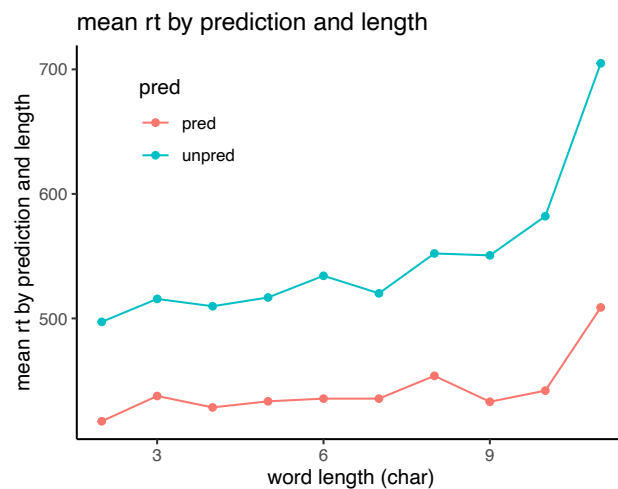Figure 2. Mean response time as a function of condition.

Figure 1. Mean response times as a function of word length for predicted and unpredicted words.

References

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