Rational adaptation in lexical prediction: The influence of prediction strength
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Recent studies indicate that the processing of an unexpected word entails additional costs when the initial prediction was strong (e.g. Federmeier et al., 2007). This was suggested to stem from a commitment made to the initial (strong) prediction, requiring its inhibition in order to integrate the actual input (e.g. Ness & Meltzer-Asscher, 2018). Additional studies show that comprehenders rationally adapt their predictions in different situations (e.g. Delaney-Busch et al., 2019).

In the current study we hypothesized that since the disconfirmation of strong predictions incurs processing costs, it would also trigger adaptation mechanisms. We tested whether repeated disconfirmation of strong predictions throughout the experiment results in lesser commitment to predictions in later trials, reflected in reduced costs for unexpected words. The experiment (N=120) included two-word phrases in which the first word was either highly constraining (e.g. ‘global’ strongly predicts ‘warming’) or not (e.g. ‘green’ does not have any highly probable completion). The second word was unexpected (i.e. low cloze) in both cases, e.g. ‘global epidemic’ (HL - high constraint, low cloze), ‘green pepper’ (LL). Filler trials were manipulated between participants; half of the participants encountered a high proportion of HL trials, and half - a high proportion of LL trials. Participants had to respond whether the phrase was anomalous as quickly as possible after seeing the second word.

Results showed a main effect of constraint such that reaction times were higher in the HL trials relative to LL, demonstrating costs of disconfirming a strong prediction. Additionally, there was an interaction such that a high proportion of disconfirmed strong predictions reduced the processing costs incurred by HL trials, indicating that participants adjusted the strength of their predictions when strong prediction was discouraged.

We formulated a Bayesian adaptation model whereby inhibition cost was modeled as $\mu*PE$. $\mu$ is the mean of a beta distribution representing the participant’s belief (updated on each trial) about the likelihood of encountering the expected word (i.e. her current estimation of the predictive validity). The initial prior was beta(1, 1), and updating occurs whenever the participant encounters a high-low trial: beta(1, 1+number of HL). PE is the prediction error (the difference between the cloze probability of the most probable word, namely constraint, and the cloze probability of the presented word). We show that this model accounts for the trial-by-trial data, indicating that participants adapt by using their belief about predictive validity to weigh the strength of their subsequent predictions.