Incremental prediction updating through consecutive cues: Evidence from ERPs

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Comprehenders can predict upcoming language based on global context [1-2] and use disconfirming evidence or informative cues to update their predictions rapidly [3-4]. A recent visual-world eye-tracking study investigated comprehenders' ability to use consecutive cues to update predictions for an upcoming noun [5]. They found that Mandarin Chinese listeners were equally quick to use an informative modifier to update their noun prediction, regardless of whether they had just encountered a classifier that contradicted their initial prediction. This suggests that the process of prediction updating is both incremental and rapid and may not incur measurable processing costs from conflict detection and resolution [cf.6]. However, the presence of visually displayed candidate objects allows listeners to identify and encode these objects' locations early on, thereby reducing the cognitive demands associated with updating predictions. Our ERP study, adopted the design of [5], corroborated the hypothesis that comprehenders can use consecutive cues to update prediction incrementally even in the absence of an accompanying visual display.

Method. 38 participants read sentences like (1) (translated from Chinese) presented word by word at a fixed rate. The sentential context was strongly predictive of a particular noun (e.g., "light") but always ended with a relatively unexpected noun (e.g., "candle"). The target noun was preceded by a nominal classifier (specific vs. general) and a modifier (informative vs. uninformative), resulting in a 2×2 design. The general classifier was compatible with a variety of nouns, including both "light" and "candle". In contrast, the specific classifier was congruent with "candle" but not with "light". Meanwhile, the uninformative modifier was compatible with many different nouns, whereas the informative modifier distinctly suggested "candle" and was incompatible with "light". Both the specific classifier and the informative modifier served to disconfirm the initially expected noun and make the originally unpredictable noun more likely.

(1) Since the night was so dark, to read the words in the book more clearly, Jack brought over ...

(a) one **CL_{zhi}** {burning / spare} candle … (*Prediction-inconsistent, specific classifier*)

(b) one **CL_{ge}** {burning / spare} candle … (*Prediction-consistent, general classifier*)

Results. The mean N400 amplitude at the critical noun in each trial was calculated using a 300-500ms window at five centro-parietal electrodes ([7]). The linear mixed effects model revealed a significant main effect of classifier ($\beta = 0.28$, $p < .05$); nouns preceded by a specific classifier elicited a reduced N400 response compared to those preceded by a general classifier. Additionally, a significant main effect of modifier ($\beta = 0.66$, $p < .001$) revealed a smaller N400 response for nouns following an informative modifier than an uninformative one. The interaction between classifier and modifier was not significant ($\beta = -0.07$, $p > .1$), indicating that the classifier type did not influence the modifier's effect on the N400 at the noun. In the subsequent 500-800 ms time window, mean amplitudes were assessed at seven frontal electrodes. The main effect of modifier was marginally significant ($\beta = -0.22$, $p < .1$). Neither the main effect of classifier nor the interaction term was significant (both ps > .1).

Conclusion. Extending beyond prior eye-tracking research [5], we asked whether comprehenders can update their prediction using consecutive cues in the absence of a visual display of candidate objects. We found that comprehenders' N400 response to the critical noun was reduced when it followed an informative modifier, no matter whether the preceding classifier disconfirmed the comprehenders' initial prediction or not. Comprehenders can use consecutive cues to update their predictions rapidly, without incurring significant costs associated with earlier prediction disconfirmation, even in the absence of visual information.

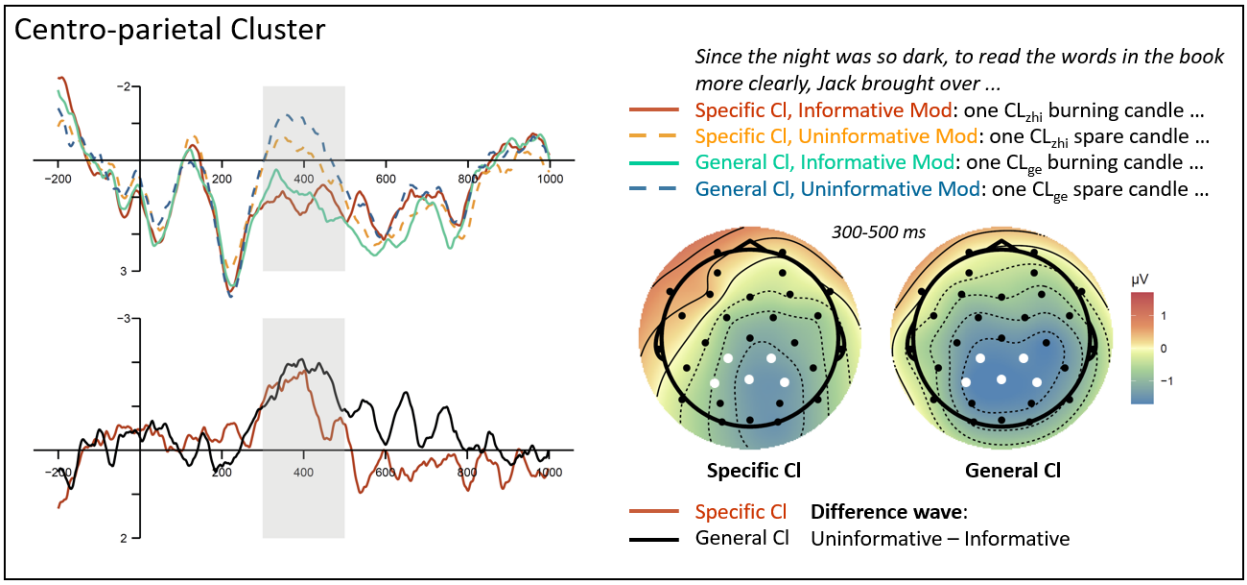

Figure 1. **Left top**: Average ERPs in four conditions in the centro-parietal cluster. **Left bottom**: Difference between informative and uninformative modifier conditions within each classifier condition. **Right**: The topographic distribution of the effects of modifier on the critical noun in the 300-500 ms time window in each classifier condition.

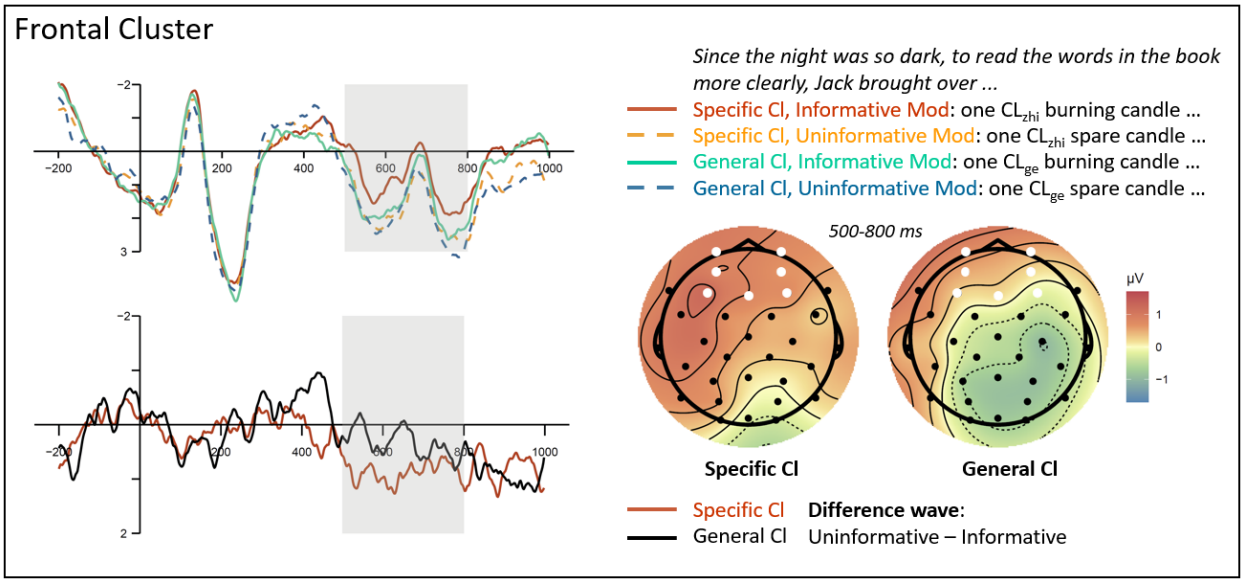

Figure 2. **Left top**: Average ERPs in four conditions in the frontal cluster. **Left bottom**: Difference between informative and uninformative modifier conditions within each classifier condition. **Right**: The topographic distribution of the effects of modifier on the critical noun in the 500-800 ms time window in each classifier condition.

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