Dissociating top-down preactivation and bottom-up priming in prediction updating

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Research has shown that comprehenders can use local informative cues to update predictions for upcoming nouns: upon encountering a prenominal cue that conflicts with their initial noun predictions, comprehenders can use this cue to pre-activate a previously unexpected noun [1-2]. However, some evidence suggested that even nouns that are implausible or unrelated to the global discourse context may become pre-activated if they are associated with the prenominal cue [3]. In this event-related potential (ERP) study, we aimed to disentangle pre-activation driven by top-down global context from that driven by bottom-up lexical association. We used a local cue to disconfirm an existing noun prediction and examined comprehenders' sensitivity to the plausibility of previously unexpected nouns that matched that local cue. The results revealed that local information consistently pre-activated related lexical representations, regardless of their plausibility within the global context. These findings suggest that top-down and bottom-up processes play independent roles in prediction updating.

Methods. Participants (n = 44) read Chinese sentences word by word at a fixed rate (SOA = 600 ms). A total of 108 sets of the experimental sentences, such as (1), were designed to be highly predictive of a specific noun ("broom"). However, they were always continued with an unexpected noun that was either plausible ("soap") or implausible ("cake") within the global context. We also manipulated the nominal classifier preceding the target noun. The specific classifier was incompatible with the most expected noun ("broom") but equally compatible with both the plausible and implausible target nouns ("soap" and "cake"; "cake" was drawn from the plausible noun in another experimental item), offering comparable local support regardless of global plausibility. In contrast, the general classifier was compatible with all three nouns and therefore uninformative. Participants rated the plausibility of each sentence on a scale from 1 (very implausible) to 5 (very plausible). Fifty-four filler sentences containing expected nouns were included to ensure a 1:1:1 ratio of expected, unexpected-but-plausible, and implausible sentences, thereby encouraging participants to use the full range of the scale.

(1) (originally in Chinese) To clean the dirty floor, Wang Fang went to the storage room to get one {$CL_{kuai\ (specific)}$ / $CL_{ge\ (general)}$} {soap $_{(plausible)}$ / cake $_{(implausible)}$} ……

Results. We analysed comprehenders' average ERP response at the target noun using linear mixed-effects models. In the 300-500 ms window, unexpected-but-plausible nouns elicited a significantly smaller N400 response than implausible nouns. Additionally, nouns preceded by a specific classifier exhibited a reduced N400 response compared to those preceded by a general classifier. While the classifier effect was smaller in magnitude than the noun effect, no significant interaction between the two factors was observed. In the post-N400 window (500-800 ms), implausible nouns elicited a greater positivity than unexpected-but-plausible nouns over posterior electrodes. The classifier effect remained significant during this time window, with nouns preceded by a specific classifier eliciting more positive ERPs than those preceded by a general classifier. No significant interaction between classifier type and noun type was found.

Conclusion. We set out to examine the mechanisms underlying prediction updating by attempting to dissociate the contributions of global and local context. Our findings indicate that local informative cues facilitate retrieval of a subsequent noun regardless of its plausibility within the global context, suggesting independent effects of global and local context in prediction updating. In the post-N400 window, implausible nouns elicited a late posterior positivity, reflecting increased difficulty in integrating the noun into the preceding context. The main effect of classifier in the late time window might suggest prolonged difficulty of integrating a previously unexpected noun which receives local contextual support.

Sample sentence materials:

为了打扫脏兮兮的地板，王芳到储藏室拿了一 …

To clean the dirty floor, Wang Fang went to the storage room to get …

(a) Specific Cl – Plausible N:

一　块　肥皂 …

one CL_{kuai} soap …

(b) General Cl – Plausible N:

一　个　肥皂 …

one CL_{ge} soap …

(c) Specific Cl – Implausible N:

一　块　蛋糕 …

one CL_{kuai} cake …

(d) General Cl – Implausible N:

一　个　蛋糕 …

one CL_{ge} cake …

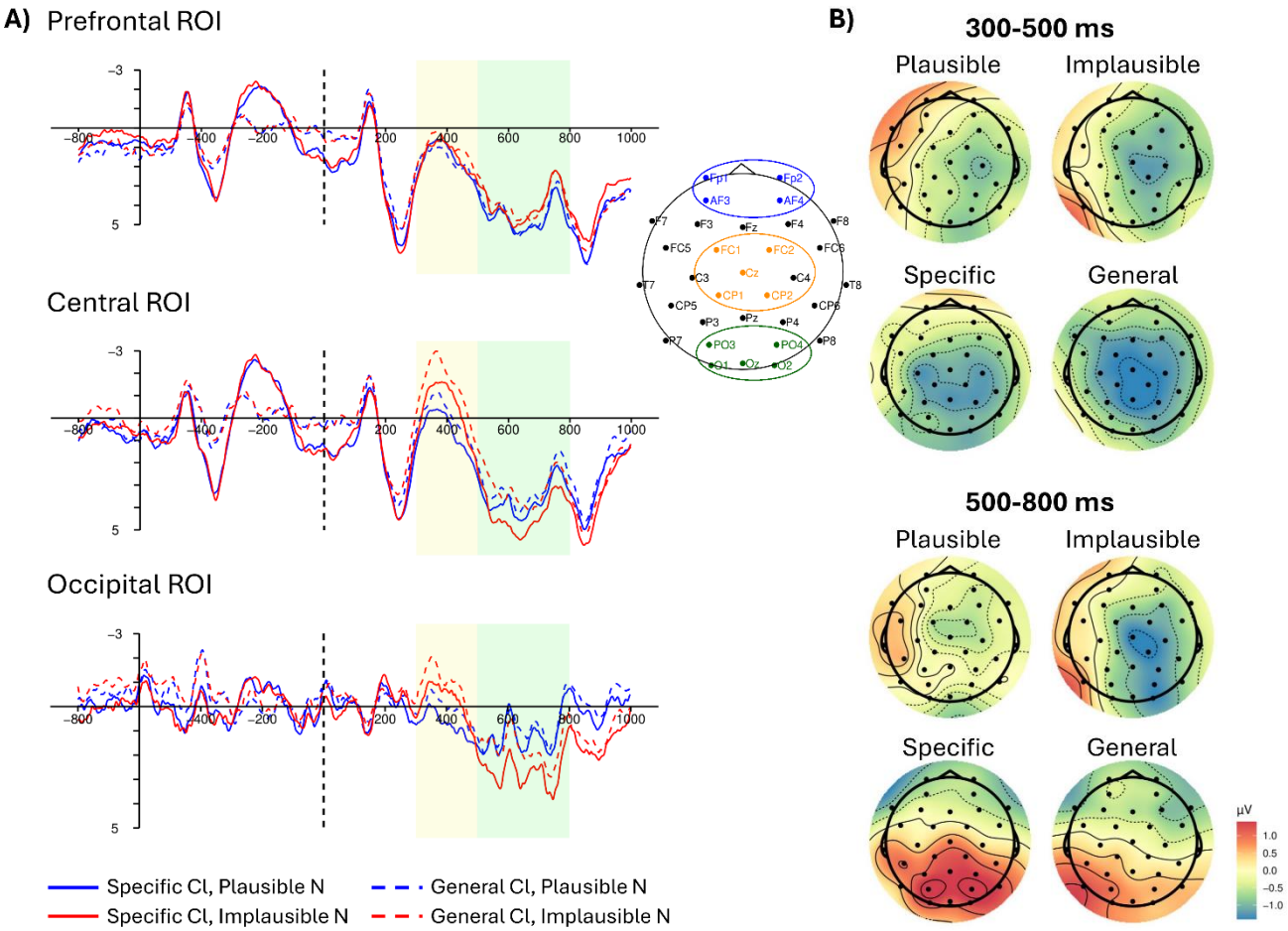

Fig 1. (A) Average ERPs across the three ROIs, with time 0 ms and the vertical dashed line indicating target noun onset. (B) Topographic distributions of the effects of classifier (general minus specific) and noun (implausible minus plausible) across the two time-windows.

Reference

[1] Chow, W.-Y., Chen, D., & Wang, S. (2019). Immediate revision of disconfirmed predictions: Evidence from Eye-tracking and ERPs [Poster presentation]. The 32nd annual CUNY Human Sentence Processing Conference, Boulder, CO.

[2] Szewczyk, J. M., Mech, E. N., & Federmeier, K. D. (2022). The power of “good”: Can adjectives rapidly decrease as well as increase the availability of the upcoming noun? *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 48(6), 856–875.

[3] Szewczyk, J. M., & Wodniecka, Z. (2020). The mechanisms of prediction updating that impact the processing of upcoming word: An event-related potential study on sentence comprehension. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 46(9), 1714–1734.