

### **Conflict Resolution during Sentence Processing Elevates Proactive Cognitive Control.**

During language comprehension, interpretations are dynamically influenced by multiple cues. When these cues conflict, comprehenders may activate multiple, incompatible interpretations. For example, in the sentence “*The bathroom floor was mopping*”, the comprehender might consider either an implausible interpretation based on morphosyntactic cues (*floor* as the Agent of *mop*) or a plausible one that disregards these cues (*floor* as the Theme of *mop*). While cognitive control is thought to resolve such conflicts by prioritizing certain cues over others, it remains unclear how this process modulates reliance on reliable cues like world knowledge. This study investigated the neural mechanisms underlying these dynamics, focusing on theta-band neural oscillations as an index of cognitive control.

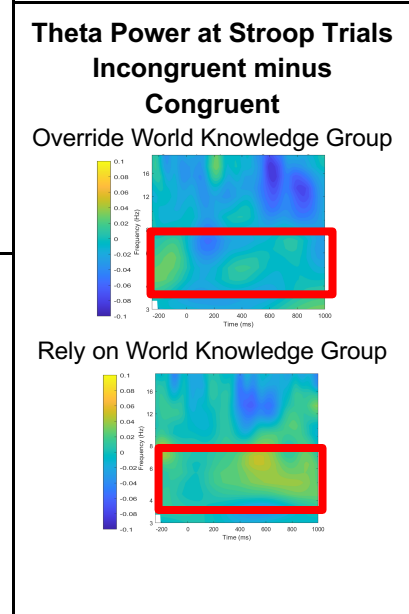
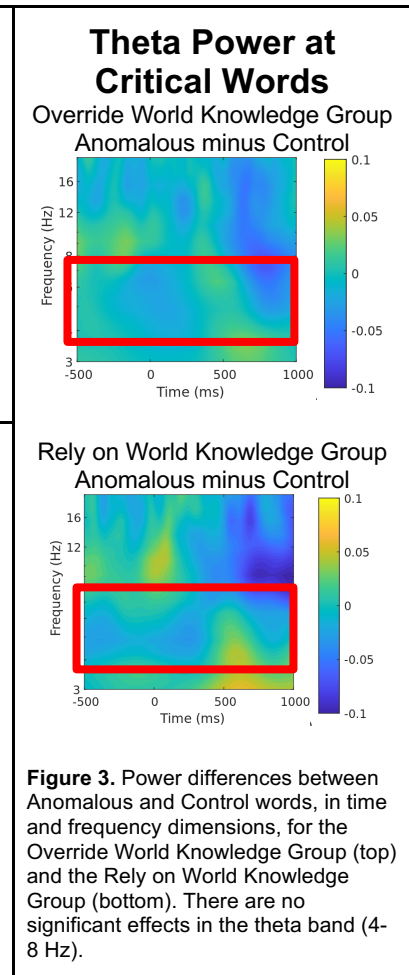
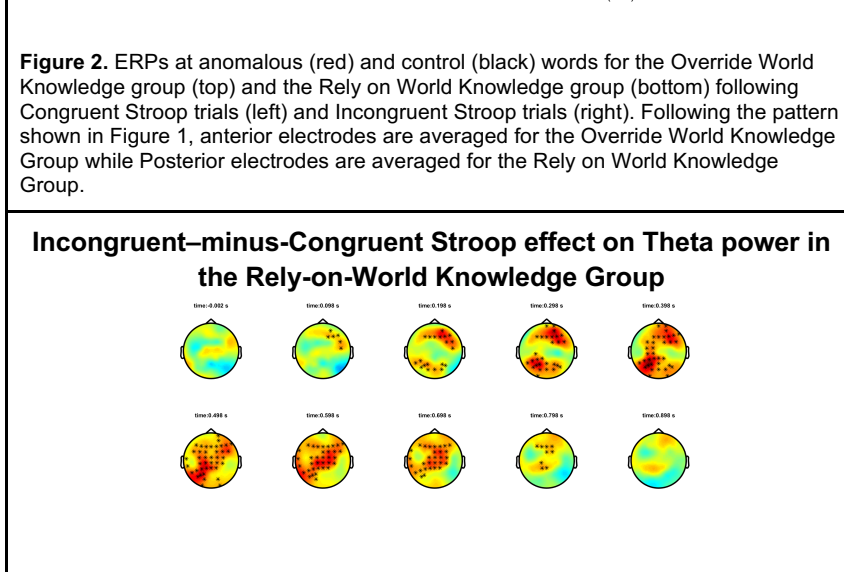
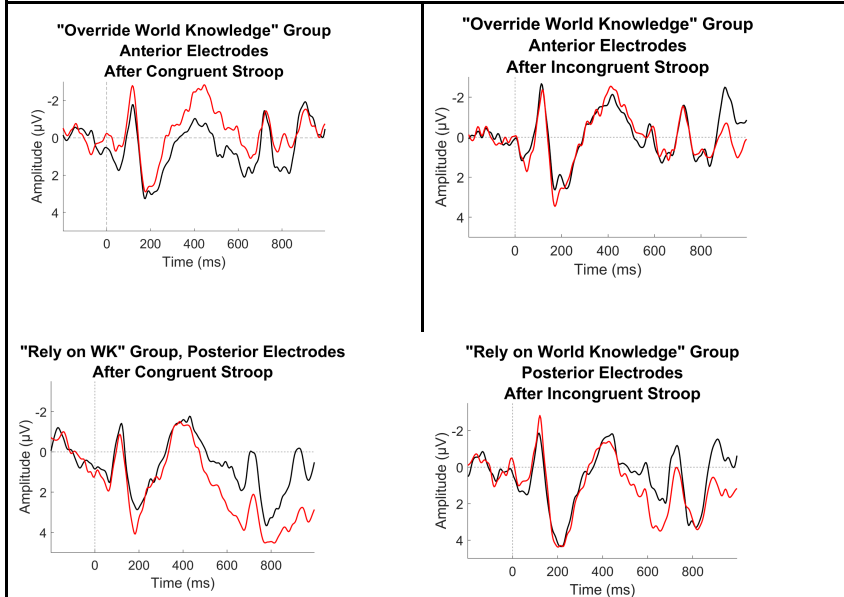
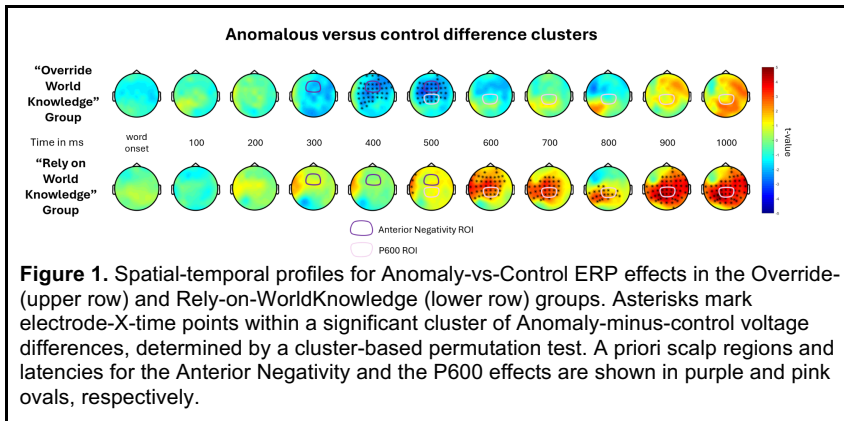
Participants read English sentences containing Semantic Attraction Anomalies or Baseline constructions (*The bathroom floor was mopping/mopped ...*) while EEG was recorded. Sentence reading trials were interspersed with Stroop-task trials, which are known to engage cognitive control, to assess how shifts in cognitive control state influenced sentence processing. Participants were divided into two groups with different task instructions. The Rely-on-WorldKnowledge group was told to mentally repair speaker errors to render sentences plausible. The Override-WorldKnowledge group was instructed to imagine cartoon-like scenarios, which accommodated the syntactic cues but required defying strong world knowledge cues. Previous work found that critical words (e.g., *mopping*) elicited P600 ERP effects relative to baseline (e.g., *mopped*) in the Rely group, which can be interpreted in terms of operations to syntactically repair the anomalous word (**Figure 1&2, bottom row**). Meanwhile, the same critical words elicited anterior negativities in the Override group, which may reflect computation of a creative interpretation that accommodates the syntactic cues but defies world knowledge (**Figure 1&2, top row**; Ness et al., 2022).

We tested the hypothesis that Semantic Attraction Anomalies would engage cognitive control, reflected in increased theta power, specifically in the Override group and not the Rely group. This is because the Override group’s task of suppressing a highly plausible, world-knowledge-consistent interpretation imposes demand on cognitive control mechanisms. In contrast, the Rely group could easily render the sentence plausible by mentally editing the critical verb to accommodate the strong world knowledge cues, requiring relatively little cognitive control. Contrary to our primary hypothesis, Semantic Attraction Anomalies did not elicit greater theta activity compared to Baseline sentences, in either participant group (**Figure 3**). Therefore, we found no evidence in the grand average data (across both groups) that the anomalies engaged cognitive control more than the Baseline sentences, despite the cognitive control required to resolve the representational conflict.

We also predicted that theta activity would be greater in Incongruent than Congruent Stroop trials, given that this effect has been widely observed. Our hypothesis was only partially confirmed: theta power was greater in Incongruent versus Congruent trials, specifically in the Rely group and not the Override group (**Figure 4**). We tentatively conclude that the pattern of Stroop theta effects stems from different levels of proactive cognitive control in the two groups. In the Override group, participants are required to repeatedly resolve conflicts by computing an implausible interpretation that defies strong WorldKnowledge cues. We suggest that these participants may enter a state of heightened readiness to engage cognitive control in both Incongruent and Congruent Stroop trials, yielding equal levels of theta activity for these two conditions. Meanwhile, in the Rely group, participants do not face frequent conflict situations, and their level of proactive control is therefore lower. For these participants, Incongruent Stroop trials engage more reactive cognitive control than do Congruent trials, resulting in a difference in theta power between these two conditions. Overall, the results are consistent with modulations in proactive cognitive control, driven by the demands of sentence processing.

#### **References**

Ness, T., Langlois, V., Kim, A.E., Novick, J.M., Cognitive control in language processing: the influence of cue reliability, poster presented at the 2023 Annual Meeting of the Human Sentence Processing Society, Pittsburgh, PA.



**Figure 4.** Incongruent-minus-Congruent differences in oscillatory activity over time, averaged across all electrodes, are shown on the right side of the figure for the Override-WorldKnowledge Group (top right) and the Rely-on-WorldKnowledge Group (bottom right). The spatio-temporal profile of the significant cluster in the Rely-on-WorldKnowledge Group is shown directly above. The space X time points that are part of the cluster are marked with an asterisk.