Task-Dependent Noisy-Channel Processing in Syntactically Ambiguous Sentences

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This study investigates how task demands modulate sentence processing in temporarily ambiguous garden-path sentences, evaluated within a noisy-channel perspective on comprehension. In sentences such as *While the man hunted the deer ran into the woods*, comprehenders often arrive at "good-enough" interpretations, frequently endorsing plausible but incorrect meanings (e.g., that the man hunted the deer) [1,2]. From a noisy-channel perspective, such interpretations arise because comprehenders integrate bottom-up input with prior expectations about plausible events, favoring interpretations that are more likely given real-world knowledge when the input is uncertain or difficult to process. Persistent misinterpretations in garden-path sentences suggest that plausibility-based inference can override syntactic structure [2,3].

Two ERP experiments examined whether task demands influence the extent to which comprehenders rely on such inference. Native English speakers read ambiguous and unambiguous sentences word-by-word while EEG was recorded, followed by comprehension questions. In Experiment 1, participants answered standard questions (e.g., *Did the man hunt the deer?*), which allow inference-based responses. In Experiment 2, participants answered "explicit" questions (e.g., *Did the sentence explicitly say that the man hunted the deer?*), designed to discourage inference and emphasize the literal input.

Behavioral results showed that ambiguous sentences elicited significantly more comprehension errors than unambiguous sentences in both experiments. However, explicit questions reduced erroneous "yes" responses by approximately 10%, indicating reduced reliance on plausibility-based inference. ERP results revealed a corresponding shift in processing mechanisms. In Experiment 1, ambiguous sentences elicited a robust P600 effect at the disambiguating verb (Figure 1), consistent with syntactic reanalysis [4,5]. In contrast, Experiment 2 elicited an N400 effect followed by a sustained frontal negativity (Figure 2). The N400 reflects increased difficulty integrating the literal input when it conflicts with strong prior expectations, while the sustained frontal negativity likely reflects prolonged conflict resolution between competing interpretations.

These findings suggest that noisy-channel inference is not obligatory but is modulated by task demands. When tasks permit inference, comprehenders rely more heavily on prior expectations, leading to "good-enough" interpretations; when tasks emphasize literal meaning, they down-weight priors and engage in more effortful evaluation of the input. Overall, the results demonstrate that sentence processing reflects a flexible balance between bottom-up input and top-down expectations.

References

[1] Christianson et al. (2001). *Cognitive Psychology.* [2] Ferreira et al. (2001). *Journal of Psycholinguistic Research.* [3] Qian & Dell (2024). *Psychonomic Bulletin & Review*, [4] Osterhout & Holcomb (1992). *Journal of Memory and Language.* [5] Hagoort et al. (1993). *Language and Cognitive Processes*.

Figure 1. Grand average ERPs for the disambiguating verb in Experiment 1.

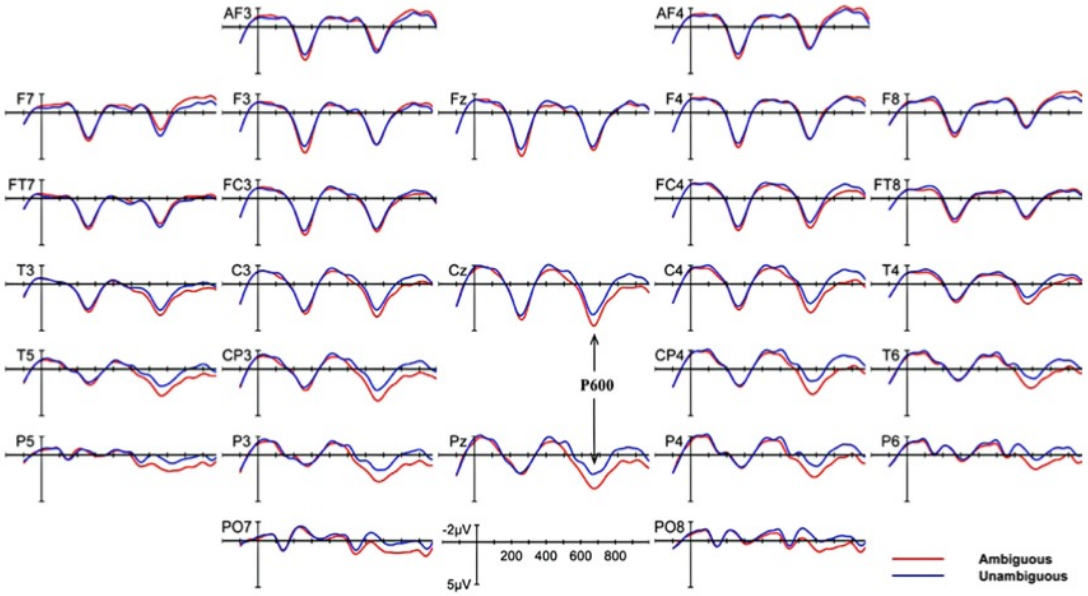

Figure 2. Grand average ERPs for the disambiguating verb in Experiment 2.