

### Give me several hundred more milliseconds: the temporal dynamics of verb prediction

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Many studies have shown that the EEG N400 component shows fine-grained sensitivity to the cloze probability and/or plausibility of incoming words (Kutas & Hillyard 1980; van Berkum, 2009). Against this backdrop, a surprising finding in recent years is that cloze/plausibility manipulations created by argument role-reversals fail to impact N400 effects (Kim & Osterhout 2005, Kolk et al. 2003, Kuperberg et al. 2003, a.o.), as in manipulations of verb morphology such as *The hearty meal was {devoured | devouring}*. Accounts of this effect agree that it reflects the fact that the improbable/implausible verbs are closely semantically associated with the preceding nouns, but accounts diverge on why close association makes the N400 'blind' to the large cloze/plausibility contrasts. According to the *independent semantic composition* account, the effect reflects semantic combinatorial processes initiated when the critical verb arrives (Kim & Osterhout 2005). According to the *delayed prediction* account, the effect reflects predictive processes that occur before the critical verb: lexical associations generate predictions more rapidly than argument role information (Chow et al. 2014). We present evidence from an EEG study in Japanese that clearly favors the delayed prediction account: simply delaying the verb by 400ms heals N400 blindness.

Japanese offers a valuable test case because it is strongly verb final, i.e., speakers are accustomed to predicting verbs, because it clearly signals argument roles via case morphology, and because it allows liberal argument drop, such that two word sentences (subject + verb, object + verb) are entirely natural. We manipulated the cloze/plausibility of Japanese verbs by varying the case marking on a pre-verbal noun (canonical vs. reversed), counterbalancing across case forms. We additionally manipulated the time delay between the noun and the verb: the stimulus onset asynchrony (SOA) was 800ms in the short conditions and 1200ms in the long conditions. Japanese speakers (n=24) read 160 fully grammatical sentences like (1-2), combined with 160 fillers, and made plausibility judgments (with a 1-second delay).

1. High cloze/plausible: a. 蜂が 刺す bee-NOM sting b. 魚を 釣る fish-ACC hook
2. Low cloze/improbable: a. 蜂を 刺す bee-ACC sting b. 魚が 釣る fish-NOM hook

ERPs time-locked to the verb onset showed a clear N400 effect due to the cloze/plausibility manipulation in the long SOA conditions (Figure 1a), but not in the short SOA conditions (Figure 1b), demonstrating that the time elapsed after the noun+case information affected how the verbs were processed. Furthermore, the N400 difference in the long SOA conditions likely reflected a reduction in the N400 amplitude in the canonical sentences, as evident in the comparison to the short canonical condition (Figure 1c). This suggests that the observed N400 effect reflects facilitated processing of verbs in the canonical sentences rather than better detection of semantic anomaly in the role-reversed sentences.

To our knowledge, this is the first evidence that N400 blindness to cloze/plausibility contrasts can be healed simply by adding time. ERPs at the nouns themselves indicate that the case morphology is rapidly recognized, and so we argue that the role of additional time is specifically to allow the grammatical-relational cues to generate more specific verb predictions. We propose that this type of prediction fine-tuning is slow because argument role information is not directly used to probe event information in memory, but instead is used to filter candidate verbs that are initially generated based on lexical associations.

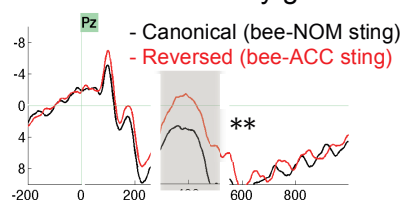


Figure 1a: ERP to verbs in long SOA conditions.

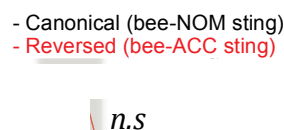


Figure 1b: ERP to verbs in short SOA conditions.

- Short-Canonical  
- Long-Canonical  
- Long-Reversed

Figure 1c: ERP to verbs in short- vs. long-canonical & reversed conditions.