

Parallel semantic processing in the flankers task: Evidence from the N400

Gabriela Meade^{a*}, Mathieu Declerck^b, Phillip J. Holcomb^c, & Jonathan Grainger^d

^a Joint Doctoral Program in Language and Communicative Disorders, San Diego State University & University of California, San Diego

^b Linguistics and Literary Studies Department, Vrije Universiteit Brussel

^c Department of Psychology, San Diego State University

^d Laboratoire de Psychologie Cognitive, CNRS & Aix-Marseille Université

*meade.gabriela@gmail.com

The extent to which higher-order representations, such as semantics, can be extracted from more than one word in parallel is an unresolved issue with theoretical import. Serial attention shift models posit that semantic information can only be accessed from one word at a time (e.g., Reichle et al., 1998), whereas parallel models allow for the extraction of semantic information from more than one word simultaneously (e.g., Kliegl et al., 2006; Snell et al., 2018). These models have largely been developed based on eye-tracking and behavioral data, which are indirect measurements of lexico-semantic processing.

Here, we used event-related potentials (ERPs) and the flankers task to more directly investigate the extent to which semantic information is extracted from parafoveal words. The N400 component of the ERP waveform is associated with lexico-semantic processing, with a smaller N400 amplitude indicative of facilitated processing. N400 amplitude was measured 300-500 ms after stimulus onset. Triads of words were presented for 170 ms. Participants (N=24) were asked to focus on the foveal target word and to determine whether or not it was an animal name. The animal status of targets and flankers was manipulated orthogonally (see Table 1), yielding four conditions that were closely matched for other variables known to affect N400 amplitude (e.g., frequency, orthographic similarity). Animal targets and flankers were chosen to be as semantically related as possible.

Non-animal targets elicited slower behavioral responses when presented with an incongruent flanker compared to a congruent flanker, $F(1,23) = 31.11$, $p < .001$, $\eta_p^2 = .57$, which we suggest is indicative of response competition. There was no significant effect of flanker type on N400 amplitude for the non-animal targets, all $ps > .09$, which was expected given that the flankers and targets were not semantically related in either condition (see Figure 1).

A different pattern was observed for animal targets. While the behavioral responses did not show any effect of flanker type, $F(1,23) = 1.03$, $p = .321$, $\eta_p^2 = .04$, N400 amplitude was significantly reduced for animal targets presented with congruent flankers compared to those presented with incongruent flankers, $F(1,23) = 6.95$, $p = .015$, $\eta_p^2 = .23$ (see Figure 2). These N400 results indicate that semantic information can be extracted from parafoveal words in parallel. We suggest that the N400 effect is driven by the co-activation of compatible semantic features that are shared between the target and flankers when these are related (e.g., animal, four legs, furry, etc.).

Table 1. Stimuli

		Target	
		Animal	Non-Animal
Flanker	Congruent	<i>newt gecko newt, wolf coyote wolf</i>	<i>twig braid twig, sock carrot sock</i>
	Incongruent	<i>twig gecko twig, sock coyote sock</i>	<i>newt braid newt, wolf carrot wolf</i>

Figure 1. Non-animal Targets. Grand average ERP waveforms at representative site Cz for non-animal targets presented with incongruent animal (solid line) and congruent non-animal (dotted line) flankers. Each vertical tick marks 100 ms and negative is plotted up. The calibration bar marks 2 μ V. The scalp voltage map shows the distribution of the flanker semantic effects (incongruent-congruent) on mean N400 amplitude (300-500 ms).

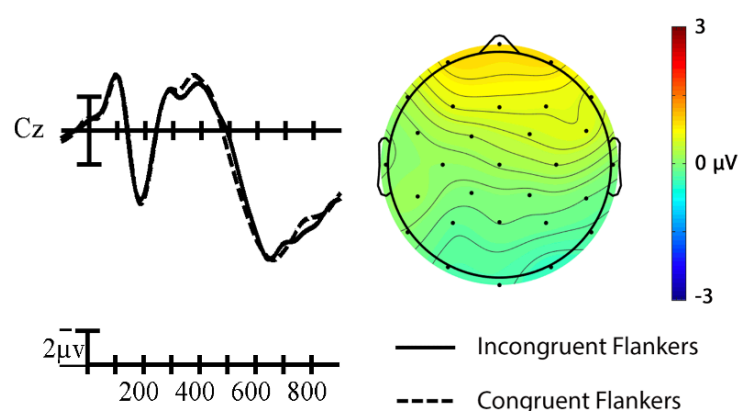
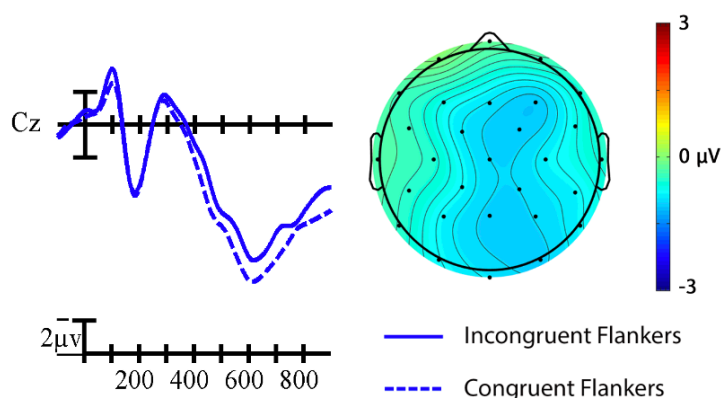


Figure 2. Animal Targets. Grand average ERP waveforms at representative site Cz for animal targets presented with incongruent non-animal (solid line) and congruent animal (dotted line) flankers. Each vertical tick marks 100 ms and negative is plotted up. The calibration bar marks 2 μ V. The scalp voltage map shows the distribution of the flanker semantic effects (incongruent-congruent) on mean N400 amplitude (300-500 ms).



References

- Kliegl et al., *Journal of Experimental Psychology: General*, 2006
 Reichle et al. *Psychological Review*, 1998
 Snell et al., *Psychological Review*, 2006