

Semantic-related N400 and EEG theta responses in second-language sentence processing

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Electrophysiological studies of language processing have mainly focused on the analysis of event-related potentials, or ERPs. For example, the N400 ERP component has been associated with the processing and integration of word meaning (Kutas & Hillyard, 1980). More recently, however, EEG time-frequency analyses have been employed in psycholinguistic research with the aim to yield additional insight into language processing beyond the information represented by ERPs (e.g., Hald et al., 2006). In the present study, we investigated the electrophysiological correlates of semantic processing in a sample of 20 proficient German-English bilinguals, using ERPs as well as time-frequency analyses. While participant's brain activity was recorded, they read short English sentences, ending in high or low probability cloze words and semantically incongruent words. Their task was to evaluate the meaningfulness of the sentence upon presentation of the cloze word (cf. Proverbio et al., 2004). Based on EEG recordings from 58 electrode sites, ERPs as well as the oscillatory dynamics in the EEG signal (ERD/S) were analyzed. Replicating earlier results, we found a N400 on semantically incongruent words, as well as on low cloze probability words with a lower amplitude. Upon the presentation of the sentence final word, theta power increased for all three word conditions, showing a peak between 400 to 600 ms after cloze word onset. Different from the ERP results, we observed a greater increase in theta power for low cloze probability words than for incongruent and high cloze probability words. This effect was especially found for left frontal electrode sites. The theta ERS in temporal and parietal regions, in contrast, was significantly reduced for incongruent as compared to high and low probability sentence endings. Hence, the spatial distribution of the ERD/S results revealed a dissociation of frontal and temporo-parietal theta power increases. Whereas the left prefrontal theta ERS may reflect semantic integration processes, the temporo-parietal theta ERS may be related to generating a mental representation of the overall sentence meaning. However, much more research is needed to elucidate the functional significance of theta band activity in language comprehension. The specific differences observed between the ERP and the ERD/S results indicate that both types of analysis tap different processes in sentence comprehension and are, therefore, of importance for the study of semantic processes involved in first and second language processing.

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