ERPs evidence for syntactic representation of case markers in Korean:

Data from a picture-sentence verification task

This study investigated the processing of case markers in Korean using event related potentials (ERPs) with a picture-sentence verification task. Knoeferle et al. (2011) found an N400 effect for the mismatch of the events between the picture and its corresponding sentence (e.g., *The gymnast applauds/**punches the journalist*). The semantic-related N400 was predictable due to the mismatch of the semantic representations of the two verbs. However, the mismatch of the events between a picture and a sentence can be caused not only by the verbs but also by the switch of the thematic roles of the arguments (e.g., *The man sees the woman vs. The woman sees the man*). In such cases, two hypotheses are possible: an N400 will be elicited if the parser processes the mismatch as a semantic issue whereas an ELAN and/or a P600 is expected if the parser processes it as a syntactic mismatch. This study investigated how Korean case markers are processed by examining the brain responses to semantic and syntactic anomalies in a picture-sentence verification task with auditory stimuli using ERPs.

EEG data were collected from 19 native speakers of Korean regarding three conditions: (A) Semantic incongruence, [AGENT-NOM/**ACC + Verb], (B) Semantic incongruence, [Patient-ACC/**NOM + Verb], and (C) Syntactic violation, [AGENT-NOM/**GEN + Verbs]. The ERPs were compared at the onsets of case markers and verbs, and the results are summarized in [Figure 1].

![Figure 1] Brain responses for case violations in an online picture-sentence verification task
The results revealed (i) that either an LPC or a P600 was elicited at the time of verbs (i.e., at the end of sentence) for both semantic incongruences (A and B) and syntactic violations (C), but (ii) that no particular brain responses were elicited at the time of case marker except an ELAN in condition A. The absence of case violation effect for [Patient-NOM] in condition B indicates that the parser opens the possibility of hearing verbs with passive morphology later (e.g., oppa-ka cap-hi-eyo, Brother-NOM catch-PASS-DEC). Similarly, the absence of case violation effect for [Agent-GEN] in condition C indicates that the parser opens the possibility of hearing a noun after the genitive (e.g., oppa-uy son-i cap-ayo, Brother-GEN hand-NOM catches). Such absence of case violation effects at the time of case marker in Condition B and C indicates that the parser can build up different linguistic representations for the visual information on-line. The case violation effect at the time of case marker in condition A (that is, ELAN) can be explained by the incongruence between thematic role and the case marker of the NP (i.e., agent vs. ACC), which is not allowed in Korean, a Nominative-Accusative language.

The LPC and P600 effects found for case violations for both semantic and syntactic anomalies in this online picture-sentence verification task provide a new type of neurophysiological evidence for the syntactic representation of Korean case markers. The finding of the similar brain responses to both semantic and syntactic anomalies is different from the results of the previous behavioral studies where response times to the two types of anomalies were different (Vincenzi et al. 2009). The findings of this ERP study provide supporting evidence for the Interaction Theory (e.g., Bates & MacWhinney, 1987) because semantic process is not very different from syntactic process in terms of the brain responses to both types of anomalies. In contrast, the findings of previous behavioral studies support the Modular Theory (e.g., Fodor, 1983). The different results from different types of evidence indicate that different results can results from different methods of study. The response time in behavioral studies includes the whole time that the processor feels the anomaly of the given sentence, make a judgment, and press the button according to the judgment. On the other hand, ERPs in physiological studies reflect more direct responses to the stimuli. Then, it can be said that more direct evidence supports the Interaction Theory. More implications of the findings are discussed regarding theories of sentence processing in general.