

Brain Activations Differentially Modulated by Case Marking, Thematic Role, and Grammatical Function During Sentence Comprehension in Japanese and Korean

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Introduction

Previous behavioral studies as well as functional brain imaging studies on sentence comprehension have convincingly shown that some word orders are more difficult to process than others (Kinno et al. 2008, Kim et al. 2009, Bornkessel-Schlesewsky & Schlewsky 2009, Yasunaga et al. 2015). It is less clear, however, what factors are responsible for the increased processing load. From a linguistic point of view, there are at least three major factors to consider: **the Grammatical Function hierarchy** (Subject-NonSubject (S-NS) order may be easier to process than NonSubject-Subject (NS-S) order), **the Thematic Role hierarchy** (Agent-NonAgent (A-NA) order may be easier to process than NonAgent-Agent (NA-A) order), and **the Case Marking hierarchy** (Nominative-NonNominative (N-NN) order may be easier to process than NonNominative-Nominative (NN-N) order). A behavioral study has reported significant effects of the Grammatical Function hierarchy, and the absence of significant effects of the Thematic Role hierarchy and the Case Marking hierarchy, on reading times for sentences with different word orders (Tamaoka et al. 2005). The present event-related fMRI studies investigated effects of these individual factors and of their interaction on cortical activations during sentence comprehension in Japanese and Korean.

Experiment 1: Japanese

Methods

Twenty-two healthy right-handed native speakers of Japanese participated in the experiment. The total number of stimuli was 360, which was divided into two sessions with a total of 180 sentences per session. There were six crucial conditions with semantically correct Japanese sentences: ACCC (active sentences (AC) in syntactically canonical word order (C) that are semantically correct (C)), ACSC (active sentences (AC) in scrambled word order (S) that are semantically correct (C)), PACC (passive sentences (PA) in syntactically canonical word order (C) that are semantically correct (C)), PASC (passive sentences in scrambled word order that are semantically correct), POCC (potential sentences (PO) in syntactically canonical word order that are semantically correct), and POSC (potential sentences in scrambled word order that are semantically correct). The six types of sentences were chosen because they differ from

one another in the three factors above (i.e. Grammatical Function, Thematic Role, and Case). In addition, there were six conditions with semantically incorrect sentences parallel to the six semantically correct conditions, as well as correct and incorrect working memory conditions and a null condition. The stimuli were visually presented phrase by phrase. Subjects were instructed to judge whether or not the sentences they just read made sense by pressing one of the two buttons (*Correct* or *Incorrect*) with their right hands. The data were acquired with a 1.5 Tesla Siemens system using an EPI sequence (TR=2300 ms, TE=50 ms, slice thickness=5 mm, 25 slices).

Results

Direct comparisons of the six semantically correct sentence conditions revealed that each of the three factors (i.e. Grammatical Function, Thematic Role, and Case) differentially modulated brain activations. In particular, regardless of the linear ordering of thematic roles (A-NA or NA-A) and/or case particles (N-NN or NN-N), sentences in scrambled (i.e. NS-S) order evoked higher cortical activations in the left frontal areas than those in syntactically canonical (S-NS) order. Taken all together, the present results suggest that among the three factors considered here, Grammatical Function is the primary factor in determining cortical activation in the left frontal regions during sentence comprehension in Japanese.

Experiment 2: Korean

A parallel experiment on Korean is underway.

References (selected)

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