

Differential Processing of Empty Categories in Japanese Control and Raising: Behavioral and Neural Evidence

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論文内容の要旨

This dissertation examines the cognitive and neural mechanisms underlying the processing of empty categories (ECs) in Japanese control and raising constructions. While theoretical linguistics, especially in generative grammar, has long debated whether the EC in control is PRO or Copy (the latter as proposed by the Movement Theory of Control (MTC)), few experimental studies have tested these hypotheses using both behavioral and neurophysiological methods. Addressing this gap, the present study examines the properties of ECs in Japanese syntactic compound verbs by combining a self-paced reading study with a probe recognition priming task, and magnetoencephalography (MEG), a neuroimaging technique with high temporal and spatial resolution.

The behavioral experiment revealed significant processing dissociations between the control and raising conditions. The probe task showed the reactivation effect of the antecedent in both control and raising, providing evidence for the psychological reality of ECs in Japanese. In addition, reading-time data, analyzed using linear mixed-effects modeling, were better explained by the PRO hypothesis than by the MTC. This result remained robust even after statistically controlling for other linguistic and non-linguistic factors, including the number of θ -role, clause type, lexical frequency, word length, spillover effects, inter-subject variability, and item-level semantic differences.

The MEG experiment further supported this distinction by identifying spatio-temporal and oscillatory neural correlates. Event-related field (ERF) analyses revealed a late left-lateralized effect (approximately 700–800 ms), in which the control sentences elicited stronger responses than both the raising and baseline sentences in the anterior temporal and insular regions, extending to the inferior frontal cortex. This late effect suggests increased neural demands associated with establishing and integrating the referential dependency of PRO. Complementing this finding, time-frequency analysis showed that control elicited stronger activation than raising in a left-lateralized network including the anterior temporal cortex, insula, and inferior frontal gyrus. This effect was characterized by an early increase in high-gamma band power (61–80 Hz) from 323–687 ms, followed by a later increase in theta-band power (4–7 Hz) from 704–874 ms. These oscillatory signatures suggest a two-stage process: the construction of a referential dependency followed by the memory-based

retrieval of the antecedent. Such frequency-specific responses were notably absent in the raising condition.

Overall, these findings provide evidence for the PRO hypothesis. By integrating formal linguistic theory with behavioral and cognitive neuroscience, this dissertation demonstrates that abstract syntactic representations such as PRO are not merely theoretical constructs but have measurable correlates in brain activity. These findings provide a foundation for developing testable linking hypotheses between syntactic theory and the neurobiology of language, highlighting the value of theory-driven experimentation in evaluating the core assumptions of generative grammar.