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Effect of Chinese Character Frequency on the Time Course of Phonological and Semantic Activation: An ERP Study

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Keywords: time course; character frequency; meaning judgment; pronunciation judgment.

Introduction

The central issue on the time course of phonological and semantic activation in word recognition has been hotly debated in English (e.g., Rayner & Pollatsek, 1989) and Chinese word recognition (e.g., Chen & Shu, 2001). In Event Related Potential (ERP) studies on this issue in Chinese, Liu, Perfetti and Hart (2003) found earlier phonology than semantic activation in high-frequency (HF) characters, whereas Chen et al. (2005) found that phonological activation lagged behind semantics in HF characters, and was earlier than semantics in low-frequency (LF) characters. In the present study, we conducted an ERP experiment to investigate this issue in Chinese and examine whether Chinese character frequency affected the time course of phonological and semantic activation.

Method

Sixteen right-handed undergraduates with normal or corrected-to-normal vision were asked to judge whether a target was semantically related to the prime in a meaning decision task and whether a target was a homophone of the prime in a pronunciation decision task. There were 60 HF targets and 60 LF targets in each task. A target was preceded by three primes that were semantically related to, homophones with, or controls to the target respectively. HF characters had frequencies more than 100 times per millions, and LF characters had frequencies lower than 30 times per millions.

In each trial, a fixation ("+") was presented at the center of the screen for 300 ms, followed by a prime for 140ms. After the prime was replaced by a 360 ms blank, a target appeared and remained on screen for 1500 ms，followed by a 1800-2200 ms presentation of another fixation point. EEG was recorded from 64 scalp electrodes in an elastic cap.

Results

In the two tasks with HF characters, ERP amplitudes selected from three time windows (170-270, 290-440, and 480-770 ms) was analyzed in a repeated-measure ANOVA with two factors, the 12 electrodes (Oz, O_1, O_2, Pz, P_3, P_4, Cz, C_3, C_4, Fz, F_3, F_4) and the type of prime (homophonic / semantically related primes vs. control primes). Results showed no significant difference between the two types of primes in all time windows in HF meaning task; but there was significant difference between semantically related and control primes in 290-440 ms interval (F (1, 15) = 7.212, p < .05), and in 480-700 ms interval (F (1, 15) = 4.879, p < .05) in HF homophone task.

In the two tasks with LF characters, a repeated-measure ANOVA was conducted to analyze the ERP amplitude in three time windows (190-280, 320-420, and 600-750 ms) with two factors, the 18 electrodes (Oz, O_1, O_2, POz, PO_3, PO_4,Pz, P_3, P_4, CPz, CP_3, CP_4, Cz, C_3, C_4, Fz, F_3, F_4,) and the type of prime. Results showed significant difference between homophone and control primes in all time windows in LF meaning task (Ps < .05); and significant difference between semantically related and control primes only in 320-420 ms interval (F (1, 15) = 5.089, p < .05) in LF homophone task.

Discussion

The present findings support that character frequency in Chinese affects the time course of phonological and semantic activation. Phonology lags behind semantic activation in HF characters, whereas it is activated prior to semantics in LF characters.

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