Neural correlates of cross script repetition priming : an fMRI study

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Introduction

Repetition priming typically leads to a decrease in the activation of sensory cortical areas upon a second exposure to the same visual stimulus. This effect is thought to reflect more efficient or fluent re-processing of previously seen stimuli so that less neural activity is required. Interestingly, it is irrespective of whether this prime-target pair is written in the same or different case (e.g. school-school vs. school-SCHOOL), and regardless of whether the prime and the target are visually similar or dissimilar (pass-PASS vs. read-READ). This is the case even when the prime word is masked such that participants are unaware of its presence (subliminal priming). In this study, we focused on the repetition priming effect that may occur between two writing systems of Korean words, Hangul, and Chinese characters in the Korean language. Importantly, when a given word is written in the two scripts, there is exact one-to-one match at the phonological level. This means that a Korean word (more than 70 % of its vocabulary) can be written either in Hangul or Chinese characters. This is the unique character of the Korean writing system, compared to the Japanese, which entails similar writing system..

Methods

12 healthy right handed undergraduate students (mean age: 21.5 SD: 1.5) were recruited. In the experimental procedure, there are total 40 items of the stimuli, which include prime (Chinese characters) and target (Hangul)Stimuli were presented using custom-made software on a PC and projected via an LCD projector onto a screen at the feet of the subjects. The subjects viewed the screen via a homemade reflection mirror attached on the head RF coil. The prime stimulus was presented for 30 ms long following a forward masking phase of 470 ms. A post-mask was followed after the prime presentation for 60 ms and target presentation was also followed for 200 ms. The interstimulus Interval for the next presentation is between 6 to 12 seconds, and this was done in a randomized order (Figure x). The running time of experiment was 722.760 seconds. During the experiment, the subjects were instructed (forced-choice option) to press the right button, if the prime and target are identical, the left button for not identical presentation. The accuracy and reaction times are also measured. Tasks were presented using the E-prime. The data acquisition was performed using a 3.0T MR scanner (ISOL, Korea) with EPI sequence (TR/TE = 2280/35ms, 5mm no gap, 30 slices, 64×64 matrix, FOV = 220×220mm, flip angle 70°)The images of each subject were realigned, coregistered, and normalized using the SPM99. Finally, the images were smoothed using a 7 mm full-width, half-maximum (FWHM) gaussian filter. Condition and subject effects were estimated using the general linear model at each voxel in brain space. Significant changes in hemodynamic response for each subject and condition were assessed using t-statistics. For the group analysis, single subject and condition were analyzed using a random effect model. Activations were reported if they exceeded a threshold $P < 0.001$ uncorrected on the single voxel level and on an extent level of ten voxels.

Results and Discussion

In the contrast of prime Chinese character vs. prime Hangul, the biliateral middle temporal (BA 37), left middle frontal (BA 9), and anterior cingulate region (BA 23) activations are observed. In the inversed contrast, only caudate and thalamus activation was observed. The bilateral activation of middle temporal region seems to be related with the function of semantic network, whereas the left middle frontal activation is related with the processing of recognizing both semantic and orthograhphic nature of the presented stimuli. The thalamus activation of the prime Chinese characters might reflect the phonological specificity of the experimental paradigm for our subjects.

Reference

[1] Nakamura, K, et al. (2005).J Cog Neursci. 17:6 954-968
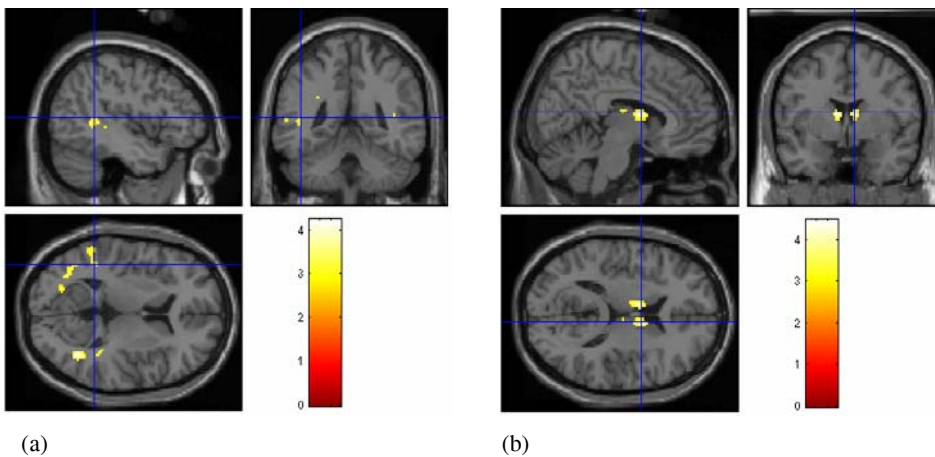
(a)   (b)

Figure 1. Activation map of regions for the direct comparison prime Chinese characters vs. prime Hangul (a), inversed comparison (b).