

# Spatial congruence in working memory: an ERP study

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The Simon effect refers to the finding that reaction times are faster when stimulus and response locations are congruent than when they are not, even stimulus locations are task irrelevant.

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Each trial began with fixation for 1000 ms. The study letters were then presented for 200 ms. Participants were asked to hold the letters in mind across a delay interval that varied randomly between 1000 and 1500 ms. The probe letter was then presented for 200 ms. Participants were asked to decide whether or not the probe letter was one of the study letters and respond by pressing a left or a right button in a button box. Participants held the box with two hands and placed their left (right) thumb on the left (right) button.

Each participant completed 10 blocks of 48 trials after 100 practice trials. The study letters were presented randomly and equally likely to the left or right of the fixation. The probe was present in the two study letters on half of the trials (yes trial) and absent in the other half (no trials). For yes trials, the probe letter was equally likely to be the first or second study letter. Half of the participants pressed the left button for yes and the right button for no. For the other half, the arrangement was reversed.

*E/ P* : The electroencephalogram (EEG) was recorded from 29 scalp electrodes located

the congruent condition being more positive than the incongruent condition, consistent with the literature on the classical Simon effect [10–12]. This finding indicates that the memory-based congruence effect was associated with the same electrophysiological signature as was the Simon effect, suggesting that they may involve the same cognitive processes.

The Simon task and the Zhang and Johnson task are different in several aspects. One is a perception task and the other a memory task. Compared to the Simon effect, the memory congruence effect is more likely to reflect response selection processes. This is because neither study items nor probe items were intrinsically associated with the left or the right response, a factor central to the perceptual-interference account of the Simon effect [4].

The finding that the congruence effects from these two different tasks were associated with the same electro-

physiological signature indicates that (1) response selection is an essential mechanism for the spatial congruence effect. Perceptual factors are unlikely to account for the effect alone; (2) the spatial congruence effect can be generalized to a wider context. It is not specific to perceptual processes but reflects some general feature of the human decision making process.

While previous ERP studies of the perceptual Simon effect report modulation of both P300 latency and magnitude by congruence [10–12], the current work found the congruency effect only on the amplitude. As the memory-based congruence effect is less subject to perceptual factors, such



## CONCLUSION

With the ERP technique, the present study identified similar neural mechanisms for the memory-based spatial congruence effect as that for the classical Simon effect. The results support theories proposing that response selection is an essential mechanism for the spatial congruence effect and further suggest that the effect is not specific to perceptual processes but may reflect general features of the human decision making processes.

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