Interactions Between Simon Effects and Flanker Effects

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INTRODUCTION

In the field of selective attention, there are a number of paradigms that are concerned with distractor interference, such as the Stroop task, Eriksen type flanker task, and Simon task. These tasks have been suggested to be related with each other, though the exact nature of the relationship has not been specified (Treccani, Cubelli, Sala, & Umilta, 2009).

The Simon effect (Simon, 1990) refers to the finding that reaction times are typically shorter when the stimulus appears in the same side as the response than when in the opposite side, even if the stimulus location is irrelevant to the task. For example, a target could be either N (associated with a right hand key) or X (left hand key). The target appears either in the same side as the response (Task compatible) or in the opposite side (Task incompatible).

In the Ericksen type flanker task (Eriksen, & Eriksen, 1974) the target item is flanked by distractor items on each side. The flanker effect refers to the finding that reaction times (RT) are longer when the target is flanked by response incompatible distractors compared to response compatible distractors.

In a typical dilution effect (e.g., Kahneman & Chajczyk, 1983), the Stroop effect is reduced when an irrelevant distractor is included in the stimulus display. This was attributed to the reduction of resources that can be allocated to the Stroop stimuli.

Miles, Yamaguchi and Proctor (2009), using Simon-type tasks, reported dilution effects were greater when distractors and diluters are in the same domain.

In the present experiment, we investigated how different types of dilution stimuli affect the Simon and the flanker compatibility effects. We used a letter discrimination task with letter distractors. For a factor of response compatibility, a diluter is the same as the target (Compatible diluter), the alternative target (Incompatible diluter), a neutral letter (Neutral diluter), or no diluter.

METHODS

Participants. Eighteen undergraduate students from California State University, San Bernardino (CSUSB) received course credit for their participation. All participants reported normal or corrected-to-normal vision. They all signed the consent form approved by the CSUSB Institutional Review Board.

Stimuli. Participants performed a Simon task and a flanker task. In the Simon task participants responded to either an N (right hand) or X (left hand) appeared on the left or right side of a central fixation point. In the flanker task, participants responded to either an N or X that was presented above the fixation point. The target was flanked by compatible or incompatible letters. For both tasks, trials contained either a compatible, incompatible, neutral or no diluter. The design was a 2 (Task: Simon and flanker) X 4 (Diluter compatibility: compatible, incompatible, neutral and no diluter) X 2 (Task compatibility: compatible and incompatible) . The conditions are shown in Figure 1.

Procedure. Half of the participants performed the Simon task first and half performed the flanker task first. At the beginning of each trial a central fixation point appeared followed by the task display. Participants responded to the target item (N or X) by pressing either the N or X keys on a keyboard, respectively. Verbal instructions and practice sessions were given before each task. Participants were told to respond to the target while ignoring the distractor.

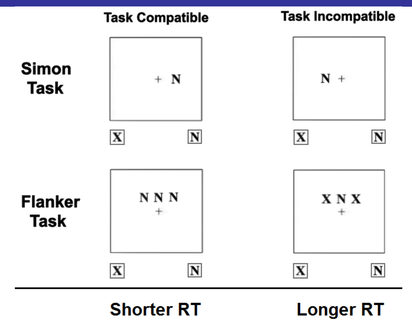

Figure. 1A. Examples of the Simon and Flanker tasks. The compatibility effect is measured by the RT for the incompatible condition minus the compatible condition.

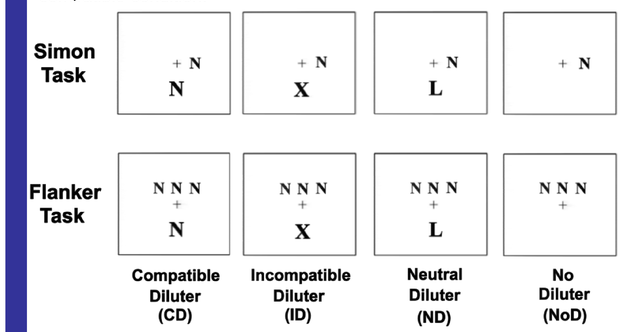

Figure. 1B. Stimulus displays for the Simon and Flanker tasks with the four diluter conditions.

RESULTS & DISCUSSION

1. Overall ANOVA

Mean RTs were submitted to a 2 (Task) X 4 (Diluter) X 2 (Compatibility) within-participant ANOVA (see Figure 2). Overall, RTs were longer for the Simon task than for the Flanker task, $F(1,17) = 5.32$, $p = 0.034$. A diluter main effect was also significant, $F(3,51) = 22.71$, $p < .001$. A task compatibility effect was also significant, $F(1,17) = 81.51$, $p < .001$.

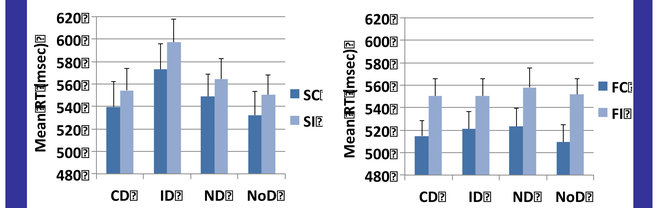

Figure 2. Mean RTs for the Simon task (left) and Flanker Task (right). The error bars represent standard errors.

More important, a Task X Compatibility interaction was significant, $F(1,17) = 9.69$, $p = 0.006$. Overall, the compatibility effect was greater for the Flanker task than for the Simon task (Figure 3).

There was also a Task X Dilution interaction, $F(3, 51) = 16.95$, $p < .001$ (Figure 4). The RT for incompatible diluter for the Simon task was greater than other conditions.

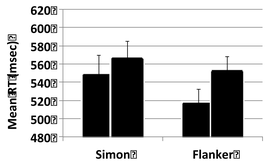

Figure 3. Mean RTs for task compatible and task incompatible conditions for the Simon task and Flanker task. collapsed across four diluter conditions.

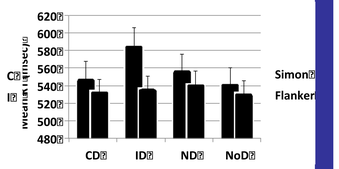

Figure 4. Mean RTs for Simon task and Flanker task for the four diluter conditions collapsed across task compatibility.

2. Are there any dilution effects?

There was a dilution effect for the ID condition for the flanker task, $t(17) = 2.11$, $p = 0.05$. The flanker compatibility effect was reduced for the incompatible diluter. No other dilution effect reached statistical significance (Figure 5).

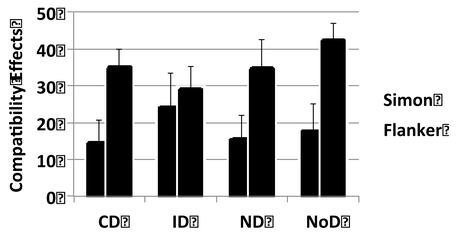

Figure 5. Simon and Flanker compatibility effects for four levels of diluter conditions.

3. Relationships between Task compatibility and dilution compatibility effects

We also examined whether or not there was a relationship between the two types of compatibility effects, Task compatibility effect and Dilution compatibility effect for each task.

For the Simon task, Task compatibility and Dilution compatibility effects were additive, $F(1,17) = 53.69$, $p < .001$ for the Dilution compatibility, and $F(1,17) = 10.39$, $p < .001$ for the Simon compatibility. For the Flanker task, there was only Flanker compatibility effect, $F(1,17) = 80.99$, $p < .001$ (Figure 6).

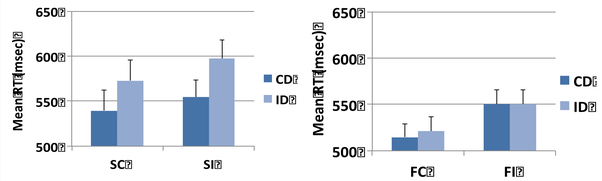

Figure 6. Relationships between Task compatibility and dilution compatibility effects. Left: Simon task, Right: Flanker task.

For the Simon task, Task compatibility and Dilution compatibility effects were additive. The Simon compatibility effect was caused by the relationship between the target location and response location; and therefore, a diluter stimulus resulted in an additional compatibility effect.

For the Flanker task, there was only the Flanker compatibility effect, $F(1,17) = 80.99$, $p < .001$. The magnitude of the flanker compatibility effect remained the same regardless of the diluter conditions. For the flanker task, the target was flanked by two response-related stimuli; and therefore, a diluter stimulus is just another response-related stimulus, resulted in minimum effect on the compatibility effect.

CONCLUSIONS

The overall compatibility effect was greater for the flanker task than for the Simon task.

There was no dilution effect except for the ID condition for the flanker task.

The relationship between the task compatibility and dilution compatibility was additive for the Simon task, but not for the flanker task. In the Simon task, the Simon compatibility effect was caused by the spatial compatibility between the target location and response key; and therefore, addition of a response related stimulus (diluter) probably resulted in an additional compatibility effect. However, in the flanker task, there were already two response related distractors; and therefore, addition of another response related stimulus did not have an additional effect on the flanker compatibility effect. The additive effect between the Simon compatibility effect and dilution compatibility effect is consistent with findings from Kornblum (1994) supporting the dimensional-overlap model for stimulus-stimulus and stimulus-response compatibility.

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