Are Binding Errors Affected by Size Congruity?

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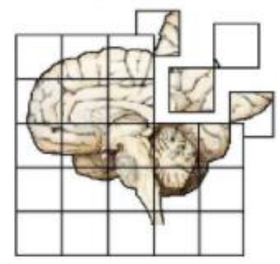

Introduction

- The visual system successfully binds the physical (e.g., size, color) and the semantic (e.g., numerical value) dimensions of stimuli. It is still under debate whether binding involving numerical value and physical size is influenced by attention. One assumption is that saliency associated with the stimulus' physical size may bias attention, increasing the size congruity effect (SiCE) (Risko et al., 2013).
- We examined the influence of attention in the SiCE by analyzing the occurrence of illusory conjunctions (ICs) in the SiCE. If binding of numerical value and physical size occurs pre-attentively, there should be less ICs for congruent relative to incongruent trials.

Experiment 1

- Arend et al. (2013) manipulated the distance effect (DE) using the distance 2 (e.g., between 2 4) and 5 (e.g., between 2 7).
- Using the same experiment, we also manipulated physical size between participants. This generated a congruent (e.g., 2 4) and an incongruent condition (e.g., 2 4).
- Figure 1 shows a graphic representation of the layout and timing of the task.
- A main effect was obtained for distance (i.e., distance 2 > distance 5), $F(1,15) = 8.698$, $p = .01$, $\eta_p^2 = .367$.
- A main effect was obtained for congruity in the opposite direction than was hypothesized (congruent > incongruent), $F(1,15) = 7.362$, $p = .016$, $\eta_p^2 = .329$.

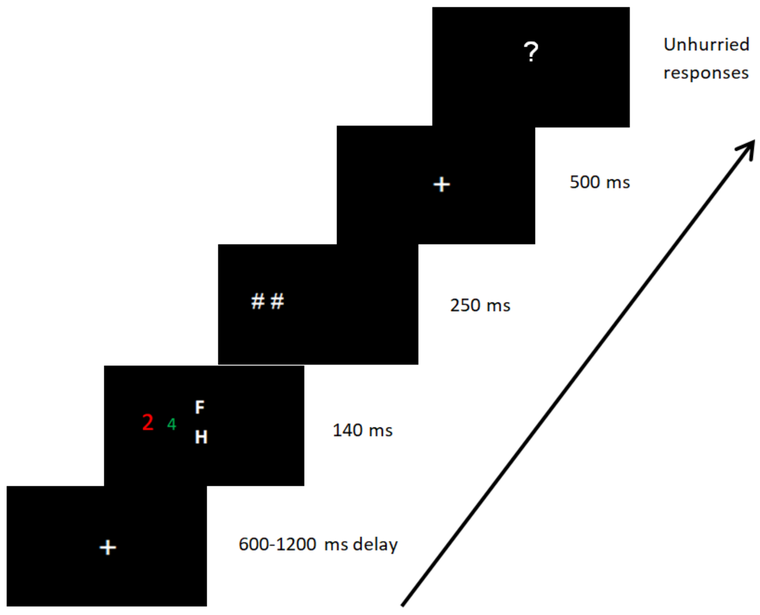

Figure 1. An example of the trial sequence. Following a variable interval (600-1,200 ms), two letters appeared in the middle of the screen and two colored digits were presented either to the left or to the right. At the end of the trial, participants were required to give three responses (same or different letters, the color of the digit and the confidence ratings). Confidence ratings were not analyzed.

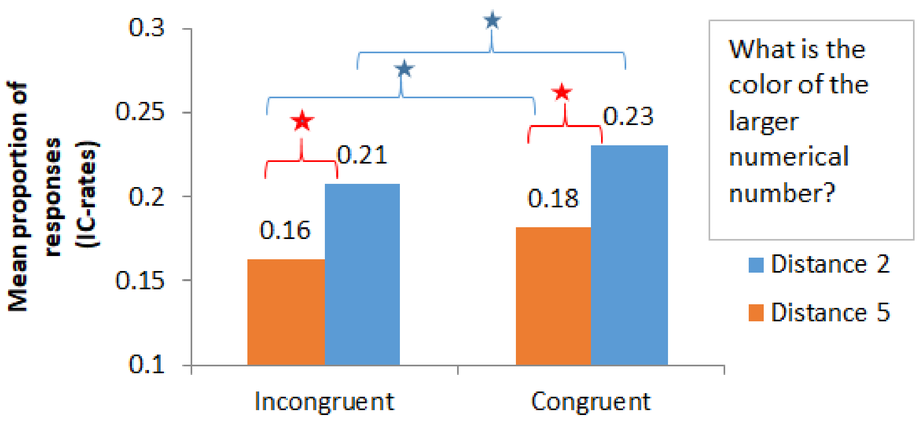

Figure 2. Exp. 1 - Mean proportion of IC-rate responses as a function of distance and congruity. There was a significant difference in congruity (congruent>incongruent) and distance (distance 2>distance 5).

Interim Conclusions

- The DE is replicated when both physical and numerical size are manipulated.
- There was no indication of less ICs in congruent trials.
- It seems cognitive control may have affected the incongruent condition, leading to increased cognitive resources (as a result of conflict) (Botvinick et al., 2001).
- Another possibility is that different kinds of migrations (color/shape) occurred, influencing this result. That is, binding from physical size is a better marker of attention bias than binding from value. This issue was examined in Experiment 2.

Experiment 2

- We examined how the SiCE was affected by two different types of binding, color vs. shape migration, by having participants report the identity as well as the color of the larger numerical digit (see Fig. 3).

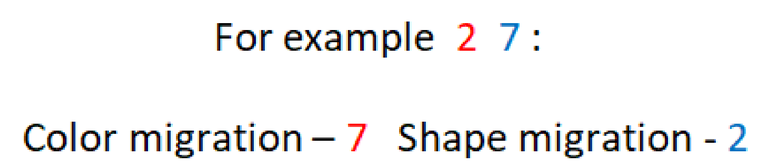

Figure 3. A schematic representation of the different migration types.

- No main effect was found for congruity, $F(1,15) = 3.189$, $p = .094$, $\eta_p^2 = .175$.
- However, a main effect was observed for migration type (color > shape), $F(1,15) = 18.484$, $p < .01$, $\eta_p^2 = .552$ (see Fig. 4). Since there was more binding for value rather than size, we conclude that size does not matter for binding.

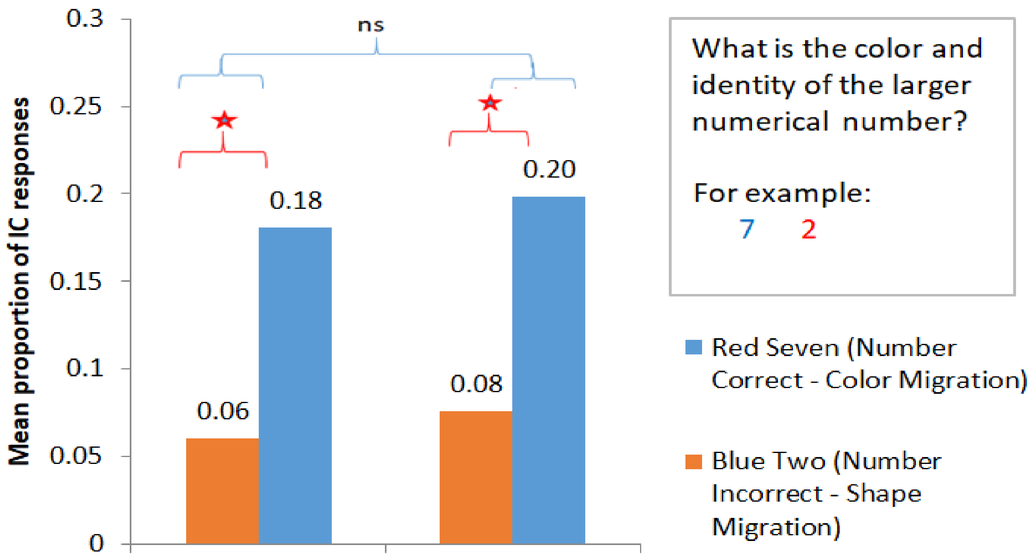

Figure 4. Exp. 2 – Mean proportion of IC responses as a function of number (number-correct/number-incorrect) and congruity (congruent/incongruent). There was a significant difference only in number (number correct>number incorrect).

Take Home Message

- No significant difference between congruity conditions when ICs were analyzed based on *number incorrect* reports, suggesting that binding does not occur outside the focus of attention.
- Higher proportions of ICs in the color misperception condition (color migration) indicate that the value of the digit matters, not the size.
- Perhaps the difference in congruity in Experiment 1 was due to control exerted in incongruent trials which was expressed in less pronounced binding in the congruent trials. Manipulating the percentage of incongruent trials may help resolve the results of these experiments (Botvinick et al., 2001; Tzelgov et al., 1992).
- These results may drive another follow-up experiment with directions to report the physical size.

References

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