THE MULTIPLE VISUAL COMPONENTS OF THEMATIC ROLE IDENTIFICATION

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INTRODUCTION

Thematic roles linguistically code 'who did what to whom'; the agent (cause) or patient (recipient) of an event. Such roles have previously been treated as linguistic concepts that are assigned from abstract features (e.g., sentience, Dowty, 1991). Extracting such features would require viewers to focus their attention on the entities in scenes in order to identify the nature of the interaction between those objects (Simon & Chabris, 1999). An alternative is that thematic roles may arise from a parallel capacity to track objects (Pylyshyn & Storm, 1988). In the present set of studies, we attempt to dissociate the focal-attention account and the parallel tracking accounts of thematic role understanding.
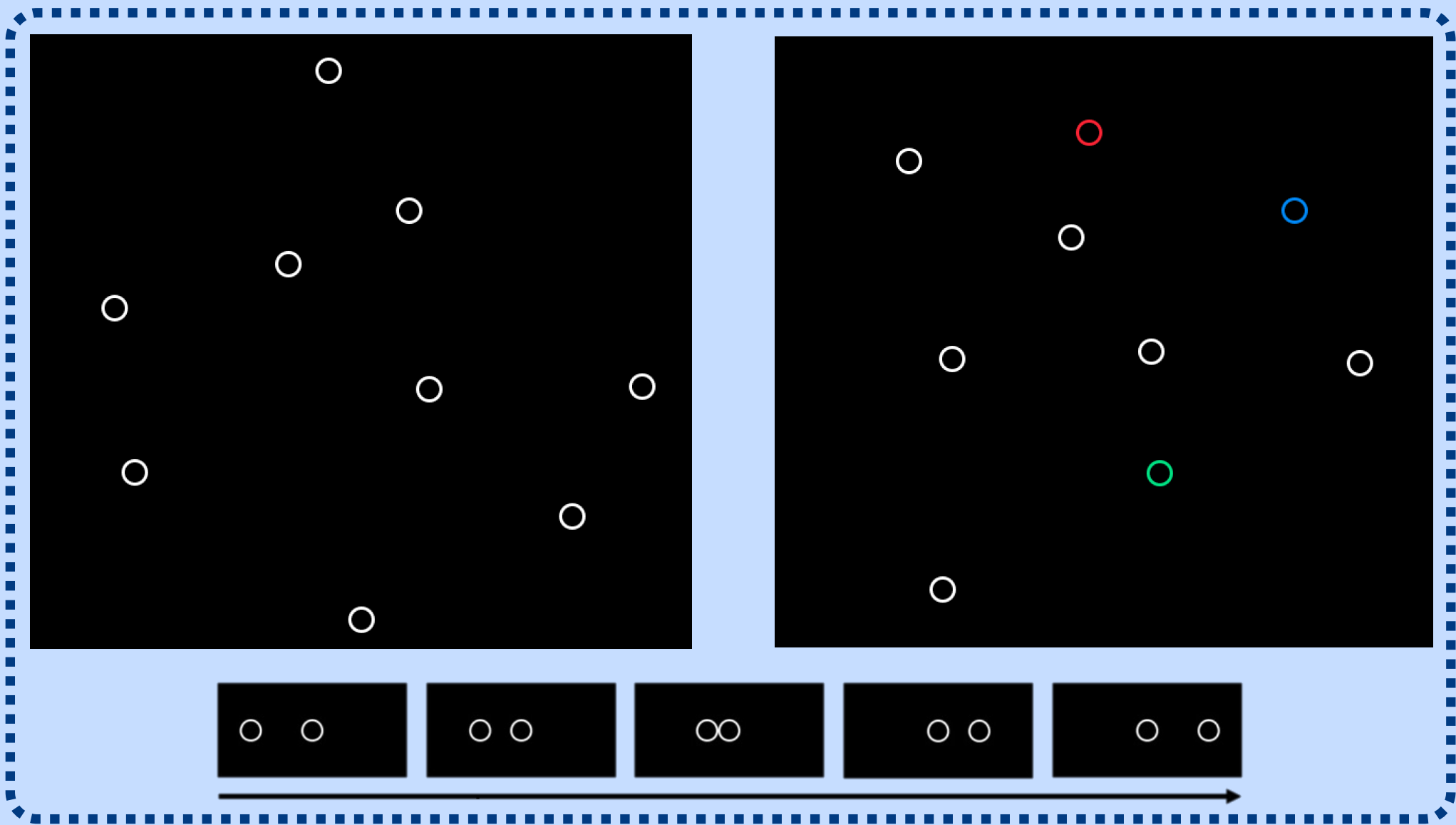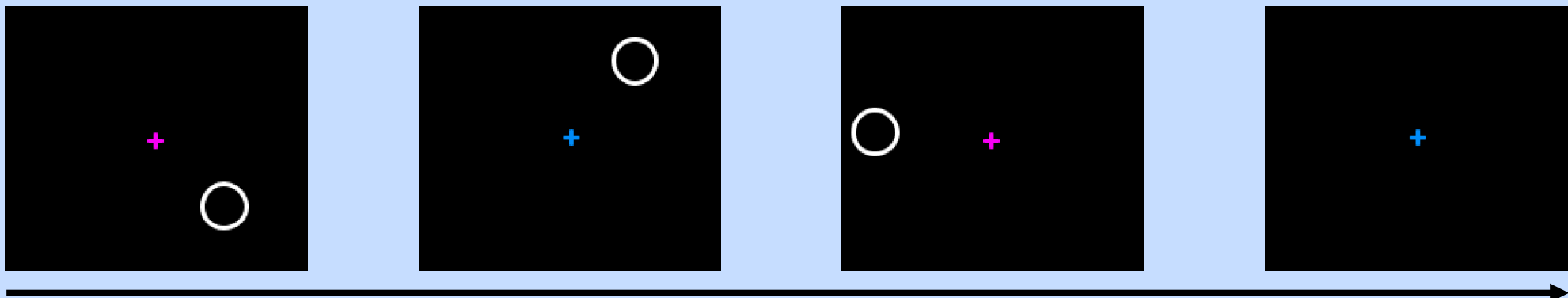
METHOD

To examine whether parallel tracking abilities are used, we used a task where participants had to identify agents/patients out of multiple identical objects that move randomly around the screen (Gao, Newman & Scholl, 2009). During these scenes one, two, or three pushing actions would occur between different pairs of objects, separated by periods of random motion. At test, three circles were coloured (red, blue, green) and participants described which objects were involved in a pushing action using an English transitive frame to mark the agent/patient relations ("red pushed blue"). If participants are not tracking which of the white circles is the agent/patient, then they will produce an incorrect response.

Experiment 1 – Response Task: To occupy the participants' focal gaze and reduce the use of conscious attention-based tracking strategies (Tombu & Seiffert, 2008), participants completed a speeded-response task while tracking: they were required to press a key every time the cross in centre of the screen changed colour.

Experiment 2 – Blackout Task: If parallel tracking is being used, then even when objects disappear temporarily, their paths can still be maintained (Scholl & Pyllysyn, 1999). In this study, circles would temporarily (<500ms) disappear from view whenever they passed near another circle.

Experiment 1 – Response Task
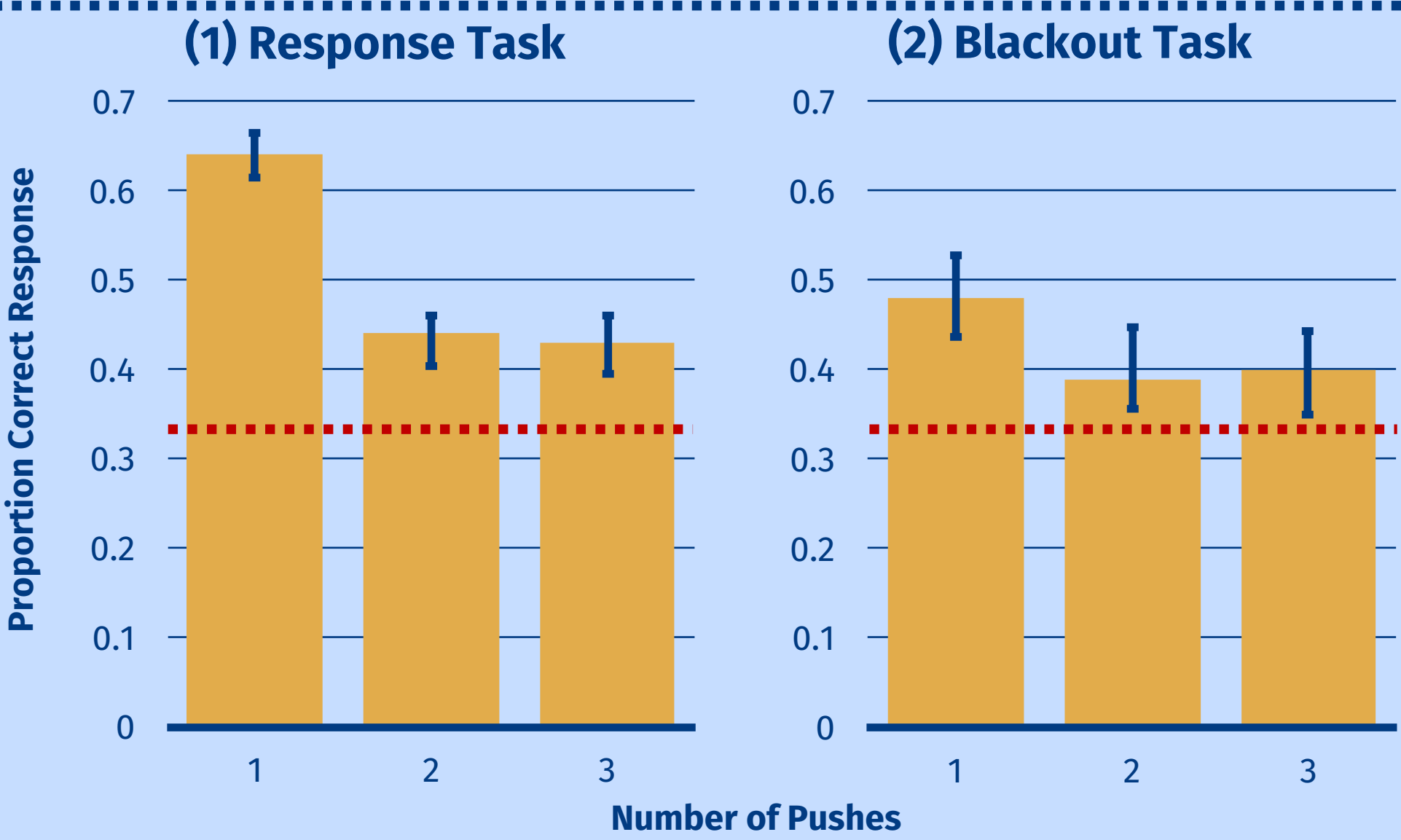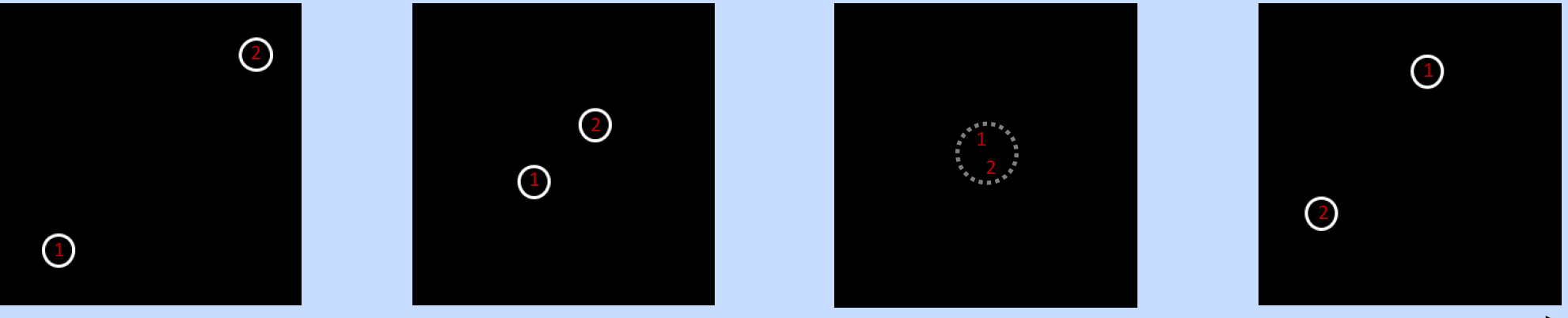
Experiment 2 – Blackout Task

RESULTS

The dependent measure in both experiments was the mean correct labelling of agent and patient for each participant in each condition with 0.33 subtracted out to allow us to use intercept of the model as a comparison against chance (dotted line).

The Response Study found that overall accuracy in assigning thematic roles was above chance (β = 1.59, t = 7.90). Furthermore, accuracy was higher in the 1-push events over the 2/3-push events ($\chi^2(1)$ = 27.63, p <.001), which were not significantly different from each other ($\chi^2(1)$ = 1.65, p = 0.20).

The Blackout Study found overall accuracy was above chance (β = 0.95, t = 6.11), the 1-push trials yielded higher accuracy than 2/3-push events ($\chi^2(1)$ = 6.92, p <.001), but there were no significant differences between the 2 and 3-push trials ($\chi^2(1)$ = 0.98, p = .33).

Fig. 1 *Thematic role assignment accuracy across the different tasks and push event frequencies with bootstrapped 95% confidence intervals.*

CONCLUSION

The above chance accuracy suggests that participants were able to track the agents and patients in scenes with up to three push events (six different circles). However, the higher accuracy for one push events suggests that focal attention is still being used. Also, the reduction in the accuracy in the one push trials between the tasks suggests that the blackouts reduced focal attention use without impacting the parallel tracking that supports the above chance ability in the two/three push events. Collectively, these studies provide preliminary evidence that thematic role processing in language depends on specialized visual systems for parallel object tracking (Leslie, Xu, Tremoulet, & Scholl, 1998).