Bard Orienting of Attention is Location-Based for both Arrows and Eye-Gaze Cues

A Place to Think

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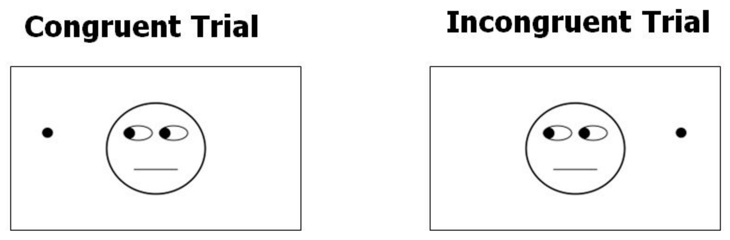
Location-Based vs. Object-Based Attention

Humans reflexively follow the gaze of others, a phenomenon demonstrated in the lab using the gaze-cueing paradigm (Driver et al., 1999; Hutcheon et al., 2024).



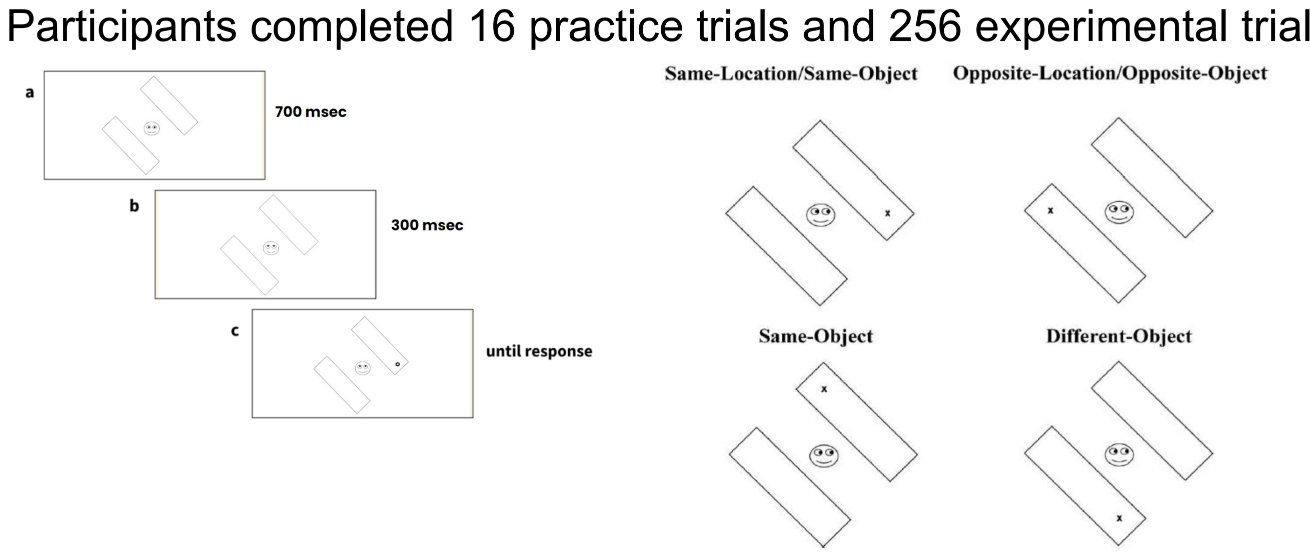
This **gaze-cueing effect (GCE)** was originally interpreted as reflecting the importance of social cues (Friesen & Kingstone, 1998). However, a similar phenomenon is observed when non-social cues (such as arrows) are used in this paradigm.

A recent study by Marotta and colleagues (2012) found that social and non-social cues drive different types of attentional selection: eye-gaze leads to specific location-based attention while arrows lead to object-based attention.

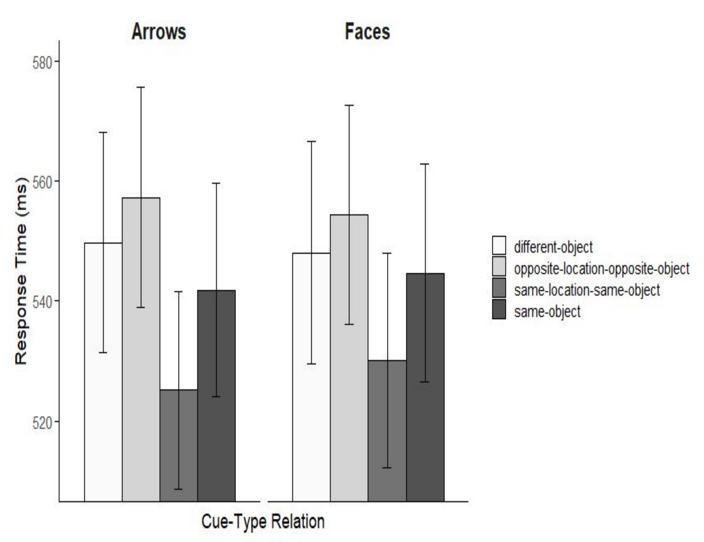
In three experiments, we investigated the claim that social and non-social cues drive qualitatively different modes of attentional selection.

Experiment 1: Replication of Marotta et al. (2012)

42 participants (Mean age = 29.8, 20 females and 22 males) were recruited from Prolific^{TM}.
Participants completed 16 practice trials and 256 experimental trials.



For a **specific location-based effect** same-location/same-object and same-object trials were compared, and for an **object-based effect** same-object and different-object trials were used.



Participants were significantly faster on same-object than on different-object trials for arrow cues only, indicating an **object-based effect** for arrows (M = 542, SE = 17.9 vs M = 550, SE = 18.4), $t(41) = -2.076$, $p = .044$, $d = -.320$.

Participants were also significantly faster on same-location/same-object trials than on same-object trials for both face (M = 530, SE = 17.9 vs M = 545, SE = 18.1), $t(41) = -4.407$, $p < .001$, $d = -.680$ and arrow cues (M = 525, SE = 16.5 vs M = 542, SE = 17.9), $t(41) = -3.945$, $p < .001$, $d = -.609$, indicating a **specific location-based effect** for both cue types.

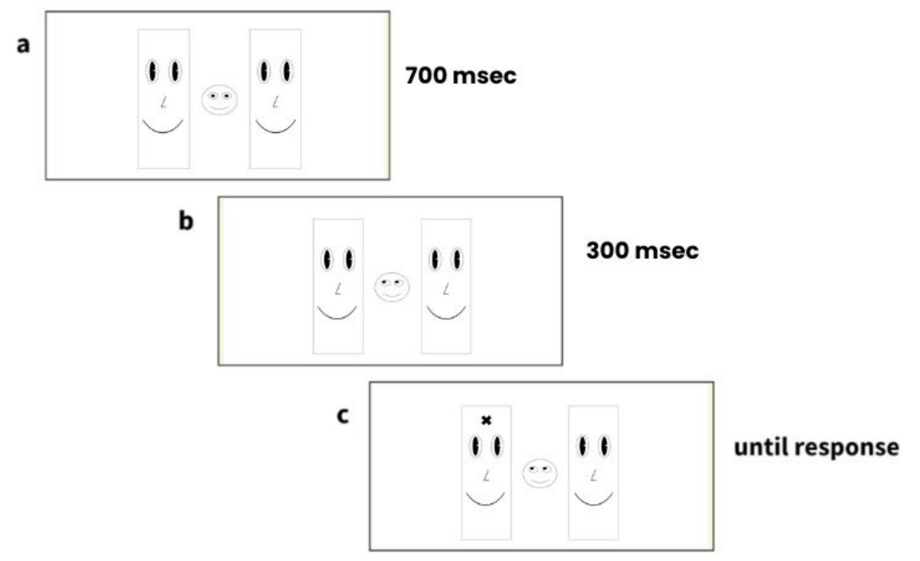
We replicated an object-based attention driven by arrow cues. However, unlike Marotta et al. (2012) results, we found a specific location-based effect for both cue types.

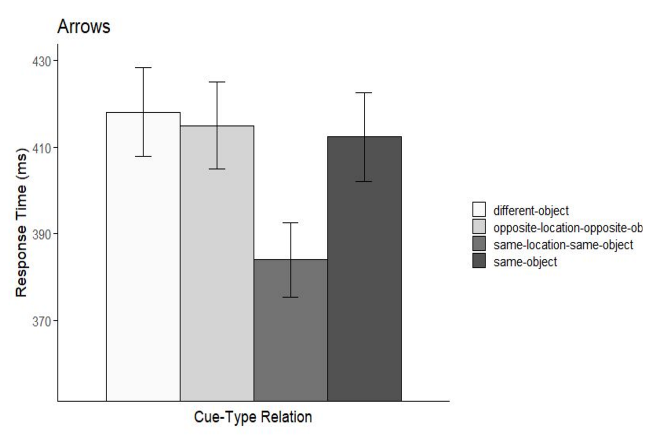
Experiment 2: More Meaningful Objects

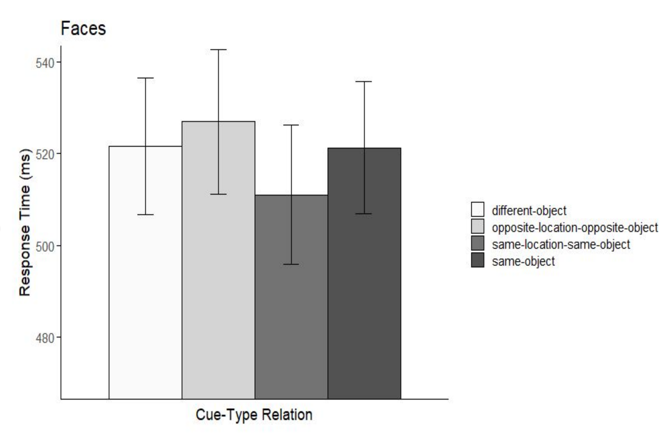
In the first experiment we found an object-based effect for arrow cues.

To test if the effects could be applied to more salient objects, rather than basic rectangles, we chose to use faces, a stimulus known to be processed as objects.

In Experiment 2, 54 participants (Mean age = 29.2, 28 females, 22 males, 3 non binary and 1 genderqueer) were recruited from Prolific^{TM}.



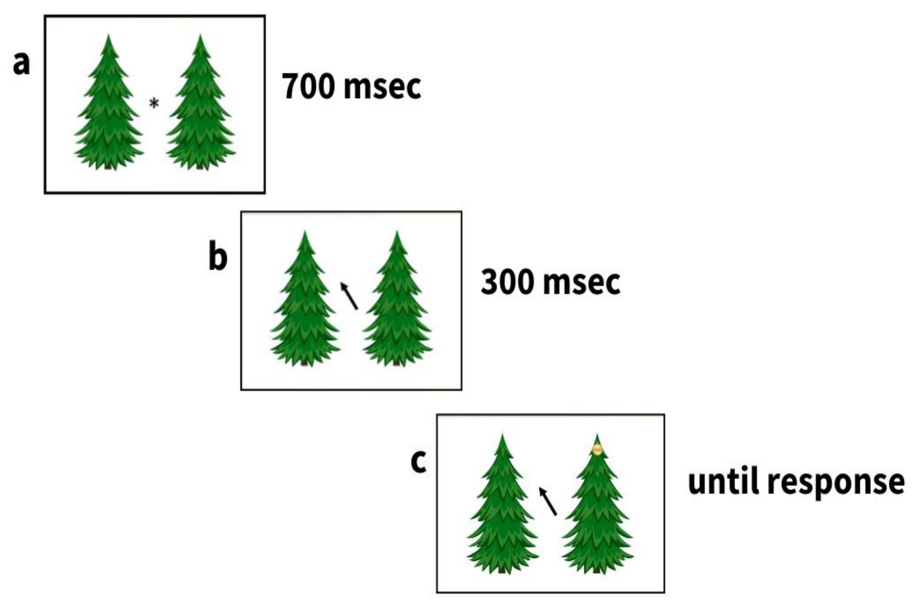


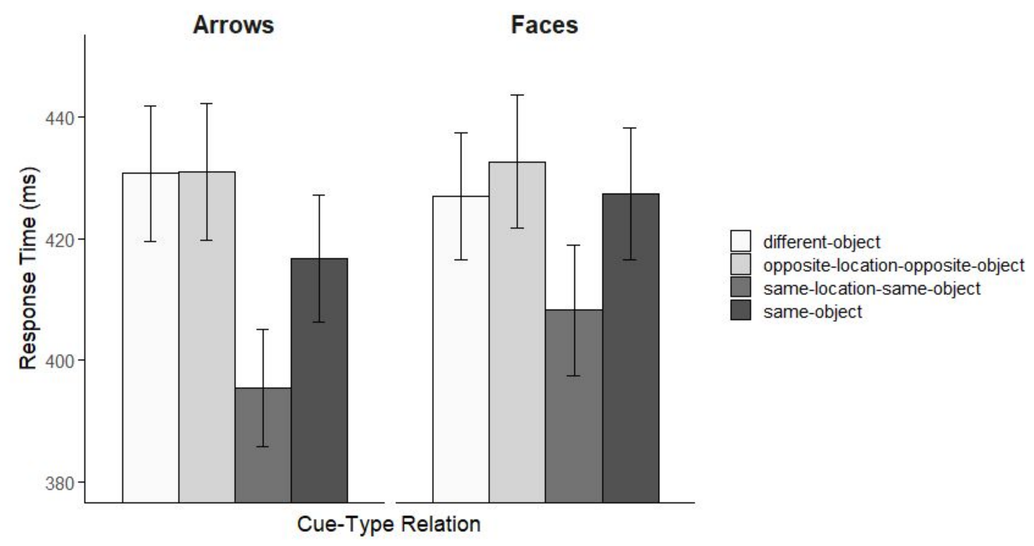


Participants were significantly faster on same-location/same-object than on same-object trials for both face (M = 511, SE = 15.11 vs M = 521, SE = 14.42), $t(53) = -2.3709$, $p < .001$, $d = -.3226$ and arrow cues (M = 384, SE = 8.58 vs M = 412, SE = 10.33), $t(53) = -6.5574$, $p < .001$, $d = -.8923$, indicating a specific location-based effect for both cue types. Participants were not significantly faster on same-object than different-object trials for either of the cues.

Experiment 3: Cueing a Real-World Object

In Experiment 2, we found no evidence for object-based attention driven by either face or arrow cues.
We tested whether a stimulus resembling a real-life object would produce an object-based effect, in contrast to schematic faces.
59 participants (Mean age = 28.4, 33 females, 22 males, 3 non-binary, and 1 agender) were recruited from Prolific^{TM}.





Again, participants were significantly faster on same-location/same-object trials than on same-object trials for both face (M = 408, SE = 10.77 vs M = 427, SE = 10.78), $t(58) = -5.1054$, $p < .001$, $d = -.6647$ and arrow cues (M = 395, SE = 9.63 vs M = 417, SE = 10.41), $t(58) = -7.0656$, $p < .001$, $d = -.9199$, indicating a specific location-based effect for both cue types. Participants were also significantly faster on same-object than different-object trials for arrow cues only (M = 417, SE = 10.41 vs M = 431, SE = 11.12), $t(58) = -3.5214$, $p < .001$, $d = -.4585$, indicating an object-based effect for arrow cues.

Conclusions

- Throughout all three experiments (including the direct replication of Marotta et al. 2012) we found a statistically significant specific location-based effect for both eye-gaze and arrow cues.
- In Experiments 1 and 3, an object-based effect was found for arrows only when using object stimuli (rectangles and Christmas trees). However, this effect was not replicated in Experiment 2, where schematic faces were employed as stimuli. It suggests that while faces may be processed as holistic objects, the presence of an atypical target, such as an 'X' on a face, may attract greater attentional resources, resulting in a specific location-based effect.
- Finding a specific location-based effect for both cue types suggests that when arrows are used, an individual's attention is first directed to a specific location pointed at by an arrowhead, and then spreads to the whole placeholder object. In future studies, these attentional mechanisms could be further investigated using eye-tracking technology.

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Abstract

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Humans reflexively follow the gaze of others, a phenomenon demonstrated in the lab using the gaze-cueing paradigm (Driver et al., 1999; Hutcheon et al., 2024). These joint attention mechanisms are essential for developmental, social and cognitive processes. The shared attention is crucial for language acquisition in children, social interaction, and social learning. Research in the area will allow to improve current educational practices, provide insights into social cognition, and enhance human-computer interaction.

Marotta et al. (2012) investigated whether arrow or eye-gaze cues drive different types of attentional selection in a gaze cueing paradigm. They found a double dissociation within the same task with arrow cues producing a pure object-based effect, and eye-gaze cues triggering a specific location-based effect. We attempted to replicate Marotta et al. (2012) findings and extend them to real-life contexts, using schematic faces and real-life objects (Christmas tree).

Three within-subjects experiments using the gaze-cueing paradigm were conducted. Participants had 16 practice trials and 256 experimental trials. The SOA between the cue and target onset was 300 msec. Cue type (arrow, face) and target location (up, down, right, left) were randomized within each block of trials.

We found a statistically significant specific location-based effect for both eye-gaze and arrow cues in all three experiments. In Experiments 1 and 3, an object-based effect was found for arrows as cues. This effect was not replicated in Experiment 2, where schematic faces were employed as stimuli. It suggests that while faces may be processed as holistic objects, the presence of an atypical target, such as an 'X' on a face, may attract greater attentional resources, resulting in a specific location-based effect.

Our findings suggest distinct attentional mechanisms for arrow cues. It seems that an individual's attention is first directed at a specific location pointed at by an arrowhead before spreading across the entire object. This mechanism highlights the dynamic nature of attentional selection when processing directional cues. Future studies could further explore this process using eye-tracking technology to capture more detailed patterns of attentional shifts.