Bard A Place to Think

amwork or competition: instructional context modulates attention in the gaze cueing paradigm

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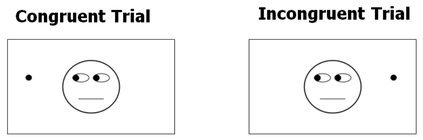
Gaze Cueing Effect (GCE)

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).

Previous studies have shown that humans interpret robot gaze differently from human gaze (Imai, Kanda, Ono, Ishiguro, & Mase, 2002). As one example, perceived humanness of the robot was found to modulate gaze cueing effects (Pfeiffer, Timmermans, Bente, Vogeley, & Schilbach, 2011).

Moreover, a robot that engages in mutual gaze with humans while interacting with an object is perceived as more human-like compared to robots that focus solely on objects (Karreman, Sepulveda Bradford, Dijk, Lohse, & Evers, 2013).

The current experiment aimed to investigate how varying the context in task instructions influences participants' visual attention to a robot's gaze. Additionally, we examined whether participants' gender affects the gaze cueing effect (GCE) toward robots, particularly in interaction with instruction type.

Experimental Design

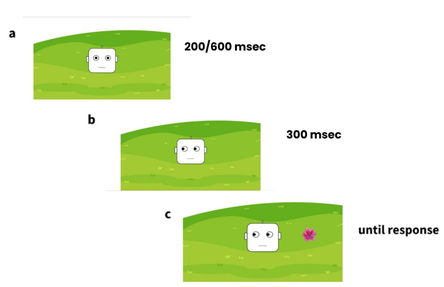
120 participants (65 females and 55 males) were recruited from Prolific™.

Participants were randomly assigned to one of the three groups: Cooperative (N = 41), Competitive (N = 39), or Neutral (N = 40) instruction type.

Participants in the *Cooperative* group were instructed to help the robot to collect flowers. Participants in the *Competitive* group were instructed to to collect as many flowers as they can before the robot picks all of them. In the *Neutral* group, the participants were asked to locate the flower on the screen

Each participant completed 16 practice trials and 256 experimental trials.

We modified the usual dot-probe experiment by adding a green flower field in the background, with a flower image replacing the dot target.

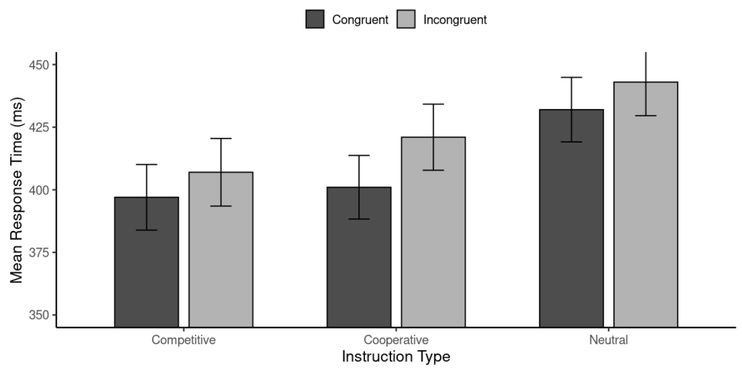


Results

We conducted a 2 (Fixation: 200 ms, 600 ms) × 2 (Congruence: Congruent, Incongruent) repeated-measures ANOVA, with Instruction Type (Competitive, Cooperative, Neutral) and Participant Gender (Male, Female) as between-subjects factors.

- GCE was found: participants' response times (RTs) were faster on congruent compared to incongruent trials (M = 409 ms, SE = 7.49 vs M = 423 ms, SE = 7.76), F (1, 114) = 44.25 , p < .001, η^2 p = 0.28;
- Participants did not appear to be sensitive to instruction type, F(2, 114) = 1.91, p = .15, η^2p = .03;
- However, there were numerical differences in reaction times (RTs) between groups. The competitive group had the fastest RTs (M = 402 ms, SE = 13.2), followed by the cooperative group (M = 411 ms, SE = 12.9), while the neutral group had the longest RTs (M = 438 ms, SE = 13.0);
- GCE was observed across all instruction types. The Congruence × Instruction type interaction was marginally significant, F(2, 114) = 2.85, p = .062, η^2p = .05, suggesting that the cooperative condition exhibited a larger GCE compared to the competitive and neutral conditions.

Post-hoc comparisons indicated that the GCE was significant in the cooperative condition, t(114) = - 5.79, p < .001, and the neutral condition, t(114) = -3.13, p = .026; in the competitive condition, no significant difference between congruent and incongruent trials was found, t(114) = -2.61, p = .102.



Does Gender Modulate the GCE?

Previous studies have shown that eye gaze is processed differently in men and women (Hutcheon et al., 2024), including robot eye gaze (Mutlu, Forlizzi, & Hodgins, 2006).

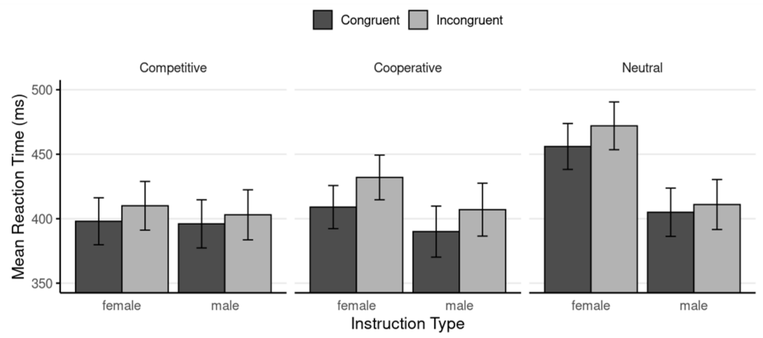
Reaction times (RTs) were longer in female participants compared to male participants (M = 430 ms, SE = 10.2 vs. M = 402 ms, SE = 11.1), though this effect only approached significance, F(1, 114) = 3.29, p = .07, ηp^2 = .03.

Notably, participant gender appeared to modulate the gaze-cueing effect (GCE). The Congruence × Gender interaction was marginally significant, F(1, 114) = 3.20, p = .07, ηp^2 = .03, suggesting that female participants exhibited a larger GCE than their male counterparts.

Does Gender Modulate the GCE?

Male participants showed no numerical differences in RTs across instruction types.
Female participants' RTs varied by instruction type, with the fastest RTs in the competitive group (M = 404 ms, SE = 18,4) and the longest RTs in the neutral group (M = 464 ms, SE = 18.0).

Instruction	Gender	M (ms)	SE	95% CI (Lower)	95% CI (Upper)
Competitive	female	404	18.4	368	441
	male	399	18.9	362	437
Cooperative	female	420	16.8	387	453
	male	399	20.0	359	438
Neutral	female	464	18.0	429	500
	male	408	18.9	371	446



Conclusions

- A stronger gaze cueing effect (GCE) in the cooperative condition compared to the neutral and competitive conditions may suggest that **participants exhibit trust towards cooperative robots** and are more reactive to incongruent trials when a robot decisions are considered 'incorrect'.
- Post-hoc analyses further indicated that the GCE was significant in both the cooperative and neutral conditions but absent in the competitive condition. This suggests that competition may reduce attentional shifts, possibly because **individuals in competitive contexts rely less on social cues**.
- Numerically longer RTs in the neutral condition can suggest that **participants in the cooperative and competitive conditions shared a common goal with the robot**, which may have facilitated more efficient responses. Future research should explore how goal alignment in social versus non-social contexts influences response times and attentional processing.
- Consistent with previous findings about gender differences in the gaze-cueing paradigm (Hutcheon et al., 2024), we found that **females have a greater gaze-cueing effect than males** in all conditions. This suggests that gender may modulate attentional responses to gaze cues.
- Research should be done to study the gaze-cueing effect in different instruction types for various cue types.

References