Avatar Gaze Guides Attention and Performance During Interface Interaction

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Avatars are increasingly used within interactive systems to guide user attention and support interaction. Understanding how avatar behaviour influences users' performance is therefore an important challenge for HCI. We report a within-subjects study in which participants completed a repeated mouse-based target selection task while interacting with visually identical avatars presented as either human-controlled or computer-controlled. Avatar gaze significantly influenced behavioural performance, with faster responses when avatar gaze aligned with the target location. Although perceived agency did not produce an immediate performance advantage, participants' performance developed differently depending on whether they believed the avatar was controlled by a human or a computer, suggesting that the behavioural consequences of agency attribution may depend on familiarity with the task. These findings demonstrate the value of avatar gaze as a mechanism for guiding attention during interaction and suggest that the benefits of perceived agency may emerge as users gain experience with an interface.

Avatar gaze. Attention guidance. Human-computer interaction. Agency. User performance.

1. INTRODUCTION

Avatars are increasingly used in interactive systems to support communication, navigation, information access, and user engagement. Beyond representing people or systems, avatars can shape interaction through visible social signals such as gaze direction, movement, and responsiveness. These cues matter because users do not only interpret interfaces visually; they also respond behaviourally to where interface elements appear to direct their attention.

Guiding visual attention is a central concern in HCI. Interfaces often need to help users locate relevant information, identify possible actions, and move efficiently between elements. Gaze is one mechanism through which avatars may support this process. Prior work has shown that gaze cues from avatars and human faces can influence users' visual attention on 2D screens, including how quickly users fixate on targets and how they allocate attention between a stimulus and a target (Albiz et al., 2023). More recent work on gaze-aware avatars has also shown that users adapt their visual behaviour in response to avatar gaze during real-time interaction on conventional 2D screens (Drewes et al., 2026). Beyond influencing visual attention and behaviour generally, avatar guidance may also direct users' attention to relevant information more quickly: Komatsu et al. (2025) found that users fixated sooner on target image regions when viewing photographs with guidance from a virtual agent. Together, this work suggests that avatar gaze can function as more than a representational feature: it can actively shape how users allocate attention and respond during interaction.

However, less is known about how avatar gaze influences performance when users must repeatedly locate and select targets across multiple spatial locations. Many studies of gaze-based attention guidance use relatively simple left-right target arrangements or focus primarily on eye-movement outcomes. In contrast, interaction with digital systems often involves locating items across spatially distributed regions and acting on them using mouse-based or touch-based responses. Examining avatar gaze within a repeated target selection task therefore provides a useful way to study whether gaze-based attention guidance remains behaviourally relevant when attention and action are both required.

A further question concerns perceived agency. Avatars may be visually identical but interpreted differently depending on whether users believe they are controlled by a human or by a computer system. Prior work on avatars and mediated agents suggests that users' responses can depend not only on visual appearance, but also on social interpretation, perceived responsiveness, and

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assumptions about the system behind the representation (Nass et al., 1994; Reeves & Nass, 1996; Fox et al., 2015; Qiao et al., 2025). More specifically, a meta-analysis by Fox et al. (2015) found stronger responses to representations perceived as human-controlled than those perceived as computer-controlled, with agency effects varying according to factors including immersion, task type, and whether outcomes were measured subjectively or objectively. For interaction design, this raises an important question: does the perceived source of avatar behaviour alter how users respond to otherwise identical gaze behaviour?

We investigated these questions using a within-subjects behavioural experiment. Participants completed a mouse-based target selection task in which an on-screen avatar shifted its gaze before targets appeared across four spatial locations. Avatar gaze either aligned with the target location or conflicted with it. The same avatar behaviour was presented under two agency framings: human-controlled and computer-controlled. In reality, avatar behaviour was pre-programmed in both conditions, allowing us to isolate the effect of perceived agency while holding the visual behaviour constant.

This paper makes two contributions to HCI. First, it shows that avatar gaze influenced behavioural performance during a repeated, multi-location target selection task, supporting its role as a mechanism for guiding attention during interaction. Second, it shows that perceived agency did not produce a simple overall performance advantage. Instead, agency interacted with task order, suggesting that the behavioural consequences of agency attribution may depend on familiarity with the task. These findings position avatar gaze as a useful design feature for guiding interaction, while also showing that the effects of social framing may develop over time rather than appearing immediately.

2. BACKGROUND

Research across psychology and HCI has demonstrated that gaze is a powerful cue for directing visual attention. Observing another person's gaze can automatically influence where attention is allocated, even when gaze direction provides no useful information about the task. This principle has informed a growing body of HCI research investigating how avatars and virtual agents influence user attention and behaviour through gaze.

Previous studies have shown that avatar gaze can guide visual attention on conventional 2D displays, influence target detection, and alter interaction behaviour during interface use (Albiz et al., 2023; Komatsu et al., 2025; Drewes et al., 2026). These findings suggest that gaze can serve as an effective interaction cue, helping users identify relevant interface elements and coordinate visual attention during task completion. However, comparatively little work has examined whether these effects extend to repeated mouse-based target selection tasks involving multiple possible target locations.

A separate line of research has shown that users often interpret interactive systems socially. Work on Computers Are Social Actors (CASA) demonstrated that people readily apply social expectations to computer systems, while subsequent research has shown that avatars, virtual humans, and conversational agents can evoke social responses through appearance, behaviour, and perceived responsiveness (Nass et al., 1994; Reeves & Nass, 1996; Fox et al., 2015). Recent research has similarly identified the distinction between user- and AI-controlled avatars as an important interaction-design consideration, including its implications for user experience (Yoshida et al., 2024). These findings suggest that behavioural responses may depend not only on what an avatar does, but also on what users believe the avatar represents.

The present study brings these two perspectives together. We examine whether avatar gaze guides attention and behavioural performance during a repeated mouse-based target selection task, and whether these behavioural effects differ according to whether users believe the avatar is controlled by a human or by a computer system. This raises the possibility that agency attribution could alter how users respond to otherwise identical gaze behaviour during interaction.

3. STUDY

3.1 Participants

Thirty-one participants (19 females, 18-62 years, mean age 24.7 years) took part in the study. All participants had normal or corrected-to-normal vision and provided informed consent prior to participation. Ethical approval was obtained from Abertay University's Ethics Committee.

3.2 Design and Procedure

Participants completed a repeated target selection task while viewing an on-screen avatar positioned centrally on the display (see Figure 1, panel A for trial sequence). Before each target appeared, the avatar shifted its gaze either towards or away from the upcoming target location (see Figure 1, panel B for animation sequence). Participants were instructed to ignore the avatar's gaze and select the target as quickly and accurately as possible using

the mouse. The task was adapted from a foundational experimental paradigm used to investigate attentional orienting (Posner, 1980; Friesen & Kingstone, 1998), but was enhanced to require repeated mouse-based target selection across multiple spatial locations. Targets appeared

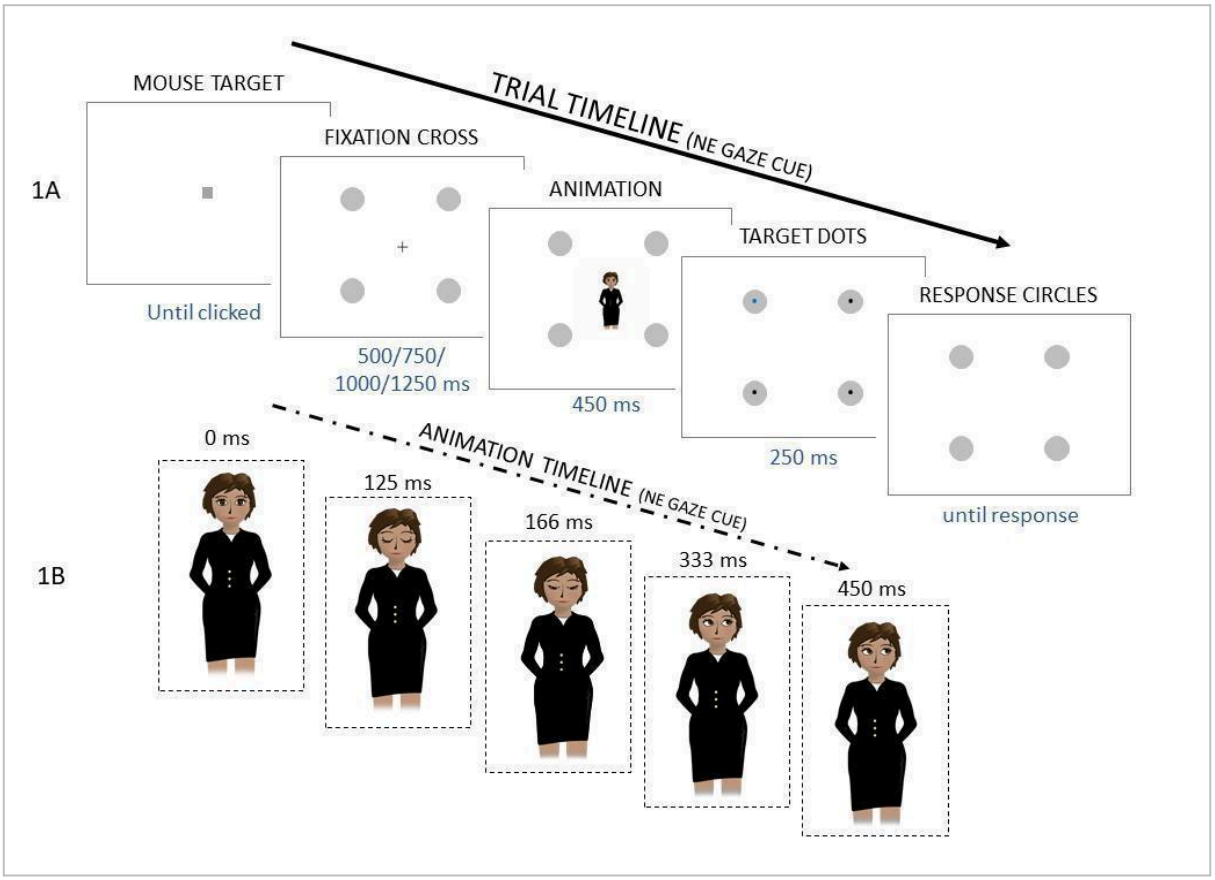

Figure 1: *Trial sequence (A) and avatar gaze animation for a north-east cue (B)*

across four spatial locations surrounding the avatar (north-east, north-west, south-east and south-west).

The avatar's gaze was either congruent, incongruent or neutral (looking straight ahead) to the location of the target. With 4 target locations, this meant there were 20 trial configurations. For each block of trials, congruent trials were presented 4 times each (16 trials), incongruent and neutral trials were presented once each (16 trials). This created 32 trials per block, with 50% predictive gaze. Neutral trials, in which the avatar continued to look straight ahead, rather than towards a target, were included to reduce the predictability of the avatar's gaze and were excluded from the primary analyses.

Each participant completed the task over 2 phases consisting of 4 blocks each (256 trials total). Before one phase, participants were told that the avatar was controlled by another human participant; before the other, they were told it was computer-controlled. The order of these phases was counterbalanced. In reality, the avatar's behaviour was pre-programmed and visually identical in both phases (i.e., agency conditions), allowing perceived agency to be manipulated independently of avatar behaviour.

3.3 Measures

The primary outcome measure was Digital Reaction Time (DRT), defined as the time between target onset and successful mouse-click target selection. Primary analyses examined the effects of perceived agency (human or computer), gaze congruency (congruent or incongruent), and presentation order (human-first or computer-first) on DRT.

DRT was analysed using a 2 × 2 × 2 mixed ANOVA, with presentation order (human-first vs. computer-first) as a between-subjects factor and perceived agency (human vs. computer) and gaze congruency (congruent vs. incongruent) as within-subjects factors. Effect sizes are reported as partial eta squared (η^2p).

3.4 Use of AI

Generative AI was used at the final editing stage to review this manuscript against BritCHI 2026

submission requirements, including anonymisation and reference formatting.

4. RESULTS

DRTs were analysed to examine whether avatar gaze influenced target selection performance, and whether this differed according to perceived agency and presentation order. Neutral catch trials were excluded from the primary analyses, which focused on congruent and incongruent trials.

Avatar gaze significantly influenced performance. Participants selected targets more quickly when the avatar's gaze aligned with the target location (M = 785 ms) than when it conflicted with the target location (M = 803 ms), indicating that avatar gaze affected behavioural responses during the task, $F(1, 29) = 14.15$, $p < .001$, $\eta^2p = .328$. There was no clear overall performance advantage for avatars presented as human-controlled compared with computer-controlled, $F(1, 29) = 1.57$, $p = .220$, $\eta^2p = .051$. However, performance differed depending on the order in which participants experienced the two agency conditions. The analysis revealed a significant interaction between perceived agency and presentation order, $F(1, 29) = 18.65$, $p < .001$, $\eta^2p = .391$.

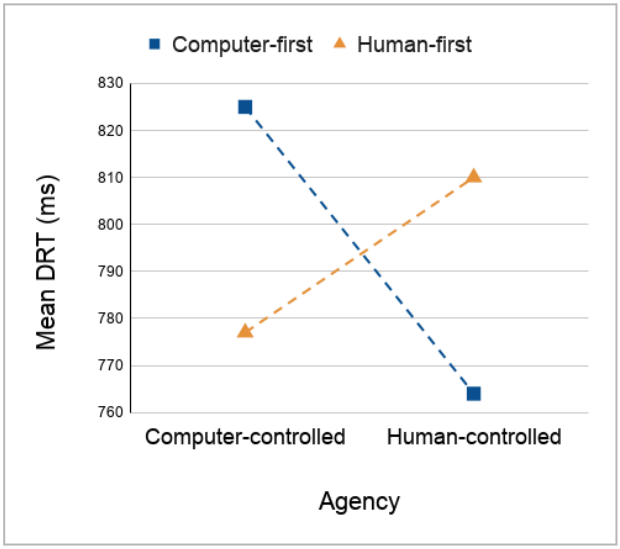

Figure 2: *Mean DRT in milliseconds by perceived agency and presentation order. Lines represent participants who completed the computer-controlled (blue/square) or human-controlled (orange/triangle) condition first.*

Follow-up comparisons indicated that when participants experienced the computer-controlled condition first, DRTs were significantly faster for the human-controlled avatar (M = 764 ms) than the computer-controlled avatar (M = 825 ms), $p = .0016$ (Bonferroni-corrected). When participants experienced the human-controlled condition first, the pattern reversed, with slower DRTs for the human-controlled avatar (M = 810 ms) than the computer-controlled avatar (M = 777 ms); however, this difference did not remain significant after Bonferroni correction, $p = .060$.

No other main effects or interactions reached significance.

5. DISCUSSION

The present study investigated whether avatar gaze and perceived agency influence behavioural performance during a repeated target selection task. Two findings are particularly relevant for HCI. First, avatar gaze influenced behavioural performance across task phases, demonstrating that users oriented attention in response to an avatar's gaze even when completing repeated mouse-based target selections. Second, although perceived agency did not produce an overall performance advantage, it influenced how performance developed over the course of the interaction. Together, these findings suggest that avatar gaze provides a robust mechanism for guiding user attention, while the behavioural consequences of agency attribution may depend on users' familiarity with a task. Results like this may become more relevant as interactive systems incorporate AI-driven avatars, virtual assistants, and socially framed interfaces. In such contexts, users may not know whether avatar behaviour is generated by automated processes, human operators, or a combination of both. The data suggest that these interpretations may influence behavioural performance independently of the avatar's visible behaviour.

5.1 Avatar Gaze Supports Attention During Interaction

Previous work has shown that avatar gaze can influence visual attention and user behaviour during interaction (Albiz et al., 2023; Drewes et al., 2026). The present findings extend this work by demonstrating the effect in a repeated target selection task requiring users to identify and select targets across multiple spatial locations using mouse-based responses. Although the task differed from the simpler paradigms commonly used to study attentional orienting, participants continued to respond more efficiently when avatar gaze aligned with the target location. The influence of avatar gaze persisted despite repeated exposure to the task and despite participants being instructed to ignore the gaze cue. This suggests that gaze-based guidance may continue to shape user behaviour even when users are focused on an explicit interaction objective.

For HCI, this suggests that avatar gaze may represent a practical mechanism for supporting attention during interaction. Rather than functioning

solely as a social or aesthetic feature, avatar gaze can actively influence how users locate and respond to information presented within an interface. This has potential implications for the design of avatars that assist navigation, guide attention towards interface elements, or support users as they complete repeated interaction tasks. This potential extends to immersive interaction, where avatar gaze has been proposed as a means of directing users' attention towards relevant objects during XR collaboration (Hart et al., 2021).

5.2 Agency Effects Develop During Interaction

Avatar gaze influenced performance throughout the study, whereas the effects of perceived agency depended on the order of the conditions. Participants did not show a simple overall behavioural advantage when interacting with an avatar they thought was human-controlled. This contrasts with the overall advantage for perceived human-controlled representations reported by Fox et al. (2015), although their meta-analysis does indicate that the strength of agency effects can vary according to characteristics of the task and interaction. Instead, the effect of perceived agency depended on the order of the conditions, with faster DRTs when participants moved from the computer-controlled to the human-controlled condition.

One possible explanation is that the cognitive demands of the task, which involved selecting targets across four spatial locations using mouse-based responses, reduced the influence of perceived agency early in the interaction (Hon et al., 2013). As participants became more familiar with the task, the effects of agency attribution may have become more salient. This interpretation requires further investigation, but it provides a possible explanation for the observed interaction and emphasises the importance of considering how social cues operate over the course of an interaction rather than only at its beginning. Alternative explanations are also possible, including changing expectations regarding the avatar, differences in strategy adoption across phases, or broader effects of social framing.

5.3 Implications and Future Work

These findings suggest that avatar-based interfaces should consider how avatars direct user attention and how users interpret avatar behaviour. Avatar gaze can support behavioural performance during interaction, even if it is not reliably predictive of upcoming events. The influence of perceived agency may emerge gradually as users gain experience with a task.

The study raises several questions for future research. The current task involved repeated target selection across multiple spatial locations using mouse-based responses. Given evidence that agency effects can vary according to characteristics of the task and interaction (Fox et al., 2015), future work could examine similar patterns across other interaction forms and interface layouts. It could also investigate how task familiarity and perceived agency interact over time.

Although perceived human agency did not produce a consistent performance advantage in the present task, this does not preclude benefits in other aspects of the interaction. Recent work comparing human- and AI-controlled avatars found greater positive affect and social presence, alongside greater attribution of emotions and intentions, when users were aware that the avatar was human-controlled (Kober et al., 2026). Future work could therefore examine whether perceived human agency provides social or affective benefits even where advantages for task performance are limited.

Relatedly, although the task was intentionally designed to examine behavioural performance during repeated interaction, the mechanisms underlying the observed agency effect remain unclear. Distinguishing between explanations based on learning, expectation, or changes in users' interpretation of the avatar represents an important direction for future work.

6. CONCLUSION

Avatar gaze influenced users' attention and behavioural performance during a repeated target selection task, demonstrating its potential to support interaction within avatar-based interfaces. While perceived agency did not produce an immediate performance advantage, its effects varied with phase order, consistent with a possible role for task familiarity. Together, these findings contribute to understanding how avatar gaze and perceived agency shape user behaviour, and highlight opportunities for designing avatar-based interfaces that support attention during interaction.

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