The role of gaze cues in social wayfinding

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Abstract

Social wayfinding refers to the way people navigate in the presence of other people. In this study we consider the impact of gaze cues, such as the direction in which other people in the environment appear to be looking. We used a Virtual Reality (VR) task in which participants navigated through a virtual room past either a single virtual person (Exp. 1) or two people (Exp. 2). In Exp. 1 the virtual person could be looking left, right, or front. When gaze was to the left or right, participants overwhelmingly chose to pass on the side opposite to the gaze direction. In Exp. 2 the two virtual people could be looking to the left, to the right, or directly at each other, and participants could pass to the left of both agents, to the right of both agents, or in between them. Participants tended to pass in such a way as to avoid crossing gaze directed at the other person (person-directed gaze), especially when both agents were looking at each other (mutual gaze). These results expand on our understanding of the role of gaze cues in determining human path selection.

Keywords: Social wayfinding, eye gaze, navigation

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Introduction

Wayfinding refers to decisional processes underlying people's navigation through the environment (Wiener, Büchner, & Hölscher, 2009). Most of the literature on wayfinding concerns depopulated spaces, and focuses on non-social factors such as path efficiency, distance, and time (Montello, 2005). But when the environment includes other people, wayfinders' trajectories can be substantially influenced by social factors, referred to collectively as *social wayfinding*[1] (R. C. Dalton, Hölscher, & Montello, 2019). Some aspects of social wayfinding stem from wayfinders' desire to avoid colliding with other people (Mousas, Koilias, Anastasiou, Rekabdar, & Anagnostopoulos, 2019). People are a special kind of environmental obstacle, because they can move, have minds and goals of their own (Spiers & Maguire, 2008), and sometimes form groups (Zhou, Han, Liang, Hu, & Kuai, 2019). But social wayfinding is also influenced by more subtle social factors, such as avoiding encroaching on others' "personal space," a broad topic often called *proxemics* (Hall, 1966; Kendon, 1990; Bailenson, Blascovich, Beall, & Loomis, 2003; Kitazawa & Fujiyama, 2008). Proxemic constraints on people's path choices are further complicated by cultural conventions like right-hand traffic and even fear of contagion (DeStefani et al., 2023).

This paper investigates a factor whose role in wayfinding is relatively poorly understood: the direction in which other people in the environment appear to be looking, referred to as *gaze cues*. People are extremely sensitive to gaze direction (Hoffman & Haxby, 2000; Guterstam, Wilterson, Wachtell, & Graziano, 2020; Davidson & Clayton, 2016), in part because it provides evidence about the target of other people's

[1] Movement through a small interior space, as in the experiments below, is sometimes called *navigation* rather than *wayfinding*. However the term *social navigation* is usually used (somewhat metaphorically) to refer to management of social relationships (e.g. Tavares et al., 2015), rather than physical movement through the environment—hence the term "social wayfinding" to refer to physical navigation through a populated environment.

attention (Langton, Watt, & Bruce, 2000; Frischen, Bayliss, & Tipper, 2007; Dalmaso, Castelli, & Galfano, 2020). A substantial fraction of human gaze is directed at other people (N. S. Dalton, Collins, & Marshall, 2015; Suchojad, Sohn, Shlivko, Feldman, & Stromswold, 2025), so gaze cues potentially provide information about social interactions and relationships. Even in other species, gaze sensitivity has been taken to demonstrate that the animal has an understanding of the attention and visual perspectives of others (Shepherd, 2010). Both direct and dieictic ("pointing") gaze convey information about visual focus, support inferences about private thought and intention, and contribute to the social coordination of behavior (Pfeiffer, Vogeley, & Schilbach, 2013). Sensitivity to gaze direction has been demonstrated in both real life (e.g. Schwarzkopf, Büchner, Hölscher, and Konieczny, 2017; Hessels, van Doorn, Benjamins, Holleman, and Hooge, 2020) and virtual reality (VR; e.g. Bailenson et al., 2003; Mousas et al., 2019).

There is a substantial literature on human sensitivity to gaze cues in social wayfinding, but key questions are still unanswered. One natural hypothesis is that wayfinders infer other people's future movements from their gaze direction, and thus might use gaze cues to help avoid collisions (Moussaïd, Helbing, & Theraulaz, 2011; Mirsky, Xiao, Hart, & Stone, 2024). Indeed people usually look in the direction they are moving (Hollands, Patla, & Vickers, 2002; Geisen, Bock, & Klatt, 2024), look at people they are about to pass (Meerhoff, Bruneau, Vu, Olivier, & Pettré, 2018; Croft & Panchuk, 2018; Suchojad et al., 2025), and use gaze-based heuristics to avoid collisions (Cutting, Vishton, & Braren, 1995; Park, Rojas, & Yang, 2013). Some evidence for this idea comes from human reaction to humanoid robots. For example, Neggers, Ruijten, Cuijpers, and IJsselsteijn (2022) found that people navigating near humanoid robots expect the robots to move in the same direction their eyes are pointing. As a result, one might expect that wayfinders would avoid crossing others' gaze, at least in part to help avoid collisions.

However evidence that human wayfinders avoid crossing other people's gaze directions is surprisingly mixed. Two studies (Nummenmaa, Hyönä, and Hietanen, 2009, and Jakobowsky, Abrams, and Rosenthal-von der Pütten, 2024), have found evidence that participants *plan* paths that avoid crossing the gaze directions of those in the immediate environment. In Nummenmaa et al. (2009), participants saw an animated character walking directly toward them on a computer screen. The character's gaze was either to the left, to the right, or shifting from side to side. Participants were asked to indicate via button press on which side they would pass the character, and generally chose the opposite side from where the character was looking. Similarly, in Jakobowsky et al. (2024), on-line subjects viewing a video of a character (human or robot) approaching along a narrow hallway, usually indicated via button press that they would "skirt" the character on the side opposite from where the character was looking. Both of these studies suggest that real wayfinders would avoid crossing gaze, though both results are somewhat inconclusive as they involved only stated intentions (conveyed by button press) rather than actual navigational choices (as participants were not actually navigating). Under these circumstances participants may not have considered potential countervailing preferences, such as minimization of path length, which might be more salient to an ambulatory subject. Indeed, in a study of freely ambulating participants by Raimbaud et al. (2023), this prediction was not borne out: although participants were very attentive to gaze direction (e.g. looking more at agents that were looking at them), their navigational paths were *not* measurably affected. Similarly, Lynch et al. (2018) found that human wayfinders were not influenced by the gaze direction of virtual agents in their environment.

In light of these mixed results, the actual influence of gaze cues on wayfinders' actual paths is unclear. In Exp. 1 we investigate this issue directly by having freely ambulating participants immersed in a VR environment navigate around a virtual agent, and manipulating the agent's gaze direction. Then in Exp. 2 we investigate an issue not raised in previous studies: the influence of gaze when *two* agents are present. The presence of a second agent raises several new questions, such as whether gaze *among* the agents—for example, mutual gaze that might be interpreted by subjects as implying a social connection—influences path choices. Our overall goal is to understand how human wayfinders use gaze direction to inform their decisions about how to navigate the environment.

Overview of experiments

We conducted our experiments in VR, which allows systematic and meticulous control of the participant's visual environment (Garau, Slater, Pertaub, & Razzaque, 2005). The participant was immersed in a VR environment via a commercially available headset (Meta Quest 2). The VR environment was a simple room with a door on the far side. The instructions were to navigate to the door. Virtual people ("agents") were positioned between the participant and the door, whose number and gaze directions we manipulated. Though the participant was not explicitly instructed to avoid colliding with the agents, they invariably did so, and the main dependent variable was the path they chose around the agent.

In Exp. 1, the obstacle agent was a single male person whose eyes were either pointing forward towards the participant, to the participant's left, or to the participant's right. The participant could choose to pass either to the left or the right of the agent. In Exp. 2, there were two agents (both standing), each of whom could be gazing directly at the other agent, towards the particpant's left, or towards the participant's right. The participant could choose to pass to the left of the left agent, to the right of the right agent, or in between them.

Both experiments were conducted in a large empty room (approximately 4m×6m). At the beginning of the experimental session, each participant was given a brief tutorial to familiarize them with the VR headset. Each experimental session included about 10–15 minutes of instructions and familiarization, 20–25 minutes of actual experimental trials, and about 5-10 minutes of debriefing, for a total of about 45–60 minutes.

Participants. Participants were adults enrolled in undergraduate psychology courses who were compensated with course credit. Participants were naive to the purposes of the experiment. We aimed for about 10 participants per experiment in order to demonstrate effects of the size anticipated on the basis of previous experiments using similar methodology. All participants had normal mobility and normal or corrected-to-normal vision. All experiments were conducted in accordance with a protocol approved by the university IRB.

Experiment 1

Participants. Data were collected from 11 participants (4 women, 7 men). We excluded one participant who did not follow instructions.

Design. Exp. 1 had two main experimental manipulations, the agent's body position (sitting or standing), and the agent's gaze direction. The agent's gaze direction was either to the *left*, to the *right*, or *forward* (i.e., looking directly at the participant's initial position). Gaze direction was conveyed by a naturalistic combination of pupil direction and head/neck position (see figure), and was plainly visible to participants. The two body positions were fully crossed with three gaze directions to yield 6 conditions (Fig. 1). The 6 conditions were presented in random order in each block, repeated for 12 blocks, for a total of $6 \times 12 = 72$ trials.

Results, Exp. 1

The dependent measure was the side (left or right) on which the participant chose to pass by the virtual agent, which we evaluated as a function of the agent's gaze direction (left, right, or front) and body position (standing or sitting). Fig. 2 shows the results, plotting mean path choice (probability of passing to the right) as a function of body position (standing/sitting) and gaze direction (left/right/front). Note that participants passed either to the right or left on every trial, so the probability of passing to the right is always one minus the probability of passing to the left. To analyze these

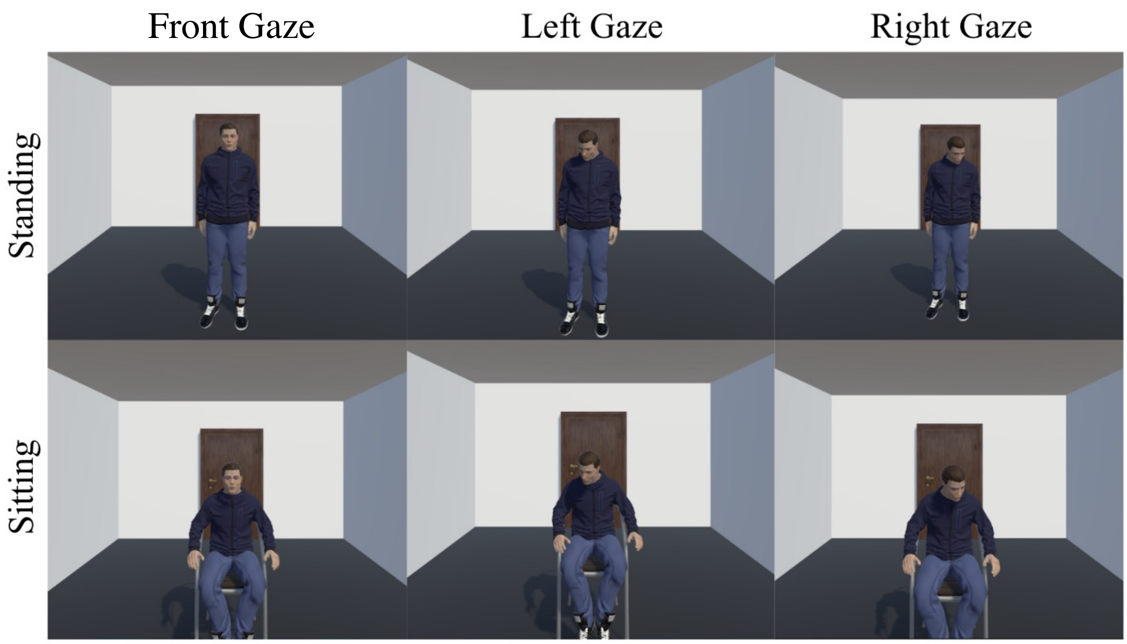

Figure 1
The 6 conditions for Exp. 1, showing standing agents (top row) and sitting agents (bottom row). Left, middle and right columns show respectively front, left, and right gaze directions.

data, we used Bayesian logistic regression (brms package in R, Bürkner, 2017), comparing nested models to provide Bayes Factors of inclusion ($BF_{inclusion}$) for each factor and interaction. ($BF_{inclusion}$ expresses the Bayes Factor of one model relative to another, in this case for a model that includes a given factor compared to an otherwise matched model that does not.) Our analysis involved two fixed factors, body position (= sitting/standing) and gaze direction (= left, right, or front) and their interaction, plus a random effect of participant. The $BF_{inclusion}$ for gaze direction was 3.21×10^{36}, indicating extremely strong evidence for an influence of gaze direction on passing side. There was no evidence for an effect of body position ($BF_{inclusion} < 1$) or a gaze direction × body position interaction ($BF_{inclusion} = 1.12$). These results clearly indicate that in Exp. 1 gaze direction strongly influenced the navigational path that participants took.

Discussion, Exp. 1

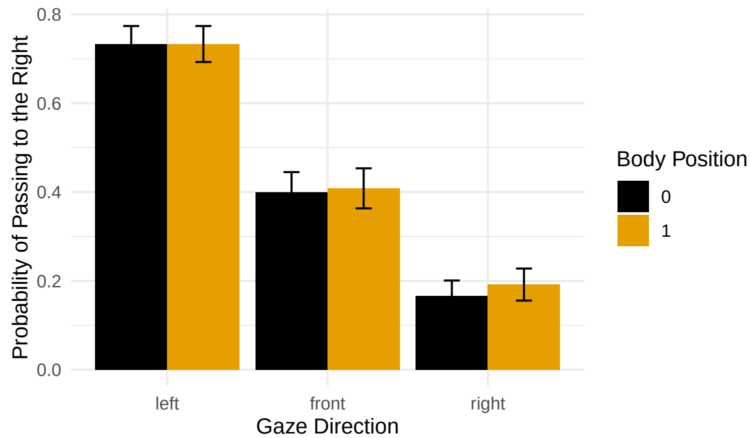

Figure 2

Plot of participants' mean probability of passing to the right as a function of body position (sitting/standing) and gaze direction (left, front, right). Each plotted point averages across 10 participants and over 12 blocks within participant. Error bars represent ± 1 s.e.

This experiment sought to understand how gaze direction and body position of a virtual agent influence participants' social wayfinding behavior, specifically regarding avoidance behavior in a virtual environment. The clear conclusion is that participants physically navigating a virtual room are strongly influenced by gaze cues, though not by the agent's body position. Specifically, just as some (though not all) earlier studies results had suggested, human wayfinders tend to avoid crossing other people's gaze. This finding sheds light on the underlying mechanisms of human social wayfinding, highlighting the strong influence that purely social factors, such as awareness of other people's perceptual attention, has on wayfinders' choices.

Experiment 2

The results of Exp. 1 raise a number of questions about the influence of gaze on wayfinding in more complex situations, such as those involving multiple people in the environment. Some researchers (e.g. Rojas and Yang, 2014) have speculated that wayfinders might treat groups of other agents as coherent "social formations" to be collectively avoided, and further suggested that wayfinders might use gaze cues to identify social groups. People use different cues to decide whether a set of people form a social group. Among these cues are proximity and body pose (Zhou et al., 2019) and mutual gaze (Huang, Andrist, Sauppé, & Mutlu, 2015; Champ et al., 2022), which facilitates non-verbal social interaction (Stawarska, 2006; Severitt, Castner, & Wahl, 2024). But the influence of mutual gaze on social wayfinding has not been studied empirically. Hence we next investigated whether multiple agents' gaze directions might influence a participant's path choices. In Exp. 2 we used two agents in a setup otherwise similar to Exp. 1, and manipulated both agents' gaze directions independently.

Participants. Data were collected from 10 participants (7 women, 3 men). No participants were excluded.

Design. In Exp. 2, there were two agents, one on the left (Agent A), and the other on the right (Agent B) (Fig. 3). The agents were positioned such that the sagittal plane of Agent A was located at 1/3 of the room width from the left wall, and the sagittal plane of Agent B was located at 1/3 of the room width from the right wall. This arrangement created three equal-width gaps (left, middle, and right) through which the subject could pass. Both agents' bodies were oriented 45° inward, toward the center of the room. We chose two male agents that were dressed differently but were otherwise similar in height, appearance and ethnicity, in order to avoid important but potentially confounding demographic variables such as gender and race which were not the subject of inquiry (see Dalmaso et al., 2020). The main experimental manipulation was the agents' eye gaze direction, which could be: (1) *direct*, meaning that the eyes were fixed on the other agent's face; (2) *left*, with gaze directed toward a fixed point on the left side of the room or (3) *right*, with gaze directed toward a fixed point on the right side of the room (Fig. 3). All gaze targets were implemented as invisible objects placed in the 3D environment and used as focal points for the agents' eyes. For gaze targets on the same side as the agent (ipsilateral targets), each point was placed relative to the position of the corresponding agent's head: the x-coordinate was offset by -0.25 units (a 1/4 of a meter) outward from the agent's position (negative for Agent A, positive for Agent B) to orient the gaze toward the outer edge of the room; the y-coordinate was lowered from 1.785 to 1.5 to produce a slightly downward gaze; and the z-coordinate was shifted from 2.65 to 0.29, aligning approximately with the participant's starting depth in the environment. For gaze targets on the opposite side from the agent (contralateral targets), the x-coordinate matched the head position of the other agent (i.e., Agent A's contralateral gaze target was placed at Agent B's x-coordinate and vice versa), while the same y (1.5) and z (0.29) values were used to create a consistent downward gaze toward the opposite side of the room.

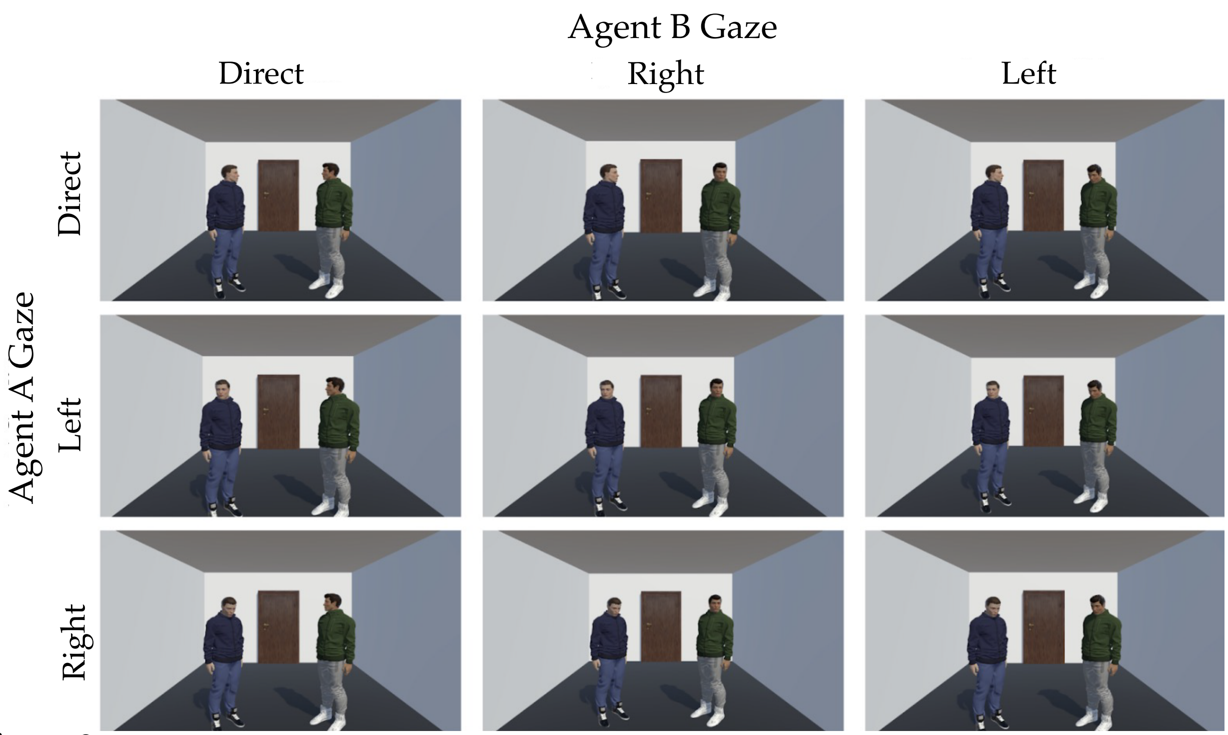

Figure 3
The 9 conditions in Exp. 2. Rows show gaze direction for Agent A (left-hand agent), respectively A-DirectGaze, A-LeftGaze, and A-RightGaze in the top, middle, and bottom rows. Columns show gaze direction for Agent B (right-hand agent), respectively B-DirectGaze, B-RightGaze, and LeftGaze in left, middle and right columns.

These three levels were applied independently to both agents, resulting in a total of 9 conditions (Fig. 3). As in Exp. 1, the 9 conditions were presented in random order in each block, repeated over 8 blocks, for a total of 72 trials, lasting about 45–60 minutes in total. Other details of the experimental procedure were as in Exp. 1.

Results, Exp. 2

We analyzed the paths participants took to pass the agents in two ways. In the first analysis, the dependent variable is trichotomous, with the participant's path classified as left (to the left of AgentA), middle (between the agents), or right (to the right of AgentB). To analyze these data, we first ran a Bayesian multinomial logistic regression (using brmc in R, as above), using AgentACondition and AgentBCondition as crossed fixed factors, plus a random effect of participant. The results show very strong evidence for AgentACondition ($BF_{inclusion} = 8.72 \times 10^{18}$), AgentBCondition ($BF_{inclusion} = 8.02 \times 10^{17}$) and the interaction ($BF_{inclusion} = 2.49 \times 10^{5}$). That is, participants' choice of path (left, middle, or right) was influenced by both agents' gaze directions, as well as by an interaction between them.

To visualize these effects, Fig. 4 shows three separate plots, respectively plotting the probability of one of the three possible responses (left, middle, and right). As can be seen in the plots, the general finding is that participants were far more likely pass on a side opposite from where the nearer agent was looking, and particularly avoided passing between the agents when they were looking at each other. For example, Fig. 4a shows that participants were much less likely to pass to the left when the left agent (Agent A) was looking left (left group of bars) then when he was looking right (middle and right groups of bars). Similarly, Fig. 4c shows that participants were much less likely to pass to the right when the right agent (Agent B) was looking right (black bars). When both agents were looking at each other (direct gaze), participants were very unlikely to pass through the middle (Fig. 4b).

Next, as a simpler and more readily interpretable analysis, we conducted a "symmetrized" logistic regression that collapsed over left and right sides. This results in a more easily plotted dichotomous dependent measure, the probability of passing *outside* (left or right) vs. *inside* (middle). In the symmetrized analysis, the nine gaze direction conditions in the original 3×3 design reduce to six gaze direction categories:

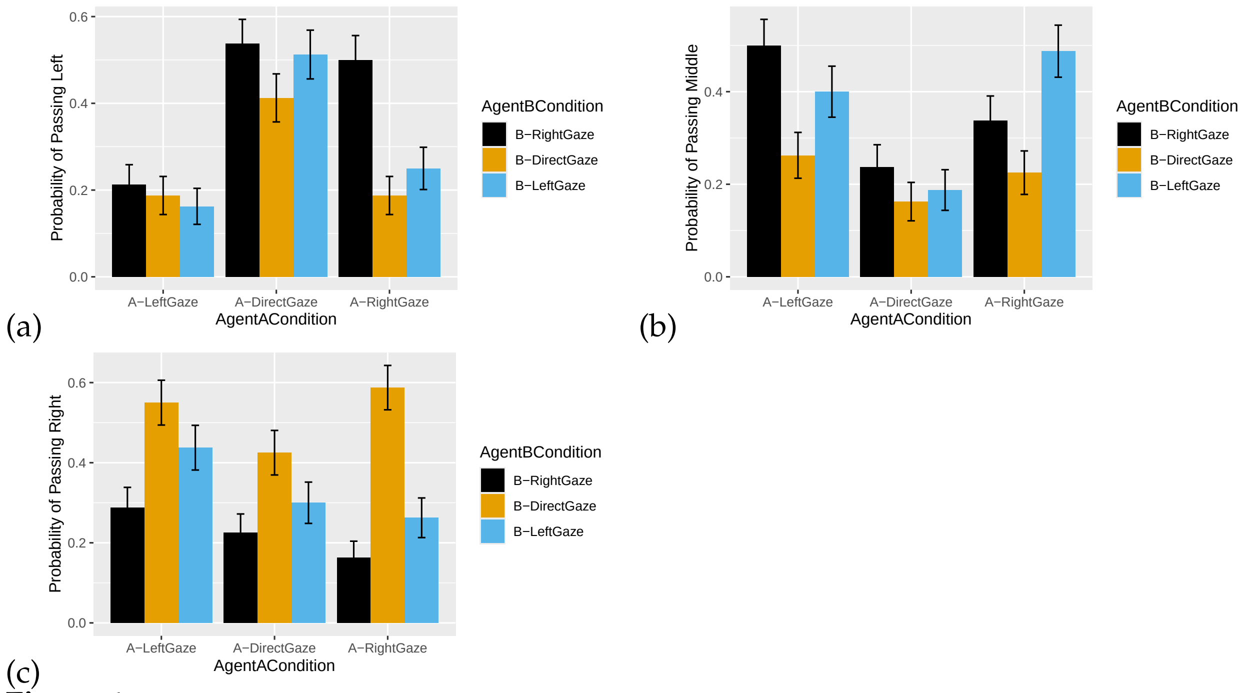

Figure 4

Influence of AgentACondition and AgentBCondition on participants' path choices. The figure shows separate plots for (a) the probability of passing on the left, (b) the probability of passing through the middle, and (c) probability of passing on the right. Each plotted point averages across 10 participants and over 8 blocks within participant. Error bars represent ± 1 s.e.

Direct/Direct, Direct/Contralateral, Direct/Ipsilateral, Contralateral/Ipsilateral, Contralateral/Contralateral, and Ipsilateral/Ipsilateral. (We use the terms *contralateral* [opposite side] and *ispilateral* [same side] to collapse cases where [e.g.] the left agent was looking right and the right agent was looking left.) These 6 cases can in turn be classified in terms of how many direct gazes they involve, respectively 2, 1, 1, 0, 0, and 0.

Fig. 5 shows the probability of passing outside by collapsed condition, with bars color-coded by the number of Direct gazes they involve. In the corresponding logistic regression, the effect of this collapsed condition is very strong ($BF_{inclusion} = 1.21 \times 10^{14}$). A post-hoc analysis also shows very strong evidence for an effect of the number of direct gazes (0 vs. 1 vs. 2), $BF_{inclusion} = 2.12 \times 10^{12}$. More specifically, further post-hoc comparisons show strong evidence for a difference between 0 and 1 direct gazes ($BF_{inclusion} = 1.47 \times 10^{9}$) and moderate evidence for a difference between 1 and 2

($BF_{inclusion}$ = 5.04). The overall conclusion is that participants were much more likely to pass outside when either agent was looking directly at the other (1 vs. 0 Direct gazes), and even more so if the gaze was mutual.

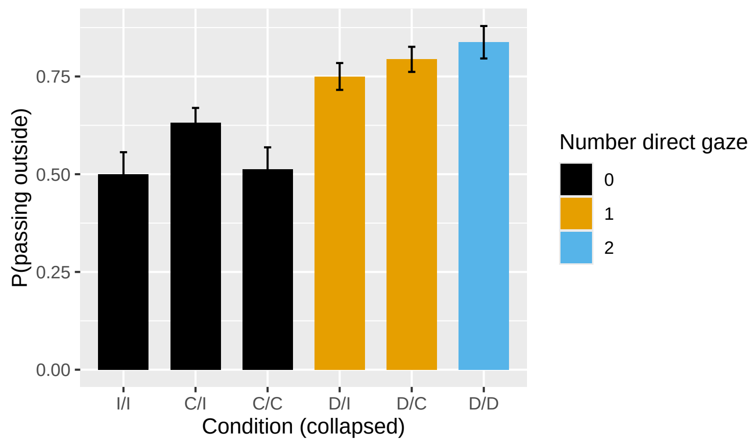

Figure 5
Results from Exp. 2, showing probability of passing outside (left or right) broken down by conditions collapsed by left/right. I/I = AgentA Ipsilateral, AgentB Ipsilateral; C/I = AgentA Contralateral, AgentB Ipsilateral; C/C = AgentA Contralateral, AgentB Contralateral; D/I = AgentA Direct, AgentB Ipsilateral; D/C = AgentA Direct, AgentB Contralateral; D/D = AgentA Direct, AgentB Direct. Color coding indicates the number of Direct gazes. Error bars represent ± 1 s.e.

Discussion, Exp. 2

The results from Exp. 2 demonstrate that wayfinders navigating near other people are extremely sensitive to which way the people appear to be looking. Most broadly, when agents look to the left, our participants tended to pass to the right, and vice versa. More subtly, when either or both of the agents were looking directly at the other, participants were extremely reluctant to pass between them. This effect was largest when both agents were looking at each other (Direct/Direct, i.e. "eye contact"), but was nearly as large in the other two conditions involving Direct gaze (Direct/Contralateral and Direct/Ipsilateral). So the main conclusion is that participants were extremely reluctant to cross a gaze directions that involve person-directed gaze, especially if it was mutual.

Some of these results might be attributed to gaze crossing avoidance, just as in

Exp. 1. However note that in many conditions of Exp. 2 it was impossible for the participant to completely avoid crossing either agent's gaze, because the two agents' gaze vectors combined to cover all three possible pathways. In fact, the substantial impact of the number of Direct gazes ($BF_{inclusion} = 1.21 \times 10^{14}$) suggests that participants are particularly sensitive to person-directed gaze.

The most plausible interpretation of this pattern is that our participants interpreted Direct gaze as implying a social engagement between the agents that they were particularly reluctant to obstruct. That is, our participants treated human-directed gaze differently from other gaze, apparently because of the social connection between two agents it implies. Notably, the data suggest that one person looking at another was sufficient to trigger this implication; the effect was higher, but only slightly higher, when gaze was mutual. It is possible that subjects interpreted person-directed gaze as particularly predictive of future movement, i.e. that someone looking at another person might be about to physically approach that person. If so, avoiding crossing human-directed gaze might be interpreted as another manifestation of collision avoidance (Moussaïd et al., 2011; Mirsky et al., 2024). But regardless of whether this interpretation is correct, the effect highlights the specifically *social* nature of wayfinders' calculations, in that their choices reflect tacit assumptions about the likely intentions of other people in the environment.

The primacy of social factors in our experiments is brought out particularly clearly by the fact that in Exp. 2 they opted to pass outside both agents on about 67% of trials, even though the middle route between the agents was *always* shorter. That is, the need to avoid social gaze crossing often overrode the well-documented tendency to minimize overall path distance (McNamara & Chen, 2022).

General discussion

Taking Exps. 1 and 2 together, our results confirm that gaze cues constitute a substantial influence on path choice in social wayfinding. As in previous studies (e.g. DeStefani, 2023), wayfinders generally avoid passing in front of other people. But when gaze direction is decoupled from overall body-facing direction, as in the current studies, it is gaze direction that seems to play the larger role. Generally, participants seem to choose paths so as to minimize crossing other people's gaze. In Exp. 1, with a single agent, this was achieved by passing on the side opposite of gaze, as earlier results (Nummenmaa et al., 2009; Jakobowsky et al., 2024) had suggested. In Exp. 2, with two agents, gaze crossings could not usually be completely avoided. Instead, participants seemed to minimize the number of gazes they needed to cross, for example favoring crossing one gaze rather than two. Most interestingly, as evidenced by the strong effect of the collapsed condition in Exp. 2, participants apparently avoided crossing Direct gazes, including both single-direct conditions (e.g. Agent A looking directly at Agent B) and especially mutual gaze (Agents A and B looking at each other). In our view this result suggests that our participants were particularly keen to avoid occluding or otherwise interfering with a social nexus (cf. Rojas and Yang, 2014), analogous with other (often non-social) "avoidance spaces" in which wayfinders avoid passing between someone and something or someone with which they are actively engaged (e.g. see Kitazawa and Fujiyama, 2008).

Numerous factors have been demonstrated to influence path choices in wayfinding. The most extensively studied are non-social factors, such as minimization of total path distance and avoidance of obstacles (McNamara & Chen, 2022; Newman, Qi, Mou, & McNamara, 2023). Several social factors are also well-documented, including passing side preferences (e.g. right-hand traffic in the U.S.) and passing behind (DeStefani et al., 2023). All these interacting factors illustrate the complexity of the decision confronting real wayfinders, who apparently combine (at the very least) agent position, gaze cues, and a variety of cultural expectations when selecting their path through the environment. In this complex mix, the avoidance of gaze crossing—and in particular the special weight apparently placed on interpersonal gaze—is a relatively poorly studied element. That said, it is apparently a quantitatively substantial factor, in some conditions outweighing non-social factors such as minimization of path length.

Conclusions

The selection of paths through populated environments is a very complex decision problem. The ultimate choice of path reflects numerous factors, including the physical structure of the environment, a variety of pragmatic elements such as time minimization, and a variety of social influences which include sensitivity to the directions in which others in the environment are looking. The effect of gaze cues suggests that our navigational decisions are profoundly influenced by the presence and perceived intentions of others, indicating a deep-rooted preference for respecting social interactions in shared environments. These biases point to the intricacies of social navigation, and suggest that our movements through space are affected not only by physical obstacles but are also deeply intertwined with the social landscape and the silent conversations of interpersonal gaze.

The implications of these findings extend far beyond our experiments, offering valuable insights for the design of both physical and virtual environments. Understanding the impact of gaze as a communicative signal can significantly enhance crowd management strategies (Kapadia, Pelechano, Allbeck, Badler, & Badler, 2016), and improve the efficiency and harmony of space utilization across various contexts. The importance of gaze cues also has clear implications for simulation models, which are often used to model the flow of people through public spaces to benefit effective space design (Hu, Yoon, Pavlovic, Faloutsos, & Kapadia, 2020). In the tradition of "social force" models (Helbing & Molnar, 1995), most contemporary simulation models impute very limited cognitive or social qualities to simulated wayfinders, usually simply assuming directed obstacle avoidance (Rudenko et al., 2020). Our findings suggest that any simulations that do not take gaze cues into account are substantially incomplete. Finally, these experiments highlight the utility of virtual environments in dissecting and understanding human social behavior, demonstrating that insights gained in digital realms can profoundly influence our approach to managing and designing physical spaces.

Declarations

Funding. [Omitted for anonymity.]

Conflicts of interest. There are no conflicts of interest to report.

Ethics approval. All procedures performed in these studies were conducted in accordance with the ethical standards of the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The project was supervised and approved by the institutional review board of the [university omitted for anonymity.]

Consent to participate. Informed consent was obtained from all participants included in the study.

Consent for publication. Informed consent to publish research reports stemming from these data was obtained from all participants included in the study.

Availability of data and materials. Neither of the experiments were preregistered. Data from both experiments are available upon request.

Code availability. R code for analyzing these data is available on request. [Omitted for anonymity.]

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