Enhancing Trust in Telepresence: The Influence of Familiarity and Varied Eye Contact on Trust in Look-Alike Avatars

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(a) Familiar Avatar　　　　　　　　　　　(b) Unfamiliar Avatar

Figure 1: Avatar representations with three levels of eye gaze behaviour each: (1) none; (2) mixed/normal; (3) direct

ABSTRACT

In digital environments, establishing trust is crucial for effective interaction between users and virtual agents. This study investigates how different levels of eye contact and avatar familiarity influence perceived trustworthiness in digital avatars. Participants engaged in a trust game scenario involving avatars displaying direct, mixed, or no eye contact, and rated their familiarity with and trust in these avatars on a 7-point Likert scale. Results indicate that avatars with mixed eye contact were consistently rated as most trustworthy, followed by familiar avatars regardless of eye contact behavior. These findings emphasise the significance of non-verbal cues and familiarity in shaping perceptions of trust in virtual interactions. The results have implications for the importance of modulating familiarity of avatars and providing more natural eye gaze behaviour in various trust-critical digital settings.

CCS CONCEPTS

• **Human-centered computing** → **Virtual reality**; • **Computing methodologies** → *Perception*.

KEYWORDS

Look-alike Avatar, Eye Contact, Trust, Virtual Reality, Human-computer interaction, Trust Game, Telepresence

1 INTRODUCTION

A look-alike avatar is an avatar with high perceived realism due to factors such as eye movement, body language, and facial gestures [Frampton-Clerk and Oyekoya 2022]. Look-alike avatar facial expression intensity affects the user's perceived realism while avatar vocal intensity affects the user's emotional recognition [Suma et al. 2023]. Seymour et al. demonstrated that the usage of realistic digital avatars increased affinity, trustworthiness, and preferences compared to a cartoon caricature, demonstrating the importance of the role of look-alike avatars in trust-critical digital environments like online banking, e-commerce, healthcare systems, government services, social media, etc. [Seymour et al. 2021].

Eye gaze behaviour is a fundamental aspect of human communication, significantly influencing how individuals perceive and evaluate others. Eye gaze behaviour in avatar settings has frequently been examined using 2x2 experimental designs, where eye gaze is classified by either averted or direct gaze. Kaiser et al. found that robots' direct eye gaze, as opposed to averted gaze, positively affected people's perceptions of anthropomorphism, trust, and satisfaction in virtual financial advisory settings [Kaiser et al. 2024].

Much research has been conducted on the perceived trustworthiness of avatars based on gaze behaviour in fully immersive virtual environments. However, research on how varying levels of eye contact, beyond just averted and direct gaze, affect trustworthiness in avatars in non-immersive settings remains scarce. Furthermore, perceived trustworthiness in look-alike avatars based on trust game scenarios and quantitative data is limited.

Additionally, the role of familiarity—whether the look-alike avatar is a representative of a known or unknown entity to the user—has not been extensively explored in these contexts. Familiarity may alter how users perceive and respond to avatars, potentially increasing trust when the avatar represents a known entity or decreasing it if the avatar is unfamiliar. Research shows that individuals classify others as belonging either to their 'ingroup' or 'outgroup' based on perceived similarity, with outgroup members often facing discrimination [Fehrenbacher and Weisner 2024]. Judgments may differ in the 'avatar world,' and virtual representation could interact with other factors to influence behaviour.

This study aims to fill the gap in existing research by examining how avatar familiarity interacts with varying levels of eye contact, represented by a spectrum of gaze behaviours from highly engaged

to entirely disengaged, to influence users' recognition of trustworthiness in photorealistic avatars. Studying these variations will allow for a comprehensive understanding of how different levels of eye contact and familiarity influence user perceptions in various contexts, including telemedicine, e-commerce, and social virtual reality settings.

2 RELATED WORK

We describe research in five areas: the quantification of avatar trustworthiness, the impact of eye contact on trust in both face-to-face and digital interactions, non-verbal factors contributing to avatar trustworthiness, the use of trust games to study trust dynamics, and the influence of avatar familiarity on trust.

Machneva et al. demonstrated that there are shared beliefs about the trustworthiness of user-generated avatars [Machneva et al. 2022] aligning with research indicating that face-based trustworthiness judgments guide behaviors in economic exchanges [Jaeger et al. 2019]. Avatars generally generate less trust than human representations [Machneva et al. 2022], suggesting that look-alike avatars, which aim to mimic human appearance, may be a better foundation for trust than generic avatars. This underscores the importance of exploring various factors, such as eye contact, that can enhance avatars' perceived trustworthiness.

Research has shown that eye contact has positive effects on the evaluation of other people, impacting ratings of likeability, competence and intelligence [Breil 2023]. For example, participants displayed more trust in those with mixed gaze activity in economic Trust Games [Breil 2023]. Also, realistic avatars evoke more complex emotional reactions and empathetic concern compared to less realistic ones [Zell et al. 2019]. Similarly, perceptions of greater levels of eye contact were positively correlated with higher levels of conversational enjoyment, closeness, and feeling understood [Rogers et al. 2022].

Non-verbal cues and gaze behavior also affect trust. Excessive upward eye movements decrease trust in avatars [Garau 2003]. High-realism avatars with inferred gaze models of eye contact outperform less realistic, random-gaze avatars, emphasizing the role of realism and appropriate gaze behavior in trust formation [Garau 2003].

Trust games are used in both face-to-face interactions [Breil 2023] and immersive virtual environments [Jaeger et al. 2019; Machneva et al. 2022] to study trust and cooperation. They provide quantitative measures and precise experimental control to isolate variables like eye contact and avatar appearance.

Research has explored how avatar familiarity influences trust and social behaviors. Song and Shin examined the humanisation of chat bot avatars and found that familiarity (celebrity vs. non-celebrity avatars) moderated the relationship between humanisation and perceived eeriness, which in turn affected trust and user behaviour [Song and Shin 2024]. Tamborini et al. demonstrated that behavioral synchrony with virtual agents affected trust depending on the agent's perceived ingroup or outgroup status [Tamborini et al. 2018]. Synchrony with ingroup avatars increased perceived self-other overlap and trust, while synchrony with outgroup avatars increased trust only in specific conditions [Ma et al. 2023]. Familiar faces are perceived more positively in terms of typicality, trustworthiness, and likability [Faerber et al. 2016]. Familiarity leads to more

consistent evaluations of trustworthiness across different images of the same identity [Mileva et al. 2019]. These studies highlight the significant impact of familiarity on trust in avatars, underscoring its importance in designing virtual agents for digital interactions.

3 METHODS

3.1 Participants

A total of 38 participants completed the anonymous survey. 30 participants were between the ages of 18 to 24, 7 participants were between the ages of 25 to 34, and 1 participant was between the ages of 35 to 44. 16 participants identified as female, 20 identified as male, and 2 identified as nonbinary. Half of the participants had no prior knowledge of avatars or the use of avatars. 34 participants had normal or corrected-to-normal vision. Participants were recruited through online forums, social media sites including Instagram and Facebook, and direct messaging.

3.2 Materials

The avatars for this study were created with Reallusion Character Creator v4.23 and the Headshot plugin v2.0. The look-alike avatar was modelled after a volunteer subject and was considered the familiar avatar, while the other was uniquely generated using a random AI generated image and was considered the unfamiliar avatar. The avatars were animated and recorded using iClone v8.02 with the Motion LIVE plugin, and the final videos were edited in CapCut v8.6.0.

3.3 Procedures and Measures

Video representations of the unfamiliar and familiar avatar models were generated and included in an anonymous online survey distributed via a Google Form. Each avatar displayed various levels of eye contact from consistent direct eye contact where gaze was fixed to intermittent eye contact where the avatar displayed mixed gaze behaviour to no direct eye contact (see Figure 1). All other facial features were normalised for each gaze behaviour for each avatar. Through written narratives and videos of avatars representing the characters in a scenario, the participants participated in a trust game scenario. They viewed three variations of each avatar, with varying levels of eye gaze behaviour for both the familiar and unfamiliar avatars (see Figure 2). Participants were provided instructions for the Prisoner's Dilemma trust game and were asked a comprehension question prior to making their decisions. They were also asked to rate the perceived similarity of the look-alike avatar and an image of the avatar model used for its generation prior to and following the trust game scenario. When the trust game began, participants were informed that their interaction partners (represented by avatars) had already decided whether or not they would trust the participant.

Each avatar with different gaze behaviours was shown one at a time and remained on screen while participants were prompted to make a trust decision. Participants had a binary choice—to either trust or not trust the avatar and they received no feedback about their decisions. Participants were also unable to go back and revise their initial responses in the Prisoner's dilemma game. After the game concluded, participants were presented with each avatar model from the trust game and were asked to rate their familiarity

with the likeness of each avatar on a 7-point scale with each avatar being (1) entirely unfamiliar to (7) being entirely familiar. Participants also rated their perceived trustworthiness of each avatar with each type of gaze behaviour on a scale of 1 to 7, with (1) being the least trustworthy and (7) being the most trustworthy. The 7-point scale surveys allowed participants to go back and re-view clips of various avatars with different eye movements to compare between various clips.

4 RESULTS AND ANALYSIS

The study used a repeated measures (within-subjects) design with two independent variables: (i) familiarity (look-alike avatar and uniquely generated avatar); (ii) eye contact (direct, normal/mixed and none). The dependent variables were the trust decisions made in the trust games, the perceived level of familiarity post-trust game and the perceived level of trustworthiness post-trust game. The dependent variable of familiarity was measured to ensure that the familiarity independent variable was effective and perceived by the participants. Participants perceived all 6 (2x3) conditions in random sequence to prevent any order influence on conclusions. Familiarity and eye contact are treated as categorical independent variables while perceived familiarity and perceived trust levels are viewed as ordinal dependent variables.

To quantify changes in users' perceived similarity of the look-alike avatar and its avatar model image before and after the trust game scenario, a Friedman repeated measures ANOVA test was performed. Here the trust game scenario was treated as the independent factor while perceived similarity was treated as an ordinal dependent variable. The Friedman test was not statistically significant, ($\chi 2$ (38) = 1.923, p = 0.166) and the model demonstrated that there was no significant difference in user perception of the look-alike avatar before and after the trust game.

A binomial logistic regression was performed to ascertain the effects of avatar type and level of eye contact on trust decisions in a trust game scenario. The logistic regression model was statistically significant, $\chi 2$ (4)= 1.451, p = 0.00835. The explained variation in the dependent variable based on our model ranges from 5.4% to 7.2% with the model explaining 7.2% (Nagelkerke R^2) of the variance in trust levels and correctly classifying 55.3% of cases in the trust game scenario. Levels of eye contact (p = 0.020) heavily modulated trust levels compared to changes in familiarity of the avatar (p = 0.877) with the former being significant ($p<0.05$) unlike the latter.

An ordinal logistic regression was conducted to examine the effects of avatar type and eye contact type on familiarity ratings. The analysis revealed that the type of avatar significantly influenced familiarity ratings, with look-alike avatars being rated as more familiar than random avatars (p = 0.019). This aligns with our hypothesis that familiarity with the avatar's appearance enhances perceived familiarity. The means and medians are presented in Tables 1 and 2.

Additionally, the type of eye contact also had an impact on familiarity ratings although this effect was not significant. Avatars with mixed eye contact received higher familiarity ratings compared to those with direct eye contact in the look-alike avatar. The interaction between avatar type and eye contact type was significant (p

Table 1: Median and (mean) values for the UNFAMIL-IAR/Random Avatar's perceived trustworthiness and perceived familiarity ratings.

Level of Eye Contact	Trustworthiness Rating	Familiarity Rating
Direct	4 (3.92)	4.5 (4.16)
Mixed	4 (3.98)	5 (4.26)
None	3 (3.05)	5 (4.39)

Table 2: Median and (mean) values for the FAMILIAR/Look-alike Avatar's perceived trustworthiness and perceived familiarity ratings.

Level of Eye Contact	Trustworthiness Rating	Familiarity Rating
Direct	4 (4.16)	5 (4.79)
Mixed	5 (4.42)	5 (4.92)
None	3.5 (3.63)	5 (4.45)

< 0.05), indicating that the combined effect of a familiar-looking avatar and mixed eye contact further enhances familiarity ratings.

An ordinal logistic regression was conducted to examine the effects of avatar and eye contact type on trustworthiness ratings. The analysis revealed that eye contact type significantly influenced trustworthiness ratings. Specifically, avatars with mixed eye contact were rated as more trustworthy compared to those with direct eye contact (p < 0.05). The type of avatar also had a significant impact on trustworthiness ratings (p < 0.05). Look-alike avatars tended to be rated as more trustworthy than random avatars.

There was a low correlation between the two dependent variables and therefore a composite score could not be computed.

5 DISCUSSIONS

A large majority (94.7%) of the participants responded affirmatively to a statement checking their understanding of the trust game scenario, indicating that the instructions were clear and well understood. 20 participants rated the familiar look-alike avatar as at least moderately matching the image of its human model. After the trust game scenario, this number did not change significantly, demonstrating that the trust game did not alter familiarity levels of the familiar avatar. 21 participants stated that they did not know the person that the familiar look-alike avatar was modelled from.

The greatest initial trust decisions were displayed for the unfamiliar avatar with mixed eye gaze behaviour (23 participants). The next greatest trust levels were displayed for the familiar avatar with mixed gaze behaviour (20 participants). The unfamiliar avatar with no eye contact received the lowest trust admissions (10 participants) followed by the familiar avatar with no eye contact (13 participants). 18 participants chose to trust the unfamiliar and familiar avatars with direct eye contact.

Participants' familiarity and trustworthiness ratings were measured on a 7-point Likert scale where 5 or above was considered slightly to extremely trustworthy or slightly to extremely familiar.

For the unfamiliar avatars, the mixed eye contact avatar was rated familiar by 21 participants and trustworthy by 15 participants, making it the most trusted among the unfamiliar avatars (see Table 1). The avatar with direct eye contact was rated familiar by 19

participants and trustworthy by 13 participants. In contrast, the avatar with no eye contact was rated familiar by 24 participants and trustworthy by only 7 participants (see Table 1).

For the familiar avatars, the avatar with mixed eye contact was rated familiar by 28 participants and trustworthy by 22 participants, making it the most trusted among the familiar avatars (see Table 2). The avatar with direct eye contact was rated familiar by 28 participants and trustworthy by 18 participants. In contrast, the avatar with no eye contact was rated familiar by 23 participants but was rated trustworthy by only 12 participants (see Table 2).
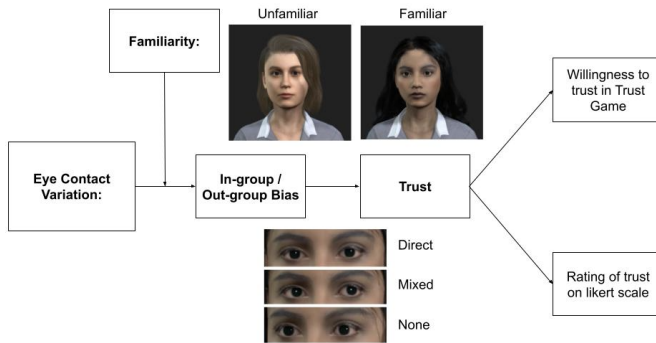

Figure 2: Familiarity ratings and eye contact levels modulated by in-group bias and their effect on trust levels.

Our hypothesis stated that avatars with mixed eye contact would be perceived as more trustworthy than those with direct or no eye contact. The results supported this hypothesis, as mixed eye contact produced the highest levels of trust across both familiar and unfamiliar avatars. This aligns with previous research indicating that eye contact and specifically mixed-gaze activity can significantly influence perceptions of trustworthiness in digital avatars in an economic Trust Game [Breil 2023]. The mixed eye contact may have struck a balance between engagement and comfort, making the avatars appear attentive without being overly intense or distant.

Additionally, our hypothesis suggested that familiarity with the avatar's appearance would enhance perceived trustworthiness. The data confirmed this, showing that familiar avatars were generally rated as more trustworthy than unfamiliar avatars, regardless of eye contact behavior. Participants who were previously familiar with the look-alike avatar's model would therefore consider that avatar to be in their in-group and would be more likely to trust that avatar as seen in previous work [Tamborini et al. 2018]. Increased familiarity likely reduced uncertainty and increased comfort of participants, leading them to trust avatars that resembled known individuals more readily than a computer-generated avatar that they had no familiarity with.

6 CONCLUSIONS AND FUTURE WORK

This study demonstrated that mixed eye contact significantly enhances trust in digital avatars, with familiar avatars generally perceived as more trustworthy than unfamiliar ones. These insights contribute to the growing body of literature on digital trust research

and offer practical guidelines for designing more effective and trustworthy virtual agents for applications in various fields including telemedicine, highlighting the need to consider both appearance and non-verbal communication cues to enhance user experience.

Some limitations should be considered when generalising the results of this study. The differing appearances of the avatars may have played a role in the trust levels of participants beyond mere familiarity. Differences in hairstyle, race or skin colour could have biased responses in favour of one avatar over another.

Future research should consider longitudinal studies to examine how repeated interactions with avatars affect trust levels over time along with varying the appearance of avatars. Additionally, exploring other non-verbal cues such as facial expressions and body language could provide a more comprehensive understanding of trust formation in virtual environments. Including a wider variety of avatars with different appearances, ethnicities and ages may also be another avenue to explore. Another factor that could be considered would be breaking down data and viewing how previous experience with an avatar model could influence perceptions of familiarity and therefore trustworthiness as well.

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