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Through the Looking Glass: The Role of Virtual Mirrors in Shaping Empathy in Virtual Reality Perspective Taking

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ABSTRACT

In this study, we explored the effect of seeing one's avatar in a virtual mirror during a virtual reality (VR) perspective taking experience. Participants were divided into two groups, with one experiencing the VR environment with the presence of a mirror showcasing their avatar and the other without. Results revealed that the sense of presence was comparable across both groups. However, a notable difference emerged in terms of empathy; participants who viewed their avatars in the mirror exhibited reduced empathic responses. These findings illuminate the nuanced dynamics of self-representation in virtual environments, suggesting that inducing self-awareness through a virtual mirror in VR might have unintended emotional consequences.

CCS CONCEPTS

• **Human-centered computing** → **Virtual reality**.

KEYWORDS

VR perspective taking, empathy, mirrors, looking in the mirror

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1 INTRODUCTION

Virtual reality (VR) is rapidly advancing as a medium for immersive storytelling, training, and various forms of immersive interaction. As technology advances, understanding the subtle intricacies of the VR experience becomes crucial. One of the primary objectives of many VR experiences is to instill a strong sense of presence — the psychological sensation that one is truly "inside" a virtual

environment [14], rather than merely observing it. Equally vital, especially in the realm of VR perspective-taking experiences (VRPT), is the cultivation of empathy — enabling users to genuinely feel and understand the emotions and viewpoints of others [16]. Both presence and empathy have powerful implications, from fostering deep connections between individuals to cultivating more inclusive and understanding societies.

The use of avatars — 3D representations of users in virtual environments — is a common method for enhancing the sense of presence in VR. Avatars function as the user's embodiment within the virtual environment, serving as the bridge between the physical and virtual realms [6]. An avatar's appearance, movement, and interactivity can significantly impact a user's immersion [5]. One intriguing but underexplored aspect of avatar embodiment is the inclusion of a mirror mechanism, allowing users to see their own avatars reflected back at them during their VR experience [4, 12, 17]. Such a feature can be both captivating and disorienting, but its effects, compared to not having a mirror, on a user's sense of presence and empathy remain largely uncharted. Therefore, this paper delves into a novel experiment designed to shed light on this very question: How does the presence or absence of a mirror enabling users to view their own avatars affect their sense of presence and empathy during a VRPT experience?

Previous studies have shown that VRPT is a potent tool for enhancing empathy and understanding among individuals. Notably, Peck et al. demonstrated that embodying a dark-skinned avatar in VR significantly diminishes implicit racial biases when compared to embodying avatars of lighter skin or no avatar at all [12]. Banakou et al. [1] discovered similar impacts on prejudice, reporting a decline in implicit biases against Black people when White participants used Black avatars. Maister et al. [9] corroborated these findings. Extending beyond racial prejudices, VRPT has proven effective in mitigating various social biases [10]. For example, Yee and Bailenson [17] found that young individuals who experienced VR as older avatars showed less stereotyping towards the elderly. Complementing these results, Oh et al. [11] found that VRPT could alleviate the impact of perceived threats on ageist attitudes, with further studies supporting this outcome [2, 15]. Herrera et al. [7, 8] observed that VRPT could foster increased empathy towards the homeless. Collectively, prior research provides compelling evidence for the effectiveness of VRPT in promoting perspective taking and understanding among individuals. An open question pertains to

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Figure 1: The two experimental conditions. Participants played the VR roleplaying game from a first-person perspective as Sarah, the hijabi woman. The screenshots are taken from a third-person perspective to illustrate the experimental manipulation

how the presence or absence of a virtual mirror showing one's roleplay character affects individuals' empathy toward the roleplay character.

2 METHOD

2.1 VR Perspective Taking Experience

For the VRPT task, we used *On the Plane* [18], a VR simulation wherein participants experience the journey of a Muslim American woman named Sarah, as seen in Figure 1. During the simulation, Sarah encounters prejudice and xenophobia due to her hijab. This VR scenario showcases an instance where a co-passenger sitting across the aisle, named Marianne, mistakenly assumes Sarah is not American based on her appearance and poses biased inquiries about her heritage, with the behavior growing more xenophobic as the experience progresses. Marianne's questions and comments involved questions as to whether Sarah is her nickname, where Sarah learned English (as a second language), and where Sarah is actually from and misconceptions about Sarah being a foreigner and less educated and having many children. Throughout this VR journey, participants assumed the role of Sarah, experiencing events from her first-person viewpoint in her seat. Participants were presented with four narrative prompts to choose how they wanted to respond to Marianne's questions, which resulted in fallout effects on Marianne's facial expressions (e.g., if participants chose an answering appeasing Marianne, she smiled). The VR experience takes about 5-6 minutes to complete (depending on the time taken by participants to read and respond to the four interactive narrative choices). A demo video of the mirror condition is available at the following link: <https://www.youtube.com/watch?v=z2e9r2rIhRQ>

2.2 Experimental Design

The independent variable of the experiment was the availability of the mirror. Half of the participants experienced the VR simulation with a mirror showcasing their avatar in front of them, as seen in Figure 1a and the other half did the same without seeing the

mirror, as seen in Figure 1b. The dependent variables were sense of presence and empathy.

2.3 Participants

The sample was recruited from our local community and included 60 participants (29 males, 17 females, 14 undisclosed), with an average age of 24.3 years old ($SD = 2.45$). No participants self-identified as Muslim.

2.4 Measures

Sense of presence was assessed using the Igroup Presence Questionnaire (IPQ) [13]. Participants' empathy level was measured using the empathy scale [3]. For both measures, participants expressed their agreement on a five-point Likert scale. An average score was computed for each measure.

2.5 Procedure

Participants completed the experiment in person. Upon arrival, they were given a tutorial on how to use the VR headset, Meta Quest 2. Then they started the VRPT experience based on their randomly assigned condition. Specifically, participants were randomly assigned to either the mirror condition or no mirror condition. At the end of the experience, the study measures were automatically presented to the participants inside the VR headset.

3 RESULTS

The assumption of normality was not met. Therefore, we compared the two experimental conditions on the dependent variables using a Mann-Whitney U test. Results revealed that there was no statistically significant difference between the mirror condition ($n = 30$, $M = 3.66$, $SD = .841$) and no mirror condition ($n = 30$, $M = 3.63$, $SD = .907$) in presence levels, $U = 445.5$, $p = .953$ (see Figure 2a). However, the two groups differed in empathy levels (see Figure 2b), $U = 588$, $p = .041$, with participants in the no mirror condition reporting higher levels of empathy ($n = 30$, $M = 3.51$, $SD = .756$), compared to those in the mirror condition ($n = 30$, $M = 2.99$, $SD = 1.06$).

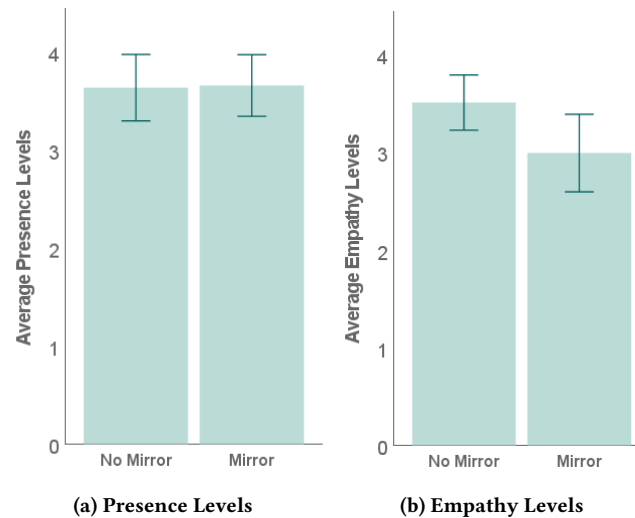


Figure 2: Bar graphs for dependent variables

4 DISCUSSION AND CONCLUSION

Our investigation focused on exploring the effect of seeing one's avatar in a virtual mirror during a VRPT task on sense of presence and empathy toward the roleplayed character. While the presence or absence of a mirror had no significant effect the sense of presence, it did significantly influence empathy levels, with reduced empathy observed when a mirror was present. This finding may seem unexpected given the body of literature showing the effectiveness of similar manipulations [1, 4, 12]. It should be noted, however, that these studies focused on racial bias. Given our focus on xenophobia towards Muslims in the US, it is conceivable that virtual embodiment manipulations involving mirrors might have different effects depending on the type of intergroup biases being simulated. While such manipulations might in fact increase perspective taking and empathy when used to address racial bias and discrimination, they may have quite the opposite effect when examining xenophobia. Another important distinction is that these studies did not include a no mirror condition to directly examines the effect of the presence of a virtual mirror on empathy toward the embodied character. One exception to this is Groom et al.'s study [4], which examined the effect of a similar virtual embodiment manipulation (participants saw their reflection in one condition and did not see their reflection in another condition) on racial bias. However, Groom et al. did not directly measure empathy toward the embodied character. Therefore, previous studies provide no directly comparable study design against which our study could be juxtaposed (at least to the best of our knowledge).

Our finding is rather interesting and can shape our understanding of the effect of virtual mirrors on perspective taking and empathy during VRPT tasks. It underscores the nuanced dynamics of VR immersion, suggesting that direct visual feedback of oneself can inadvertently divert the user's emotional alignment with the roleplayed character.

In light of our findings, future work should further probe the underlying mechanisms by which mirrored avatars impact emotional

resonance in VR. This may include examining different intergroup biases, the duration of exposure to one's own reflection, the degree of avatar personalization and identification with the avatar, or the interplay of cognitive load during such experiences.

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