Trusting Strangers in Immersive Virtual Reality

Ceenu George[1], **Malin Eiband**[1], **Michael Hufnagel**[2], **Heinrich Hussmann**[1]
[1] {ceenu.george, malin.eiband, hussmann}@ifi.lmu.de, [2] {michael.hufnagel}@campus.lmu.de
[1,2]LMU Munich, Germany

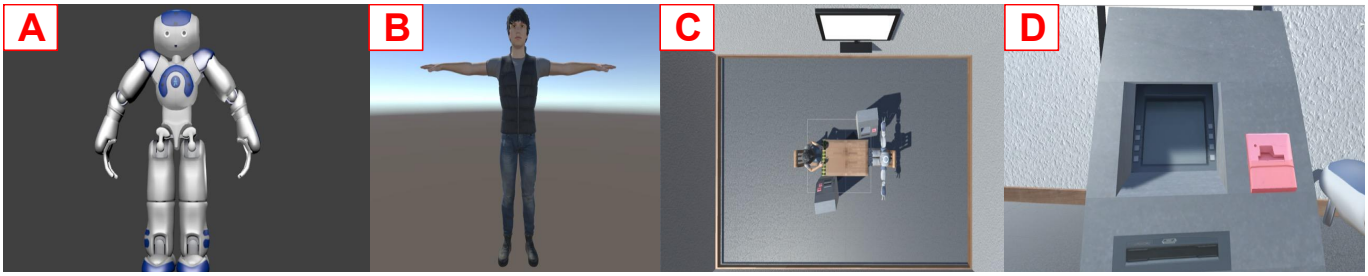

Figure 1. (A) Robot avatar (B) Human-like avatar (C) VR room for trust game (D) Machine, to send money to trust game partner.

ABSTRACT
Social interactions in immersive virtual reality (IVR) benefit from more realistic designed avatars whilst head mounted displays (HMD) are simultaneously offering virtual reality experiences with improving levels of immersion and presence. The combination of these developments creates a need to understand how users remit trust towards avatars in IVR. We evaluated trust towards two categories of avatars (robot vs. human-like) in VR by conducting a lab study (N=21) where participants had to play a trust game (TG) with each avatar. Our findings highlight that although the trust game revealed equal trust levels towards both categories of avatars, participants felt a significant sense of "togetherness" with the human-like avatar compared to the robot.

Author Keywords
Trust; Avatar; HRI; VR

ACM Classification Keywords
H.5.2 Information Interfaces and Presentation: Multimedia Information Systems—AR,VR

INTRODUCTION AND BACKGROUND
Immersive virtual reality's (IVR) potential as medium for communication and social interactions has been recognized in research. However, in contrast to video chat, IVR enables users to socialize with avatars, i.e. representation of oneself in a virtual environment. Previous work on avatar realism has highlighted the fact that rich graphics and realistic behaviour, such as blinking, result in improved social interactions [7] and co-presence. However, it has also revealed that users believe co-present avatars to be intelligent systems rather than real world humans who are represented as avatars [3].

The increasing level of immersion and presence (subjective measures of how real the virtual world feels) and this uncertainty – not knowing whether one is facing a system or a human, or making false assumptions about the other's identity – may potentially have negative implications for co-presence and trust, and thus for social interaction in general. Hence, there is a need to understand whether avatar design on its own influences the perception of trust and co-presence in IVR.

[R1] *How does avatar design impact trust in IVR?*

[R2] *How can avatar design help users distinguish between intelligent systems and humans in IVR?*

Our research is guided by the above questions, however as a first step into investigating trust towards avatars in IVR, we evaluated two categories, namely robot vs. human-like (RvsH). Previous work in human robot interaction has highlighted the high level of trust humans have towards robots [4]. Similarly, in virtual reality human-like characters were found to be less trustworthy [8].

To measure trust, we relied on three strands of previous work: Firstly, a trust game that is a quantitative tool, built on the concept of social dilemmas, which describes situations in which the individual outcome is in conflict with the shared group outcome (e.g., prisoners dilemma) [2]. The TG is also a form of social dilemma, as both players achieve the best monetary outcome if they trust each other. Trust is measured by the amount of money the trustor sends the trustee and how much the latter sends back (asynchronously). Starting money is provided by the experimenter and the trustor has the option to (1) walk away with it or (2) gamble it in the TG, as the money sent to the trustee is trippled when it arrives and the trustee has to decide how much of it he wants to (1) keep or (2) send back. Thus, the more the trustor sends the trustee, the higher the opportunity (and trust) to make money.
In contrast to the original concept, we are only interested in measuring the *perceived trust by the trustor towards the trustee*

IUI'18 Companion March 7–11, 2018, Tokyo, Japan

ACM ISBN 978-1-4503-5571-1/18/03.
DOI: https://doi.org/10.1145/3180308.3180355

and are therefore only measuring the initial money sent by the trustor.

Secondly, trust questionnaires, such as the interpersonal trust scale [6] – measuring propensity to trust – and the SOEP [5] – specifically measuring trust in strangers.

Thridly, we also measured social presence [1] to understand whether people perceived a togetherness in the virtual scene.

This paper presents preliminary results of a lab study that used *quantitative* - in form of a TG -, and *qualitative* - in form of questionnaires - tools, to measure trust towards categories of avatars (RvsH) in VR.

STUDY

We conducted a within-subjects lab study (N=21, 6 female, Age: Mean=23.6/SD=3.5) to investigate whether *categories of avatars* (RvsH, counterbalanced) influence trust in strangers in IVR. We measured the *amount of money sent* during the TG and completed pre- and post game questionnaires, such as interpersonal trust, SOEP and social presence.

Apparatus

We built a virtual scene (Fig.1) in Unity that was accessible with an Oculus Rift and controllers. Two virtual avatars, human-like and robot, were developed to depict the trustee. The trustor was always a human-like avatar, however participants could only see their avatar's hands during the entity of the VR experience. Money was sent through an ATM-like machine (Fig.1, D) to avoid body movement in VR and only rely on hand gestures.

Procedure

Participants were first asked to sign a consent form and were then presented with Rotter's Interpersonal Trust Scale. An introductory task to the HMD (Oculus Rift) consisting of picking up and putting down items was used to prepare participants for the TG. Participants were given 2.5 EUR for each round, they had to play two rounds (RvsH) of the game and were told that they were matched with a different random [real world human] player in another room in each round. However, the second player was in fact always controlled by an assistant during the TG who simply returned the amount of money a participant had sent to maintain a neutral experience for all participants. Rounds were counterbalanced and introductions were provided on a screen in VR and verbally prior to entering the virtual world. After the TG, participants answered the SOEP and the social presence questionnaire. We additionally asked them if they believed that they had really played with another human player or not and whether their behaviour in the second round had been influenced by the first on a seven-point Likert Scale. In addition to the money received for playing the TG, participants were compensated with 5 EUR.

RESULTS AND DISCUSSION

We could not confirm a significant difference between the amount sent to the human-like ($Mean$ = 6.8, SD = 3.5) vs robot ($Mean$ = 6.3, SD = 3.4) avatar. This indicates that there may not be a difference in trust towards these categories of avatars. A dependent t-test showed a significant difference ($p < 0.05$) in the social presence scores between the two categories, such that human-like ($Mean$ = 4.1, SD = 2.8) was perceived to create a more intimate level of togetherness in the virtual world than robot ($Mean$ = 3.1, SD = 4.1). The variance in scores for robot was high, which reduces the effect of these results, however this suggests that although participants sent the same amount of money to both categories, they felt more comfortable when in the presence of the human-like avatar.

We found no relationship between the trust in strangers, that the TG measured, and the propensity to trust, which was measured by the 'Interpersonal Trust Questionnaire'.

CONCLUSION AND FUTURE WORK

This paper presented preliminary results on the perception of trust between categories of avatars (human like vs. robot) in IVR. Trust was evaluated by questionnaires as well as in form of a trust game, whereby participants had to play against both categories of avatars. Our preliminary quantitative results could not confirm a difference in trust between the categories, however, qualitative findings revealed participant felt more comfortable in presence of the human-like avatar.

Future work may look into how these results are comparable to the real world differences between the described categories (e.g. real world robot vs. human). We argue that there is a need to obtain an understanding on trust in IVR prior to releasing connected social and collaborative apps for HMD devices.

REFERENCES

1. Jeremy N Bailenson, Jim Blascovich, Andrew C Beall, and Jack M Loomis. 2003. Interpersonal distance in immersive virtual environments. *Personality and Social Psychology Bulletin* 29, 7 (2003), 819–833.
2. Joyce Berg, John Dickhaut, and Kevin McCabe. 1995. Trust, reciprocity, and social history. *Games and economic behavior* 10, 1 (1995), 122–142.
3. Ceenu George and Heinrich Hussmann. 2017. Going Beyond Human Communication Capabilities with IVR. In *Proceedings of the CHI 2017 Workshop on Amplification and Augmentation of Human Perception, May 07, 2017, Denver, CO, USA. Copyright is held by the owner/author(s). (CHI '17)*. ACM, New York, NY, USA.
4. Peter A Hancock, Deborah R Billings, Kristin E Schaefer, Jessie YC Chen, Ewart J De Visser, and Raja Parasuraman. 2011. A meta-analysis of factors affecting trust in human-robot interaction. *Human Factors* 53, 5 (2011), 517–527.
5. Michael Naef and Juergen Schupp. 2009. Measuring trust: Experiments and surveys in contrast and combination. (2009).
6. Julian B. Rotter. A new scale for the measurement of interpersonal trust. *Journal of Personality* 35, 4 (????).
7. Anthony Steed and Ralph Schroeder. 2015. Collaboration in Immersive and Non-immersive Virtual Environments. In *Immersed in Media*. Springer, 263–282.
8. Amanda M Surprenant. 2012. Measuring Trust In Virtual Worlds: Avatar-mediated Self-disclosure. (2012).