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Do People Matter? Presence and Prosocial Decision-making in Virtual Reality

Shu Wei
Department of Psychiatry,
University of Oxford,
Oxford, UK
shu.wei@psych.ox.ac.uk

Anna Bramwell-Dicks
XR Stories, Department of Theatre, Film,
Television and Interactive Media, University of
York, York, UK
anna.bramwell-dicks@york.ac.uk

Virtual reality (VR) simulations with virtual characters have been increasingly deployed to understand context-based human behaviour. The current study investigated the effects of perceived agency of the *other* players, who were either (human-controlled) avatars or (computer-controlled) agents, on the player's overall presence levels (with 3 subscales of spatial presence, involvement, and realism). We also tested the relationship between the player's perception of the agency of the other players, in-game prosocial behaviour (voluntary behaviour to help other players) and their own real-life prosocial traits. 32 university students played a VR game with agents, but half the participants were told they were playing with avatars (an experimental deception). The group who were told they were playing with other humans had higher overall presence than the group who knew they were playing with agents, due to increased spatial presence and involvement. While there was no direct link between the player's perceived agency of the other players and their own in-game behaviours, higher prosocial scores increased their chance of helping the other players in the agent group. Overall, this study suggests that multi-player VR experiences (or those purported to be multi-player) lead to greater influence on people's psychological and behavioural reactions over single-player experiences.

Virtual Reality; perceived agency; presence; prosocial behaviour; decision making

1. INTRODUCTION

Virtual reality (VR) is frequently used to study human behaviour as the environment enables researchers to create realistic situations under tight experimental control (Bombari et al., 2015; Pan & Hamilton, 2018). VR provides a particularly useful setting for sociological and psychological research. For example, VR has been used to understand the psychological mechanisms behind complex social effects (e.g. Gillath et al., 2008; Slater et al., 2013) and encourage positive behaviour such as helping others or overcoming paranoid thoughts (e.g. Lambe et al., 2020; Rosenberg et al., 2013). The characters within the virtual environment play an important role in these VR-based studies as they can be designed to affect the player's attitude and behaviour as well as to enhance user engagement and evoke social feedback (Fox et al., 2015).

When looking at existing VR applications that have constructed social scenarios within Sociology and Psychology research, we find these experiences are primarily used in a single-player mode, where the participant embodies one character and other characters are controlled by the computer. For example, Slater et al. (2013) created a VR confrontation scene including a virtual victim and perpetrator, with the participant embodied within a crowd of virtual spectators, allowing the researchers to observe bystander behaviour. Additionally, Souto et al. (2020) deployed virtual characters in a clinical VR tool for social perception training where patients with social impairment evaluated the mood of facial-animated humans to practise emotion recognition. These examples show that interactive VR has particular strengths that allow researchers to study human behaviour by designing and manipulating specific social interactions to meet the experiment needs, while monitoring people's responses (Gillath et al., 2008; Pan & Hamilton, 2018). At the same time, VR affords a strong level of presence, i.e. sense of being in the virtual world (Witmer & Singer, 1998), that allows people to think and behave as if the virtual events are really happening (Slater, 2009). These studies rely on the understanding that the results from within the VR experience can be translated to the real world. But, is it reasonable for researchers to conclude that findings established within a VR environment would apply outside that environment too? And, if using VR experiences, does it make a difference in people's perception, decisions, and behaviour when the characters' social entity they are playing with or against changes?

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Although most of the current research has focused on single-player experiences, there is potential to use multi-player VR experiences within psychology experiments. However, the practicalities of running these studies are complex, e.g. coordinating real-time behaviours from different users and ensuring sufficient internet bandwidth. While researchers have explored multi-player experiences in immersive VR (e.g. Du et al., 2016; Freeman & Acena, 2021), the differences between interacting with other humans as opposed to with the computer has not been thoroughly explored. This under-tested aspect sets a challenge for VR developers and researchers alike to better understand the efficacy of virtual environments, both as a player experience, and when used as a tool for studying human behaviour. Therefore, we aimed to explore whether people matter within the context of playing VR within a multi-character environment, by comparing the player's experience of VR with (human-controlled) avatars versus (computer-controlled) agents.

This paper reports on a study that set out to address 3 research questions:

- **RQ1.** How does a player's perceived agency of other players in a VR game affect their overall presence (including presence subscales of spatial presence, involvement and experienced realism)?
- **RQ2.** Does a player's perceived agency of other players in a VR game affect their prosocial decision-making?
- **RQ3.** Is there any association between player's in-game prosocial decisions and their real-life prosocial tendencies?

The results provide insights into how people respond behaviourally and psychologically under different agency conditions. We also consider whether interactive VR can serve as a suitable medium for unpacking social-psychological insights from the laboratory into the real world. In sum, this study contributes to (1) understanding immersive experiences in VR and how the social entities of interaction partners influence the experience; (2) understanding people's prosocial behaviours and decision-making in interactive experiences; and (3) informing future research about connecting people's in-game behaviours with their real-world traits.

2. RELATED WORK

2.1 Do People Matter? Agency and Presence

The term *agency* refers to the source of control of the virtual representation of characters, which can be categorised as either human-controlled avatars or computer-controlled agents (Morkes et al., 2009). It has been argued that people respond differently to virtual characters based on their agency (Blascovich et al., 2002). Fox et al. (2015) conducted a meta-analysis of 32 studies and concluded that avatars have a stronger social influence on players than agents. Appel et al. (2012) explored people's social reactions within a desktop environment, suggesting a stronger feeling of social presence, i.e. the sense of being with another human (Biocca et al., 2003), and attention focus were associated with avatars than agents. This result aligns with findings from Bailenson et al. (2003) who explored the concept of interpersonal distance in VR, finding participants maintained greater interpersonal space and gave way to virtual characters more promptly when they believed they were controlled by another human. However, in this example, it is notable that after increasing the behavioural realism of the agent by introducing eye gaze the participants started to increase their distance, similar to the avatar group. Another study explored people's physiological reactions to ostracism in response to different agencies when playing a VR cyberball game (Kothgassner et al., 2021). In this study, participants experienced elevated salivary cortisol levels and stronger acute stress when they felt socially excluded by avatars rather than agents. Further, the stress triggered by avatars lasted longer after the VR session compared to the agent stressor group. These findings suggest that agency type can have behavioural, psychological, and physiological impacts on players. This work also suggests true multi-player experiences may have greater impacts on players than single-player games where other virtual characters are known to be controlled by computer.

These agency-related studies focused on using social presence to evaluate participants' experience of interactive media. To date, it seems that efficacy and immersion due to playing with computer-controlled agents or human-controlled avatars within VR as a whole, that is, going beyond social presence, and looking more broadly at ideas relating to other factors of presence and immersion has received limited attention. A sense of presence, i.e. the subjective feeling of presenting in the computer-generated world despite one's physical location, is a crucial measurement of user immersion (Hoyt et al., 2003; Slater, 2009). But, does this go beyond ideas of *social* presence in VR? One of the most promising questionnaires in understanding presence, is the Igroup Presence Questionnaire (Schubert et al., 2001) which decomposes presence into three sub-scales: spatial presence (the feeling of being physically located in another space), involvement (the user's attention to the virtual environment), and experienced realism (the subjective realism of the virtual experience). It is believed the stronger presence makes users more engaged in virtual scenarios and behave more naturally (Bulu, 2012; Diemer et al., 2015; Slater, 2009), which also strengthens their emotions (Fox et al., 2015; Jicol et al., 2021). Therefore, an investigation into presence on a more comprehensive scale is needed to lay the foundation for future studies to understand the impact of perceived agency of other players in VR. Further, it will help to establish if single-player VR experiences can be useful as a social experimental tool without the complexities of running studies with true multi-player VR experiences requiring multiple human participants to be within the VR environment simultaneously. Finally, this will help VR creators understand whether the social entity of virtual characters affects people's sense of presence within the experience, and ultimately their levels of immersion.

2.2 Studying Prosocial Behaviour in Virtual Reality

In addition to our interest in how agency affects presence, we are also interested in how perceived agency affects other player behaviour. Prosocial behaviour are voluntary actions which are intended to benefit others, e.g. comforting, sharing or helping (Staub, 2013). Prosocial behaviour can be categorised as altruistic (i.e. helping others without any expectation of benefits to oneself) or non-altruistic. It is important for people to develop prosocial traits, especially altruistic behaviours, which have been shown to lead to improved self-confidence and higher-quality relationships (Eisenberg at al., 1991).

Psychologists have been exploring the potential to use virtual characters within VR to understand and encourage prosocial behaviour. For example, Kozlov and Johansen (2010) used a virtual maze to investigate how the number of bystanders influences people's decision to assist strangers, finding that rooms with fewer bystanders led to higher incidences of assistance. Further, both Slater et al. (2013) and Rovira et al. (2021) looked at the impact of people's social identities and affiliations on bystander intervention when an unfair situation occurs. Another VR experiment focused on the virtual character's ethnicity and found people tend to help victims more if they are from the same ethnic background (Gamberini et al., 2015). These studies all utilized VR's capability to recreate emergency scenarios to monitor people's responses and thought processes, which is otherwise hard to accomplish in a live setting.

Aside from using VR to understand prosocial behaviours, Rosenberg et al. (2013) used VR as a persuasive tool to change behaviours outside the virtual environment. In this study, participants were equipped with a superpower that allowed them to fly and were encouraged to save others within the virtual world. Results showed that having the superpower in the virtual scenario led to greater helping behaviour in the real world after the VR session was completed. Ahn et al. (2013) carried out similar research where participants were allocated to either a colourblind or normal vision group. Compared to the group with normal vision, people who experienced being colourblind in VR displayed a higher tendency to offer help to colourblind people. These insights support the assertion that VR can serve as a social-psychological tool, both to understand behaviour and facilitate positive behaviour change, with subsequent effects transferred into real-life (Gillath et al., 2008; Pan & Hamilton, 2018). However, caution needs to be taken when interpreting people's behaviour in VR as representative of their behaviour in real-life, as in-game decisions are not always aligned with players' real-world attitudes (Iten et al., 2018; Pan & Hamilton, 2018). When facing prosocial decision-making within an interactive experience, such as a videogame, people tend to think strategically rather than morally (Bertrand et al., 2018; Iten et al., 2018). The specific task type (competitive vs neutral) and scenario context also change people's mindsets, with the neutral setting providing a better representation of people's real-life traits (Fox et al., 2015). Furter, Bombari et al. (2015) identified that social desirability effects can also exist in social VR studies where participants act according to experimenters' expectations rather than their intuition. These factors add to the complexity of understanding and applying results from experiments within virtual environments to the real world, but also provide potential for researchers to manipulate or optimize the social impact of VR. So, more empirical evidence is needed to understand people's decision-making in interactive virtual environments, particularly within VR.

3. METHOD

3.1 Hypotheses

Based on the findings of previous work, we formed the following hypotheses:

- **H1:** Participants will have higher presence levels when they believe they are playing with avatars rather than agents in VR.
- **H2:** Participants will be more likely to offer to help other characters within the experience when they believe they are playing with avatars rather than agents in VR.
- **H3:** Participants who display in-game prosocial behaviour will be more likely to have higher prosocial tendencies in real life.

3.2 Participants

Thirty-two participants (22 male, 10 female) were randomly divided into two groups (perceived-as-avatars group and perceived-as-agents group). All participants were students (perceived-as-avatars group: M = 22.69 years, SD = 2.39; perceived-as-agents group: M = 22.38 years, SD = 3.14). Participants were given a brief description of the study and written informed consent was obtained. All participants had normal or corrected to normal vision and reported no previous issues with using VR systems or vertigo. The study was approved by the University of York Ethics Committee.

3.3 Experimental Design

The independent variable (IV) was perceived agency of the other players with 2 levels (perceived-as-avatars and perceived-as-agents). A between-participants design was used where participants were told that they were either playing the VR game with human-controlled characters or with computer-controlled characters. This was an experimental deception as both groups were playing with computer-controlled characters. We used this deception for greater control within the experiment and stronger internal and construct validity.

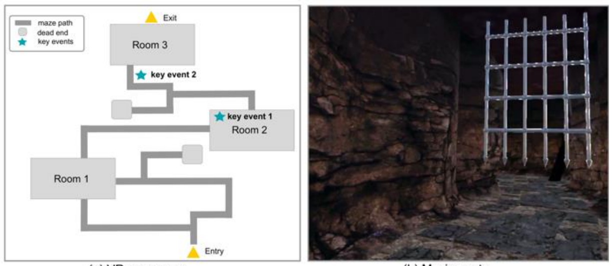
The dependent variables (DVs) were the (a) in-game prosocial decision (whether the participant decided to help or not) and (b) the overall presence level, calculated using the English version of the Igroup Presence Questionnaire (IPQ) (Schubert et al., 2001). This questionnaire measures presence level by summing the scores of three subscales (involvement, experienced realism and spatial presence) and a general presence statement. The total overall presence scores range from 14 to 84.

To test the H3, participants' real-life prosocial tendencies were measured after the VR gameplay session using the adapted 14-item Self-Report Prosocial and Altruism Scale (Rushton, 1981). We chose to assess this after the gameplay so as not to prime the participants to know we were observing their prosocial behaviour within the game. The scale contains Likert items formatted as statements (e.g. "I would give directions to someone I did not know."), which are rated from 0 (never) to 4 (very often). The total scores range from 0 to 56.

3.4 VR Scenario

3.4.1 VR Game Design
We developed a bespoke VR maze adventure game to measure prosocial tendencies and presence. We created a cave maze environment with three separate rooms (see Fig. 1-a for the game map). We chose a maze style adventure game as it can effectively facilitate the user's sense of space and direction "as a spatial sense conceptual tool" (Lin et al., 2010). To complete the game mission, participants needed to go through three rooms and solve puzzles in exchange for clues, enabling them to open the locker at the end of the maze.

The only obstacle was a series of moving gates that could kill the player (Fig. 1-b). Participants could collect crystals and bullets into their inventory to help within the game. Crystals could be used to replenish health so participants could continue with the game if they were killed, and the bullets were used in a shooting task. The game would end if the player died without any crystals available to replenish their health. There was no leader board or any direct competition among the players. Rather, the VR simulation was set as a neutral adventure game.



(a) VR maze map (b) Moving gate

Figure 1: *Design of the VR experience*

3.4.2 Key Events
The game included two pre-programmed key events to monitor participants' prosocial decisions (Fig. 2).

(a) Key Event 1 (b) Key Event 2

Figure 2: *Key events within the game. (a) Key event one UI Text: "Oops you run out of bullet. Player2 is around, try to send a request to borrow more bullets."); (b) Key event two UI Text: "Player3 is sending you a request to borrow crystals.", "Player3 has 0 health point, need 4 crystals to continue the game.", "Inventory check: you have 4 crystals").*

Key Event One – Request Help: In the first key event, the player is told they have run out of bullets for the shooting task but have the option to ask help from nearby player2 for bullets. This means the participant can become the beneficiary of prosocial behaviours from other characters. If the participant chose to request help, the player2 character was pre-set to give 10 bullets to the participant. A response delay of 10 seconds was applied to make it seem that the other player was thinking about the participants' request for bullets and might reject it. If the participant chose not to request help, the game was designed so that they could not finish the shooting task and had to try to finish the game without an important clue. This event was included in the game as a social cue for prosocial behaviour, as it has been suggested that seeking and receiving help can increase one's motivation to help others (Nadler, 2015). This event also demonstrated the game mechanic that players could share resources and help each other.

Key Event Two – Provide Help: For the second key event, participants encounter player3 and have the option to give away their crystals to help. Agreeing to help means the participant risks going through the most difficult obstacle (two opposing moving gates with accelerating speed) without any crystals to replenish their life if they should die. The participants who helped player3 were categorized as displaying prosocial behaviour within the game, as opposed to the participants who refused to help.

3.5 Procedure

Participants were first instructed to fit the VR headset (HTC Vive) and got familiar with the basic interaction in VR. The participants were informed they were going to play a VR maze adventure game. The participants in the perceived-as-agents group were told they would be playing with two computer-controlled characters. Participants in the perceived-as-avatars group were deceived and told that they would be playing alongside characters controlled by two other participants who were in different rooms within the same building. At this point, the experimenter also told participants in the perceived-as-avatars group they needed to briefly step away into nearby rooms to ensure the other participants were ready for the game to begin. The experimenter left the room and hid outside for a few minutes to reinforce the experimental deception.

Formal game play began once the participant was clear about the task and had no further questions. After playing the game, the participants were asked to complete the IPQ and Prosocial Tendencies questionnaires. Then an informal post-task interview was undertaken in which the experimenter asked questions such as "What did you think when you needed to decide whether to give out the crystals?" Participants in the perceived-as-avatars group were also asked if they believed they were playing in a multi-player VR game with other human players. The participants were then fully debriefed, including explaining to the perceived-as-avatars group that they had been part of an experimental deception.

4. RESULTS

All 16 participants in the perceived-as-avatars group said they believed they were playing with real human players, confirming our IV manipulation was successful. Therefore, the quantitative analysis can proceed to establish whether the perceived agency of the other players affected participants' behavioural and psychological responses.

4.1 Perceived Agency and Presence Level

Participants' average overall presence and subscale scores are displayed in Figure 3. Preliminary analysis confirmed normality and homogeneity of variance through the Shapiro-Wilk normality test and Levene's test, respectively. The data were analysed using an independent-samples 2-tailed t-test (alpha level of 0.05). The overall presence level was significantly higher, t(30) = - 2.06, p = 0.048, d = 0.727, for the perceived-as-avatars group (M = 75.56, SD = 8.35) than the perceived-as-agents group (M = 69.88, SD = 7.24). We then analysed the three contributing presence subscales separately. The spatial presence subscale was significantly higher, t(30) = -2.33, p = 0.027, d = 0.823, for the perceived-as-avatars group (M = 31.19, SD = 2.86) over the perceived-as-agents group (M = 28.63, SD = 3.34). The involvement subscale was also significantly higher, t(30) = -2.22, p = .034, d = 0.784 for the perceived-as-avatars group (M = 21.69, SD = 3.32) compared to the perceived-as-agents group (M = 19.25, SD = 2.89). However, there was no significant difference in perceived realism, t(30) = -0.497, *n.s.*, between the perceived-as-avatars (M = 16.56, SD = 3.245) and perceived-as-agents groups (M = 16.00, SD = 3.162).

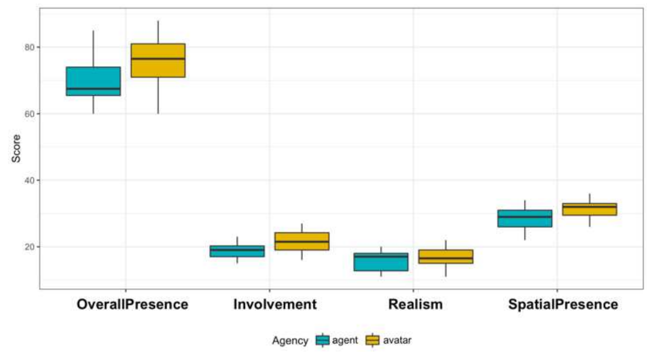


Figure 3: *General presence level compared to the 3 contributing presence subscales*

4.2 Perceived Agency and Prosocial Decision

Based on the in-game decision to help player3 at key event 2, the participants were subdivided into two groups within each condition. Nine participants (56%) in the perceived-as-agents group chose to help. Twelve participants (75%) in the perceived-as-avatars group chose to help. Overall more than 66% participants (21 out of 32) displayed in-game prosocial behaviour. A Chi-square test was used to analyse the in-game prosocial behaviour when people were playing under different agency conditions, which indicated there was no significant association between agency level and the decision to help, x^2= 1.25, *n.s.* We also looked at the time participants took to respond to the help request, where there was no significant difference identified, t(30) = 1.044, n.s., between the perceived-as-avatars (M = 10.25 S, SD = 2.44) and perceived-as-agents group (M = 11.19 S, SD = 2.64).

4.3 Association of In-game Prosocial Behaviour and Real-life Prosocial Tendencies

Participants' real-life prosocial scores were grouped according to their decision to help or not, as shown in Table 1. A Mann-Whitney U test was used to investigate the direct association between people's in-game prosocial behaviours and their real-life prosocial tendencies (alpha level of 0.05). There was no significant difference in real-life prosocial tendencies between the group offering help and the group not offering help, U (11,21) = 93.00, *n.s.*

Table 1: *Real-life prosocial scores grouped by in-game helping decision*

Help Decision	N	Mean	Median	SD
No help	*11*	*33.00*	*32.00*	*5.138*
Help	*21*	*34.52*	*32.00*	*6.765*

To further understand how the combined factors of perceived agency and real-life attitude affect people's in-game decision, a binary logistic regression model was used to model the probability of the participants' in-game prosocial decision. Participants' real-life prosocial score, perceived agency, and the interaction term (real-life prosocial score * agency) were taken as the explanatory variables, after passing the significant test through linear regression. The model has a strong fit (McFadden Pseudo-R^2= .261) (McFadden, 2977) with the variable coefficients shown in Table 2.

Table 2: *Logistic model coefficient of the explanatory variables*

	Estimate	Std. Error	Z value	Pr(>|z|)
(Intercept)	*-9.3018*	*4.4971*	*-2.068*	*0.0386*
real_life_score	*0.2682*	*0.1258*	*2.132*	*0.0333*
agency (): computer; 1: human)	*17.4305*	*6.8781*	*2.534*	*0.0113*
real_life_score: agency	*-0.4800*	*0.1970*	*-2.437*	*0.0148*

For the perceived-as-agents group (agency:0), the odds ratio of participants choosing to help was exp(0.27) = 1.31 for a one-unit increase in their real-life prosocial score. For the perceived-as-avatars group (agency:1), the odds ratio of helping was exp(0.27-0.48) = 0.81 for a one-unit increase in their real-life prosocial score. Therefore, it is possible to observe for the players in perceived-as-agents group have an increase of 31% in the odds of offering help, while for the players in perceived-as-avatars group there is a decrease of 19% in the odds of offering help for each 1 unit increase of their real-life prosocial score.

4.4 Qualitative Analysis

Qualitative data was collected through an informal post-task interview for supplementary insights about participants' decision making. One reason for helping player3, that was given by multiple participants was they previously received help from another player, so they felt they "should also be kind and generous" to the others. Some participants also explained they felt confident they would survive the game so they did not feel it was necessary to keep the crystals so they decided to give their crystals to player3 who needed them more. However, some participants also provided help with the expectations of some potential benefits, e.g. "I thought there would be a reward if I helped player3". Interestingly, one participant attributed the prosocial decision to the impact of their religion, stating "I am Christian and I tend to be kind to someone who is in need of help regardless of whether it's real life or not". For the 11 people who did not help player3, the majority stated that it was only a virtual game, and "being evil in the game" will not make them feel guilty as there was no real-world consequence. Half mentioned the decision to not help was partly driven by the curiosity about what would happen if player3 died. Another reason for rejection was some perceived the double moving gates as a significant challenge, so decided to save the crystals to secure themselves first. Additionally, one participant mentioned they expected the other player to offer help.

5. DISCUSSION

The goal of this study was to investigate people's behavioural and psychological responses in VR when interacting with different types of character agency, while also exploring whether people's in-game decisions can reflect their real-life personality traits. The results from the analysis of the effect of perceived agency (perceived-as-avatars vs perceived-as-agents) on presence was consistent with our predictions: People who believed they were playing with avatars had significantly higher presence (with higher subscales in spatial presence and involvement) than those who believed they were playing with agents. In contrast to our initial predictions, there was no significant difference for the in-game prosocial decision between the perceived-as-avatars and perceived-as-agents groups. When looking at the association of in-game decision and personality traits, our results suggest that although there was no difference in the prosocial tendencies between the people who offered help and those did not, higher prosocial scores increased the chance they would provide help to others in VR. Intriguingly, this association only applied to the perceived-as-agents group rather than the perceived-as-avatars group.

5.1 Influence of the Perceived Agency in Presence Level

There was an overall effect on presence due to perceived agency of the other players, with the spatial presence and involvement subscales found to be particularly important.

One explanation for the impact of perceived agency of the other players on spatial presence subscale is that when participants believed they were playing with avatars, the experimenter observed that although they did not spend significantly longer playing the game, these participants seemed to explore the virtual maze more comprehensively by teleporting faster around the environment, presumably to meet up with the other participants. During this exploration process, the participants could form better ideas of their self-location in the virtual world, which in turn reinforced their spatial presence (Havranek et al., 2012). This observation suggests that the belief of facing human-controlled entities can affect people's movement in VR and lead to a stronger spatial presence however follow up research is needed to explore this idea further by specifically tracking movement.

The involvement subscale was also significantly higher in the perceived-as-avatars group which can be attributed to a higher level of social context in the perceived-as-avatars condition. Previous research suggests people tend to have a stronger connection with social interaction partners when they believe the virtual counterparts are controlled by humans (Appel et al., 2012; Bailenson et al., 2003; Kothgassner et al., 2021). Moreover, this phenomenon occurs especially when people need to make interpersonal decisions that will affect others. In this sense, participants in the perceived-as-avatars group experience stronger sense of togetherness and involvement when they were thinking through the potential outcomes of their responses to the other character's request for help. Additionally, the knowledge people received before the virtual experience may dominate their thoughts and perception meaning participants could have established initial thoughts of getting involved in a social interaction within the playthrough, based on the knowledge they were playing with other humans.

5.2 In-game Prosocial Behaviours Towards Different Agency

Although avatars are believed to elicit stronger social and emotional responses, which makes people more likely to display prosocial behaviours, we did not identify any evidence that people offered more help to avatars over agents. One explanation for this is that people may have prioritised solving problems and winning the game, which was confirmed by some of the participants who declined to help, and aligns with previous observations from Knoppers et al. (1989) and Iten et al. (2018), as it seems that the players preferred options that maximise their chance to survive in the end, so the social identity of other players did not influence their responses. Meanwhile, the presence of the experimenter may also have exerted some social pressure on participants' decision-making (Bombari et al., 2015; Pan & Hamilton, 2018). Although none of the participants mentioned they felt observed for their in-game behaviours, the participants may have noticed their VR sessions were being streamed on the experimenter's monitor. This factor may increase their tendencies to help others to build a positive image in both conditions (Bombari et al., 2015). So, it was perhaps less likely that we would identify a difference based on the perceived agency of the other players.

5.3 Transfer of real-world and game behaviour

Higher prosocial scores increased people's chances of helping the other players in this VR experience, with this positive association only applying to the perceived-as-agents group. Therefore, it is possible to conclude that there is an interaction effect between people's prosocial tendencies and perceived agency of other players on their helping decisions in VR. Although this finding fits the general prediction that participants' personalities influence their in-game behaviours (Wang & Yu, 2017), it is opposite to the belief that human-controlled avatars can trigger people's real-life traits to a stronger extent (Fox et al., 2015; Kothgassner et al., 2021). One possible explanation is that people have an increasing sense of competition when playing with the same social entity (e.g. with other humans), even though this VR game had been intentionally designed to have a neutral setting. So, those who believed they were playing with agents may have focused less on the competition aspect and better reflected on their real-world value system. Alternatively, this interaction effect could also be linked to the bystander effect (Darley & Latane, 1968), especially for the people in the perceived-as-avatars group. As one participant mentioned even though he did not help player3, it was still possible for player3 to be saved by another participant. In this sense, the human identity of the virtual characters decreased participants' motivation to offer help, as the helping responsibility was diffused to the other characters. Meanwhile, it is worth noticing that the people who chose to help others do not have stronger real-life prosocial tendencies compared to those who did not. This demonstrates the individuals' real-life traits somewhat influence social interaction in the immersive world, but researchers should be cautious when inferring real-world value systems based on people's in-game behaviours.

5.4 Limitations and Future Work

This experiment successfully investigated the effect of perceived agency of other players on presence and prosocial behaviour using an interactive experience in VR. We have also discussed the potentials and pitfalls when measuring the real-life traits within a virtual game. However, there are also some limitations which must be acknowledged. First, there is limited generalizability of the experiment to other VR experiences. This VR environment was designed as a cave adventure and there was no competition involved between different players, so people may hold an attitude only exclusive for this specific type of game (Elliott, 2012). Although this design without a competitive element was intentionally used to avoid risks of egoism confounding the experiment, it does lead to questions as to whether the result could also generalise to the other interactive experience with different themes and mechanics. Further work is needed within other, more competitive, scenarios to increase the generalizability.

Fox et al. (2015) explain the actual control of virtual characters has moderated effects on social influence from different perceived agencies. Our study used the same agent with idle animation and low-level behavioural realism. So, one future suggestion would be to adopt a 2x2 design to further understand the interactive experience towards different agency and different agency perception with different levels of behavioural realism included. In this setting, participants would similarly interact with an agent while believing that the other character is controlled by human, but with different realism. This design can also help identify the potential impact of participants' experience of gaming or VR. As IJsselsteijn et al. (2007) suggested, experienced players tended to have a higher expectation and requirement for the game content and quality than the beginner players. Finally, the informal qualitative interviews revealed that even for the participants who chose to help, there were different intentions. Some of the helping decisions were an altruistic choice (not expecting anything in return), while others were non-altruistic. Building up from this insight, an in-depth analysis could also be done with a bigger sample size to understand how the agency type influences the non-altruistic prosocial behaviours and altruistic behaviours respectively, which could contribute to decoding the prosocial mechanics from the motivation perspective (2018).

6. CONCLUSIONS

So, do people matter? The key question posed in this paper was whether there are potential benefits in using multi-player VR experiences for social-psychological insights. We have shown that even when playing a game with computer-controlled characters, the sense of presence increases by believing that the social entity of other players is human. Therefore, we can conclude that should presence, particularly spatial presence and involvement, be an important aspect of the objectives to understand social interaction (e.g. helping behaviours), then real multi-player VR experiences (or, those where the participant believes they are playing with other humans through a deception) may lead to more significant social impact and behavioural changes over a single-player experience. These findings also have potential consequences for VR developers who should consider that higher presence is likely to be achieved in multi-player environments, which may similarly impact on user engagement. As a novel practice of measuring presence and prosocial tendencies under experimental deception, the VR stimuli effectively immersed participants and elicited their behaviours and emotions. The post-task interview suggested all the participants had little awareness of the actual study objective and experimental manipulation. While any experimental deception must be carefully managed under ethical concerns, importantly none of the participants had concerns or complaints about the deception following the debrief, so this study has demonstrated that VR games have the potential to simulate social interaction for real-world insights. People's in-game behaviours are influenced by the combined factors of their personality traits and perceived agency of the other players. However, there was no direct cause-effect link identified between people's in-game decisions and real-life attitudes. So, researchers in the interdisciplinary area of VR psychology should be mindful of the difference between virtual environment and the real world when translating the playing experience, as most participants are highly engaged with the game and aware of the experiment setting. Ultimately, we are not fully defined by how we play in a virtual game, or how we behave in a monitored laboratory.

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