Avatar Customization, Personality, and the Perception of Work Group Inclusion in Immersive Virtual Reality

Lauren Buck
buckl@tcd.ie
School of Computer Science and
Statistics, Trinity College Dublin
Dublin, Ireland

Gareth W. Young
youngga@tcd.ie
School of Computer Science and
Statistics, Trinity College Dublin
Dublin, Ireland

Rachel McDonnell
ramcdonn@tcd.ie
School of Computer Science and
Statistics, Trinity College Dublin
Dublin, Ireland

ABSTRACT

Virtual reality (VR) has experienced exponential growth in attention in the past five years. Many see it as a new communication mechanism through which people can come together in a way they have never been able to via traditional online interfaces. However, much is still unknown about how VR may affect how groups of users communicate. In this work, we present preliminary findings on how avatars, the customization choices users make to create them, and user perception of them may affect feelings of work group inclusion. We study this in the context of a formal classroom setting with work groups comprised of students. Avatars are known to transform user perception and behavior in virtual environments – both immersive and non-immersive – and can dictate the way social interactions play out in these scenarios. We produce results that align with this paradigm, showing that elements of work group inclusion are different between the physical world and VR, and that customization choices and user perceptions of avatars may shape the perception of inclusion.

CCS CONCEPTS

• **Human-centered computing** → **Empirical studies in collaborative and social computing**; **Virtual reality**; **Collaborative interaction**.

KEYWORDS

Virtual reality, Avatars, Customization, Personality, Collaboration, Inclusion

1 INTRODUCTION

Interest in virtual reality (VR) has increased exponentially over the last five years alone. This is due to the fact that VR is a novel tool

that can potentially offer what current technological devices do not: a one-to-one analog of physical, face-to-face (F2F) interaction. This has given rise to various applications meant to supplant interactions that usually happen F2F, from surgical and defense training [6, 16] to academic conferences [13] and business meetings [25]. But while these developments are promising and indicate a bright future for VR, many elements of the technology may affect its efficacy as a communication medium. In particular, avatars alone beget significant changes in the way users communicate with one another. Untethered from the physical constraints of the real world, VR users can create and embody a boundless number of characters with unique features that transform their self-perceptions and social interaction behaviors [20]. Therefore, in this preliminary study, we look at work group dynamics in a F2F and VR setting, and explore how avatar customization choices and perceived avatar personality may affect work group dynamics. In the context of our work, we consider a work group to be a grouping of 5-6 classmates engaging in a formal, goal-directed discussion.

We chose to focus on one component of work group dynamic: the perception of work group inclusion. We consider work group inclusion as defined by Shore et al. [21], which is the "degree to which [a group member] perceives that [they are] an esteemed member of the work group through experiencing treatment that satisfies [their] needs for belongingness and uniqueness." In the past decade, literature on work group inclusion has gained traction, with studies championing positive correlations between work group inclusion and a group's performance [8]. Inclusion can positively affect team creativity, innovation, motivation, and self-efficacy, suggesting that it can determine the degree to which that group operates successfully [4, 23]. It is essential that we understand feelings of inclusion experienced in VR settings if they are to be used as an alternative to F2F settings.

Virtual environments are notorious for inducing behavioral shifts in users via the *Proteus effect* [18]. The Proteus effect describes a phenomenon in which users adjust their own behavioral patterns to match their avatar's external appearance. For example, users tend to act more confident and extraverted when driving avatars that are considered tall and attractive [3, 24]. Avatars depicted in a cartoon rendering style, such as the ones used in our study, are typically perceived as more friendly, agreeable, appealing, and trustworthy [9, 15, 26]. While these avatars are perceived in a positive light, current VR applications do not support avatars that convey accurate nonverbal cues (body language, mutual gaze, etc.) due to technical limitations. Therefore, we believe that shifts in behavior and communication may change the perception of inclusion during group work in VR. Thus, our first research question is:

RQ1: Does work group inclusion differ between F2F and VR settings?

Since avatars have such a major impact on how users interact in virtual environments, we also wanted to look at how avatar customization and personality influenced the feeling of work group inclusion. Several previous studies have delved into customization choice and personality perception in the context of massively multiplayer online role-playing games [2, 7, 19], mainly focusing on how customization choices influence perceived personality, but none have ever considered how avatar customization choices and personality may influence group behavior in VR. Thus, our final two research questions are:

RQ2: Do avatar customization choices impact work group inclusion?

RQ3: Does the perception of the personality traits attributed to avatars influence work group inclusion?

To our knowledge, this is the first preliminary study to directly measure and compare the perception of work group inclusion between F2F and VR settings. Moser et al. [17] did consider group discussion and decision quality between F2F, videoconferencing, and VR platforms, finding no difference. In VR settings, it has been found that avatars can increase synchrony between group members, as well as self-presence and realism, and can affect enjoyment [11]. Earlier works have mainly focused on group work facilitated via desktop platforms. Desktop-based group work can facilitate less conformity and opinion change [1], and can be more enjoyable and task-driven [14] than F2F group work. Moreover, immersion during online group work has been found to enhance leadership capability [22], as it can lead to higher involvement and satisfaction [12]. However, extensive group studies in immersive VR have been limited by the expenses, technical, and organizational challenges that surround VR implementation and experimentation.

This work contributes novel preliminary findings about group collaboration in VR in an area that has not been explored. We ask study participants to design avatars, report on their design choices and the perceived personality of their avatars, and then ask them to engage in a group task in both F2F and VR settings. After each task, participants rate their feelings about work group inclusion. We find that components of work group inclusion differ between settings and that avatar design and personality elements could potentially contribute to feelings of inclusion in VR.

2 METHOD

Surveys and Procedure. Participants were first asked to design a self-avatar in AltspaceVR and to reflect on the avatar customization choices they made as well as their own personality and the personality that they attributed to that avatar. We generated a set of 14 questions presented in a 1-5 Likert type format (i.e., 1 = disagree, 5 = agree) to understand the design choices that participants made when creating their self-avatars (see Appendix A). We titled this set of questions the Avatar Design Choice Survey (ADCS) to distinguish them from other sets of questions used in our study. To measure personality, participants answered the *Ten-Item Personality Inventory* (TIPI) [10] (see Appendix B). Items were presented in a 1-5 Likert-type format (i.e., 1 = disagree, 5 = agree). The TIPI is a

measure of the Big Five (or Five-Factor Model) personality dimensions: extraversion, agreeableness, conscientiousness, emotional stability, and openness to experiences. We chose this measure due to its brevity and optimized validity. In a follow-up survey on a later day, participants were shown images of the avatars created by other participants and were asked to rate the personalities of those avatars via the TIPI. Some examples of the avatars participants created can be seen in Figure 1.

On a later day, after customizing their avatars and completing the ADCS and TIPIs, participants took part in a two-hour session in which they were asked to complete two different decision-making tasks (the NASA Moon Landing and Desert Survival Situation) in groups of 5-6. One of these tasks took place F2F while the other took place in AltspaceVR in a virtual classroom (see Figure 1). Participants were each given an Oculus Quest 2 and its handheld controllers to carry out the task in VR. In both F2F and VR conditions, participants were in the same collocated space. We counterbalanced the tasks so that groups performed the tasks in different settings in a different order. After each session, participants were asked to report how inclusive they felt their groups to be. Inclusion was assessed via an adapted version of the Work Group Inclusion Measure (WGIM) [5] (see Appendix C). Items were presented in a 1-7 Likert-type format (i.e., 1 = strongly disagree, 7 = strongly agree). This measure was designed to measure the feelings of belonging and uniqueness of work group members. Chung et. al [5] note that the WGIM has a high level of validity. We added two additional self-generated questions to the end of this survey regarding feelings of leadership. These questions were used to determine if users felt more outspoken and influential in one scenario over another.

Figure 1: Top: Examples of avatars participants created in our study. Bottom: Participants interacting in the virtual classroom.

Sample. We recruited 55 students (27 male, 21 female, 5 not reported) aged 18-35 (20.71 ± 2.89) who were enrolled in emerging technology classes at our institution. Customizing an avatar and participating in group work in AltspaceVR was part of their coursework, but they separately volunteered to submit their data to our study. Informed consent was collected from our participants, and the study was approved by our ethics review board. A subset of

25 of these students designed their own avatars, filled out their responses to the ADCS and self-TIPI, participated in the group tasks and filled out the WGIM. All 55 students volunteered to rate the personalities of the other students' avatars (i.e., they filled out the TIPI related to avatars that were not their own). The majority of students noted that they were unfamiliar with social VR, with only 11 indicating that they had some familiarity with it.

3 RESULTS

Statistical analyses were performed using IBM SPSS Statistics. Before conducting all of our analyses, we checked the normality of our data using Shapiro-Wilk tests. These tests revealed that our data is not normally distributed, thus we have performed nonparametric tests in the analyses below.

3.1 Inclusion

First, we wanted to determine if feelings of inclusion differed when participants worked together F2F instead of in VR. Therefore, we performed Wilcoxon Signed-Rank tests on the responses to each WGIM question after completing the group task F2F and in VR. We analyzed the differences between each question to produce a more nuanced understanding of inclusion. There was a significant difference between responses to WGIM Q7 ("People in my group listened to me even when my views were dissimilar.") ($Z = -2.04, p < 0.05, \eta^2 = 0.16$). The mean score of WGIM Q7 in the F2F condition was 6.15 ± 0.61 and in the VR condition was 5.69 ± 1.29. There was also a significant difference found in responses to WGIM Q11 ("I felt that I was a leader in the group discussion.") ($Z = -2.55, p < 0.05, \eta^2 = 0.27$). The mean score of WGIM Q11 in the F2F condition was 4.08 ± 1.23 and in the VR condition was 4.79 ± 1.44.

3.2 Avatar Customization and Inclusion

Next, we wanted to determine if one's avatar customization choices may affect feelings of inclusion during interaction in VR. Thus, we chose to run Spearman's Rank-Order correlations between the responses to the ADCS and WGIM. There were several positive, moderate correlations between the choice to match a self-avatar's race with one's own (ADCS Q6) and WGIM items, including WGIM Q2 ("I felt that I belonged in my group.") $r_s(23) = 0.5, p < 0.05$, WGIM Q6 ("I felt that I could bring aspects of myself to this group that others in the group didn't have in common with me.") $r_s(23) = 0.43, p < 0.05$, and WGIM Q7 ("People listened to me even when my views were dissimilar.") $r_s(23) = 0.45, p < 0.05$.

There were additional positive, moderate correlations between feelings about equal group leadership (WGIM Q12) and ADCS Q10 ("I designed my avatar to stand out as much as possible.") $r_s(23) = 0.54, p < 0.01$, ADCS Q11 ("I did not want want my avatar match my real appearance.") $r_s(23) = 0.043, p < 0.05$, and ADCS Q12 ("I feel that the appearance of my avatar encapsulates my personality.") $r_s(23) = 0.47, p < 0.05$. There were negative, moderate correlations between feelings about equal group leadership (WGIM Q12) and ADCS Q8 ("I would consider the clothing I chose to be formal.") $r_s(23) = -0.43, p < 0.05$ and ADCS Q14 ("I matched my avatar's body type to my own.") $r_s(23) = -0.4, p < 0.05$.

3.3 Personality

Before analyzing the results from the TIPI surveys, we scored the TIPI data according to Gosling et al. [10] and produced a score for each Big Five personality dimension. This was done for the self-ratings, the ratings of the self-avatar, and the ratings of others' avatars. We performed Wilcoxon Signed-Rank tests to determine if there were differences between the personality traits. Our analyses first showed a significant difference between the TIPI scores for the self and self-avatar related to extraversion ($Z = -2.53, p < 0.05, \eta^2 = 0.24$). There were also significant differences between the TIPI scores for the self-avatars and ratings of others' avatars, particularly with relation to extraversion ($Z = -2.07, p < 0.05, \eta^2 = 0.19$), agreeableness ($Z = -1.96, p = 0.05, \eta^2 = 0.17$), emotional stability ($Z = -1.96, p = 0.05, \eta^2 = 0.17$), and openness ($Z = -2.21, p < 0.05, \eta^2 = 0.21$). A graphical representation of these results can be found in Figure 2.
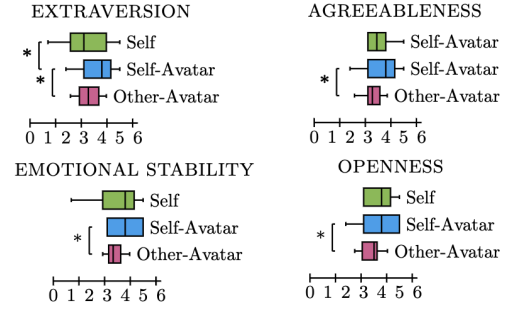

Figure 2: Scored TIPI results (extraversion, agreeableness, emotional stability, and openness) for the self, self ratings of the avatars, and other ratings of the avatars. Significance is represented between conditions by asterisks.

3.4 Personality and Inclusion

Last, we wanted to determine if feelings of group inclusion may be affected by one's perception of their own or others' personalities. Spearman's Rank-Order correlations were run to determine the relationship between the perception of one's own personality and the feeling of inclusion in the real world. A positive, moderate correlation was found between conscientiousness and WGIM Q7 ("People in my group listened to me even when my views were dissimilar.") $r_s(23) = 0.41, p < 0.05$, as well as between emotional stability and WGIM Q6 ("I felt that I could bring aspects of myself to this group that others didn't have in common with me.") $r_s(23) = 0.48, p < 0.05$. No other correlations were significant. We also ran correlations to determine the relationship between self-perception of one's personality and the feeling of inclusion in VR and found no correlations.

Next, we ran correlations to determine the relationship between the perception of one's self–avatar personality and the feeling of inclusion in VR. Positive, moderate correlations were found between emotional stability and WGIM Q6 ("I felt that I could bring aspects of myself to this group that others in the group didn't have in common with me.") $r_s(21) = 0.044, p < 0.05$ and WGIM Q12 ("How did you feel about the leadership dynamic in your group?")

$r_s(21) = 0.47, p < 0.05$. A positive correlation was also found between openness to experience and WGIM Q11 ("I felt that I was a leader in the group discussion.") $r_s(19) = 0.48, p < 0.05$.

Finally, we ran correlations to determine the relationship between the perception of other's avatar's personalities and the feeling of inclusion in VR. A positive correlation was found between agreeableness and WGIM Q3 ("I felt connected to my group.") $r_s(21) = 0.458, p < 0.05$. No other correlations were significant.

4 DISCUSSION

Ultimately, our results revealed several interesting preliminary findings that link avatar design and personality to feelings of inclusion. We were able to determine that inclusion varied when groups completed a decision-making task F2F and in VR, answering our preliminary research question (RQ1). Group members felt less heard when expressing varied viewpoints, albeit feeling more like leaders in VR. These findings alone are novel as work group inclusion in a VR setting has not been explored at all, nor has it been compared to work group inclusion in a F2F setting.

We analyzed whether avatar customization choices may have an affect on work group inclusion (RQ2). We found several positive correlations between inclusion and the choice to match one's avatar's race to one's own race. Choosing to match one's avatar's race to his or her own race was correlated with a stronger sense of belonging, feeling that one could bring unique aspects of themselves to their work group, and feeling heard when expressing one's views. However, it is important to note that very few participants in our study actually engaged in race swapping. 91.7% of participants reported that they matched their avatar's race to their own. Further study should be conducted to understand how race swapping and identity tourism at large affect work group dynamics.

Additionally, there were several positive correlations between leadership dynamics and avatar customization choices. Participants felt that more members of their group emerged as leaders when they designed avatars that stood out, that did not match their real appearance, but that did encapsulate their personality. Participants also felt that more members of their group emerged as leaders when they chose more casual clothing and when they adopted a body type dissimilar to their own. These findings suggest that users who design avatars more closely linked to an idealized version of themselves – one that stands out and encapsulates their personality rather than physical appearance – may be likely to feel a stronger sense of work group inclusion. In addition, choosing an avatar to be more casually dressed may encourage more communication and a stronger sense of participation among group members.

Next, we further explored whether one's perception of their own and others' personalities would have an affect on work group inclusion (RQ3). Participants rated their own avatars as being more extroverted than themselves while rating the avatars of others more conservatively. They felt that the avatars of others were less extroverted, agreeable, emotionally stable, and open than their own avatar. These ratings differ slightly from prior literature, where users have typically rated their own avatars as being more extroverted, conscientious, and emotionally stable than themselves [7]. Ducheneaut et al. did note that, over time, the personalities of the offline and online self are likely to converge.

In a F2F setting, we found that higher scores of conscientiousness and emotional stability could be potentially linked to feeling heard when holding a different viewpoint and feeling like one could bring unique aspects of themselves to their group. In a VR setting, when users saw their own avatar as more emotionally stable, they felt that they were able to bring unique aspects of themselves to the group and that leadership was more evenly distributed. Additionally, when participants perceived themselves as more open they felt more like a leader in group discussions. Finally, in a VR setting, when they saw the avatars of others as being more agreeable they felt more connected to their group.

Our work ultimately lays the foundation for understanding work group inclusion in VR. We collected preliminary baseline measurements of inclusion in F2F and VR settings, and augmented these findings by assessing whether avatars may impact it. Our results are complex and just scratch the surface when it comes to understanding what factors affect the way VR users interact with one another during a group task. There are many future directions for this work, including assessing whether avatar stylization and design, environmental context, group configuration, and embodiment affect work group inclusion.

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A   AVATAR DESIGN CHOICE SURVEY

1. When you created your avatar, which of the following statements best describes you? Choose only one.
   - When I created my avatar, I created it as realistic and similar to myself as possible.
   - When I created my avatar, I created it as an idealized version of myself.
   - When I created my avatar, I created it as someone distinctly different from myself.
2. I was satisfied with the degree of customization available to me.*
3. I designed my avatar to look like me.*
4. My avatar's appearance is related to my personal identity.*
5. I matched my avatar's gender to my own.*
6. I matched my avatar's race to my own.*
7. The clothing I chose is similar to something I would wear in real life.*
8. I would consider the clothing and accessories I chose to be formal.*
9. I would consider the clothing and accessories I chose to be fun and/or silly.*
10. I designed my avatar to stand out as much as possible.*
11. I did **not** want my avatar to match my real appearance.*
12. I feel the appearance of my avatar encapsulates my personality.*
13. I designed my avatar to be more attractive than myself.*
14. I matched my avatar's body type to my own.*

*Statement was presented in 1-5 Likert-type format: 1 = disagree, 2 = somewhat disagree, 3 = neither disagree nor agree, 4 = somewhat agree, 5 = agree.

B   TEN-ITEM PERSONALITY INVENTORY (TIPI)

Questionnaire developed by Gosling et al. [10].

1. I see myself as extraverted, enthusiastic.*
2. I see myself as critical, quarrelsome.*
3. I see myself as dependable, disciplined.*
4. I see myself as anxious, easily upset.*
5. I see myself as open to new experiences, complex.*
6. I see myself as reserved, quiet.*
7. I see myself as sympathetic, warm.*
8. I see myself as disorganized, careless.*
9. I see myself as calm, emotionally stable.*
10. I see myself as conventional, uncreative.*

*Statement was presented in 1-5 Likert-type format: 1 = disagree, 2 = somewhat disagree, 3 = neither disagree nor agree, 4 = somewhat agree, 5 = agree.

C   WORK GROUP INCLUSION MEASURE (WGIM)

Questionnaire developed by Chung et al. [5].

1. I felt I was treated as a valued member of my group.*
2. I felt that I belonged in my group.*
3. I felt connected to my group.*
4. I believed that my group was where I was meant to be.*
5. I felt that people really cared about me in my group.*
6. I felt that I could bring aspects of myself to this group that others didn't have in common with me.*
7. People in my group listened to me even when my views were dissimilar.*
8. In my group, I was comfortable expressing opinions that diverged from the group opinions.*
9. I felt that I could share my perspective on issues that was different from the other members of the group.*
10. I felt that if my group perspective was too narrow, I was able to bring up a new point of view.*
11. I felt that I was a leader in the group discussion.*
12. How did you feel about the leadership dynamic in your group?
    - I felt that one person dominated or led the group.

- I felt that there was a group of people that dominated or led the group.
- I felt that we all participated equally.

*Statement was presented in a 1-7 Likert-type format: 1 = strongly disagree, 2 = disagree, 3 = somewhat disagree, 4 = neither disagree nor agree, 5 = somewhat agree, 6 = agree, 7 = strongly agree.