Self-representation does (not) spark joy: Experiment on effects of avatar customisation and personality on emotions in VR

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Abstract

There is an increasing relevance of our virtual representations and identities in the contexts of immersive virtual reality (VR) whether it be for leisure, work, or studies. Importantly, various communities are progressively turning to collaborating in virtuality, which has been made approachable and more intuitive through full body tracking and co-presence in virtual environments. Moreover, avatars used to present oneself have been shown to have profound meaning and effects on social experiences, on-screen and in VR alike. However, there is still a paucity of research on embodied, immersive VR collaborative experiences, and the influence of avatar customisation on user experiences in such contexts.

This exploratory study employed a repeated-measures between-subjects laboratory experiment design (N = 55) to probe the relationships between avatar customisation, individual differences, and emotional outcomes. Primarily through thorough investigation of data using descriptive and visual statistical techniques, the results suggest that allowing for free avatar customisation results in an overall more emotionally positive experience than when a default avatar was provided. Additionally, this effect is significantly driven by those higher in Extraversion and Neuroticism. Finally, these findings shed light on the potential implications of individual differences and avatar customisation in design and further research of collaborative VR.

Keywords

Player experience, user modelling, embodiment, avatar, big five, virtual reality, metaverse

1. Introduction

Representation of self plays a significant role in daily life, physical and digital alike. From the choice of clothes and ornaments to other values and subculture signaling [1], representations shape both intrapersonal, how individuals see themselves, and interpersonal relationships, or how others see them and what behavioral dynamics consequently emerge. In classic and often controversial psychology research, role-taking and uniforms could heavily alter psychological patterns which might not resemble common ones of the individual [21], and this line of research has also even been seen in virtual reality (VR) research [28]. However, representation is often used in playful and exploratory ways, including through make-believe and pretend play, but are constrained by physical and imaginative limitations. Digital representations and especially those in games and game-like contexts have been well-suited for virtually boundless explorations of visual representations through avatars and narrativised identities through gameplay. [32]

Indeed, the potential for impact on cognition and behavior of physical self-representations is transferred to the digital or virtual contexts. This phenomenon of individuals' conformity to their avatars has been referred to as the Proteus effect [37]. These effects are visible through a variety of representational aspects, from height affecting dominance to attractiveness affecting intimate behaviours and interpersonal distance in VR.

Similarly, users exhibit preferences when it comes to choosing of the avatars, but

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predominantly have their digital self-presentations reflect their perceived actual self or enhanced self [20]. Related to this, it has also been noted that individual differences such as the relationships between the perceived real, ideal, and ought self (how one thinks others would wish them to be) affect the preferred type of avatar [16]. As such, creating an avatar makes it possible to compensate or correct for perceived real-world shortcomings [22].

In head mounted VR, these phenomena can be coupled with the illusion of body ownership [18], which due to the immersive environment and embodiment builds into a temporary restructuring of one's self. Some of the most prominent and well-known effects are in perception and cognition [2], for example size-estimation based on embodied age, racial bias [23], cognitive task performance [3], and behavioral performance [14]. Intriguing curiosity results are found in changes of cognition and bias and well-being when virtually embodying Einstein and Freud, respectively [3, 29]. These are demonstrative of appropriating the assumed characteristics of the embodied personality.

However, in the domain of VR, current literature on avatar customisation, preferences, and effects beyond proof-of-concept studies is mostly focused on rehabilitation and exergames [e.g., 10] if employing experiment design, or to an extent on social VR commercial applications, if employing qualitative inquiry methods [12]. Unsurprisingly, it appears that the choice of digital self-presentation can also be dependent on the use context, with users often customising an avatar to be a more appropriate fit to the platform and the social experiences that it focuses on [12].

Beside the various and interesting research efforts in the field of user and player experience, a systematic ground-up investigation of the relationships between avatar customisation, psychological outcomes, and the role individual differences play in these dynamics is still missing. Most common approach is by using player typologies in games and gamified contexts such as the classic Bartle's taxonomy [4] and Hexad [30]. Their prominence is likely due to their practical implications for segmenting the user base and recognising differentiating needs. However, typology approaches are reductionist and lack the power to explain nuances in gameful experiences [13]. Investigations of avatars and personality, however, primarily consider individual differences in terms of customisation preferences [e.g. 17]. Moreover, due to the unique affordances of VR in relation to the body ownership illusion, it represents an additional layer of challenge and the unknown. Stratifying and understanding different user groups would thus be relevant and valuable for serious applications such as mental health and simulation training as well as leisure interaction in VR.

To start filling this gap, the present exploratory study delves into the relationships between self-representation, individual differences, and affect (Figure 1) through three research questions in the context of a collaborative VR spatial puzzle task:

RQ1: Does freedom of avatar customisation, or lack thereof, affect emotional outcomes?

RQ2: Do personality traits affect emotional outcomes?

RQ3: Do personality traits play a role in the relationship between avatar customisation and emotional outcomes?

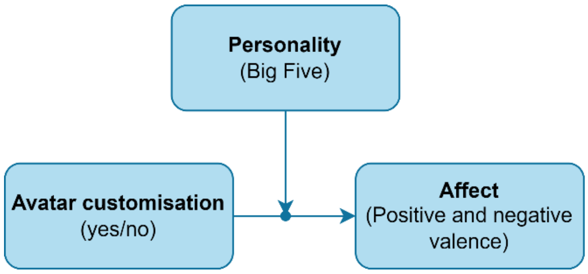

Figure 1: Study research model with the three variable categories.

2. Method

For this study, a between-subject repeated-measures laboratory experiment was conducted in 2022. Two condition groups were designed, with one using a pre-defined "plain" avatar ("No-choice") and the other using the avatar they created ("Choice" condition). Repeated-measures design was implemented to assess the change in emotional states before and after a VR task.

According to the Finnish National Board on Research Integrity, no ethics board approval was required for this study due to no known risks. Privacy notice and voluntary participation information were reviewed and approved by the University where the research was conducted. This study is a part of a larger experiment and therefore the questionnaires contained other measures which are not mentioned here; the full list is available upon request.

Due to this study's exploratory and data-driven rather than hypothesis-driven nature, data was analyzed and represented predominantly through descriptive statistics, with post-hoc statistical inference testing when appropriate for added clarity. However, these null hypothesis tests should be considered with caution and solely as indications for further confirmatory studies due to the lack of a priori hypotheses and therefore increased Error I rates, or false positives [33]. All computations and transformations, and graphs and analyses were done using Jamovi v2.3.18.0.

3.1. Participants

Using convenience sampling approach, participants were recruited through various University newsletter lists and promotional materials around the campus. The invitation contained basic information on the study, such as that it entails collaborative puzzle solving in virtual reality, as well as the requirements, such as that only those of age and with a self-assessed level of English language knowledge on at least upper-intermediate level could participate. All participants who completed the study received a movie voucher as compensation.

In total, 66 participants initially completed the experiment. However, due to failed attention checks placed in the post-questionnaire to ensure participants are carefully reading the questions and technical issues resulting in damaged validity or complete lack of responses, 11 cases were missing or removed. Thus, N = 55 dataset was used in this study with no missing data points.

Table 1
Sample characteristics.

Condition	**N**	**Age** M (SD) Mdn	**Gender** F, M NA
Choice	27	27 (5.5) 26.5	14, 12 2
No-Choice	28	28.6 (6.2) 27	13, 13 1
Total	55	27.8 (5.9) 27	27, 25 3

Note: N – Participant count, M - Mean, SD - Standard Deviation, Mdn – Median, F – Female, M – Male, NA – Not Answered.

Participants were randomly assigned in pairs to one of the two groups (Choice or No-Choice), while minding the distribution of self-reported gender across conditions. The sample consists of ages ranging from 19-45 years old, whereas n = 15 (25.4%) obtained no higher education degree, n = 23 (39%) had a Bachelor's, n = 16 (27.1%) a Master's, and n = 5 (8.5%) had obtained a Doctoral degree. Age and gender distributions across the conditions are reported in Table 1.

The sample's self-reported familiarity with video games (M = 3.4, SD = 1.2, Mdn = 3) was higher than that with VR (M = 2.8, SD = 1.2, Mdn = 2) on a single 5-point Likert-type scale. Free form and optionally reported national or ethnic identity showed that n = 14 (41%) identified as other than white or European.

3.2. Measures

Two psychometric instruments were used to assess personality traits and emotional states, with the latter being presented to participants on-site and both before and after performing the collaborative VR puzzle task. Item-order was randomized within each of the instruments to avoid order-biasing [15]. In this study, internal consistency reliability of the emotional valence states scales was assessed using McDonald's ω as it provides a more robust estimate than the commonly used Cronbach's α, whereas neither is suitable for evaluating 2-item dimension scales such as the personality scale used in this study [5].

Big Five personality traits measure (BFI-10; [26]), a widely used and cross-culturally validated abridged version of the Big Five instrument, was adopted in its original form with the following question stem: "I see myself as someone who..." and a 5-point Likert scale. The 10-item instrument captures the five personality dimensions with two items per dimension and each dimension containing one reversed item that was consequently recoded.

Openness ("...has an active imagination."),
Conscientiousness ("...does a thorough job."),
Extraversion ("... is outgoing, sociable."),
Agreeableness ("... is generally trusting."),
Neuroticism ("... gets nervous easily.").

Positive and negative affective states instrument (**PANAS**; [33]) was used in its original form as a bipolar instrument capturing emotional valence. It consists of a total of 20 items on a 5-point Likert scale introduced by the following: "This scale consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer on the scale. Indicate to what extent you feel this way right now, that is, at the present moment.”. The scale thus specifically measures the magnitude of positive and negative valence of affect as reflected through specific emotions. Items themselves were equally divided into the two valence dimensions and each consists solely of a word describing an emotion:

Positive affect (pre ω = .92; post ω = .91; “Determined”),

Negative affect (pre ω = .74; post ω = .78; “Ashamed”).

3.3. Procedure

The complete experiment procedure consisted of several steps which were identical in both conditions: pre-questionnaire (demographics, Big Five), pre-PANAS, avatar customisation, collaborative VR task, and post-PANAS.

Participants who expressed their interest in the study were presented with information about the research and voluntary participation, followed by questionnaires concerning their demographic data and personality traits. They booked their preferred time slot for the experiment, with a note not to choose a slot together with a friend as the study assumes collaborators have not met in-person before meeting in the VR task.

Upon arrival to the study site at the University campus, pairs of participants were assigned to nearly identical experiment rooms before ever meeting each other in-person. First, they filled out the baseline or pre-PANAS questionnaire and were given additional information about the collaborative task and avatar customisation. The instructions for customisation suggested thinking about the virtual context, type of task, and that it will be done together with another person.

Regardless of whether they were assigned to No-Choice or Choice condition, all participants went through the step of creating their avatar so that the confound of imagining and building a VR character for the puzzle was diminished. For avatar customisation the *readyplayerme.com* service was used as it enables customisation of virtually all parts of a 3D avatar through a wide presets range of shapes and colors of aspects, from facial features to clothing. Moreover, it facilitated a simple procedure for quick and simple importing of avatars to the experiment application. Although constrained by the system’s range of choices, participants were fully free to explore and customise their avatar as they wished. The largest constraints were that only human-like avatars were possible and there was a lack of body shape and size options. Participants were instructed to use 7 minutes within the avatar customisation system and that they would be notified when there are 2 minutes left for this task.

Next, to enable full body tracking within VR, all participants were equipped with Vive trackers on their waist and both feet. After entering the VR environment and calibrating the avatar to their physical body measurements, participants individually explored their virtual representation using a mirror. To ensure that they could see their avatar whenever they wanted to, mirrors were also placed on one of the walls of each virtual environment they went through. They also privately tested moving around the virtual room, both by walking and using locomotion, and interacting with objects - namely pushing buttons and grabbing and manipulating 3D objects. When ready, they proceeded to the common VR room where they met the other participant and continued to the collaborative puzzle task, when so agreed between them.

The task was a collaborative puzzle assignment *CoBlock* [35] integrated as a custom world in *VRChat* (VRChat Inc.) for ease of use in a multi-user experiment VR setting. The puzzle consisted of communicating 2D or “flat” information presented in participants’ individual views and collaboratively devising a composite 3D object corresponding to given perspectives. For example, if one saw a circle and the other a triangle, the target object would be a cone. However, without the second piece of information, the final shape could also have been a pyramid, resulting in a wrong solution. The puzzles consisted of at least two such objects and they could be either white or red. All primitive shapes in two colors were visible and available near the participants (ball, pyramid, cylinder, cube, and cone). The system provided no feedback on whether the solution is correct or not but the decision to proceed to the next puzzle was agreed upon by the participants. There were a total of ten different puzzles and participants were given 15 minutes to solve as many as they could in that timeframe. The time was set with the premise that it would be significantly difficult to solve all the puzzles, so to ensure an equal duration of time was spent in the experiment.

Finally, after the 15 minutes for the task had passed, participants' attention was brought back to the physical environment, VR equipment was removed, and they were again presented with the PANAS questionnaire.

4. Results

The findings of this study are guided by the research question and use an exploratory approach with no specified hypotheses. They primarily rely on a deep understanding of the structure of the dataset, uncovered through extensive descriptive statistics and graphical representations of relationships between variables. As such, results are suggestive of the existence, or lack of, significant relationships but should not be interpreted as confirmatory on an alpha level of 5%. Due to several variables' distribution being non-normal as well as a modest sample size for more complex analyses, median values, variances, non-parametric tests, and graphs are primary results with the highest explanatory power and robustness.

4.1. Customisation and affect

As a starting point, the effects of the two conditions were explored by comparing the pre- and post-test positive (*PA*) and negative (*NA*) valence, considering the difference in the changes between groups (*PAdiff* and *NAdiff*, computed as post- minus pre-test scores). Difference scores were used to circumvent possible differences in the baseline scores between the groups.

The only significant difference was found for positive emotional valence, namely that those who used the avatar they created reported higher positive emotional state after the experience when compared to just before starting the experiment. However, it should be noted that the variance in responses in both groups is large despite the found difference, suggesting that the effects of the conditions markedly differed within the groups themselves (Figure 2; Table 2). This effect of the manipulation on positive emotions is not evident with those participants who used a default avatar. On the other hand, neither group experienced a detectable change in emotions of negative valence.

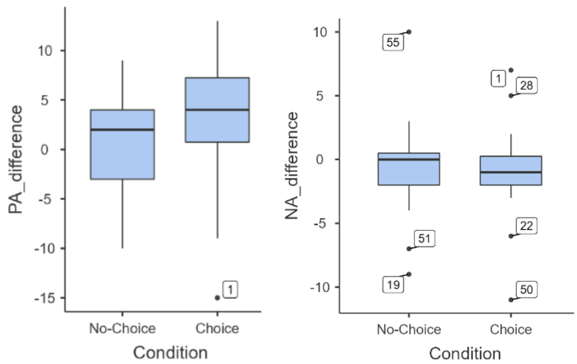

Figure 2: Boxplots of positive valence difference between post- and pre-test per condition.

4.2. Personality and affect

Individual differences were analysed using the Big Five personality traits for possible relationships with changes in affect. A correlation table of the positive and negative affect changes

Table 2
Descriptive statistics and non-parametric repeated measures tests of the affective states in the two conditions.

	Positive affect				Negative affect			
Condition	**prePA**	**postPA**	**PAdiff**	**Wilcoxon rank**	**preNA**	**postNA**	**NAdiff**	**Wilcoxon W**
		M (SD) Mdn		W *p*-value r_{rb}		M (SD) Mdn		W *p*-value r_{rb}
Choice	29.9	33.2	3.3	72	14.0	13.1	-0.8	190
	(6.8)	(7.32)	(6.3)	**.009**	(4.1)	(4.2)	(3.2)	.113
	30	33.5	4	-.590	13	12	-1.0	.377
No-Choice	32.7	33.1	0.4	132.5	13.7	13.0	-0.7	125
	(8.6)	(8.74)	(5.0)	.626	(3.1)	(2.8)	(3.5)	.232
	31	31	2	-.117	13	12	0.0	.316

and the five personality dimensions (Openness/OPEN, Conscientiousness/CONS, Extraversion/EXTR, Agreeableness/AGRE, and Neuroticism/NEUR) was computed using Kendall's tau as the data satisfies the test's assumptions (Table 3). These changes in valence values represent the entirety of the sample, containing values from both Choice and No-Choice conditions and represent an overview of the relationships of traits and valence changes after a collaborative VR task.

Table 3
Correlations between the Big Five personality traits and positive and negative valence changes

Big Five	Positive Affect change	Negative Affect change
	Tau B *p*-value	
OPEN	.145 .154	-.118 .258
CONS	-.011 .911	-.124 .233
EXTR	.183 **.069**	.062 .545
AGRE	-.034 .742	-.071 .501
NEUR	-.032 .751	-.068 .512

The obtained correlation values do not indicate robust connections between most of the individual traits and emotional outcomes. The sole, somewhat weak, positive relationship could possibly be found between Extraversion and positive affect change, suggesting that those higher in extraversion also possibly finalised the experiment with more prominent positive emotions than before the experiment.

4.3. Personality, affect, and customisation

Personality, and Extraversion in particular, could moderate the effects of Choice and No-Choice conditions on affective changes, shedding light on which segments of users and players avatar customisation is relevant for in terms of emotional outcomes, and for which it is less so.

For this purpose, interaction effects between avatar customisation option, or the two conditions, and personality was explored using Jamovi *flexplot* package (Figure 3). However, due to the modest sample size and consequent power for detecting interactions, differing ranges and variances across the traits, as well as the aim being finding preliminary evidence if such relationships exist, trait variables were transformed into binary ones (0 = low and 1 = high prominence of the trait), with median values serving as cut-off points. The presented comparisons thus have more statistical power to broadly detect potentially differing effects between higher and lower values, rather than what would be achievable with this dataset by using more demanding regressions. Moreover, negative affect change was omitted from these analyses as the very low variance of the negative affect change variable (Figure 2) would make the possible effects of personality on that change quite nuanced. Such minor effects have a high likelihood of producing false negative results in the context of the available dataset. In contrast, personality traits might be suited to explain some of the large variances of the positive affect change.

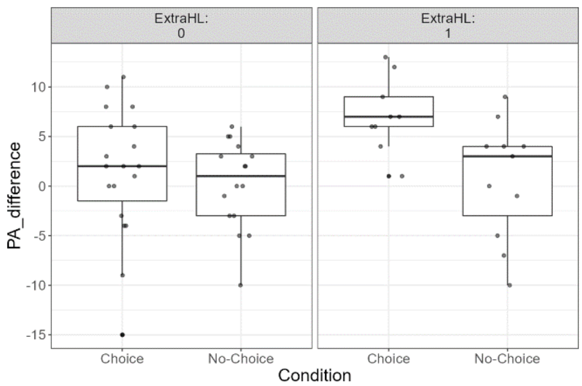

Figure 3: Positive affect change per low (0) and high (1) trait Extraversion per condition. The "ghost line" shows the relationship from the left panel on the right panel for ease of interpretation.

Examination of the descriptive statistics stratified per low vs high trait and Choice vs No-Choice conditions with positive affect change as the outcome variable revealed notable interactions of the two conditions on one side and Extraversion (Figure 3) and Neuroticism (Figure 4) on the other. Although other traits (e.g., Openness) might show some interaction with the conditions, the effects are not as distinguished nor discussed here further for the risk of overanalysing the data.

Those participants who are on the lower, or weaker, side in the trait Extraversion do not seem to differ significantly in their change of positive emotions regardless of the whether they used the customised avatar or not. However, those who are more highly extraverted seem to prominently benefit from using the chosen avatar.

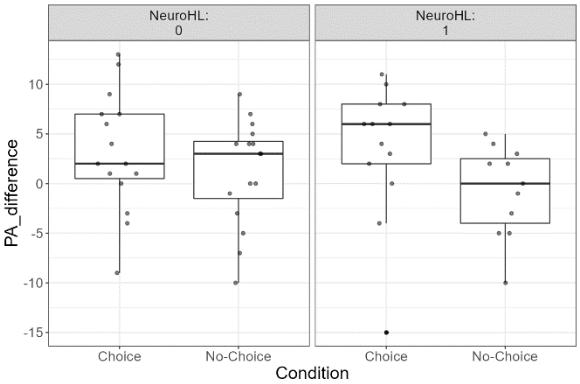

Figure 4: Positive affect change per low (0) and high (1) trait Neuroticism per condition

Similarly, albeit with seemingly lower effect size, those higher in trait Neuroticism had distinguishably heightened change in positive emotions when using their chosen avatar than when using one given by the researchers. And again, such differences are not visible for those on the lower end in the trait.

5. Discussion

With the rising prominence of immersive virtual reality (VR) serious applications and games alike coupled with the increasing accessibility of equipment and intricacies of VR environments, there is an increasing need for understanding the unique user experiences in immersive media. Beside the value of this line of research for e.g., simulation training, it is also relevant for beneficial and fruitful interaction in VR, whether for work or leisure. Although VR experiences still tend to predominantly replicate the on-screen ones in an immersive environment, the new technologies afford phenomena that deepen those experiences, such as avatar embodiment through body tracking. With the illusion of body ownership [18], the effects of avatars [25, 27, 36] and consequently avatar customisation [10], as well as individuals' particularities that parse those effects are becoming increasingly important in the sphere of immersive VR. In particular, collaboration in VR is gaining a prominent place due to the increase of working, studying, playing, and socialising virtually over the past few years.

This paper presents one of the first studies to investigate the effects of avatar customisation freedom in virtual reality. Moreover, it employed a multiuser collaborative puzzle solving task, adding the critical mark of the combined social and gameful contexts in immersive environments [7]. Whereas the complexity of the design involves a variety of confounding aspects, such as communicating in a non-mother tongue, previous experience in VR interactions using natural physical movements, and the success of collaborative efforts, the repeated-measures between-subjects design allows for a clear differentiation of the effects of avatar customisation freedom and lack thereof.

With one part of the participants using an avatar they created and the other a default, premade avatar, there are apparent differences in their experiences as seen through the reported emotional states before and after the task. An arguably positive effect is that the positive emotions become more prominent when using the chosen avatar, despite other possibly interfering aspects of the experience, which might be explained by the heightened agency and therefore autonomy in the virtual environment [10, 11, 31]. However, this rationale is weak due to the context of the task, and consequently most of the time spent in VR, not being focused on self-representation and role-play [6]. Moreover, using customised avatar is not relevant for all users, while the intrinsic motivational drive for autonomy is considered relatively universal.

Avatar customisation in this case might be particularly relevant and beneficial for the experiences of those higher in Extraversion and Neuroticism. Most importantly, the two trait groups might have significantly nudged the results on the overall change in positive affect [19], whereas that significant change might not hold true for other subgroups of the sample.

5.1. Implications

Firstly, it seems likely that providing avatar customisation in expansive collaborative virtual reality environments has some, but severely limited influence on users emotional experiences. Developing the option should thus be carefully considered in terms of needed resources and expected outcomes. Whereas some systems, such as VRChat, provide ample opportunities to customise one's self-representation quickly and easily, the integration is not as simple and cost-effective in own applications. Moreover, the purpose of the system and target audience might significantly influence such design choices as the feature appears to be more relevant for some users than for others. On the other hand, using a default avatar does not seem to elicit higher negative emotions either and thus the scenario of only being able to use a default avatar similar to that of the collaborator does not seem to be significantly damaging. Consequently, for most general contexts and purposes, avatar customisation option would not appear to be a priority when it comes to emotional outcomes.

That said, these results might not be applicable to contexts where self-expression, social influence or character identification is more important. Previous studies indicated that virtual costumes in VR environments might lead to interactions and distinct types of gameful interactions through clothing and accessories [8]. For example, certain clothing for avatars might grant different social (e.g., influence over other players) or physical skills (e.g., a clothing item that grants hints for the solution in CoBlock). Therefore, customisation of the avatar that goes beyond the visual representation might lead to different outcomes, for example, negative responses for the participants who cannot obtain the advancements provided by different virtual looks or accessories. On the other hand, tools such as the design framework for playful wearables [9] could also effectively relate to virtual costumes, whereas more customisation might shift the experience towards more imaginary. Thus, in contexts where character identification is important, customisation may create positive experiences in people who are open to imagine themselves as their virtual representation.

5.2. Limitations and future studies

Whereas some contexts and tasks are more focused on the representation and interactions between self and other or environments, some such as *CoBlock* direct users' attention to objects and require a high cognitive load for resolving the task. Hence the effects of customisation, or lack thereof, are highly likely to be largely determined by the focus being so prominently outside of the self and other's representations. Although mirrors were placed in each VR section and participants had the opportunity to familiarise themselves with their avatar in front of one, the mental rotation task did not in any way guide them to allocate attention to themselves during the puzzle solving. Other social VR contexts might guide users' attention to their avatars and pronounce, or alter, the effects of customisation.

Another factor affecting the results can be the time spent in the VR environment with the avatar. This experiment gave participants a chance to experience their avatars only in a duration of 15 minutes. Despite the measures such as the mirrored environment, this period may not be enough for participants to identify themselves with their avatars, and experiments which expose participants to the environment longer or several times might lead to different results.

However, the body tracking and body ownership illusion in VR are likely unfamiliar or at least unexplored experiences to most individuals. As similar computer-mediated senses cannot be understood unless experienced, participants might not have created the most suitable or effective avatars. With some further familiarity and repeated exposure to embodiment of different avatars, users might be more skillful at influencing their VR experiences through customising their self-representation.

On the other hand, the experiment set-up itself and the unavoidable awareness of participants that they are taking part in a study necessarily have repercussions on their attitude toward the experience, task, and finally avatar customisation itself. As they might be less inclined to be playful and performative as well as to explore their identities, the results might differ in their private or public but gameful engaging with VR when more nuance regarding the relationship between personality and customisation might emerge. Hence, particular care should be given in comparing and contrasting different sources and types of data in order to understand the ecosystem of context, framing, personality, and affective outcomes.

Similarly, as mentioned earlier, the trend of customisation driving higher positive affect change might have been steered by those higher in Extraversion and Neuroticism where in fact they would be the only ones showing a clear connection in this relationship. It could be hypothesised that those higher in Extraversion were more likely to focus on the social aspect and their performative representation within it. If the experience had not been social, Extraversion might not have had such a prominent influence on the outcomes. However, the mechanism of Neuroticism in particular affecting emotions differently in the two groups is less clear. One explanation could be that the choice of representation helped empower the user and curb the lower propensity for positive emotions. The used Big Five personality conceptualization and measurement further should be problematised as culture dependent, whereas such short measures fail to catch nuanced differences. As such, the results should be taken broadly and investigated further in this context.

Moreover, without further data on users' motivations and drives behind customisation choices, it is impossible to determine what lies behind the suggested effects. On one side, it could be that the driving factor is avatar customisation itself as a feature and opportunity for autonomous agency, but on the other, it might be the type of avatar those with certain characteristics create.

Finally, limitations of this study pertaining to the design mostly refer to the common ailments, namely the particularity of the sample drawn from a university, sample size, and the constraints of psychometrics self-report instruments in their explanatory power. Confirmatory replications are needed as this study is data-driven and further qualitative inquiry through interviews and behavioural data would significantly aid in understanding the experiences of avatar customisation in collaborative VR.

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