

The Proteus effect in *Fallout: New Vegas*: Investigating gender-conforming behaviours in videogames

Kim Szolin^{*}, Daria J. Kuss, Filip M. Nuyens, Mark D. Griffiths

Nottingham Trent University, 50 Shakespeare Street, Nottingham NG1 4FQ, UK

ARTICLE INFO

Keywords:

Proteus effect
Avatar
Videogame
Gamer
Virtual world

ABSTRACT

Avatars are often a key component of many videogames, and users can frequently develop relationships with these virtual characters that can impact their gameplay behaviour. The purpose of the present study was to explore the Proteus effect (PE) and the impact that avatar gender can have on an individual's gameplay experience in *Fallout: New Vegas*, a videogame environment that has not been present in any previous PE research. A total of 353 participants were recruited using an online survey measuring three previously unexplored gameplay behaviours, comprising (i) number of quests completed, (ii) number of locations discovered, and (iii) number of non-player characters (NPCs) or enemies killed. The results of the present study indicated that players controlling an avatar of the same gender to their physical selves demonstrated a significantly greater performance across the variables of quest completion and location discovery than players controlling an avatar of a different gender. Furthermore, a newly identified potential PE consequence was found in terms of the number of NPCs or enemies killed, with players controlling a female avatar achieving a significantly higher score on this measure irrespective of the physical world gender of the user.

1. Introduction

Videogames are a widely accessed and popular entertainment medium, with thousands of new titles being released each year. For example, on the digital distribution platform *Steam*, over 10,000 videogames were released in 2021 alone [37]. These games can now be played on traditional videogame consoles and specialist PCs, as well as smartphones and tablets, with even the most graphical intensive games available to a wide audience through cloud-based gaming services [17,20]. Part of this rising popularity of videogames and a key element in their global growth is the wide array of options and accessibility for playing videogames, with games played on smartphones and tablets now accounting for a significant proportion of the gaming market [14,18].

A feature that is common and often intrinsic to many games, but certainly not all, is the avatar. An avatar in the context of videogames refers to a character or digital representation of the player that an individual uses to interact with and navigate a videogame world [19,21]. Different videogames provide different levels of player input and control over their avatar, with some games limited to simply controlling when a character performs an action to other games that allow the player to determine the physical appearance, attributes, and how that character

interacts with the digital world [42]. However, although a game player always exerts some degree of influence over their avatar, whether that be customising their eye colour or simply choosing when to jump over an obstacle, this relationship dynamic can also be viewed as being bi-directional. More specifically, although a user may influence their avatar, research suggests that the opposite may also be true and that avatars can influence the user in a phenomenon referred to as the Proteus effect (PE; [50]).

1.1. The Proteus effect

The PE in the context of digital avatars refers to the process where an individual may be influenced by the observed characteristics or attributes of their avatar and this can affect their behaviour and attitudes in a virtual environment [50]. More specifically, it is suggested that when an individual controls an avatar, they will make specific assumptions and inferences based on available identity cues, and that this will then lead to the user attempting to mimic and align their virtual world behaviour and attitudes to correspond with their avatar. For example, Yee and Bailenson [50] found evidence to suggest that individuals who control an avatar seen as physically attractive adopted behaviour patterns

^{*} Corresponding author.

E-mail address: kim.szolin@ntu.ac.uk (K. Szolin).

associated with greater extraversion, namely disclosing more personal information and approaching confederates more closely compared to individuals controlling less-physically attractive avatars. The researchers argued that the recorded difference in avatar behaviour based on levels of attractiveness was due to the expectation that extraversion is positively linked with beauty (i.e., the more attractive an individual is the more likely they are to display extraverted behaviour patterns – [50]). Furthermore, research evidence indicates that the PE not only occurs while in control of an avatar, but may also transfer to post-avatar use. For example, individuals who control taller avatars will negotiate more aggressively irrespective of their physical world height both while in control of an avatar during a virtual world task as well as afterwards during a physical world task [51].

The theoretical basis for the occurrence of the PE is rooted in self-perception theory [3,10], which suggests that individuals will infer information about themselves through self-observation and this will then guide or influence behaviour and attitudes. In the case of virtual environments, individuals may experience a sense of embodiment and connection with their avatar [2,50], which can lead to the avatar being viewed as an extension of the individual [43]. Through this process of identification and connection with an avatar, individuals may begin merging their physical world self with their virtual world avatar and aligning their behaviours and attitudes accordingly [40]. For example, research on the PE has indicated that individuals who control an avatar of a different gender to their physical world self will alter their behaviour both during and after gameplay to align with pre-existing schema or beliefs regarding that gender [32,52]. This gender-based PE research suggests that even something as intrinsic to an individual's physical world identity such as gender can be temporarily replaced by the adopted gender, and subsequent behaviours relating to this gender based on pre-existing schema, of a virtual world avatar [43].

In the specific context of videogames, there has been a growing number of research studies highlighting the various ways that the PE may manifest, including: food choice [34]; maths performance [32]; body satisfaction [41]; attitudes towards immigrants [27,26]; physical activity [29,28,35]; social participation [4]; and gender-conforming behaviours [52]. In addition, research has also indicated a number of factors that may affect the strength and likelihood of this phenomenon occurring, including: the option to customise an avatar [9], player immersion [38], emotional connection to an avatar [32], and avatar identification [31,39]. However, although research relating to the PE has highlighted a number of key ways this phenomenon can occur as well as factors that may facilitate this process, a number of crucial limitations remain in this field of study.

In particular, in a systematic literature review by Szolin et al. [43] which evaluated research regarding the PE in the context videogames, a number of important limitations were identified. Most notably, Szolin et al. [43] discussed how the majority of PE videogame research is conducted using a very narrow range of videogame titles and genres, with the majority of research being focused on *World of Warcraft* (i.e., a fantasy massively multiplayer online role-playing game) and *Wii Sports Resort* (i.e., a sports simulation game using motion controls). This limited selection of games and genres represents only a fraction of the vast array of titles available, and means that only a small collection of videogame worlds are represented in current PE research. Furthermore, and related to the previous point, Szolin et al. [43] noted that only one study was based on a single-player role-playing game, namely *The Elder Scrolls V: Skyrim* (an open-world role-playing game) [41]. This highlights an important limitation with the current accumulation of PE research through the highly constrained use of videogame worlds and specifically the near complete absence of single-player role-playing games, a genre which inherently contains elements that would likely facilitate the occurrence of the PE, such as avatar customisation [9,32].

A further limitation highlighted in the paper by Szolin et al. [43] relating to the current PE research base concerns the relatively small number of identified behaviours that occur due to the PE. More

specifically, and despite growing interest in this topic, research into precise ways the PE may manifest is scarce. For example, the literature review conducted by Szolin et al. [43] identified only two studies that explored avatar gender and the PE in the context of videogames (i.e., [32,52]). This small number of studies exploring gender and the PE means only a very narrow range of potential PE consequences have been identified, and highlights a clear need for innovative research to explore new ways this phenomenon may manifest.

In addition, it must be noted that the PE remains a fairly recently discussed phenomenon, with the term first coined in the context of avatar research in 2007 by Yee and Bailenson [50]. Moreover, of the growing studies in this field, a large proportion contain studies involving custom-designed virtual worlds rather than commercially available videogame worlds [43]. Although studies based on bespoke virtual worlds designed by researchers purely for the purpose of an experiment do not necessarily exclude themselves from being relevant to the real-world experiences of individuals and their avatars, such as during videogame use, there inevitably remain concerns over ecological validity when applied beyond the custom-made virtual settings in which these studies are conducted. This means that due to the majority of studies relating to the PE being based on bespoke virtual worlds and non-commercially available videogames, combined with the arguably limited research available as a consequence of this field of study still being in its infancy, evidence-based knowledge concerning the ways this phenomenon may manifest specifically during videogame use remains highly limited and highlights another key weakness of this topic area.

1.2. The present study

The aims of the present study were to address the aforementioned limitations present in the extant PE literature in the context of videogames, namely the lack of diversity in virtual worlds used in PE studies as well as expanding the identified ways that this phenomenon may manifest. More specifically, the present study was based on the single player action-roleplaying game *Fallout: New Vegas*, a title that has not been utilised in any previous PE research regarding commercially available videogames and belongs to a genre which, despite potentially lending itself well to the occurrence of the PE, has largely been under-represented in the current literature concerning this phenomenon [43].

In particular, *Fallout: New Vegas* is particularly well suited to research on the PE for a number of key reasons. More specifically, *Fallout: New Vegas* provides players with a large amount of freedom and choice in how to play the game, which means players involved may more easily be influenced by their avatar without being constrained by game-based restrictions that could inhibit occurrence of the PE. For example, many of the quests in *Fallout: New Vegas* are both optional and may be completed in a number of different ways (e.g., violent or pacifist routes). Furthermore, *Fallout: New Vegas* may be seen as archetypal for the genre of single-player action-roleplaying games, with many fundamental components and design choices common across this and similar genres, while still being relatively novel to this field of research.

In addition, the present study explored novel ways in which the PE may manifest during videogame use in the context of gender-conforming behaviours, which refers to changes to attitudes and behaviours that occur as a result of playing as either male or female avatars. There have previously been several PE studies that have investigated gender-conforming behaviours in videogames. For example, Yee et al. [52] found evidence to suggest that irrespective of their biological gender, individuals controlling male avatars were more likely to engage in hostile interactions with other players while individuals controlling female avatars were more likely to engage in healing behaviours, with each of these game behaviours having previously been linked to their respective genders. In addition, Ratan and Sah [32] obtained research evidence that linked improved maths performance to the use of male avatars compared to female avatars among female participants. However, it should be noted that these listed gender-conforming behaviours,

in particular maths ability, are stereotypes that do not necessarily represent real-world gender-based behaviours or abilities [11].

The present study expanded on the current documented gender-conforming behaviours by exploring three novel behaviours that have not been present in any previous PE research but which are common across many videogames of this and similar genres, and investigated whether these are more likely to occur due to the gender of the player's avatar. These three behaviours comprised: (i) number of quests completed, (ii) number of locations discovered, and (iii) number of non-player characters (NPCs) or enemies killed. These precise gameplay variables were chosen for several key reasons.

Firstly, the included variables of the present study encompass a variety of different and varied game behaviours, ranging from exploration to violence/pacifism to chasing objectives and missions. Secondly, these particular variables are not unique to this videogame title, and are in fact common across both this and similar genres of game. This means that the results obtained may have relevance and be appropriately applied to a wide range of videogame environments and contexts. Finally, and as previously discussed, these three variables explored in this study are entirely novel to the field of PE in the context of videogames, and will therefore provide new research data to expand this field of study.

2. Method

2.1. Participants

A total of 537 participants were initially recruited for the present study. However, after reviewing the data collected, 184 were removed due to providing incomplete or erroneous responses (i.e., reporting a number for a variable that would not have been possible to achieve during gameplay) leaving 353 for further analysis. Participants were primarily recruited from online videogame forums ($n = 330$) as well as students from the research team's University Research Participation Scheme using opportunity sampling methods ($n = 23$). In order to participate in the present study, all participants were required to have played the videogame *Fallout: New Vegas* and have access to a previous save file. In addition, as an ethical requirement of the present study, all participants were asked to confirm they were at least 18 years old before taking part in the study.

The final sample of participants comprised 276 identifying as male and 77 identifying as female, with a total of 107 reporting using a female avatar and 246 reporting using a male avatar (see Table 1). The number of hours participants reported playing *Fallout: New Vegas* ranged from 1 to 500 ($M = 60.92$, $SD = 56.08$). However, as participants were reporting pre-existing archival data from their game files, the period of time over which they amassed their hours playing the game was not recorded.

2.2. Materials

The present study was based on experiences playing the videogame *Fallout: New Vegas*. This game is a 2010 action-roleplaying game developed by *Obsidian* and published by *Bethesda Softworks*, and available on a number of game systems including: *PC*, *PlayStation 3* and later models through backwards compatibility, and *Xbox 360* and later models through backwards compatibility. *Fallout: New Vegas* is an open-world game set in a post-apocalyptic future centred primarily in the US

Mojave Desert. Since release, *Fallout: New Vegas* has won a number of awards including the 2011 Golden Joystick Award and was nominated for two BAFTA awards, and is still cited as one of the most popular roleplaying videogames [13].

Fallout: New Vegas was selected as the focus of the present study for a number of key reasons. Firstly, *Fallout: New Vegas* provides players with notable freedom of choice in how they complete quests or missions and how they interact or navigate through the game world. For example, the majority of quests or missions may be completed in a number of ways including either through violence or pacifism. In addition, while there is an intended route to completing this game in terms of order of activities and quests, a player may deviate from this and either skip or avoid missions to pursue other in-game activities, such as completing minor quests, collecting items and equipment, or even spending time gambling for in-game currency. This freedom of choice in how players approach the game means participants are not forced to approach the game in a particular way through the game's systems, and any behaviours occurring as a result of avatar gender and the PE may be appropriately observed. Furthermore, the previously discussed popularity of this videogame title means that a strong community of gamers continue to play this game, thereby increasing the recruitment rate of participants.

2.3. Measures

The dependent variables for the present study comprised three in-game behaviours: (i) number of quests completed; (ii) number of locations discovered; and (iii) number of non-player characters (NPCs) or enemies killed. The frequency of each of these in-game behaviours is automatically recorded by the game and accessible through the game's character information menu. In particular, these three measures were selected because they represent three novel behaviours that have not appeared in any previous PE research based on this type of videogame. Furthermore, these particular three behaviours are common for this genre of videogame, which means the results from the present study may be generalised and applied to other roleplaying videogames. Finally, each of these measures explores a distinct form of gameplay, including violence, quest completion and exploration. This included range of variables provided a novel opportunity to explore the link between gender-conforming behaviours and gameplay behaviours.

2.4. Procedure

After initial recruitment, participants were asked to complete an online survey based on their pre-existing save file for the videogame *Fallout: New Vegas*. This survey contained questions relating to the participants' gender identity, their avatar gender, the number of hours spent playing *Fallout: New Vegas*, and the total number of occurrences for each of the three gameplay behaviour variables (i.e., number of quests completed, number of locations discovered, and number of NPCs or enemies killed). The information relating to the frequency of each of these gameplay variables is automatically recorded by the game and accessible through the character menu, and instructions for accessing this information were provided at the start of the survey.

2.5. Design

The present study was a quasi-experiment using pre-existing data

Table 1
Group information.

Group	Number of players	Number of male avatars	Number of female avatars	Time spent playing game (mean)	Time spent playing game (standard deviation)	Time spent playing game (Range)	Time spent playing game (Median)
Male	276	215	61	64.20 h	58.58 h	1–500 h	53 h
Female	77	31	46	49.16 h	44.38 h	2–239 h	40 h
Total	353	246	107	60.92 h	56.08 h	1–500 h	52 h

collected through a survey. An initial analysis of the relationship between the variables was conducted using the Pearson correlation coefficient on the three variables consisting of: (i) number of quests completed; (ii) number of locations discovered; and (iii) number of NPCs or enemies killed. Following this, a multivariate analysis of covariance (MANCOVA) was performed to explore the relationship and interaction effects of gender (i.e., player gender vs. avatar gender) on the three aforementioned dependent variables while also controlling for the variable of time (i.e., hours spent playing the game). This statistical technique was selected in order to explore the interaction or influence between a player’s virtual world avatar gender and their physical world gender identity on specific gameplay behaviours, and thereby observe the potential for gender-conforming behaviours arising as a consequence of the PE. Data were analysed using SPSS 28 statistical software package.

2.6. Ethics

Approval for the study was provided by the research team’s university ethics committee. Each participant provided their consent to be involved in the study through the online survey before completing any of the questions, along with being provided other supplementary materials concerning the present study. Included with this information were the aims of the research, how the data would be used, contact information for the researchers, guidance on how to obtain support or help after the survey, and the participants’ rights (including their right to withdraw their data and the procedure for doing so).

3. Results

Firstly, in order to explore whether the dependent variables (i.e., quests completed, locations discovered, and enemies or NPCs killed) were significantly associated with one another, and thereby determine the most appropriate manner of analysing the data for the present study, bivariate Pearson’s correlation coefficients were run on these variables. The results indicated that these variables were significantly correlated with each other. More specifically, quest completion was significantly correlated with location discovery ($r = 0.845, p < 0.01$) and enemies or NPC killed ($r = 0.627, p < 0.01$) and location discovery was significantly correlated with enemies or NPCs killed ($r = 0.761, p < 0.01$).

In addition, Levene’s test of equality of error variances was examined, which showed that the dependent variables of number of quests completed and number of NPCs or enemies killed had equal variances at an alpha level of 0.05 ($p = 0.66$), and the variable of number of locations discovered at a modestly adjusted alpha level of 0.01 ($p = 0.01$) as recommended by Allen and Bennet [1]. Finally, Box’s test of equality covariance matrices was found to be significant ($p < 0.01$), which meant that while a MANCOVA could be conducted, Pillai’s Trace criterion was selected as the specific multivariate test for this analysis as it is considered to be robust enough to counter this violation to the assumptions of a MANCOVA [23,22].

Next, a MANCOVA was conducted using the independent variables of player gender (male and female) and avatar gender (male and female) and the three dependent variables of: (i) number of quests completed; (ii) number of locations discovered; and (iii) number of NPCs or enemies killed. In addition, the covariate for the MANCOVA was time (i.e., hours spent playing the game) in order to control for its potential extraneous effects.

The MANCOVA results of the multivariate tests (see Table 2) showed significant interactions between avatar gender and player gender (Pillai’s Trace = 0.02, $F(3, 347) = 2.88, p = 0.04$), as well as the factors of avatar gender (Pillai’s Trace = 0.03, $F(3, 347) = 3.70, p = 0.01$), and player gender (Pillai’s Trace = 0.05, $F(3, 347) = 5.57, p < 0.01$).

Following this, the univariate tests of between participants results were explored to provide more details on the effect of player and avatar gender on the three dependent variables (see Table 3). Firstly, the results

Table 2

MANCOVA results of multivariate tests for player/avatar gender when interacting with variables of quest completion, location discovery and number of enemies or NPCs killed.

Source	Effect	Value	F	DF	Error DF	p	η^2
Time	Pillai’s Trace	0.28	45.38	3	347	<0.01	0.28
Player	Pillai’s Trace	0.05	5.57	3	347	<0.01	0.05
Avatar	Pillai’s Trace	0.03	3.70	3	347	0.01	0.03
Player*avatar	Pillai’s Trace	0.02	2.88	3	347	0.04	0.02

Table 3

MANCOVA results of tests of between-subjects effects for player/avatar gender when interacting with variables of quest completion, location discovery and number of enemies or NPCs killed.

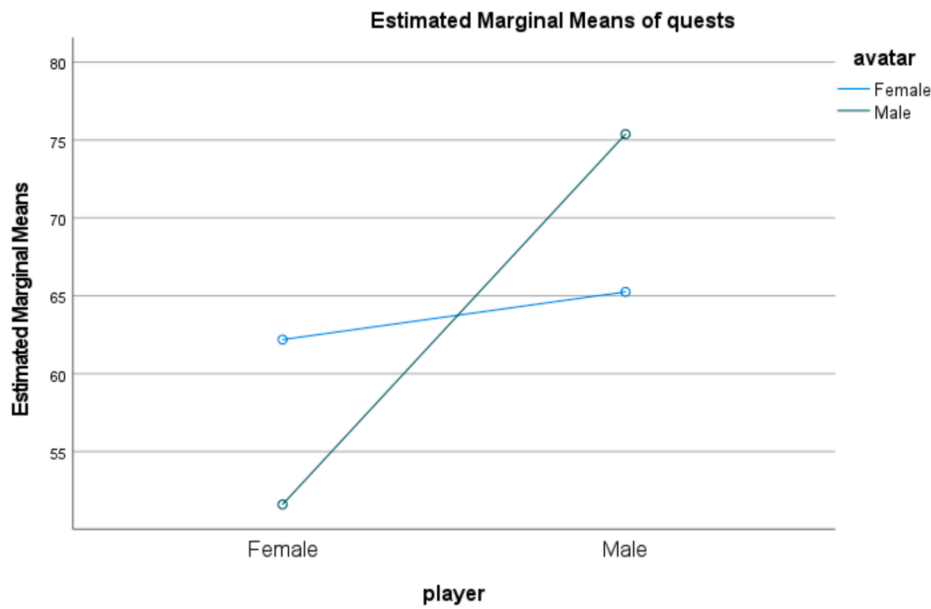
Source	Variable	F	DF	p	η^2
Time	Quests	84.81	1	<0.01	0.2
	Locations	79.83	1	<0.01	0.19
	Kills	115.97	1	<0.01	0.25
Player	Quests	6.79	1	0.01	0.02
	Locations	9.45	1	<0.01	0.03
	Kills	16.37	1	<0.01	0.05
Avatar	Quests	0.00	1	0.96	<0.01
	Locations	2.75	1	0.1	<0.01
	Kills	7.30	1	<0.01	0.02
Player*avatar	Quests	4.09	1	0.04	0.02
	Locations	8.23	1	<0.01	0.02
	Kills	2.63	1	0.11	<0.01

indicated that there was a significant interaction between player and avatar gender for quest completion ($p = 0.04$) (see Fig. 1), but with a relatively weak effect size ($\eta^2 = 0.02$). In addition, a further significant main effect of player gender was identified ($p = 0.01$), with male players ($M = 74.22$) being significantly more likely to complete more quests than female players ($M = 54.05$) but with a relatively weak effect size ($\eta^2 = 0.02$).

Secondly, there was a significant interaction between player and avatar gender for location discovery ($p < 0.01$) (see Fig. 2), but with a relatively weak effect size ($\eta^2 = 0.02$). In addition, a significant main effect of player gender was identified ($p < 0.01$), with male players ($M = 156.87$) being significantly more likely to discover more locations than female players ($M = 113.29$), but with a relatively weak effect size ($\eta^2 = 0.03$).

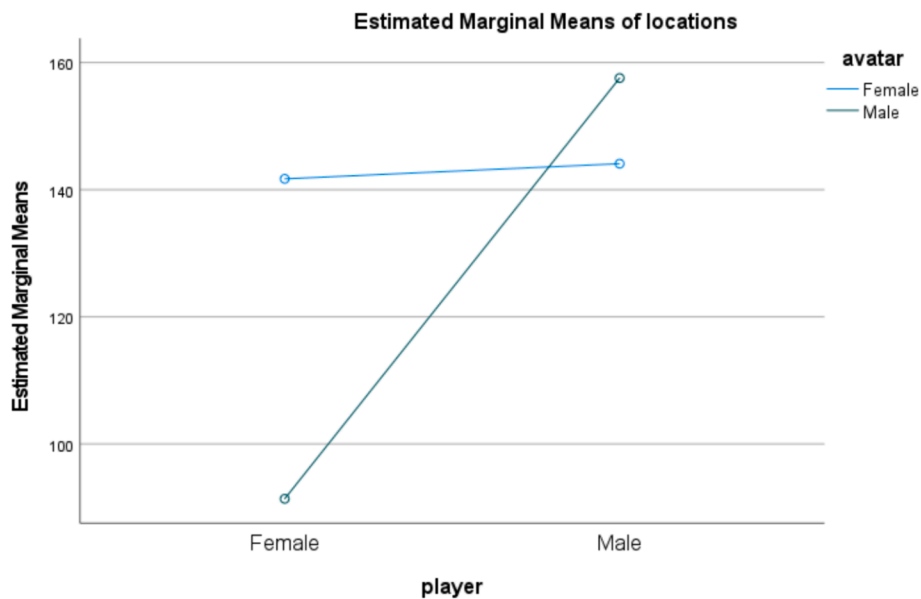
Thirdly, there was no significant interaction between player gender and avatar gender on number of NPCs or enemies killed ($F(1, 349) = 2.63, p = 0.11$). However, there were significant main effects for avatar gender ($p < 0.01$) and player gender ($p < 0.01$), with female avatars ($M = 900.34$) being significantly more likely to score higher for number of NPCs or enemies killed than male avatars ($M = 849.68$) irrespective of the player’s gender, and male players ($M = 941.4$) being more likely to score higher for number of NPCs or enemies killed than female players ($M = 591.3$) but with relatively weak effect sizes ($\eta^2 = 0.02$ and $\eta^2 = 0.05$).

Finally, there was a significant effect of the covariant of time on the three measures of quest completion ($F(1, 349) = 84.81, p < 0.001$), location discovery ($F(1, 349) = 79.83, p < 0.001$), and number of enemies or NPCs killed ($F(1, 349) = 115.97, p < 0.001$). In addition, the effects sizes for each of these variables were all large ($\eta^2 = 0.2, \eta^2 = 0.19, \eta^2 = 0.25$).



Covariates appearing in the model are evaluated at the following values: time = 60.92

Fig. 1. Interaction graph for player/avatar gender on quest completion.



Covariates appearing in the model are evaluated at the following values: time = 60.92

Fig. 2. Interaction graph for player/avatar gender on location discovery.

In order to further explore the identified significant interaction effects of player and avatar gender on the measures of quest completion and location discovery, follow-up one-way MANCOVA analyses using the Bonferroni correction were conducted which split male and female players to allow the strength and direction of these interactions to be observed (see Table 4). The initial multivariate test results were significant for both male players (Pillai's Trace = 0.03, $F(3, 271) = 3.16, p = 0.03, \eta^2 = 0.03$) and female players (Pillai's Trace = 1.38, $F(3, 72) = 3.8, p = 0.01, \eta^2 = 0.14$).

Next, in terms of quest completion, the results of the follow-up between participants tests indicated that there was no significant difference between male and female avatars for female players ($p = 0.44$), nor was there a significant difference between male and female avatars for male players although this approached statistical significance ($p =$

0.07), with pair-wise comparisons indicating that male players controlling a male avatar ($M = 76.45$) scored higher on quest completion than male players controlling a female avatar ($M = 66.31$). In terms of location discovery, the results of the follow-up between participants tests indicated no significant difference between male and female avatars for male players ($p = 0.26$), but there was a significant difference between male and female avatars for female players ($p = 0.01$), with pair-wise comparisons indicating females controlling a female avatar ($M = 129.13$) scored significantly higher for location discovery than females controlling a male avatar ($M = 89.78$).

4. Discussion

The aims of the present study were to (i) explore three forms of in-

Table 4

Follow-up MANCOVA results of between-participants effects for player/avatar gender on the variables of quest completion and location discovery after splitting player gender.

Player gender	Source	Variable	F	DF	p	η^2
Male	Avatar gender (male vs. female)	Quests	3.4	1	0.07	0.01
	Avatar gender (male vs. female)	Locations	1.25	1	0.44	<0.01
Female	Avatar gender (male vs. female)	Quests	0.6	1	0.26	<0.01
	Avatar gender (male vs. female)	Locations	6.98	1	0.01	0.09

game behaviours that have not been present in any previous research on the PE and (ii) investigate whether they were more likely to occur due the gender of the player's avatar using a sample of male and female participants who played the videogame *Fallout: New Vegas*. The three behaviours comprised (i) number of quests completed, (ii) number of locations discovered, and (iii) number of non-player characters (NPCs) or enemies killed. The analysis resulted in two main findings regarding gender differences in regard to male and female avatars and players. These were (i) an own-gender avatar/player increase to game performance in terms of quest completion and location discovery, and (ii) a potentially new PE consequence relating to the use of female avatars and the number of NPCs or enemies killed during gameplay.

Firstly, the present study identified a significant interaction between avatar gender and player gender across the measures of both quest completion and location discovery. More specifically, the results indicated that game performance was significantly higher for players who controlled an avatar of the same gender to the player across the measures of quest completion and location discovery (i.e., male players controlling a male avatar, and female players controlling a female avatar), suggesting the potential presence of an own-gender bias in game performance.

This own-gender bias was further confirmed in the post-hoc analysis, specifically for female players controlling a female avatar for the measure of location discovery, and male players controlling a male avatar which approached statistical significance for the measure of quest completion ($p = 0.07$). However, the post-hoc analysis did not indicate any further significant results concerning player/avatar gender and the measures of quest completion or location discovery, although it must be noted that these findings do not necessarily disprove the interaction results obtained from the initial MANCOVA, and these results should not be dismissed on that basis. Instead, the identified significant results of the post-hoc tests may be seen as providing additional support for specific individual findings, namely an own-gender bias for females across the measure of location discovery and, to some extent, an own-gender bias for male players across the measure of quest completion which approached significance ($p = 0.07$).

Taken together, these findings which suggest that game performance or efficacy in this case measured by quest completion and location discovery, may be improved or increased when a player controls an avatar that is seen as visually similar to the self-identified gender of the player, and which is supported by previous research regarding game performance and avatar similarity. For example, research has previously indicated that game performance may be positively influenced through controlling an avatar that is seen as visually similar to the player [15,30,47], although there have also been examples of conflicting studies that have not identified a link between these factors [25]. In the case of the present study, the results from the analysis appear to show that game performance may be improved through controlling an avatar that is seen as similar to the player, although it must be noted that this appearance variable is only measured in terms of the gender of the

avatar and that data concerning the precise customisation of each player's avatar (e.g., hairstyle, ethnicity, facial features) were not available in the present study.

The result from the present study suggesting that players who control an avatar of the same gender may experience improved game performance may potentially be explained through avatar identification and the effects this has on gameplay experiences. More specifically, research has previously indicated that player and avatar similarity is positively associated with avatar identification [46], which in turn is linked with factors such as game enjoyment and sense of presence in a game world [7,30,44]. In the present study, the argument may be made that players who controlled an avatar of the same gender experienced a greater degree of identification with their character, and this in turn may have led to a greater sense of in-game presence as well as enjoyment and therefore engagement with the game, which resulted in improved game performance in terms of quest completion and location discovery. However, it must be acknowledged that this conclusion regarding the association between avatar identification, similarity, and game enjoyment with the results obtained is not based on direct research evidence, and should be treated with a degree of caution.

However, while an own-gender performance bias is seemingly present for the variables of quest completion and location discovery based on the analysis in the present study, this effect was not present for the variable of number of NPCs or enemies killed. This lack of own-gender bias for the variable of NPCs or enemies killed suggests that the link between avatar identification, in this case the mirroring of player and avatar gender, and game performance may be linked to specific measures of gameplay performance and may help to partially explain the previously stated conflicting results in this area of study [15,25,30,48]. More specifically, the studies exploring the link between gameplay performance and avatar identification used a range of different videogame contexts and measures of gameplay performance, and the seemingly conflicting results concerning the presence of this phenomenon, may be due in part to the different measures of gameplay performance specific to each of these studies and that avatar identification may potentially only affect specific forms of gameplay behaviours or even only occur in specific videogame contexts. Nevertheless, the present study appears to support the idea that controlling an avatar that is seen as similar to the user in terms of gender identity may have a positive impact on specific aspects of game performance, such as location discovery and quest completion.

Secondly, the results of the present study also identified a potential PE consequence in terms of avatar gender and number of NPCs or enemies killed during gameplay. More specifically, the findings indicated that female avatars were significantly more likely to score higher on the measure of number of NPCs or enemies killed than male avatars, and this occurred irrespective of the gender of the player. In terms of the PE, the indication that female avatars demonstrated higher scores for number of NPCs or enemies killed may mean that players, both males and females, associated or imbued their female avatar with specific characteristics in line with behaviours that would result in a higher number of in-game kills.

These results concerning a potential PE in terms of gender and number of NPCs or enemies killed is both surprising and interesting given that historically stereotypical gender roles place males as being more aggressive than females [24,49], and this is also true in regard to videogame representations of gender [5]. In fact, the results of the present study identified that male players were significantly more likely to score higher on number of kills than female players. Similarly, in a related piece of research, Yee et al. [52] identified that male players were more likely to engage in PvP (player versus player combat) while playing *World of Warcraft* (a massively multiplayer online game released in 2004). However, the present study and the research conducted by Yee et al. [52] appear to conflict in terms of the PE, with Yee et al. [52] identifying that male avatars were more likely to engage in this behaviour irrespective of the gender of the player whereas the present

study indicated that female avatars were more likely to score higher on number of NPCs or enemies killed irrespective of the gender of the player.

There are a number of potential explanations for both the finding that female avatars scored higher for the number of NPCs or enemies killed and the seemingly conflicting results with the study by Yee et al. [52]. Firstly, while arguably similar, PvP combat and NPC combat differ in terms of opponent, with PvP based on combat between physical world users controlling an avatar, whereas NPC combat is based on characters controlled by the computer, and this may have affected the results of these studies. More specifically, the perceived virtual presence of a physical world user may have played a part in shaping the behaviours of the players in the study by Yee et al. [52], a factor which the authors acknowledged in their paper. As discussed, there is a historical social stereotype for males to be seen as more aggressive than females, and this societal expectation potentially generated by the virtual presence of physical world users may have influenced the results of Yee et al. [52] in the online videogame context employed in their study. By contrast, the videogame context used in the present study was an entirely offline experience, with no other physical world users present during the gameplay experience beyond the players themselves. This difference in videogame context and presence of other players may in part account for the conflicting results between the present study and the research conducted by Yee et al. [52].

Secondly, while there is certainly a stereotypical societal view of males as more aggressive than females, media representations of women are not consigned purely to passive and non-combative characterisations. For example, in videogames there is a range of employed portrayals of female characters, including strong and independent protagonists (i.e., Aloy from the *Horizon* series), femme fatale characters (i.e., Anna Williams from the *Tekken* series), as well as the frequently employed trope of the damsel in distress (i.e., Princess Peach from the *Mario* series). Although videogames often portray their female characters and protagonists in a problematic and overtly sexualised manner [8,16], these characters can sometimes be seen as both powerful and objectified [45], such as the popular but controversial Lara Croft from the *Tomb Raider* series.

In terms of the present study, the finding that players achieved a higher number of kills while controlling a female avatar irrespective of the gender of the user may be due to a held assumption or belief associating this behaviour with female digital characters, facilitated by the absence of physical world virtual users to reinforce societal expectations of gender and aggression as seen in the study by Yee et al. [52]. This potential PE concerning digital female characters as being more combative or aggressive than male characters may suggest a disparity between physical world and virtual world gendered expectations of behaviour, with female avatars being imbued with these characteristics more so than male avatars.

Finally, and in relation to the previously discussed point concerning female representation in videogames, a further point may be used to explain the present study's conflicting results with Yee et al.'s study [52] and the finding that female avatars were more likely to score higher on the measure of number of NPCs or enemies killed compared to male avatars, namely the date these studies were conducted and the subsequent proliferation of media female representation. In particular, research indicates that between the years of 2015 and 2020, the number of female protagonists in videogames doubled from 9 % to 18 % [37], and this rise in female representation was also true for other forms of media with a 21.6 % increase in the number of female lead actors in US films between 2011 and 2021, accounting for a total of 47.2 % in 2021 [37]. This increase in female media presence, particularly in videogames, may have caused a shift in how players perceive female avatars. More specifically, in the twelve years since Yee et al. [52] conducted their study, there has been a notable rise in female videogame representation, and this may have contributed to a change in how females are perceived, departing from the traditional and passive 'damsel in distress'

trope to more aggressive, assertive, and combative characters that seemingly outpace male characters in these attributes in the specific context of the present study.

4.1. Limitations and future research

The present study identified a number of different ways that the gender of both the player and their avatar can influence gameplay behaviour and performance in *Fallout: New Vegas*. However, it is important to acknowledge a number of key limitations in the present study which means the interpretation of the results discussed should be viewed with caution, including the limited and unbalanced sample sizes, uncontrolled and potentially confounding variables, the quasi-experimental design of the study, and restricted generalisability.

Firstly, a limitation in the present study relates to the unbalanced and relatively small participant sample sizes across specific groups. In particular, as seen in Table 1, there were substantially more male players ($n = 276$) than female players ($n = 77$), and this was also true for male avatars ($n = 246$) compared to female avatars ($n = 107$). Furthermore, examining the group sizes across the main factors showed a notable difference in size between male players controlling a male avatar ($n = 215$), male players controlling a female avatar ($n = 61$), female players controlling a female avatar ($n = 46$), and female players controlling a male avatar ($n = 31$). These relatively small group sizes combined with the considerable size difference between specific groups may have affected and distorted the analysis and subsequent interpretation of the data, and any conclusions drawn should be viewed with a large degree of caution until further evidence from future related studies are obtained.

In addition, it must also be noted that the effect sizes for the univariate tests were often modest (see Table 3). These small effect sizes mean that while a significant result may have been obtained for specific variables, the strength of these observed differences between groups may be considered to be fairly minimal. Therefore, the discussed results and the strength of the conclusions drawn should be viewed with some caution in respect to these relatively small effect sizes.

Secondly, a further limitation relates to the potential for uncontrolled and confounding variables to have impacted the results. The data for the present study did not distinguish participants in terms of various individual factors that may have affected their gameplay performance beyond their identified gender. For example, experience and familiarity with a videogame have been shown to have a significant impact on a player's gameplay performance [6,33]. Although this present study did include time spent playing as the selected avatar as a covariant, no data were collected regarding each participant's total familiarity or time spent with the videogame or videogames more generally which may have affected the results obtained in the study.

Thirdly, another limitation relates to the quasi-experimental design of the present study. More specifically, the present study used pre-existing save file data in order to observe and record an individual's gameplay behaviour, whereas a traditional experimental design would involve randomly placing participants in the various conditions relating to player/avatar gender. Therefore, there may be some difficulty in determining causality of player/avatar gender in respect to differences in gameplay behaviours due to the quasi-experimental design of this study. In particular, the selected design of the study introduces the issue of whether participants selected their character to reflect how they wanted to engage with the game or whether their character influenced their in-game behaviour.

In addition, and related to the previous point concerning participant data, the means by which participant responses were collected may have also impacted the quality and reliability of the data and analysis. In particular, participants were primarily recruited from online forums and the research team's university participation scheme using opportunity sampling methods. Although this method of participant recruited provided notable benefits in terms of ensuring sufficient data for the statistical analysis, it also meant that the data collected were far less

reliable compared to more traditional in-person experimental set-ups where participants can be observed and external variables be more tightly controlled.

Finally, another limitation relating to the present study concerns the potentially restricted generalisability of these results. In particular, while the results may appear to indicate specific gender-conforming behaviours relating to players and their avatars, these may be specific to the videogame context of the present study and may not occur to the same degree in other virtual environments. For example, while research relating to virtual world avatars may often seemingly treat videogames homogeneously [43], this assumption has increasingly been challenged [44] with some research evidence indicating that different virtual environments can lead to different user experiences relating to factors such as sense of presence, pleasure, and synchrony [12]. In light of this indication of the heterogeneity of virtual worlds, while the results of the present study may potentially suggest specific behaviours relating to gender, any application to other virtual environments should be done with caution.

However, although the inherent differences between game worlds does cause some issues when applying these results to other virtual environments, it should be noted that the present study specifically attempted to reduce these issues and improve generalisability through the particular choice of game behaviours that were measured. More specifically, the behaviour measures used in the present study comprised: number of quests completed; number of locations discovered; and number of NPCs or enemies killed. These variables were selected because they not only cover a wide range of different forms of gameplay behaviour, but are also common to many videogame genres and titles. This means that the results obtained in this study may potentially be applied, or at least compared, to other videogame environments. Furthermore, it should also be noted that the present study used pre-existing (i.e., actual as opposed to self-report) data from participants' save files from *Fallout: New Vegas*. This use of archival data meant that player's gameplay experiences occurred in a natural, non-laboratory environment and without any possibility of demand characteristics affecting the data, and thereby strengthening the ecological validity of the obtained results.

Finally, there are a number of interesting avenues of future research related to the results identified in the present study. Firstly, and related to the previous point regarding virtual world heterogeneity, future research of this topic may benefit from exploring the extent to which the identified PE consequence and gender-conforming behaviours discussed in the present study occur in other virtual world environments and videogame titles. More specifically, previous research has indicated that the precise nature of a virtual environment can affect a user's experience, including factors such as self-presence [12] and strength of the user-avatar relationship [44], elements which have been highlighted as key to the occurrence of phenomena such as the PE [43].

Furthermore, and related to the previously discussed point relating to the experimental design of the present study and issues concerning causality, future research may benefit from exploring these identified potential effects of avatar and player gender on gameplay behaviour in experimental settings. In particular, this present study highlighted a number of novel ways that avatar and player gender may affect gameplay behaviour, but the quasi-experimental design of the present study meant that causality could not be confidently established. Therefore, to address this highlighted limitation, future research should investigate these discussed effects of avatar/player gender on gameplay behaviour through controlled experimental settings in order to help establish causality.

In addition, it should also be acknowledged that the topic of the PE is still relatively new, and there is currently only a relatively small number of identified consequences of this phenomenon particularly within the specific context of commercially available videogames [43]. In light of this limited research base, future studies may benefit from exploring not only already known PE consequences in different virtual world

environments, but also from investigating new ways this phenomenon may manifest and affect users.

In particular, the use of avatars and videogames has become an increasingly popular part of modern culture, with an estimated 3.457 billion players worldwide by 2024 [36]. Furthermore, previous research has indicated that the occurrence of the PE can have a notable impact on a user both in-game and outside of the game, with effects ranging from changes to gameplay styles [52] to altered perceptions and attitudes of physical world socio-political issues, such as immigration [27,26]. However, despite these numbers and powerful influence of videogame avatars, there are still very few identified consequences of the PE in this context. Therefore, future research may benefit from not only exploring existing PE consequences in new virtual world contexts, but from beginning to identify new ways that this phenomenon may occur.

4.2. Conclusion

The aims of the present study were to investigate the PE and gender-conforming behaviours in the videogame *Fallout: New Vegas* using three behavioural measures (i.e., quest completion; location discovery, and number of NPCs or enemies killed). The findings in the present study indicated the potential presence of an own-gender bias to gameplay performance across two of the measures (i.e., quest completion and location discovery), suggesting that players who controlled an avatar of the same gender were more likely to gain a higher score on these measures than players controlling an avatar of a different gender to themselves. Furthermore, the present study also found a potential PE consequence relating to gender, with female avatars more likely to score higher on number of NPCs or enemies killed irrespective of the physical world gender of the user. In addition, and based on these results and previous literature, the present study highlights several avenues of future research, including both further exploration of these identified gender-conforming behaviours and PE consequence in other virtual world contexts and game titles as well as expanding the current research base of known PE consequences.

CRedit authorship contribution statement

Kim Szolin: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing. **Daria J. Kuss:** Supervision, Writing – review & editing. **Filip M. Nuyens:** Supervision, Writing – review & editing. **Mark D. Griffiths:** Supervision, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. MDG has received research funding from *Norsk Tipping* (the gambling operator owned by the Norwegian government). MDG has received funding for a number of research projects in the area of gambling education for young people, social responsibility in gambling and gambling treatment from *Gamble Aware* (formerly the *Responsibility in Gambling Trust*), a charitable body which funds its research program based on donations from the gambling industry. MDG undertakes consultancy for various gambling companies in the area of player protection and social responsibility in gambling.

Data availability

Data will be made available on reasonable request.

References

- [1] P. Allen, K. Bennet, SPSS for the Health and Behavioral Sciences, Thomson, Victoria, 2008.

- [2] E. Ash, Priming or Proteus effect? Examining the effects of avatar race on in-game behavior and post-play aggressive cognition and affect in video games, *Games Cult.* 11 (4) (2016) 422–440, <https://doi.org/10.1177/1555412014568870>.
- [3] D.J. Bem, Self-perception theory, *Adv. Exper. Soc. Psychol.* 6 (1) (1972) 1–62, [https://doi.org/10.1016/S0065-2601\(08\)60024-6](https://doi.org/10.1016/S0065-2601(08)60024-6).
- [4] Y. Bian, C. Zhou, Y. Tian, P. Wang, F. Gao, The Proteus effect: influence of avatar appearance on social interaction in virtual environments, in: *International Conference on Human-Computer Interaction*, Springer, Cham, 2015, pp. 78–83, https://doi.org/10.1007/978-3-319-21383-5_13.
- [5] G. Blackburn, E. Scharrer, Video game playing and beliefs about masculinity among male and female emerging adults, *Sex Roles* 80 (1) (2019) 310–324, <https://doi.org/10.1007/s11199-018-0934-4>.
- [6] R.M. Brown, L.R. Hall, R. Holtzer, S.L. Brown, N.L. Brown, Gender and video game performance, *Sex Roles* 36 (1) (1997) 793–812, <https://doi.org/10.1023/A:1025631307585>.
- [7] K.R. Christy, J. Fox, Transportability and presence as predictors of avatar identification within narrative video games, *Cyberpsychol. Behav. Soc. Netw.* 19 (4) (2016) 283–287, <https://doi.org/10.1089/cyber.2015.0474>.
- [8] E. Downs, S.L. Smith, Keeping abreast of hypersexuality: a video game character content analysis, *Sex Roles* 62 (2010) 721–733, <https://doi.org/10.1007/s11199-009-9637-1>.
- [9] N. Ducheneaut, M.H. Wen, N. Yee, G. Wadley, Body and mind: a study of avatar personalization in three virtual worlds, in: *Proceedings of the SIGCHI Conference on Human Factors in Computing System*, ACM Press, New York, 2009, pp. 1151–1160, <https://doi.org/10.1145/1518701.1518877>.
- [10] M.G. Frank, T. Gilovich, The dark side of self-and social perception: black uniforms and aggression in professional sports, *J. Pers. Soc. Psychol.* 54 (1) (1988) 74–85, <https://doi.org/10.1037/0022-3514.54.1.74>.
- [11] S.N. Georgiou, P. Stavrinides, T. Kalavana, Is Victor better than Victoria at maths? *Educ. Psychol. Pract.* 23 (4) (2007) 329–342, <https://doi.org/10.1080/02667360701660951>.
- [12] E. Han, M.R. Miller, C. DeVeaux, H. Jun, K.L. Nowak, J.T. Hancock, J.N. Bailenson, People, places, and time: a large-scale, longitudinal study of transformed avatars and environmental context in group interaction in the metaverse, *J. Comput. Mediat. Commun.* 28 (2) (2023) 1–27, <https://doi.org/10.1093/jcmc/zmac031>.
- [13] IGN, The 10 best open-world games of all time, 2022, Retrieved April 4, 2023, from: <https://www.ign.com/articles/the-10-best-open-world-games>.
- [14] IGN, The 10 best-selling video games of all time, 2023, Retrieved April 4, 2023, from: <https://www.ign.com/articles/best-selling-video-games-of-all-time-grand-thrift-auto-minecraft-tetris>.
- [15] Y. Jang, W. Kim, S. Ryu, An exploratory study on avatar-self similarity, mastery experience and self-efficacy in games, in: *2010 The 12th International Conference on Advanced Communication Technology (ICACT)*, vol. 2, IEEE, 2010, pp. 1681–1684. Accessed from: <https://ieeexplore.ieee.org/document/5440353>.
- [16] D.J. Kuss, A.M. Kristensen, A.J. Williams, O. Lopez-Fernandez, To be or not to be a female gamer: a qualitative investigation of female gamer identity, *Int. J. Environ. Res. Public Health* 19 (3) (2022) 1–18, <https://doi.org/10.3390/ijerph19031169>.
- [17] A.A. Laghari, H. He, K.A. Memon, R.A. Laghari, I.A. Halepoto, A. Khan, Quality of experience (QoE) in cloud gaming models: a review, *Multiaagent Grid Syst.* 15 (3) (2019) 289–304, <https://doi.org/10.3233/MGS-190313>.
- [18] A.A. Laghari, K.A. Memon, M.B. Soomro, R.A. Laghari, V. Kumar, Quality of experience (QoE) assessment of games on workstations and mobile, *Entertain. Comput.* 34 (1–10) (2020) 100362, <https://doi.org/10.1016/j.entcom.2020.100362>.
- [19] H. Lin, H. Wang, Avatar creation in virtual worlds: behaviors and motivations, *Comput. Hum. Behav.* 34 (1) (2014) 213–218, <https://doi.org/10.1016/j.chb.2013.10.005>.
- [20] H. Madiha, L. Lei, A.A. Laghari, S. Karim, Quality of experience and quality of service of gaming services in fog computing, in: *Proceedings of the 2020 4th International Conference on Management Engineering, Software Engineering and Service Sciences, ICMSS*, 2020, pp. 225–228. doi: 10.1145/3380625.3380644.
- [21] K.L. Nowak, J. Fox, Avatars and computer-mediated communication: a review of the definitions, uses, and effects of digital representations, *Rev. Commun. Res.* 6 (1) (2018) 30–53, <https://doi.org/10.12840/issn.2255-4165.2018.06.01.015>.
- [22] R.G. O'Brien, M.K. Kaiser, MANOVA method for analyzing repeated measures designs: an extensive primer, *Psychol. Bull.* 97 (2) (1985) 316, <https://doi.org/10.1037/0033-2909.97.2.316>.
- [23] C.L. Olson, On choosing a test statistic in multivariate analysis of variance, *Psychol. Bull.* 83 (4) (1976) 579, <https://doi.org/10.1037/0033-2909.83.4.579>.
- [24] B. Paaßen, T. Morgenroth, M. Stratemeyer, What is a true gamer? The male gamer stereotype and the marginalization of women in video game culture, *Sex Roles* 76 (1) (2017) 421–435, <https://doi.org/10.1007/s11199-016-0678-y>.
- [25] M. Paleczna, P. Buczkowicz, B. Szmigielska, Player-avatar similarity and game experience: game efficacy, game enjoyment, and immersion, *Pol. Psychol. Bull.* 53 (4) (2022) 193–202, <https://doi.org/10.24425/ppb.2022.141867>.
- [26] J. Peña, J.F. Hernandez Pérez, Game perspective-taking effects on willingness to help immigrants: a replication study with a Spanish sample, *New Media Soc.* 22 (6) (2020) 944–958, <https://doi.org/10.1177/1461444819874472>.
- [27] J. Peña, J.F. Hernández Pérez, S. Khan, Á.P. Cano Gómez, Game perspective-taking effects on players' behavioral intention, attitudes, subjective norms, and self-efficacy to help immigrants: the case of "papers, please", *Cyberpsychol. Behav. Soc. Netw.* 21 (11) (2018) 687–693, <https://doi.org/10.1089/cyber.2018.0030>.
- [28] J. Peña, S. Khan, C. Alexopoulos, I am what I see: how avatar and opponent agent body size affects physical activity among men playing exergames, *J. Comput. Mediat. Commun.* 21 (3) (2016) 195–209, <https://doi.org/10.1111/jcc4.12151>.
- [29] J. Peña, E. Kim, Increasing exergame physical activity through self and opponent avatar appearance, *Comput. Hum. Behav.* 41 (1) (2014) 262–267, <https://doi.org/10.1016/j.chb.2014.09.038>.
- [30] K.M. Rahill, M.M. Sebrechts, Effects of Avatar player-similarity and player-construction on gaming performance, *Comput. Human Behavior Rep.* 4 (1) (2021), 1–11, 100131, doi: 10.1016/j.chbr.2021.100131.
- [31] R. Ratan, D. Beyea, B.J. Li, L. Graciano, Avatar characteristics induce users' behavioral conformity with small-to-medium effect sizes: a meta-analysis of the Proteus effect, *Media Psychol.* 23 (5) (2020) 651–675, <https://doi.org/10.1080/15213269.2019.1623698>.
- [32] R. Ratan, Y.J. Sah, Leveling up on stereotype threat: the role of avatar customization and avatar embodiment, *Comput. Hum. Behav.* 50 (1) (2015) 367–374, <https://doi.org/10.1016/j.chb.2015.04.010>.
- [33] R. Ratan, N. Taylor, J. Hogan, T. Kennedy, D. Williams, Stand by your man: an examination of gender disparity in League of Legends, *Games Culture* 10 (5) (2015) 438–462, <https://doi.org/10.1177/1555412014567228>.
- [34] Y.J. Sah, R. Ratan, H.Y.S. Tsai, W. Peng, I. Sarinopoulos, Are you what your avatar eats? Health-behavior effects of avatar-manifested self-concept, *Media Psychol.* 20 (4) (2017) 632–657, <https://doi.org/10.1080/15213269.2016.1234397>.
- [35] H. Song, J. Kim, K.M. Lee, Virtual vs. real body in exergames: reducing social physique anxiety in exercise experiences, *Comput. Hum. Behav.* 36 (1) (2014) 282–285, <https://doi.org/10.1016/j.chb.2014.03.059>.
- [36] Statista, Global digital populations as of October 2020, 2022, Retrieved April 4, 2023, from: <https://www.statista.com/statistics/748044/number-video-game-rs-world/#:~:text=While%20there%20we,re%20almost%20two,three%20billion%20gamers%20by%202023>.
- [37] Statista, Number of games released on Steam worldwide from 2004 to 2022, 2023. Retrieved April 4, 2023, from: <https://www.statista.com/statistics/552623/number-games-released-steam/>.
- [38] V. Stavropoulos, J. Rennie, M. Morcos, R. Gomez, M.D. Griffiths, Understanding the relationship between the Proteus effect, immersion, and gender among World of Warcraft players: an empirical survey study, *Behav. Inform. Technol.* 40 (8) (2020) 821–836, <https://doi.org/10.1080/0144929X.2020.1729240>.
- [39] V. Stavropoulos, H.M. Pontes, R. Gomez, B. Schivinski, M. Griffiths, Proteus effect profiles: how do they relate with disordered gaming behaviours? *Psychiatr. Q.* 91 (3) (2020) 615–628, <https://doi.org/10.1007/s11126-020-09727-4>.
- [40] S. Sun, J.H. Kim, K.M. Lee, D. Nan, Exploring the association between the Proteus effect and intention to play massive multiplayer online role-playing games (MMORPGs), *Internet Res.* (2023), <https://doi.org/10.1108/INTR-07-2022-0487>. Ahead of Print.
- [41] Z. Sylvia, T.K. King, B.J. Morse, Virtual ideals: the effect of video game play on male body image, *Comput. Hum. Behav.* 37 (1) (2014) 183–188, <https://doi.org/10.1016/j.chb.2014.04.029>.
- [42] K. Szolin, D. Kuss, F. Nuyens, M. Griffiths, Gaming disorder: a systematic review exploring the user-avatar relationship in videogames, *Comput. Hum. Behav.* 128 (1) (2022) 107124, <https://doi.org/10.1016/j.chb.2021.107124>.
- [43] K. Szolin, D.J. Kuss, F.M. Nuyens, M.D. Griffiths, Exploring the user-avatar relationship in videogames: a systematic review of the Proteus effect, *Human-Comput. Interact.* 38 (5) (2022) 374–399, <https://doi.org/10.1080/07370024.2022.2103419>.
- [44] K. Szolin, D.J. Kuss, F.M. Nuyens, M.D. Griffiths, "I am the character, the character is me": a thematic analysis of the user-avatar relationship in videogames, *Comput. Hum. Behav.* 143 (1) (2023) 107694, <https://doi.org/10.1016/j.chb.2023.107694>.
- [45] J.E. Tompkins, T. Lynch, I.I. Van Driel, N. Fritz, Kawaii killers and femme fatales: a textual analysis of female characters signifying benevolent and hostile sexism in video games, *J. Broadcast. Electron. Media* 64 (2) (2020) 236–254, <https://doi.org/10.1080/08838151.2020.1718960>.
- [46] S. Trepte, L. Reinecke, Avatar creation and video game enjoyment: effects of life-satisfaction, game competitiveness, and identification with the avatar, *J. Media Psychol.* 22 (4) (2010) 171–184, <https://doi.org/10.1027/1864-1105/a000022>.
- [47] A. Vasalou, A.N. Joinson, Me, myself and I: the role of interactional context on self-presentation through avatars, *Comput. Hum. Behav.* 25 (2) (2009) 510–520, <https://doi.org/10.1016/j.chb.2008.11.007>.
- [48] H. Wauck, G. Lucas, A. Shapiro, A. Feng, J. Boberg, J. Gratch, Analyzing the effect of avatar self-similarity on men and women in a search and rescue game, in: *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*, ACM Press, New York, 2018, pp. 1–12, <https://doi.org/10.1145/3173574.3174059>.
- [49] L.M. Ward, P. Grewer, Media and the development of gender role stereotypes, *Annu. Rev. Develop. Psychol.* 2 (1) (2020) 177–199, <https://doi.org/10.1146/annurev-devpsych-051120-010630>.
- [50] N. Yee, J. Bailenson, The Proteus effect: the effect of transformed self representation on behavior, *Hum. Commun. Res.* 33 (3) (2007) 271–290, <https://doi.org/10.1111/j.1468-2958.2007.00299.x>.
- [51] N. Yee, J.N. Bailenson, N. Ducheneaut, The Proteus effect: implications of transformed digital self-representation on online and offline behavior, *Commun. Res.* 36 (2) (2009) 285–312, <https://doi.org/10.1177/0093650208330254>.
- [52] N. Yee, N. Ducheneaut, M. Yao, L. Nelson, Do men heal more when in drag? Conflicting identity cues between user and avatar, in: *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, ACM Press, New York, 2011, pp. 773–776, <https://doi.org/10.1145/1978942.1979054>.