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Exploring the user-avatar relationship in videogames: A systematic review of the Proteus effect

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1. Introduction

Since their commercial introduction in the 1970s, videogames have become an increasingly popular form of entertainment leading to the multi-billion-pound industry seen today (Juniper Research, 2020). The mechanics of videogames can vary significantly, and may require little more than pressing a specific button at the correct time to sweeping narrative-driven epics in vast and dynamic game worlds.

Although not universal, a common and often integral component found in videogames is the avatar. An avatar is a visual representation of a character that the gamer uses to navigate and interact with in a virtual world through which gamers are able to seek out and achieve in-game objectives. Avatars can often be highly customized characters whose visual design and in-game behavior are controlled by the gamers themselves.

As both a visual representation of the gamer as well as a means of facilitating manipulation of a virtual world, an avatar can be seen as a means through which an individual is able to project their physical world self into a game world (Ducheneaut et al., 2009). This projection of individuals in a virtual world via their avatars has received increasing research attention, and personal aspects such as an individual's personality (Worth & Book, 2014; Yee et al., 2011) and appearance (Cacioli & Mussap, 2014; Kafai et al., 2010; Messinger et al., 2008) have been indicated as factors with the potential to affect in-game avatar appearance and behavior.

However, while the research evidence indicates that the gamer can, and often does, project elements of themselves into a game world through their avatar, the reverse may also be true and an avatar can impact or influence the gamer. More specifically, it has been suggested that the avatar may become integrated into the gamer's sense of self, allowing for in-game avatar-related characteristics to influence the gamer in terms of both attitudes and behavior (Ratan & Sah, 20152015). One specific and increasingly prominent area of research regarding this aspect of the user-avatar relationship is referred to as the 'Proteus effect' (PE).

1.1. *The Proteus effect*

The term 'Proteus effect' (Yee & Bailenson, (2007)) is derived from the mythological Greek god Proteus who had the power of metamorphosis and was able to alter himself to any shape or form he desired in order to avoid showing his knowledge of past, present, and future events. More specifically, in the context of virtual avatars, the PE refers to the phenomenon where the player-observed features of virtual avatars can influence the in-game behavior or attitudes of gamers.

Simply put, Yee and Bailenson (2007) argued that an individual will make inferences concerning their avatar based on identity cues such as the avatar's appearance, and will then modify their behavior or attitudes to align with the expected behavior believed to be associated with these

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observed attributes or characteristics. For example, research evidence has been found to indicate that individuals who play as taller avatars act more confidently and negotiate more aggressively irrespective of their physical world height (Yee & Bailenson, 2007; Yee et al., 2009).

In addition, research has identified that specific factors can influence the likelihood of the PE occurring as well as its strength. For example, research has indicated that the PE is more likely to occur when an individual is able to customize their avatar (Ducheneaut et al., 2009; Ratan & Sah, 2015), which is due to the greater degree of avatar identification and avatar embodiment that this allows (Ratan & Dawson, 2016; Li & Lwin, 2016; Song et al., 2014). Furthermore, the graphical fidelity of a videogame as well as controller type (i.e., gamepad, keyboard and mouse, motion controllers) has indirectly been shown to potentially affect the strength of the PE through factors such as immersion and avatar embodiment (Blomberg, 2018: Gorisse et al., 2019). Furthermore, these studies have found some support for the claim that the PE can occur not only within the game world, but can transcend the virtual environment and affect physical world behaviors and attitudes of individuals (Yee & Bailenson, 2007; Peña et al., 2009; Yee et al., 2009). However, there is some debate concerning the theoretical components that explain this process.

1.2. *Theoretical components of the PE*

One particularly prominent and widely advocated argument focuses on the importance of self-perception theory as a means of understanding the phenomenon of the PE. Self-perception theory (Bem, 1972) suggests that individuals will first infer and then subsequently assimilate attitudes and beliefs from observing their own behavior. This theory suggests that beliefs and attitudes follow from self-observed behavior, and this process is used by the individual to explain their actions. A frequently cited research example of this process can be found in the work by Valins (1966), who measured the heart rate of participants while viewing pictures of various individuals before asking them to rate each picture based on attraction levels. Participants were found to rate pictures of individuals as more attractive if they were told their heart rate had increased during the picture viewing stage, irrespective of whether this was true. Valins (1966) suggested that this was due to participants assuming their erroneously ascribed increased heart rate had occurred because of an increase in emotional arousal, which subsequently influenced how attractive they rated the pictures of individuals. In summary, the participants observed a behavior, in this example based on false evidence provided by the researcher, and this in turn influenced their attitudes and behavior.

In terms of the PE and the user-avatar relationship, Yee and Bailenson (2007) argued that individuals will observe various identity and visual cues concerning their avatar, and assimilation of these cues will lead to attitudinal and behavioral changes in the gamer. Furthermore, it is claimed that the very nature of a virtual world can increase the potency of this process due to factors such as deindividuation and anonymity, whereby an individual experiences some degree of separation from their physical world self and is more reliant on observable external cues found within the virtual world (Yee & Bailenson, 2007).

However, in response to this, it has been argued that any behavioral or attitudinal changes that occur for users within a virtual world are a result of priming and preexisting schemata triggered by situational cues (Peña, 2011; Peña et al., 2009). For example, when a user observes some visual characteristic of their avatar, such as obesity, learned concepts or schemata will trigger from the user's memory, for example, sluggishness, and this will inform their subsequent behaviors or attitudes (Peña et al., 2016).

The key difference between these two perspectives is subtle, but significant in how they describe the user-avatar relationship. Priming models posit that individuals make observations of external stimuli, such as the avatar, and then connect this with preexisting schemata to influence behavior. On the other hand, self-perception explanations posit that individuals consider their avatar not merely as some external visual cue, but rather an extension and embodiment of themselves.

Consequently, the gamer will then align their behavior and attitudes to match that of the avatar, thereby connecting their physical world self with the virtual self (Yee et al., 2009).

However, while self-perception theory and priming models arguably each appear to provide a strong explanation for this phenomenon, it has also been suggested that these should be viewed as interconnected theories that together explain how and why the PE occurs. Ratan and Sah (2015) argued that using an avatar creates a bond between the gamer and their avatar, and this may lead to a mixing of the gamer's sense of self and the identified characteristics of the avatar (Ratan & Dawson, 2016; Ratan & Sah, 2015).

When this occurs, schema related to the gamer connect with the schema related to the avatar, and the priming of one may affect the other too, and stronger user-avatar relationships increase the likelihood of this occurring (Ratan & Sah, 2015). Therefore, individuals experiencing this associating of user-avatar schemata may engage in behaviors or report attitudes more aligned to their avatar than their selves depending on the current strength and direction of this relationship.

1.3. *The present study*

While there is clearly still some debate concerning the precise theoretical underpinnings that explain how and why this process occurs, since the term 'Proteus effect' was first coined by Yee and Bailenson (2007), there has been a growing body of research evidence to support the existence of the PE with research studies published identifying many different ways this process can take effect. However, to date, there have been very few attempts to synthesize this research in order to explore the impact and consequences of the PE upon individuals. To date, there have only been two studies that have reviewed the PE in the context of avatars, namely a meta-analysis conducted by Ratan et al. (2020) and the related review by Praetorius and Görlich (2020). While each of these analyses provided illuminating insight into the PE, particularly the strength and reliability of this phenomenon based on available research evidence, there is an important reason relating to ecological validity why further review work is needed in this area.

More specifically, neither the analyses by Ratan et al. (2020) nor Praetorius and Görlich (2020) made any distinction between types of virtual environment. In particular, research studies utilizing commercially available videogames and studies using bespoke virtual environments that were custom made for a research study were both included and discussed in the analysis of both Ratan et al. (2020) and Praetorius and Görlich (2020) without distinguishing between these virtual settings. While using bespoke environments allows researchers greater control in determining how the PE may occur, by virtue of this artificial gameplay and avatar experience, these studies do not necessarily provide evidence of how the PE occurs during typical gameplay experiences outside of the research study, and are arguably much less representative of real world experiences (i.e., less ecologically valid) compared to studies utilizing commercially available videogames.

The inclusion of research studies that involve bespoke virtual environments or avatar experiences is not problematic in of itself. However, the issue arises when these studies are seamlessly blended with other forms of research that focus on commercially available videogames and forming overall conclusions based on the aggregated findings. In particular, this may mean that the videogame world experiences that individuals have relating to the PE are not being given due consideration, and in fact any application of the reviews by Ratan et al. (2020) or Praetorius and Görlich (2020) to typical gameplay or avatar experiences may be misleading due to this highlighted potential for low ecological validity of bespoke virtual environments and the authors' decision to merge these different forms of research.

Therefore, while aggregating research findings from across commercially available videogames and bespoke virtual environments involving an avatar custom made for a research study may provide a broad and general outline of the PE, the fact that both Ratan et al. (2020) and Praetorius and Görlich (2020) did not distinguish or attempt to separate these environments

potentially means important differences in the strength or outcomes of the PE regarding the specificity of virtual environments were not appropriately considered within the field of research.

In addition, beyond the lowered ecological validity inherent in the merging of videogames and custom-made simulations, a review focused on the PE specifically in the context of commercially available videogames may provide unique insight into the user-avatar relationship that may be of benefit to a range of individuals and organizations within the videogame industry. For example, the strength of the PE is often a strong indicator of the type of relationship a videogame player has with their avatar, and this may affect how much an individual engages with a virtual world, as well as their in-game behavior, which is likely of interest to games developers and companies when designing virtual worlds in order to optimize and improve videogame player's experiences within their product.

To address this limitation relating to combining commercially available videogames and custom-made simulations, and to gain greater clarity regarding the specific outcomes and nuances of the PE phenomenon relevant to real world gameplay and avatar experiences, the present systematic literature review focuses exclusively on exploring the consequences of the PE specifically in the context of videogames. As such, only commercially available videogames were considered in the synthesis of findings.

2. Methods

2.1. *Aims and design*

The present study aimed to synthesize the literature related to the 'Proteus effect' (PE) in the context of videogames in order to highlight and explore the various consequences this phenomenon has on the gamer. To do this, the study is conducted and presented according to the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) guidelines (Moher et al., 2009).

2.2. *Inclusion criteria*

In order to be included in the systematic literature review, all PE studies and papers obtained were required to adhere to a number of different criteria. More specifically, the inclusion criteria were that the studies and conference papers needed to be (i) published since 2007 when the PE term was first coined, (ii) published in peer-reviewed journals and conference papers, (iii) written in English, (iv) focused on the PE on the context of avatar research, and (v) based on research conducted using commercially available videogames. More specifically, this meant that all PE studies that were focused on avatar-based chat rooms, social networking applications, or custom-made virtual simulations were excluded from the present study's analysis. In particular, in terms of videogames, only papers that were based on a videogame that was commercially available were included, and any research based on bespoke, custom-made or highly modified videogames were excluded to align with the aims of this literature review.

It should be noted that the term 'videogame' can often be ambiguous and a matter of contention among both researchers and individuals within the videogame industry, and a range of differing definitions can be applied to what may constitute a videogame (Stenros, 2017). For example, Tavinor (2009) defines a videogame in terms of being a form of entertainment presented in an audio-visual medium, encompassing rule and objective gameplay or interactive fiction. However, this loose definition of videogame would not exclude interactive films where the viewer is given some control and choice in determining how the plot develops, such as *Unbreakable Kimmy Schmidt: Kimmy Versus The Reverend*. Similarly, many individuals may consider 'walking simulations' such as *Gone Home*, which do not contain typical game objectives, as videogames. Clearly, the question of what may be regarded as a videogame remains a contentious issue, and a more robust definition of videogame may be required to separate videogames from other forms of media, and vice versa.

Although there is no current industry definition for what constitutes as a videogame, for the purpose of this literature review, a videogame is defined as (i) an interactive form of audio-visual media, (ii) requires some form of computer device (e.g., videogame console, personal computer or mobile device), and (iii) features a clear fail-state. A fail-state in the context of videogames means that progression in the videogame is not automatic without player input and is in some way reliant on the player's actions, and that there exists the possibility of failing at the in-game objectives. Consequently, the application of these criteria, particularly the fail-state, means that experiences that may be found on a PC or videogame console, such as particular forms of simulation or social networking applications, are not deemed as videogames for the purposes of this literature review.

2.3. *Information sources and search strategy*

Searches for relevant literature were carried out using the following databases: *Web of Knowledge*; *PsycPapers*; *PubMed*; *Pro-Quest*; *PsychInfo*; and *Science Direct*. This was done using the research team's Library One Search database search engine. In addition, *Google Scholar* was also separately used as a search engine for locating appropriate studies. However, given the high volume of papers identified, the vast majority of which were not related to virtual worlds or psychology, only the first 500 search results were reviewed.

The search terms used to search for relevant literature in these databases relating to the PE were: (Proteus effect) AND (video game OR gaming). These terms were selected in order to obtain literature specific to the PE while also maintaining sufficient scope to include a wide range of potentially relevant studies.

2.4. *Study selection and data collection processes*

All papers that appeared during the search were initially screened based on their title and abstract, after which the full texts of the remaining studies were inspected in detail and screened based on the previously stated eligibility criteria. This process is presented as a flow diagram (Figure 1). This includes the total number of papers at each stage of this process and reasons for exclusion.

3. Results

3.1. *Academic literature*

After using the search terms to scope the academic literature, a total of 2,334 papers were identified. Of these, 1,129 papers were removed due to not being published in a peer-reviewed journal or conference, and a further 37 papers were removed because they were not written in English. Next, based on the titles and abstract, a further 15 papers were removed due to being either duplicates or not relevant to the aims of this literature review, leaving a total of 53 papers. The full texts of these remaining papers were then read in detail before a further 36 were removed due to not meeting the aforementioned inclusion criteria, including: (i) not meeting the listed criteria for being considered a relevant videogame (n = 25); (ii) using a combination of virtual worlds within one study which included non-videogame environments (n = 1); and (iii) not being specifically relevant to the PE (n = 10). This left a total of 17 papers that were included in the present review, and the general characteristics and results of these are summarized in Table 1. These 17 papers contained a number of different consequences relating to the PE in the context of videogames, and are divided into two sections: (i) in-game PE consequences, and (ii) post-game PE consequences. In-game consequences and post-game PE consequences were separated to differentiate between what may occur within a videogame setting and the physical world, and thereby highlight the unique consequences of this phenomenon in the different environments of the virtual and physical world.

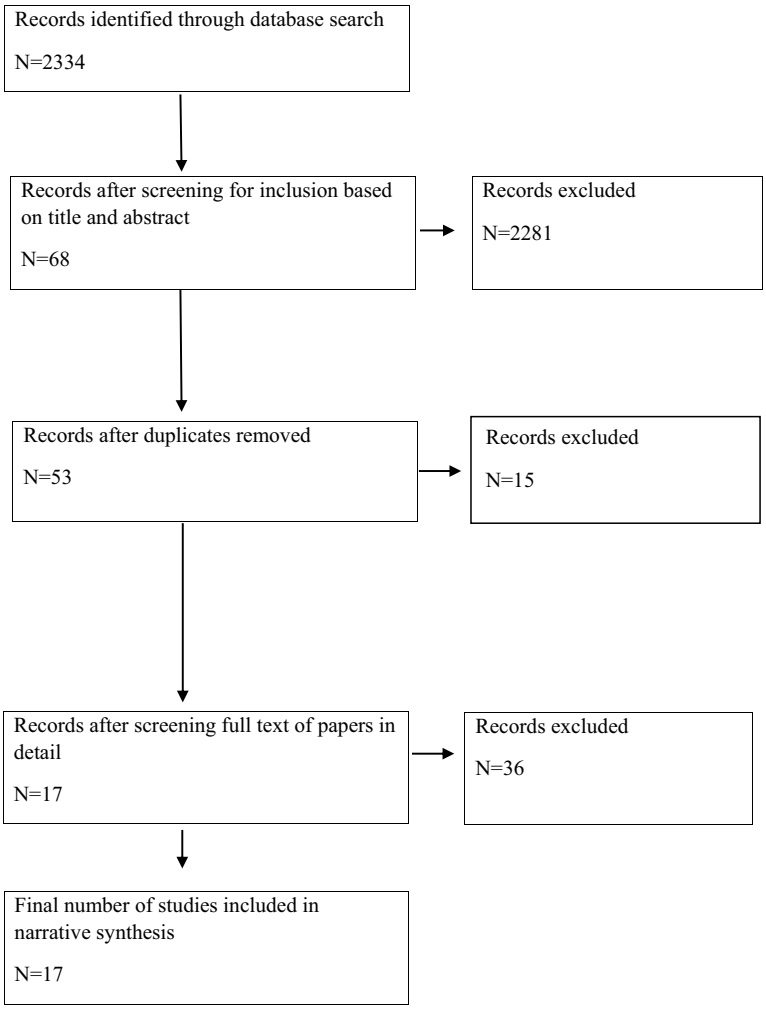

Figure 1. PRISMA flow diagram.

In addition, it should be noted that several of these papers featured more than one study within the paper probing a combination of in-game/post-game attitudes and/or behaviors. These papers are therefore divided into the relevant section of the present review's 'Results' section based on the specific objectives of the individual study within that paper. Finally, and related to this point, a number of papers featured one or more studies that were not relevant to the aims of this present literature review. For example, the study by Yee et al. (2009) contained two separate studies, including one which met the eligibility criteria and one that did not. In these cases, although the paper was included, only the studies within the paper which were pertinent to the aims of this literature review were discussed.

Finally, although the distinction between what may constitute a commercially available videogame is largely unequivocal in the majority of the identified papers, there are several examples identified through the literature search where this difference was less clear due to varying degrees of game modification. In these examples where a videogame was modified for the purposes of a research study, the study was only included within the final selection if the actual gameplay and in-game objectives remained similar to the unmodified original game on which it was based. For example, although a study identified through the literature search by Peña et al. (2009) was based on

Table 1. Main characteristics of reviewed studies (N=17)

Study	Sample size, description and population cohort, and country of study	Proteus effect investigated	Game environment	Measures/instruments	Main results
Ash, 2016	84 students from United States University. 51 females and 36 males, age range 18 to 25 years (M = 20.93, SD = 0.49). Convenience sampling	Avatar race and in-game/postgame aggression	*Xbox 360 Fight Night 4* (boxing sports simulation videogame)	Aggression: cognition, assessed using word completion task (Anderson et al., 2003); affect, assessed using state-hostility scale (Anderson et al., 1995); and behavior, assessed through in-game behavior.	No significant effect found for avatar race predicting in-game behavior, nor any significant effect found for post-game aggression cognition or affect. However, post-hoc analysis showed a stronger PE for participants who experienced higher levels of avatar embodiment.
Bian et al., 2015	92 students (46 high-shy, 46 low-shy). (Participant description not detailed) (Country not detailed)	Avatar attractiveness/ participant shyness and social behavior (social interaction participation and maintenance)	*The Sims 3* (life simulation videogame). PC	Self-report questions evaluating social performance	Significant effect of high avatar attractiveness and greater social participation, marginally significant effect of lower participant shyness and greater social participation. Significant effect of shyness and maintaining-interaction, but no significant effect for avatar attractiveness and maintaining-interaction.
Li & Lwin, 2016	322 Singapore high school students. 160 females and 162 males. Mean age 12.37 years (SD = 2.21). Convenience sampling	Influence of self-avatar in exercise videogame on future exercise intention	*Xbox Kinect Sports* and *Just Dance 3* (exercise videogames)	Self-report questions assessing: self-presence; identification; enjoyment; exergame intention; exercise intention.	Self-presence significantly associated with identification. Identification significantly associated with enjoyment. Enjoyment significantly associated with exergame intention. Exergame intention significantly associated with exercise intention.
Peña & Kim, 2014	96 female United States university students. Age range 19 to 25 years (M = 21.07, SD = 1.24). Convenience sampling	Influence of avatar weight on in-game physical activity	*Nintendo Wii Virtua Tennis 2009* (sports simulation videogame)	Physical activity measured with accelerometers	Normal-weight-avatar players were significantly more active during gameplay than obese-avatar players. Participant BMI had no significant effect on results.
Peña et al., 2016	96 male United States university students. Age range 18 to 32 years (M = 21.25, SD = 2.35). Convenience sampling	Influence of avatar weight on in-game physical activity	*Nintendo Wii Virtua Tennis 2009* (sports simulation videogame)	Physical activity measured with accelerometers	Normal-weight-avatar players were significantly more active during gameplay than obese-avatar players. Participant BMI had no effect on results.

(*Continued*)

Table 1. (Continued).

Study	Sample size, description and population cohort, and country of study	Proteus effect investigated	Game environment	Measures/instruments	Main results
Peña et al., 2018	172 United States university students. 149 females and 23 males. Age range 18 to 29 years (M = 20.15 years, SD = 2.05) Convenience sampling	Influence of avatar job on post-game attitudes toward immigrants	*Papers, Please* (dystopian immigration officer simulator) and *Westport Independent* (newspaper editor simulation videogame). PC	Self-report questionnaire assessing: intention; attitudes; subjective norms; and self-efficacy	Significant decrease in intention, subjective norms and self-efficacy relating to helping immigrants after playing Papers, Please compared to Westport independent
Peña & Hernandez Pérez, 2020	180 south-eastern Spanish university students. 79 female, 91 male and 10 identified as neither male nor female. Age range 18 to 35 years (M = 21.41, SD = 10.09). Convenience sampling	Influence of avatar job on post-game attitudes toward immigrants	*Papers, Please* (dystopian immigration officer simulator) and *Westport Independent* (newspaper editor simulation videogame). PC	Self-report questionnaire assessing: intention; attitudes; subjective norms; and self-efficacy	Significant decrease in intention and attitudes relating to helping immigrants after playing Papers, Please compared to Westport Independent
Ratan & Sah, 2015	64 female western university students. Age range 18 to 28 years (M = 19.83, SD = 2.07). Convenience sampling of females	Influence of avatar gender on post-game gender conforming behavior	*Nintendo Wii Sports Resort Swordplay* (sports simulation videogame)	Self-report avatar embodiment scale and 10 math questions from GRE practice material (Educational Testing Service, 1999)	Female participants who customized an avatar but experienced low avatar-embodiment performed significantly better at a math task than those using a female avatar.
Ratan & Dawson, 2016	76 female western university students. Age range 18 to 28 years (M = 19.83, SD = 2.07). Convenience sampling of females	Avatar self-relevance after avatar use	*Nintendo Wii Sports Resort Swordplay* (sports simulation videogame)	Survey measures included proto self-presence and core self-presence scales (Ratan, 2013). Additional HR, SCR and Corrugator EMG metrics recorded with 4-channel MP36 system and Biopac Student Lab software	Significant results indicating: avatar/user gender consistency increases post-use avatar-self relevance; high avatar-emotional connection increases post-use avatar self-relevance; and high avatar-body connection decreases post-use avatar self-relevance
Sah et al., 2017	133 female college students. Mean age 20.26 years (SD = 1.34). Convenience sampling of females specifically not restricting their diet. (country not detailed)	Avatar related self-concept influencing in-game and post-game health behavior	*Yoobot versus YooNot* (healthy eating intervention web based videogame)	Self-report survey measuring: health consciousness; in-game healthy food choice; and post-game healthy food choice	Significant result for ought-self avatar and healthier food choice both within and post-game. No significant results identified for ideal-self and actual-self avatars on healthy food choice within or post-game

(*Continued*)

Table 1. (Continued).

Study	Sample size, description and population cohort, and country of study	Proteus effect investigated	Game environment	Measures/instruments	Main results
Song et al., 2014	72 students from mid-western United States university. 34 females and 38 males. Recruitment based on online survey measuring BID (only included participants scoring in the upper and lower 30% of BID scores). (Ages not detailed)	Avatars and reducing social physique anxiety in-game	*Nintendo Wii* boxing videogame (sports simulation videogame)	Measures for: social physique anxiety (Yao & Flanagin, 2004); perceived exercise enjoyment and exergame experience questionnaire	Significantly reduced social physique anxiety for both high and low BID participants. Significantly higher exercise enjoyment for high BID participants.
Stavropoulos et al., 2020a	404 *World of Warcraft* players. 299 females and 83 males. Mean age 25.56 years (SD = 7.61). Online survey using posts on relevant forum sites and social media to recruit gamers.	Associations between avatar race, immersion and offline behavior	*World of Warcraft* (fantasy MMO). PC	Modified Proteus Effect Scale (Van Looy et al., 2012), and Immersion subscale from UAR Questionnaire (Blinka, 2008)	Significant positive association between immersion and offline PE behavior. Playing as Drenai character race significantly positively associated with higher immersion and offline PE behavior.
Stavropoulos et al., 2020b	1022 *World of Warcraft* players. 202 females and 820 males. Mean age 28.60 years (SD = 9.90). Online survey using posts on relevant forum sites and social media to recruit gamers.	PE profiles and the link to disordered gaming	*World of Warcraft* (fantasy MMO). PC	Modified Proteus Effect Scale (Van Looy et al., 2012) and Internet Gaming Disorder Scale–Short-Form (Pontes & Griffiths, 2015)	Three PE classes identified, including: non-influenced gamers (NIGs), perception-cognition influenced gamers (PCIGs), and emotion and behavior influenced gamers (EBIGs). Reported disordered gaming symptoms were lower for the NIGs and then progressively higher for PCIGs and EBIGs.
Sylvia et al., 2014	50 male students from northeast United States university. Age range 18 to 24 years ((M = 19.76, SD = 1.49). Convenience sampling of males	Influence of avatar body type on post-game body dissatisfaction and attitudes	*The Elder Scrolls V: Skyrim* (open world fantasy RPG). Platform not described	The Rosenberg Self-Esteem Scale (Rosenberg, 1965), Swansea Muscularity Attitudes Questionnaire (Edwards & Launder, 2000), and Body Esteem Scale (Franzoi & Herzog, 1986)	Significant result indicating participants controlling a high muscular-avatar reported lower body satisfaction post-game. No significant difference in post-game attitudes toward muscularity
Vandenbosch et al., 2017	115 adolescents from secondary school in Belgium. 48 females and 67 males. Age range 11 to 14 years (M = 12.63, SD = 0.85). Convenience sampling of adolescents	Influence of sexualized avatars on self-objectification	*RuneScape* (fantasy MMO). PC	Self-objectification questionnaire (Noll & Fredrickson, 1998; Vandenbosch & Eggermont, 2014)	Significant result indicating playing as a sexualized avatar increased self-objectification amongst both male and female adolescents
Yee et al., 2009	76,843 *World of Warcraft* characters. Data collected from in-game automated script performing census of character information across three servers during a seven day period. (No details of game players)	Avatar height and attractiveness on in-game and post-game behavior	*World of Warcraft* (fantasy MMO). PC	Height/attractiveness (as rated by sample of students) and player performance assessed by player level	Significant result indicating avatar height and attractiveness were positively associated with player performance
Yee et al., 2011	1084 *World of Warcraft* players. 282 females and 802 males. Age range 18 to 65 years (M = 27.03, SD = 8.21). Posts on relevant forum sites and social media to recruit gamers.	Influence of avatar gender and player gender on gender-conforming in-game behaviors	*World of Warcraft* (fantasy MMO). PC	Healing metric and PVP metric based on in-game character data	Significant effect of avatar gender on healing behavior. Significant effect of avatar gender on PVP behavior. No significant effects identified for player gender for either PVP or healing behaviors.

the commercially available videogame *Star Wars Jedi Knight II: Jedi Outcast*, the researchers only used the virtual environment and avatar models to run their experiment, and the study itself did not feature any gameplay or in-game rules or objectives that would be found in the original unmodified version of the game, and was consequently removed from the final selection of literature for this review.

3.2. *In-game Proteus effect consequences*

A total of eight papers (Ash, 2016; Bian et al., 2015; Peña et al., 2016; Peña & Kim, 2014; Sah et al., 2017; Song et al., 2014; Yee et al., 2009, 2011) identified in the present review contained studies that explored in-game PE consequences, and included in-game behavior (n = 7) and attitudes (n = 1). Each of these studies explored a different potential consequence of the PE, and with varying degrees of success.

Firstly, Ash (2016) attempted to identify whether avatar race influenced in-game aggression in a boxing simulation videogame; more specifically, whether playing as a black avatar would result in a greater number of offensive rather than defensive actions within the videogame *Fight Night 4* for *Xbox 360*. This hypothesis was based on racial stereotypes that link African-Americans with aggression and criminality (Maddox & Gray, 2002; Collins, 2004; Ferber, 2007). The analysis of the obtained data did not show any statistically significant results for this hypothesis, suggesting that neither avatar race nor the use of stereotyping of African Americans influenced in-game aggressive behavior. In addition, analysis showed that avatar embodiment was a potential moderator to the positive relationship between avatar race and in-game aggression with a result that was marginally statistically significant (p <0.10).

However, a study by Peña and Kim (2014) and the later replication observing male rather than female participants (Peña et al., 2016) reported results that provided statistically significant evidence for the PE. In these two studies, the researchers attempted to identify whether appearance of an avatar in terms of weight would influence in-game behavior in a tennis simulation videogame. The results from both of these studies showed that players who controlled an obese avatar were significantly less active in-game than players controlling a normal weight avatar, and this effect occurred irrespective of the players' true body mass index. This finding suggests that players were influenced by the appearance of their avatar, and this affected their in-game behavior. In these two particular studies, the researchers argued that this effect occurred due to priming, and that players associated specific activity-related behavioral traits with the perceived weight of their controlled avatar which influenced their physical activity outcome.

This may also explain the findings from the study conducted by Ash (2016), which did not find a statistically significant result in terms of black avatar use and greater in-game aggression. Whereas the individuals in the studies by Peña and Kim (2014) and Peña et al. (2016) associated specific activity related behavioral traits with weight, the participants in the study by Ash (2016) may not have associated behavioral traits relating to aggression with African Americans due to their pre-existing schema, which may have subsequently affected the results of this study in regard to racial stereotyping. More specifically, this may mean that the participants in Ash's (2016) study did not link African Americans with aggression through racial stereotyping while in control of their avatars, and that this subsequently meant that there was no recorded statistically significant PE outcome.

The final sports simulation study was conducted by Song et al. (2014), and was also based on a *Nintendo Wii* sports simulation videogame. However, unlike the aforementioned studies, this research was focused on changes to attitudes during gameplay rather than in-game behavior. More specifically, Song et al. (2014) attempted to identify whether playing a sports simulation videogame would improve social physique anxiety during gameplay and exercise enjoyment for individuals with body image dissatisfaction (BID), both of which were assessed using self-report questionnaires. The results indicated significantly reduced reported social physique anxiety during

gameplay for both high and low BID participants as well as significantly higher reported exercise enjoyment for high BID participants during avatar use.

The results identified by Song et al. (2014) suggest that, similarly to the studies by Peña and Kim (2014) and Peña et al. (2016), individuals controlling an avatar in a sports simulation videogame change their in-game attitudes and behaviors to align with that of their avatar. In the case of Song et al.'s (2014) study, individuals reported lower social physique anxiety while exercising due to embodiment with their avatar through a shift in self-presence, whereby the individual experienced the virtual self, or avatar, as though it were their physical self (Lee, 2004). This research suggests that, through the PE, individuals during avatar use identify less with their physical world self and instead use their virtual self to inform and direct their in-game behavior and attitudes.

However, this must be tempered with the results from Ash (2016), which did not identify any significant results concerning the PE. Among the possible reasons for this, it may be suggested that factors important to the occurrence of the PE such as embodiment and immersion were not sufficiently high in the study by Ash (2016) compared to the studies by Peña and Kim (2014), Peña et al. (2016), and Song et al. (2014). Although there may be many potential reasons for this, one immediately observable and notable difference between these studies concerns the controller type.

The studies by Peña and Kim (2014), Peña et al. (2016), and Song et al. (2014) were each based on games played on a *Nintendo Wii*, which famously employs motion controls whereas the study by Ash (2016) uses a more traditional gamepad. It may be the case that these different controller types may have contributed to factors such as embodiment or immersion, which have been found to be important for the occurrence of the PE (Yee & Bailenson, 2007), and subsequently partially explain the difference in results between these studies.

The next study was conducted by Sah et al. (2017) and explored whether self-concepts experienced through a customized avatar influenced in-game health behavior in *Yoobot versus YooNot*. Participants were required to create an avatar based on either their ideal, actual, or ought-selves before selecting in-game food items for their avatar. More specifically, the ideal-self avatar (n = 41) represented how an individual would ideally like to look and act like outside of the game; the ought-self avatar (n = 44) represented how an individual should look and act like outside of the game; and the actual-self avatar (n = 40) represented how an individual actually looked and acted like outside of the game. The results indicated there was a significant relationship between ought-self avatar and healthier in-game food choice, but not for actual or ideal-self avatars.

While it was predicted by the researchers that this study would not show a significant relationship between the actual-self avatars and in-game healthy food choice, the authors suggest the lack of significant results for the ideal-self avatar may have occurred due to the ideal-self potentially not priming healthy eating behavior among already healthy individuals, and the majority of participants in this study had either a normal or below normal BMI (85.2%). This explanation is supported by the research by Hoyle and Sherrill (2006), who also identified that the ideal-self does not promote or encourage healthy eating habits for healthy or normal weight individuals. This suggests that whereas playing as an ought-self avatar can act as a motivator for developing healthy food choices, playing as an ideal-self avatar may not be as effective in changing these behaviors for individuals already within a normal or healthy weight range.

These results tentatively suggest that designing and playing as an avatar that reflects how the individual feels they should be like outside of the game can act as a motivator for the individual to behave in a specific manner that would align with or facilitate the achievement of this goal. Accordingly, controlling an avatar that reflects an individual's ought-self may influence in-game decisions and behavior patterns to correspond with this particular self-concept.

The next study was conducted by Bian et al. (2015), and attempted to identify whether avatar attractiveness and participant shyness affected in-game social behavior in *The Sims 3*. The results from this study indicated a significant main effect of avatar attractiveness on social participation, with high avatar attractiveness participants being significantly more likely to demonstrate social participation and only a marginally significant result regarding participant shyness on social

participation (p =0.053), with less shy participants being more likely to engage in social participation. In addition, there was a significant effect of shyness and maintaining interaction with less shy participants being more likely to maintain an interaction, but no significant effect for avatar attractiveness and maintaining interaction.

These results provide insight into the consequences of the PE when viewed alongside preexisting personality characteristics of the gamer. In particular, based on these results, it appears that the PE can affect individuals' in-game behavior, despite the actual personality characteristics of the gamer, but that this effect may only be temporary before the physical world personality of the individual and the associated behavior patterns that stem from this become dominant once more.

In this study, high avatar attractiveness appeared to be the prevailing factor in determining initial social participation. However, when participants were required to maintain this social interaction, the attributes of their avatar assumed a less salient position in informing their behavior and their physical world personality became the leading factor in maintaining social interaction. This suggests that the PE can influence individuals to act in a manner incongruent with their physical world personality within the game world, but that this effect is either only temporary or of insufficient power to maintain this change during more strenuous situations, such as maintaining rather than just participating in a social interaction.

A study by Yee et al. (2009) also explored the effects of avatar attractiveness on in-game behavior, but combined this with avatar height. In this large-scale study using data from 76,843 *World of Warcraft* characters, Yee et al. (2009) explored whether the purely nonfunctional and cosmetic factors of avatar height and attractiveness were associated with player performance as assessed using in-game character level. The results indicated a significant positive relationship between both avatar height and player performance and avatar attractiveness and player performance. Tall and attractive characters were suggested as showing the strongest performance. This again suggests a link between the PE and in-game behavior, with cosmetic character elements such as height and attractiveness able to influence in-game behavior and performance outcomes. However, it should also be noted that other factors may have contributed to this observed result, such as more experienced players spending a greater amount of time customizing their characters compared to novice players.

Although these results appear to provide evidence for the PE, it should also be noted that any data concerning the physical world characteristics of the individuals controlling their avatars was not available to the researchers. More specifically, while this research can certainly be viewed in the same light as other similar studies such as Song et al.'s (2014) and Bian et al.'s (2015) studies which indicate that physical world characteristics become less relevant during avatar use than those of the avatar, it cannot be entirely ruled out that physical world height and attractiveness of the gamer may have informed and mirrored their character design. If this was the case, then this would not provide evidence for the PE, but merely indicate that physical world player characteristics can inform videogame performance and behavior.

A second study that explored the PE in *World of Warcraft* attempted to identify whether avatar gender and player gender influenced gender-conforming in-game behaviors (Yee et al., 2011). In this study, the researchers first identified two in-game gender-conforming behaviors, with healing behavior identified as a stereotypical female behavior and player versus player (PVP) behavior identified as a stereotypical male behavior. The results indicated both a significant effect of avatar gender on healing behavior and a significant effect of avatar gender on PVP behavior, with each avatar gender-conforming to its respective stereotypical behavior pattern with male avatars more likely to engage in PVP and female avatars more likely to engage in healing behaviors. In addition, no significant effects were identified for player gender for either PVP or healing behaviors.

These results again appear to demonstrate that during avatar use, the gamer identifies less with their physical self and more with their virtual self, and this counteracts the effects of physical world gender and subsequent gender-conforming behavior. This provides a novel insight into the PE because it suggests that a factor as intrinsically innate and pivotal to the personality and identity of

an individual such as gender arguably becomes superfluous to the point of irrelevance to the virtual gender assumed through an avatar while inhabiting a virtual game world.

This, combined with the other examples of aforementioned research studies, suggests that physical world characteristics of an individual which would ordinarily determine behavior and attitudes become supplanted by the characteristics of the player-controlled avatar when determining in-game behavior or attitudes. This arguably indicates that through the PE, it is the characteristics of the avatar rather than the user that has dominance in shaping how a player navigates through a virtual game world, and signals the strength of this phenomenon in influencing behavior and attitudes.

3.3. *Post-game Proteus effect consequences*

A total of eleven papers (Ratan & Sah, 2015; Ratan & Dawson, 2016; Li & Lwin, 2016; Ash, 2016; Sah et al., 2017; Peña et al., 2018; Peña & Hernandez Pérez, 2020; Sylvia et al., 2014; Vandenbosch et al., 2017; Stavropoulos et al., 2020a, 2020b) were identified which contained studies which explored post-game PE consequences, and included post-game attitudes (n = 7) and post-game behavior (n = 4).

First, a study conducted by Ratan and Sah (2015) used the *Nintendo Wii Sports Resort Swordplay* videogame to explore whether a player's avatar gender influenced post-game negative stereotypical gender-conforming behavior after a stereotype threat prompt. Stereotype threat theory refers to the tendency for individuals who are exposed to a negative stereotype connected with their identity or group to perform worse on a task associated with the stereotype (Ratan & Sah, 2015; Steele & Aronson, 1995). In this research example, the negative stereotype induced was that females perform worse at a math task compared to males. However, it should be noted that in the absence of such effects induced by negative stereotypes, research indicates that there is no relationship between math performance and gender (Georgiou et al., 2007; Kimball, 1989).

The results indicated that female participants who controlled a customized male avatar but experienced low avatar-embodiment performed significantly better at a post-game math task than females using a customized female avatar. This suggests that controlling an avatar of a different gender may induce post-game stereotypical gender-conforming behavioral changes after a stereotype threat prompt.

In addition, this research indicated that both customization and embodiment play an important role in post-avatar use gender-conforming behavioral changes. However, whereas higher levels of customization led to greater post-avatar use effects, embodiment worked in the opposite manner and participants who scored high for avatar embodiment were significantly less likely to adopt negative stereotypical gender-conforming behavioral changes. Ratan and Sah (2015) suggested that this may have occurred due to the disconnection that happens when an individual is separated from their avatar after experiencing high avatar embodiment, and therefore inhibited avatar influenced post-game behavioral changes while increasing the potential for this to occur during avatar use.

This suggests that, similar to Yee et al. (2011), the gender of the avatar controlled by the player can lead to behavioral changes to align with gender-conforming behaviors connected with negative gender stereotypes, and that this can occur in-game and post-game. However, while avatar gender may influence post-game behavior, this is tempered with both avatar customization and embodiment.

In a similar study, also using the *Nintendo Wii Sports Resort Swordplay* videogame, Ratan and Dawson (2016) attempted to identify factors that contributed to avatar self-relevance, the extent to which an individual views their avatar as relevant to themselves, after avatar use. Their results indicated that (i) avatar/user gender consistency increased post-use avatar-self relevance, (ii) high avatar-emotional connection increased post-use avatar self-relevance, and (iii) high avatar-body connection decreased post-use avatar self-relevance. However, and in contrast to Ratan and Sah (2015), avatar customization was not identified as being significantly related to post-game avatar

self-relevance (p <0.10), although the authors acknowledged that the lack of significant results on this occasion did not necessarily preclude this from potentially being a salient factor as customization has often been found to be an important contributor to factors related to the PE (Ducheneaut et al., 2009; Ratan & Sah, 2015; Vasalou & Joinson, 2009). In particular, Ratan and Dawson (2016) designed this study using an all-female sample in order to explore avatar gender consistency and avatar gender stereotyping. However, the authors argued that using an all-female sample may have restricted avatar self-relevance for participants customizing an avatar of a different gender to themselves compared to participants customizing an avatar of the same gender to themselves, and that this may have influenced the collective results for the avatar customization condition resulting in the lack of a significant finding for the customization condition of this experiment.

The next study based on a sports simulation videogame was conducted by Li and Lwin (2016) which used both *Just Dance* and *Kinect Sports* for the *Xbox 360* to explore avatar use and motivation. The results from the study indicated that (i) self-presence player's avatar was significantly associated with avatar-identification, (ii) avatar-identification was significantly associated with videogame enjoyment, (iii) enjoyment was significantly associated with exergame (fitness or exercise game) intention, and (iv) exergame intention was significantly associated with exercise intention. Similar to Ratan and Dawson (2016), these findings appear to show a number of potentially important factors which contribute to the development of a user-avatar bond which in turn influences the strength of the PE.

The next study was conducted by Ash (2016), and was focused on avatar race and both in-game and post-game aggression using the boxing simulator videogame *Fight Night 4* for *Xbox 360*. Similar to the aforementioned in-game results, no significant effect was identified for post-game aggression cognition or affect. This again suggests that playing as an African-American avatar did not induce any post-game attitudinal changes based on racial stereotypes. However, and again similar to the in-game results, post-hoc regression tests indicated that high levels of embodiment was found to significantly predict post-game PE.

When this post-hoc result is viewed alongside research by Ratan and Dawson (2016), Li and Lwin (2016), and Ratan and Sah (2015) potential explanations for the lack of significant results in the main experiment begin to emerge. It may be the case that participants involved in the study did not experience appropriate levels of avatar identification or embodiment, which has been identified as affecting the strength and likelihood of the PE occurring (Ash, 2016; Li & Lwin, 2016; Ratan & Sah, 2015). Furthermore, in the study, the participants were not able to individually customize their avatars, relying instead on the avatars created by the researchers themselves. Therefore, these factors may have contributed to the lack of any significant results relating to either in-game or post-game PEs.

In addition to Ash (2016), the aforementioned study by Sah et al. (2017) likewise contained elements also pertinent to post-game PE consequences. More specifically, and similar to the discussed in-game PE outcomes, significant results were identified for ought-self avatars and healthier food choice post-game, but no significant results for ideal-self and actual-self avatars on healthy food choice post-game.

Similar to the in-game results, it is perhaps surprising that no significant results were identified for the ideal-self condition in terms of post-game healthy food choice (p = 0.10), but this may be explained by the relatively small sample size (n = 41). However, analysis again revealed a positive association between ideal-self avatars and post-game healthy food choice in the expected direction. Nevertheless, this study once again provides evidence for the power of the PE in influencing healthy food choices based on playing as an avatar that resembles the ought-self of a player. This can extend beyond the videogame into affecting physical world post-game health-related behaviors and attitudes, although based on this research the effects of using an ideal-self avatar are still questionable.

The next two studies identified were conducted by Peña et al. (2018) and a later replication using a sample from a different country (Peña & Hernandez Pérez, 2020). Both of these studies attempted to explore the influence of avatar job on post-game attitudes toward immigrants using the dystopian

immigration officer simulation videogame *Papers, Please* and the newspaper editor simulation videogame *Westport Independent* as the control.

In the game *Papers, Please*, players assume the role of an immigration officer and are given the task of reviewing immigrants' documents before deciding whether to deny or grant entry to a fictional country. *Westport Independent* has players assume the role of a newspaper editor who must choose what to publish and what to reject. These two games were selected as they both have similar graphics, style and gameplay mechanics despite the different in-game objectives.

The results indicated a significant decrease in intention, subjective norms, and self-efficacy relating to helping immigrants after playing *Papers, Please* compared to *Westport Independent* among the sample of US undergraduate students (Peña et al., 2018), and a significant decrease in intention and attitudes relating to helping immigrants after playing *Papers, Please* compared to *Westport Independent* among the sample of Spanish undergraduate students (Peña & Hernandez Pérez, 2020).

These results indicate that individuals who performed a job role within a game world may be influenced into changing or adjusting their post-game social and political views to align with their experiences during gameplay. This suggests that, under specific conditions, the PE has the ability to instill notable changes to an individual's attitudes and beliefs concerning important socio-political issues after only a relatively short amount of gameplay time. In addition, while there were some differences identified between the different participant samples from these two studies, such as the attitudes measure, there was an overall significant change in player's socio-political views, in particular concerning intention, regarding immigrants identified in both studies providing some evidence for replicability and cross-cultural validity.

However, it should be noted that the link between the PE and the studies conducted by Peña et al. (2018) and Peña and Hernandez Pérez (2020) may be considered contentious given that gameplay in these videogames does not specifically involve a player-controlled avatar. Instead, players take a first-person view from the game character's perspective, and the player-observed surroundings and context provide the visual clues regarding the avatar. Nevertheless, it may still be reasonably argued that these studies provide evidence for the occurrence of the PE through perspective taking in a specific virtual environment and reliance on visual identity clues regarding an individual's avatar beyond the avatar itself, both of which are congruent with the PE.

The next study was conducted by Sylvia et al. (2014), and attempted to explore the influence of avatar body type on post-game body dissatisfaction and muscle attitudes in the videogame *The Elder Scrolls V: Skyrim* among males. The results indicated that participants controlling a highly muscular avatar reported significantly lower body satisfaction post-game than males playing as an avatar of average build, and there were no significant differences in post-game attitudes toward muscularity.

These results suggest that there was not a post-game PE occurrence for individuals who played the videogame as a highly muscular avatar as assessed using a body satisfaction scale, and in fact individuals who played using a highly muscular avatar were more likely to experience post-game body dissatisfaction than individuals using an avatar of average muscular build. More specifically, previous research on the PE would predict that had the PE occurred, then individuals who played as a muscular avatar would experience higher body satisfaction post-game because higher muscle mass is generally seen as desirable and a key component of body satisfaction among men (Sylvia et al., 2014). In particular, the study by Sylvia et al. (2014) shares fundamental similarities to the study by Yee et al. (2009), who found evidence to suggest that individuals who played as an avatar with an increased height negotiated more confidently both during and after avatar use. However, it should be noted that the participants in the study by Sylvia et al. (2014) were not able to customize their avatars, and were instead assigned pre-built avatars designed by the researchers. As customization has repeatedly been indicated as being important for post-game behavioral and attitudinal changes (Ducheneaut et al., 2009; Ratan & Sah, 2015), it may be the case that the lack of significant results for muscle attitudes could be related to this.

In addition, despite key similarities between the studies by Sylvia et al. (2014) and Yee et al. (2009) regarding post-game PE consequences, two potentially important differences may also help to explain the lack of a PE occurring in the study by Sylvia et al. (2014). Firstly, Yee et al. (2009) based their study on a VR simulation, whereas participants in the study by Sylvia et al. (2014) played the videogame using a more traditional non-VR monitor display. Therefore, it is possible that participants may have experienced a greater degree of avatar embodiment while using VR as opposed to a non-VR monitor, and this may have affected the strength and likelihood of PE occurrence. Secondly, Yee et al. (2009) used a bespoke VR simulation for their experiment, whereas Sylvia et al. (2014) used the commercially available videogame *The Elder Scrolls V: Skyrim*. Therefore, it is possible to argue that, as a consequence of using a custom-made simulation experience as opposed to a commercially available videogame, the experimental context and environment of the study by Yee et al. (2009) may have been more conducive in eliciting a PE. Furthermore, this comparison between Yee et al.'s (2009) and Sylvia et al.'s (2014) highlights the need to differentiate between custom-made virtual environments and those found in commercially available videogame environments.

Another study investigating avatars and self-body image was conducted by Vandenbosch et al. (2017), and was based on the MMO videogame *RuneScape*. In this study, the researchers attempted to explore the influence of sexualized avatars on self-objectification among adolescents. More specifically, the researchers designed avatars with features that corresponded with previously identified characteristics associated with sexualization (Dill & Thill, 2007; Zurbriggen et al., 2007), including male avatars with high muscle mass and revealing clothing and female avatars with slim figures and revealing clothing.

The results indicated that playing as a sexualized avatar of any gender significantly increased self-objectification among both male and female adolescents, and suggests that playing a videogame as an avatar with some form of heightened physical attributes, in this example a sexualized avatar, affects an individual's self-body image and self-perceptions. While the results by Vandenbosch et al. (2017) may not initially be seen as relevant to PE research, and in fact self-objectification can occur in a similar manner after exposure to different forms of media (Aubrey et al., 2009), the observed finding by Vandenbosch et al. (2017) that self-objectification still occurred irrespective of the player and avatar gender incongruence suggests some form of avatar embodiment and PE occurred during this study. In particular, the results by Vandenbosch et al. (2017) suggest that the perceived characteristics of the controlled avatar were observed and embodied by the participants during gameplay and the effects of this persisted after gameplay, and that the experience of being sexualized experienced through playing as a sexualized avatar led to self-objectification due to the occurrence of the PE.

Furthermore, this study highlights an interesting aspect of the PE relating to gender and embodiment. The results indicated that irrespective of either participant or avatar gender, participants still experienced self-objectification. This could be interpreted as meaning that due to successful embodiment of their avatar, the actual physical world gender of the participants was no longer the most salient factor in how participants viewed themselves. While this has been detailed as occurring during avatar use in-game in terms of gender-conforming behaviors (Yee et al., 2011), the fact that the consequences of this cross-gender avatar-embodiment can potentially persist into the post-game world provides a novel insight into how influential the PE can be in terms of behavioral and attitudinal changes.

The next study was conducted by Stavropoulos et al. (2020a) and focused on exploring the associations between avatar race, immersion, and offline behavior based on the results of an online survey conducted with 404 *World of Warcraft* players. The study reported a significant positive association between immersion and offline PE behavior. This suggests that the greater degree to which an individual becomes immersed within the game world increases the post-game PE behaviors reported by individuals. The authors argued that through greater videogame immersion, factors important to the development of post-game PE behaviors such as deindividuation and self-perception become more pronounced.

In addition, the study by Stavropoulos et al. (2020a) also explored immersion and the PE in relation to a specific in-game character race. *World of Warcraft* allows players to choose from a number of different character races including humans, elves and other fantasy creatures, each with unique appearances and backstories. The authors reported that playing as the non-human fantasy race of *Draenei* was also associated with higher immersion and offline PE behaviors. The authors suggested that the specific racial backstory and characteristics of the *Draenei* may increase the likelihood of greater immersion within a population of players that either relate to or desire to be like this particular race. This can increase factors such as avatar embodiment, deindividuation, and immersion, subsequently increasing the likelihood of post-game PE behavioral changes occurring.

The next study, and also based on *World of Warcraft*, was conducted by Stavropoulos et al. (2020b), and was focused on PE profiles and the association with disordered gaming. In this research, three PE classes were identified comprising (i) non-influenced gamers (NIGs) who reported lower perception-cognition and lower emotional and behavioral influences from avatars compared to the other two groups, (ii) perception-cognition influenced gamers (PCIGs) who reported some instances of out of game influences related to avatar use, but without high avatar related emotional or behavioral influences, and (iii) emotion and behavior influenced gamers (EBIGs) who were the most likely to report out of game feelings and behaviors being influenced by their in-game avatars. The study found disordered gaming symptoms were lower among the NIGs and then progressively higher among the PCIGs and EBIGs.

In addition to reporting novel associations between disordered gaming and profiles of gamers in the context of therapeutic formulation and intervention planning, important insight was also provided in terms of different gaming group's characteristics and susceptibility to post-game PE behaviors. Of particular note is the NIG group, which, despite above average videogame participation and achievement scores relative to other groups, were less prone to exhibiting post-game PE behaviors than the other two groups. This indicates that factors such as amount of time playing a videogame do not necessarily determine the likelihood that post-game PE related behaviors will occur, and instead factors such as individual perception and cognition are more relevant the development of post-game PE behaviors.

4. Discussion

The present systematic literature review located and organized the extant psychological literature relating to the PE in the specific context of videogames in order to explore what the consequences of this phenomenon are and how this affects the gamer both in-game and post-game. In terms of in-game consequences that may arise due to the occurrence of the PE phenomenon, a number of novel attitudinal and behavioral changes were identified in the peer-reviewed published literature. For example, two of the included studies (Bian et al., 2015; Yee et al., 2009) explored the effects of playing as an attractive avatar. In these studies, it was found that player performance and social participation were both significantly associated with higher avatar attractiveness. This indicates that the appearance of an avatar in terms of beauty and aesthetics can impact an individual's gameplay experience, which, in these reported cases, means gamers will perform better and be more likely to participate socially in-game. However, it should be noted that in terms of social participation, these effects only impacted initial social contact, and when an individual is required to maintain this social performance, the strength of the PE appears to diminish and the individual's physical world personality once again becomes the dominant factor (Bian et al., 2015).

In addition, the observed physical characteristics of an avatar in terms of weight were also identified as affecting individuals during gameplay in several key ways. This included (i) activity during gameplay (Peña et al., 2016; Peña & Kim, 2014), (ii) healthier food choices in-game (Sah et al., 2017), and (iii) reduced social physique anxiety (Song et al., 2014). Taken together, these studies all appear to indicate that during gameplay, individuals experience a substantial degree of avatar embodiment, and this in turn can affect individuals behaviorally and attitudinally.

In particular, it appears that the observed physical attributes of an avatar can affect in-game behavior, and appropriate customization of an avatar can lead to altered in-game decisions. Furthermore, in cases where an individual experiences some degree of social physique anxiety exercising in the physical world, this anxiety significantly subsides when exercising in a virtual game world despite playing the game while being physically accompanied by others.

Finally, and of particular note, is a study relating to avatar/user gender crossing and gender-conforming in-game behavior. It was reported in the study by Yee et al. (2011) that individuals were significantly more likely to perform gender-conforming in-game behaviors based on the gender of their avatar, and irrespective of their physical world gender. While this initially appears to simply mirror the previously discussed studies relating to avatar appearance affecting in-game behavior and attitudes, it is arguably indicative of something more significant.

Avatar appearance in terms of attractiveness, weight, and other similar cosmetic features are all subjectively appraised and not necessarily stable in the physical world. However, gender is comparatively much more constant, unchanging, and objectively assessable for the majority, although certainly not the entirety, of individuals in the physical world. Furthermore, through unique experiences and various innate differences, gender can be viewed as being a fundamental component of who an individual is and can subsequently have a large role in determining behavior and attitudes. Therefore, in the study by Yee et al. (2011), it is noteworthy that the participants would put aside their physical world gender and perform gender-conforming behaviors in line with their avatar's gender. However, this is only one study concerning this specific aspect of the PE, and drawing such conclusions should be avoided until further empirical evidence is available. Nevertheless, it does tentatively suggest a novel component of the PE in terms of gender fluidity in a game world.

This study, combined with the research on avatar attractiveness and other physical characteristics (e.g., weight), signals the strength and varied effects of the PE in terms of in-game attitudes and behaviors due to purely cosmetic and nonfunctional factors relating to an avatar's appearance. However, in addition to in-game consequences, the research identified in this systematic literature review also indicates that the PE can likewise affect an individual's post-game behavior and attitudes.

For example, two of these studies (Peña et al., 2018; Peña & Hernandez Pérez, 2020) reported evidence suggesting that individuals can be influenced into changing their post-game attitudes and beliefs based on experiences within a videogame. More specifically in these research examples, individuals playing a videogame as a dystopian immigration officer subsequently reported decreased intention to helping immigrants after gameplay. This indicates that under specific conditions, the PE has the power to influence and change an individual's post-game socio-political views. This suggests that the PE can be a potentially powerful mechanism in influencing shifts in post-game attitudes and beliefs concerning physical world events and individuals. Furthermore, the study by Peña and Hernandez Pérez (2020) represented one of very few examples of a replication study. Despite some differences in results, this particular study identified consequences of the post-game PE which can arguably be more confidently asserted in terms of cross-cultural validity than the majority of other studies concerning this phenomenon.

In addition to changes in socio-political views, the present review also identified that the PE can lead to post-game changes to an individual's body image. For example, research has identified that playing as a sexualized avatar is significantly associated with greater self-objectification irrespective of the gender congruence between the player and their avatar (Vandenbosch et al., 2017). Similar to the research based on in-game PE outcomes relating to avatar appearance, this suggests that the physical appearance of an avatar can be an important factor in influencing behavioral or attitudinal changes in an individual in-game and post-game.

In particular, based on this research, it appears that playing a videogame with an avatar comprising heightened or potentially desired physical characteristics can lead to problematic or negative post-game self-perceptions. While these studies provide some insight into how the physical

characteristics of an avatar can affect an individual's attitudes or beliefs post-game, these studies did not assess any behavioral changes that could occur as a consequence of this.

When these studies are viewed alongside the work by Sah et al. (2017), it is possible to make the argument that these consequences represent the first stage to a change in behavior. More specifically, in the study by Sah et al. (2017), participants' physical world behavior appeared to be influenced by playing a videogame using an ought-self avatar, which is how the individual felt they ought to appear in life outside the game. Given the particular experimental manipulation used in these studies, it is possible that after gameplay, participants may have felt their avatars represented an element of their ought-selves, and may have experienced some degree of behavioral changes in an attempt to align themselves with this avatar represented self-concept after the experiment.

It must be acknowledged that this assertion is little more than speculation given the available evidence. However, when considered alongside other related research, an argument may be made in support of this prediction, and this may serve as the basis of future research. In addition, a further aspect of note concerning the study by Vandenbosch et al. (2017) concerns the observation that self-objectification occurred regardless of the gender of the avatar and gamers. More specifically, the results from this study indicated that male participants were still significantly likely to report self-objectification post-game irrespective of the gender of the avatar they controlled, and the same was true for female participants.

In addition, the post-game effects of avatar gender crossing are supported by the study by Ratan and Sah (2015). In their study, female participants playing as a male avatar performed significantly better in a post-game math task than those using a female avatar due to stereotype threat. These two studies link back to the research by Yee et al. (2011) concerning avatar gender and in-game behavior, and suggest that avatar gender may become dominant over physical world gender in terms of perceived stereotypical behavior patterns both in-game and post-game. This again signals the strength of the PE in influencing behavior and attitudes both in-game and also, perhaps more surprisingly, post-game.

However, although these studies indicate that the PE can alter an individual's gender related behavior and attitudes to align with their avatar's gender, this is primarily in the context of conforming to gender stereotypes. This may mean that when an individual manifests an avatar, any behavioral or attitudinal changes that occur through avatar use are based on preexisting schemas held by individuals concerning gender that are derived from or informed by gender stereotypes. This is similar to the research relating to avatar attractiveness and avatar height (Bian et al., 2015: Yee et al., 2009), both of which also involve applying these stereotype-derived behaviors or attitudes to themselves in-game and post-game, and indicate the important role of preexisting schemata in the occurrence of the PE.

Finally, and in addition to these in-game and post-game PE consequences, several of the studies included in the present review identified important factors that appear to contribute to the likelihood of the PE occurring. For example, factors such as avatar customization (Ratan & Sah, 2015), player immersion (Stavropoulos et al., 2020a), avatar self-relevance, and emotional connection (Ratan & Dawson, 2016) appeared to affect the strength and likelihood of the PE occurring in videogames.

In addition, the study by Sah et al. (2017) indicated that an avatar modeled on a particular version of an individual's self, namely the ought-self, was significantly more likely to influence both in-game and post-game changes behavior and decision-making. Furthermore, Ratan and Sah (2015) found that while high avatar embodiment was associated with greater in-game PE consequences, this in fact appeared to inhibit the post-game consequences.

On the other hand, a number of these studies identified various factors that did not appear to affect the likelihood of the PE occurring. For example, the physical characteristics of the gamer in terms of weight were not found to significantly affect the PE consequences related to the user-perceived body weight of an avatar (Peña et al., 2016; Peña & Kim, 2014), nor was the occurrence of the PE necessarily linked to the amount of time an individual plays a game, but rather individual factors such as cognition and perception (Stavropoulos et al., 2020b). In addition, several of these

studies found evidence which indicated that the physical world gender of an individual did neither affect immersion or post-game PE behaviors (Stavropoulos et al., 2020a), self-objectification (Vandenbosch et al., 2017) nor in-game or post-game gender-conforming behaviors (Ratan & Sah, 2015; Yee et al., 2011).

However, and in contrast to these studies, the research by Ratan and Dawson (2016) found evidence to suggest that avatar/user gender consistency improved avatar self-relevance, which is an important factor in determining the strength and likelihood of the PE occurring. Taken together, this indicates that while gender-crossing in a videogame may not necessarily inhibit the PE, playing as an avatar consistent with the individual's physical world gender may improve the likelihood of the PE occurring.

A final point that should be noted in terms of the likelihood of the PE occurring relates to duration and the physical world personality of the gamer. The study conducted by Bian et al. (2015) found evidence to suggest that avatar attractiveness influenced initial social participation irrespective of the gamer's physical world personality, but that these effects diminished while maintaining social contact over a period of time and the physical world personality of the participants again became dominant. This suggests that although the PE can trigger substantial changes to an individual's behavior and attitudes both in-game and post-game, the duration of these changes may only be relatively short and temporary. This question concerning the duration and permanence of the PE has received very limited research attention to date, and would benefit from further exploration in the future.

However, while the present review was able to identify a number of novel ways the PE may manifest in gamers, it must be noted that among these identified studies, there are a number of important limitations indicating any findings discussed must be viewed with a degree of caution. For example, most studies included in the present review only used students as their research participants. In fact, of the 19 studies across 17 papers, 15 were based on a sample of students as participants, and these were predominantly university students from the United States. While research within psychology has a longstanding tendency to use university students due to the relative ease with which they can be recruited, this does impact the extent to which the results from these studies can be generalized to wider populations and cohorts. In particular, it has long been acknowledged that university students differ from the general population in various key ways, and research carried out solely among this population can lead to limited generalizability, a potentially incomplete or narrow range of findings, and even misinformation (e.g., erroneously ascribed effects of a phenomenon; Henrich et al., 2010; Peterson, 2001; Sears, 1986). This suggests that until further research is conducted using a wider range of participants, the generalizability of the results of these discussed studies is relatively limited. However, given that PE research is still a relatively new area of psychological investigation, this limitation is not unique to this topic area and merely indicates a need for further empirical investigation.

A second limitation concerns the videogames and videogame systems used in the studies included. Firstly, in terms of videogame genres, there appears to be a very limited range of videogames included in the reviewed studies, with a tendency for *Wii Sports* simulation videogames or *World of Warcraft*. These videogames are undeniably popular, but still only represent two videogame examples in an arguably over-saturated market where a large collection of different game worlds are available to research and which may yield differences in terms of any PE consequences. While this may mean that the results from this literature review are only applicable to these specific and limited game environments, more concerning is simply the missed opportunities to obtain novel research data from a plethora of available game worlds, many of which having an innate videogame design that lends itself well to PE research. For example, and perhaps most surprising, is the near-total absence of single-player open-world RPGs studies, with only one such study based on the game *The Elder Scrolls V: Skyrim* (Sylvia et al., 2014) identified in the present review. Many of these videogames offer a number of easy to manipulate options that could probe into the consequences of the PE both in-game and post-game, including substantial avatar

customization, deep immersion due to graphical fidelity, perspective options and gameplay mechanics, and often player-based decision-making regarding in-game events and relationships. These factors would lend themselves well to any PE research, and the notable lack of these videogames in this research area indicates a significant under-utilization of available resources.

Finally, and related to the previous point, the majority of the videogame console studies included in this literature review were based on videogames played either on the *Nintendo Wii* or *Xbox 360*. At the time of writing, both of these videogame consoles are now two generations old and largely obsolete. This means these consoles and the videogames available are substantially inferior in terms of both graphical fidelity and gameplay mechanics, which may potentially impact factors important to the occurrence of the PE, such as immersion and avatar-embodiment (Gorisse et al., 2019). Furthermore, this literature review did not identify any PE studies based on commercially available videogames that utilized a VR headset. Although VR videogaming is still a relatively recent innovation, there now exists a wide library of titles that could be appropriately used in this field of study, and which may provide useful research evidence relating to the PE in VR settings while maintaining the greater ecological validity inherent in research involving commercially available videogames.

While this does necessarily detract from the research contribution made by these previous studies, it does suggest that future research using more up-to-date technology may yield different results in terms of the strength and likelihood of the PE occurring in videogames. Furthermore, this signals a need for PE research to both build on previous research study methods as well as align itself with videogame technological advancements in order to contribute relevant and up-to-date research evidence of this phenomenon.

4.1. *Limitations and future research*

The present systematic literature review identified a number of key findings concerning the in-game and post-game consequences of the PE in the context of playing videogames. However, the present review contained several limitations that must be noted. Firstly, as the review was the first such study to separate the various forms of virtual worlds and focus specifically on videogames, no attempt was made to differentiate between potentially important differences between videogames such as different forms of player input and avatar perspective.

In terms of player input, the review identified several different types of videogame controls being used. For example, a large number of the studies were based on *Nintendo Wii* videogames, which characteristically employ motion controls, while others used more traditional gamepads or a computer keyboard and mouse. It is possible that differences exist between these controller types that may affect factors such as immersion and avatar embodiment (Ratan & Sah, 2015). The studies identified in this review used a variety of game perspectives, including: first-person, where an individual observes the game world through the eyes of the avatar; third-person, where an individual views their avatar from behind; or top-down, where the avatar is viewed from above. No attempt was made to differentiate between different game perspectives which may also potentially affect factors important to the likelihood of the PE occurring (Gorisse et al., 2019).

In addition, the present review focused specifically on peer-reviewed journal papers and conference papers, and did not include any 'grey literature' or non-English texts, unpublished PhD theses, and papers published in other non-peer reviewed outlets. This may have led to an under-representation of the available research on this topic as well as increasing the risk of publication bias. In particular, while relying solely on peer-reviewed journal papers may have been useful in ensuring the validity, quality and scientific robustness of the included literature, the findings presented in this review paper were skewed toward positive and confirmatory results concerning the PE. Consequently, a wider and less restricted search of the PE literature may have presented the strength and consequences of the PE in a different light, but any such conclusions would be tempered by the fact that the quality of these studies would not have necessarily been subjected to the rigor and scrutiny of the peer-review process. Furthermore, it may be argued that the search terms used to

obtain the studies included in this review were limited, which may have meant specific potentially relevant studies relating to the PE were not included. However, while this may indicate a limitation with the present literature review, it also signals an opportunity for future research to explore the PE in the context of commercially available videogames with inclusion criteria that includes a wider and less restricted array of research literature in order to complement and expand this field of study.

Furthermore, and related to the previous point, the number of studies that were included in the present systematic literature was limited as only 17 were found to meet the criteria for inclusion in this paper. In addition, many of these studies used a wide range of different methods, materials, and outcome measures. For example, and as previously noted, a large number of these studies focused on a single videogame title or specific outcome relating to the PE, and any follow-up study or similarly designed research was rare among the included literature. This means that many of the results and conclusions relating to the PE discussed within the present paper should be treated with some caution in lieu of supporting and confirmatory research. However, while this limited research may be viewed as a potential limitation, it must also be acknowledged that the field of research relating to the PE in the context of videogames is a relatively new and still developing area of psychology, and that the present literature review provides a novel first attempt at synthesizing this research and provides a basis for future reviews once the research base increases.

Finally, and based on the research findings from the various studies included here, a number of avenues of future research have been identified that may help direct and increase the relevant literature relating to the PE in the context of videogames. In particular, and as previously discussed, future research concerning the PE should attempt to explore videogames in a wider context in terms of genre, gameplay mechanics, and game systems. The findings of the present review identified that very few single-player open-world RPGs have been used as the game environment for PE research, despite being especially well-suited for research into this phenomenon. Furthermore, the present paper identified that the relatively few examples of MMOs were predominantly based on *World of Warcraft*, which represents only one of a large range of online game worlds each with unique features and mechanics that may potentially impact the PE. Therefore, future research should both explore a wider variety of videogames and genres in order to fully utilize the available resources as well as investigate whether differences exist between different game worlds within the same videogame genre.

In addition, there were no commercially available videogames that utilized VR identified in this review, despite relatively wide adoption of this technology by both consumers as well as software developers. Given the greater levels of immersion experienced through VR compared to traditional monitor displays and the importance this has in the occurrence of the PE (Gorisse et al., 2019), research based on commercially available videogames would benefit from utilizing VR in future studies.

Finally, this review identified that very few studies made any attempt to explore how long the PE persists either in-game or, more importantly, post-game. While this particular avenue of investigation represents an opportunity to expand the knowledge base concerning the PE in videogames, it may also become an important ethical issue. The question of ethics in PE research is exemplified in the studies conducted by Peña et al. (2018) and Peña and Hernandez Pérez (2020) which indicated that individuals' post-game physical world socio-political perspectives appeared to be influenced as a consequence of the PE. However, these researchers did not assess how long these effects lasted, and indeed whether or not any changes were permanent. If participants experienced any long-term effects of this research that went beyond the videogame and affected their life and personal values, then this would potentially conflict with ethical guidelines detailed by organizations such as the British Psychological Society Code of Human Research Ethics. The argument can be made that, given that these are commercially available videogames, the participants are not necessarily being exposed to anything they would not experience ordinarily in real life. Nevertheless, should the consequences of the PE be found to be long-term or permanent, it appears prudent to at least acknowledge this when designing and implementing research into this phenomenon, and signals a

need for future research to investigate this potential issue relating to ethical treatment of research participants.

4.2. *Conclusion*

The present systematic literature built on the extant literature relating to the PE by specifically focusing on the consequences of this phenomenon in the context of videogames, and is the first research to do so. Through the review of the available literature, several novel in-game and post-game consequences of the PE were identified that may affect an individual behaviorally and attitudinally, and include changes to factors such as socio-political views, gender-conforming behaviors, self-perceptions, and game performance. In addition, a number of important factors contribute to the likelihood of this phenomenon occurring, such as immersion, avatar customization, embodiment, and avatar self-relevance. Furthermore, through the exploration of the extant literature, several key limitations commonly found among this type of research were highlighted and future avenues of research have been discussed that will expand the current knowledge base relating to the PE in videogames. These limitations include: an over-reliance on obsolete hardware; an under-utilization of available videogame titles and genres; and issues relating to the limited range of participant samples commonly used in PE research. Finally, the present systematic review also highlights the ethical issues of conducting videogame and avatar research based on the PE, which has consistently been overlooked in other PE literature reviews and research (Ratan et al., 2020; Praetorius & Görlich, 2020; Peña et al., 2018; Peña & Hernandez Pérez, 2020). Moreover, as videogame consumption rises and the role of technology and avatars continues to take a progressively critical role in society, these findings relating to the PE will be of increasing relevance and importance in understanding the relationship that can develop between an individual and their virtual world avatar Aubrey, 2009.

Disclosure statement

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