



## Gaming Disorder: A systematic review exploring the user-avatar relationship in videogames<sup>☆</sup>

Kim Szolin<sup>\*</sup>, Daria Kuss, Filip Nuyens, Mark Griffiths

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

### ARTICLE INFO

#### Keywords:

Gaming disorder  
Avatar  
Videogame  
Self-concept  
Identification

### ABSTRACT

Videogames can often be a source of pleasure and relaxation for many individuals, but they can also lead to disordered and potentially addictive behaviour, which is referred to as Gaming Disorder (GD). The purpose of the present systematic literature review was to explore virtual world avatars and the dynamics of the user-avatar relationship in the context of GD utilizing the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) guidelines. A total of 15 peer-reviewed studies were identified that met the inclusion criteria. The results showed a consistent positive association between avatar identification and GD across many of the studies. Gamers with GD often design an avatar to resemble their vision of their ideal self, and the avatar can be used as a means to reduce self-discrepancy between the actual and ideal self as well as compensate for perceived physical-world inadequacies. Moreover, the present review highlights how an individual's view of their ideal self in the context of the user-avatar relationship may extend beyond the limitations of what may be achievable in the physical world and include elements of fantasy derived from a game world.

## Introduction

Videogames have increasingly become a popular entertainment staple of modern culture, with a rise of approximately 700 million players globally in just the past five years with a projected estimate of 3.01 billion players worldwide by the year 2023 (Statista, 2020). Furthermore, videogames have developed into much more than entertainment platforms, and have also seen successful applications in educational, medical, and sports settings (Bavelier & Green, 2019; Cole & Hooley 2013).

With the growth in videogame use and popularity, increasing research attention has focused on the effects or consequences of engaging with videogames and has shown a range of benefits to the gamer. For example, research has identified that gamers engage in videogames to experience pleasure and enjoyment (Boyle et al., 2012) and challenge (Denisova et al., 2020). However, research has also indicated that playing videogames can yield far more substantial benefits to an individual than merely entertainment or passing time. For example, previous studies have demonstrated that videogame use can enhance cognitive skills such as perception, attentional control and decision making (Reynaldo et al., 2021) as well as motivation (Pront et al., 2018) and educational success (Vlachopoulos & Makri, 2017). In addition, research has shown that videogame use can provide a means of coping with and escaping from the stresses or life challenges of the physical world (Melodia et al., 2020; Villani et al., 2018). Furthermore, online videogames and their often intrinsic social component have been shown as an important motivator for engagement with online videogame use (Frostling-Henningsson, 2009; Pontes et al., 2019) and can provide benefits to an individual's social well-being (Raith et al., 2021).

However, although videogame use can be an enjoyable and beneficial experience for many individuals, providing an often harmless and stimulating activity, this is not the case for all gamers. For some individuals, videogaming can become excessive and uncontrollable, leading to various negative physical and psychological effects. In extreme cases, this has been termed as Gaming Disorder (GD).

## ***Gaming Disorder***

GD is defined by the World Health Organization (WHO) in the 11<sup>th</sup> edition of the International Classification of Diseases (ICD-11) as impaired control over gaming behaviour that takes precedence over other life activities and continues or escalates despite occurrence of negative consequences, and causes significant impairment to social, occupational, personal or other area of functioning (WHO, 2018).

A wide variety of different terms have been used to describe the problematic and addictive use of videogames (Pontes & Griffiths, 2014), including, among others: internet gaming addiction, pathological gaming, videogame dependency, and problematic gaming. Although many names have been used to describe excessive and problematic videogame use, literature reviews suggest that these terms have largely been used interchangeably and all point to the same disorder (Petry et al., 2015).

However, differences in conceptualisation and diagnostic criteria exist among these different terms. For example, Internet Gaming Disorder (IGD), detailed in the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5, American Psychiatric Association, 2013), comprises nine diagnostic criteria: preoccupation with gaming, withdrawal symptoms, tolerance, loss of control, loss of interest in other activities, continued overuse, deceiving others about amount of gaming, use of gaming to alleviate negative feelings, functional impairment. Of these nine criteria for IGD, five must be met over the past year to be diagnosed with the disorder, whereas GD listed in the ICD-11 comprises three symptoms (i.e., impaired control over gaming, increasing priority given to gaming, continuation or escalation of gaming despite the occurrence of negative consequences) for an individual to be diagnosed with GD. Furthermore, the biological components related to IGD, such as withdrawal symptoms, are not included in the ICD-11 in favour of the criterion concerning functional impairment (Jo et al., 2019). This indicates that some differences are present between the various terms for disorders related to excessive and problematic gaming, in particular in terms of their diagnostic criteria and conceptualisation of terms.

Before the formal inclusion of IGD in the DSM-5, many terms (e.g., problematic gaming, pathological gaming) had been used for the concept of problematic or excessive gaming (Kuss & Griffiths, 2012). This inconsistency of terms has led to some debate concerning the prevalence of this disorder (Burleigh et al., 2018). However, research conducted by Stevens et al. (2020) indicates that the worldwide prevalence rate of GD to be 1.96% of the global population, and affects males more often than females.

Nevertheless, despite the debate in the field and inconsistency of terms used, a large body of research has developed focused on the associated problems and negative consequences associated with GD, and has found evidence that highlights specifically how GD can have a significant and detrimental impact across several domains of functioning in line with diagnostic criteria (Guglielmucci et al., 2019). For example, research has indicated that GD is associated with a loss of interest in activities outside of gaming and depression (Burleigh et al., 2018), poor social skills (Gentile et al., 2011), and low self-esteem (Niemz et al., 2005). Moreover, these negative consequences may also include decreased academic achievement (Jeong & Kim, 2011), disruption of work and social relationships (Griffiths et al., 2004; Yee, 2006) and social isolation (Yee, 2006). In addition, GD has also been associated with maladaptive coping (Hussain & Griffiths, 2009) and auditory and visual hallucinations (Ortiz de Gortari & Griffiths, 2014).

Clearly, GD can have a detrimental impact on the lives and functioning of individuals suffering from this disorder, and GD has been identified as one of the major factors of videogame use to

negatively affect well-being (Mancini et al., 2019). However, relatively few individuals who play videogames develop GD, as indicated by the study on prevalence of GD conducted by Stevens et al. (2020), which showed a prevalence rate of 1.96% of the global population. While this number is not insignificant, it is nevertheless clear that GD affects only a minority of individuals.

To account for why not all gamers are affected by GD, one explanation has been proposed suggesting that individuals with specific pre-existing psychosocial and personal factors may be predisposed to developing this disorder, including impairment or issues relating to an individual's self-concept (Leménager et al., 2020; Smahel et al., 2008). The self-concept broadly refers to how individuals view themselves based on perceived skills, abilities, appearance and other personal attributes or behaviours (Leménager et al., 2013). More specifically, the self-concept is divided into three parts, including the actual self (i.e., how a person realistically views themselves), ideal self (i.e., how a person would ideally like to be) and the ought self (i.e., how a person feels they ought to be; Higgins, 1987). Higgins (1987) argues that individuals will feel distress if there is substantial distance or discrepancy between their actual self and ideal self, and will be motivated to attempt to reach a state where these two versions of the self are in alignment. When applied to GD, it has been suggested that individuals with low self-esteem or other similar psychosocial dysfunctions may attempt to create an avatar that aligns with their version of their ideal self to compensate for perceived deficits present in their actual self (Leménager et al., 2020; Smahel et al., 2008).

In videogames, most notably Massively Multiplayer Online Role-Playing Games, individuals create and design an avatar which is both their visual representation within the game and the means with which they interact with the virtual world and other players. However, this is not solely restricted to videogames, and similar processes occur across social media platforms, virtual simulations, and other forms of virtual worlds that involve an avatar (Nowak & Fox, 2018). In designing and customising avatars in these different contexts, individuals will base their decisions on various factors relating to both how they see themselves and how they would like to be perceived by others. In addition, individuals may shift between using avatars that represent their ideal, ought or actual selves depending on which aspects of their personality or self they wish to convey to other game players. Furthermore, customisation of an avatar can be influenced by factors such as social influence, conformity, and context (Triberti et al., 2017). For example, individuals may choose to use an avatar deemed more attractive, and therefore more akin to ideal self, if entering a virtual dating scenario (Lin & Wang, 2014; Toma et al., 2008).

In the specific context of videogames, creating an avatar to be an idealised version of an individual's self is quite common and frequently occurs across the spectrum of gamer populations (Sibilla & Mancini, 2018), and is certainly not unique to individuals with depression, low self-esteem, or other similar difficulties. However, problems can arise when significant avatar identification and attachment occurs, which has been shown to be positively associated with depression and negatively associated with social skills and self-esteem (You et al., 2017). Consequently, it has been proposed that individuals who create an idealised self inspired avatar to compensate for an undesirable or negative actual self may use videogames as a medium in which to close the distance and discrepancy between these two versions of the self (Leménager et al., 2020). More specifically, in the virtual world, individuals are given the opportunity and means to possess a virtual version of their ideal self and thereby circumvent or negate the undesirable qualities attributed to their physical world actual self.

A further component vital to this process is avatar identification, which is the extent to which an individual identifies with and feels connected to their avatar (Bowman et al., 2012), and this

has often been positively associated with GD and idealised avatar creation (Mancini et al., 2019; Smahel et al., 2008; You et al., 2017; Zhong & Yao, 2013). Consequently, when the components of avatar identification and self-concept are considered alongside each other, it is possible to see how GD may develop and be maintained for specific individuals with predisposing factors.

More specifically, it may be posited that individuals who experience some form of psychosocial dysfunction, be it depression, poor social skills, or other related problems, who begin engaging in an online videogame may construct an avatar that aligns with their version of their ideal self. There have been various studies highlighting the association between psychosocial dysfunction and this form of avatar creation (Sioni et al., 2017; You et al., 2017), although the temporal precedence of GD or similar technology-based disorders and mood disorders such as anxiety or depression is difficult to firmly establish (Floros et al., 2014). Nevertheless, this ideal self-avatar creation then acts as a compensatory measure for their negative perception of their actual self, meaning that within the online world and while inhabiting the body of their avatar these individuals are able to reduce the discrepancy between their ideal and actual self through high levels of avatar identification. In this way, videogames become the domain in which these individuals feel closest to their ideal self and provide a means to circumvent the perceived inadequacies of their actual self. Furthermore, self-discrepancy theory suggests that these individuals will be motivated to continue this behaviour in order to maintain this reduction in self-discrepancy (Higgins, 1987), which, as a consequence, can lead to either the development and/or maintenance of GD.

### ***The present study***

The role of the avatar can be argued as often being an important component in the development and maintenance of GD given the described link between this disorder and virtual world characters (Mancini et al., 2019; You et al., 2017), and this topic has received increasing research attention. However, despite this, there have been very few attempts to synthesise this research and explore the relationship between individuals with GD and their in-game avatar. Currently, there are three systematic literature reviews conducted that are broadly relevant to this, but they do not specifically explore the role and features of the user-avatar relationship in the context of GD.

Firstly, a systematic literature review by Sibilla and Mancini (2018) explored the user-avatar relationship in Massively Multiplayer Online Worlds. However, in this review, the authors investigated the user-avatar relationship in general terms without using any criteria concerning any specific population. Although gaming addiction was discussed within the paper, it was in the context of relating the user-avatar relationship to various psychological variables such as sociality, motivation, and attitudes, and forms only a relatively minor part of the discussed results within the present review.

This means that while Sibilla and Mancini (2018) provide illuminating insight into the user-avatar relationship in the context of Massively Multiplayer Online Worlds, as well as providing some discussion of gaming addiction, their focus was predominantly on broad-spectrum gamer populations and not specific to gamers with GD. Given the discussed critical role of the avatar in the formation and maintenance of GD, a bespoke review study concerned solely with the user-avatar relationship and the link with GD may help shed light on the relationship between this specific gamer population and their avatars in a manner only hinted at by Sibilla and Mancini (2018).

Secondly, a systematic literature review was conducted by Leménager et al. (2020) which explored self-concept and avatar identification in GD. However, in this review paper the

authors included several studies that investigated avatar identification, but were not linked to GD. In addition, many of the studies included in their review did not explicitly investigate videogame avatars but instead look at factors such as emotional self-concept within general videogame use without reference to avatars. For example, one included study that exemplifies this issue was that of Wartberg et al. (2019), which identified that low self-esteem was linked with GD, but any link to the user-avatar relationship or reference to avatars was never explicitly stated or discussed within the paper.

Accordingly, the merging of research specifically focused on avatars with studies which explore aspects of the gamer's personality with GD (e.g., Wartberg et al., 2019) but which do not discuss avatars means that the conclusions drawn regarding the user-avatar relationship are often arguably tenuous, and instead may refer to relationships with videogames more generally rather than specifically avatars. Consequently, although the paper by Leménager et al. (2020) provides some detail on elements of the user-avatar relationship, the fact that this is frequently merely alluded to with indirect research indicates a notable limitation with their review paper.

The issue of including research that does not reference avatars present in the review by Leménager et al. (2020) is largely addressed by Green et al. (2020), who explored avatar and self-related processes in the context of GD. In particular, these authors specified in their inclusion criteria that only research that references avatars was included in their analysis. However, the purpose of the review paper by Green et al. (2020) was to evaluate research on avatar and self-related processes to understand individual level determinants and risk factors associated with GD to be considered in the context of assessment and treatment of this disorder. While this review by Green et al. (2020) provides some insight into the association between GD and the relationship between a user and their avatar, the actual dynamics of this relationship remain unexplored, and this indicates a notable gap in the GD and user-avatar literature base. More specifically, previous reviews such as the one conducted by Green et al. (2020) do not explicitly discuss how an individual and their avatar interact, the personal role the avatar plays in the users' virtual and physical life world, and the precise details of how and why these user-avatar relationships develop and are maintained.

Consequently, and to address the gap in the current literature, the purpose of the present systematic literature review is to explore in detail the user-avatar relationship in the specific context of GD. While associations between elements such as avatar identification and self-concept processes with GD will be discussed, the main focus of the present review is to explore what this means in terms of the relationship dynamic that develops between a user and their avatar and provide an account of both why this occurs and how it is maintained.

## **Method**

### ***Aims and design***

The present study aimed to synthesise the literature related to the avatar-user relationship in the context of GD and videogames in order to highlight and explore the various consequences this phenomenon has on the gamer. To do this, the study was conducted and presented according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines (Moher et al., 2009).

### ***Inclusion criteria***

In order to be included in the systematic literature review, all studies obtained were required to adhere to a number of different criteria. More specifically, the inclusion criteria were that the studies had to have been (i) published since 2000 to align with the sixth generation of

videogame consoles and the popularisation of online videogaming as well as substantial improvements to graphical fidelity, (ii) published in peer-reviewed journals, (iii) written in English, German, or French (languages spoken by the authors), (iv) specifically investigating avatars, (v) focused on videogames, but with no restriction on the type of videogame in regards to genre, platform and/or online capability, and (vi) focused on GD.

### ***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* using the research team's library *One Search* database search engine, and *Google Scholar*. The search terms used to search for relevant literature in these databases relating to avatar-user relationships in the context of GD were: avatar AND (self\* OR identit\*) AND gam\* (disorder\* OR addict\* OR problem\* OR obsess\* path\* OR compuls\* OR depend\* OR excess\*). These terms were selected in order to obtain literature specific to the avatar-user relationships in the context of GD. In particular, a range of terms for problematic or disordered gaming were used to obtain a wide scope of pertinent literature given their largely synonymous meaning and interchangeable usage within this research area.

### ***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.

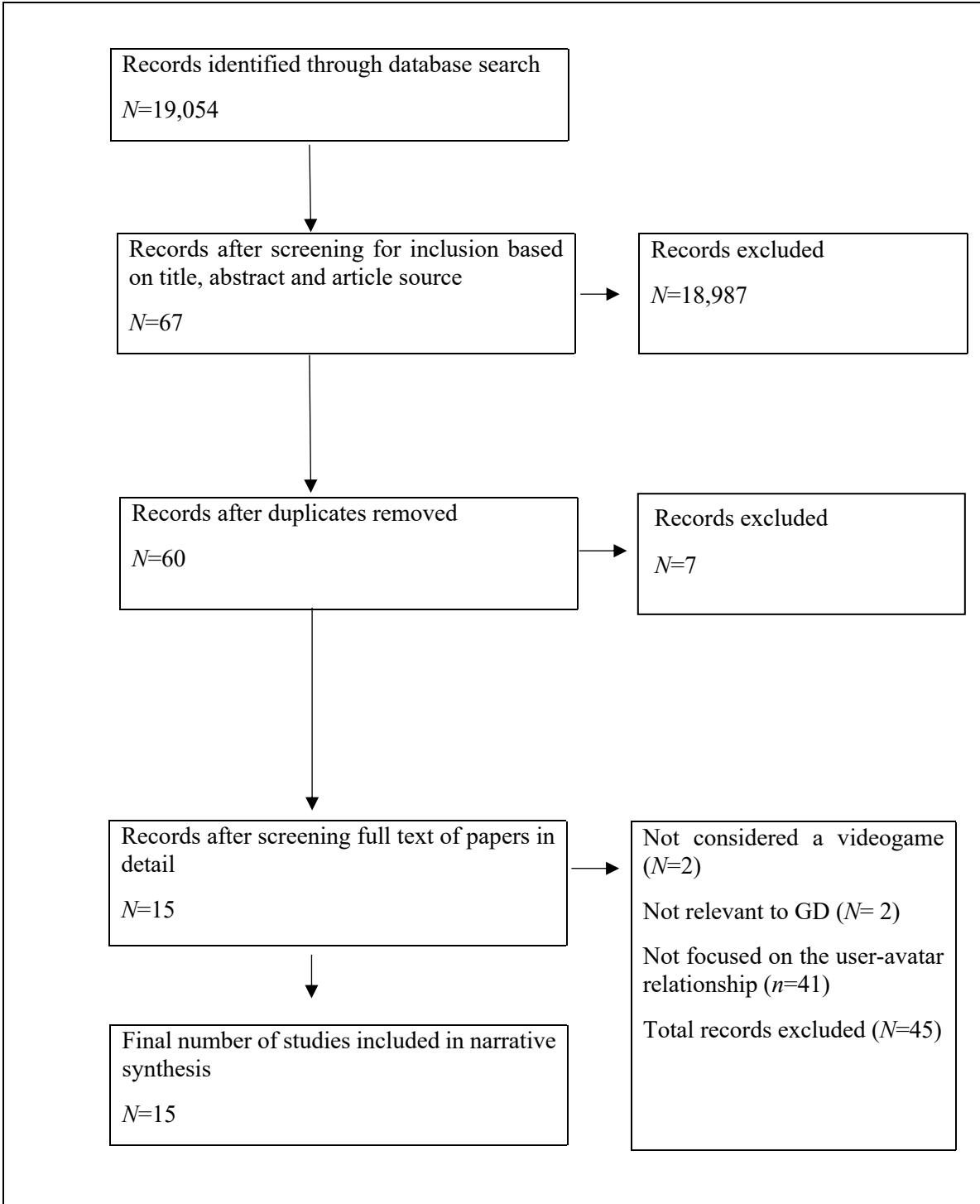


Figure 1: PRISMA flow diagram

## Results

### *Academic literature*

After using the search terms to scope the academic literature, an initial 19,054 papers were identified including 870 from *Google Scholar*. Of these, 11,582 were removed due to either not being published in a peer-reviewed journal or because they were not written in English, German, or French. Next, based on the titles and abstract, 7,405 papers were removed due to not being relevant to the aims of this literature review, and an additional seven were removed due to being duplicates, leaving a total of 60 papers.

The full texts of these remaining papers were then read in detail before removing 45 due to not meeting the aforementioned inclusion criteria, including: (i) not considered a relevant videogame (e.g., social media application) ( $n=2$ ); (ii) not being relevant to GD ( $n=2$ ); and (iii) not being specifically focused on the user-avatar relationship ( $n=41$ ).

In terms of focus on the user-avatar relationship, the application of this criterion meant that any studies that discussed GD and videogames, but which did not make explicit mention of avatars were not included. For example, although the study by Collins et al. (2011) which explored personality traits associated with problematic videogame use was initially identified as being potentially relevant to the present review, closer examination showed that this study did not specifically mention avatars nor any synonymous terms for player-controlled game characters. Therefore, in accordance with the aims of this review paper to explore the user-avatar relationship, studies such as Collins et al. (2011) which may explore videogames and GD or similar related terms but which do not explicitly discuss avatars were removed from the final selection of studies.

This left a total of 15 studies that were included in the present review, and the general characteristics and results of these are summarised in Table 1. These 15 studies contained a number of different aspects of the user-avatar relationship in the context of GD and videogames, and were subsequently divided into three sections: (i) identification, (ii) self-concept, and (iii) functional magnetic resonance imaging (fMRI) studies.

Although the fMRI studies identified in the present review were primarily concerned with avatar identification, these studies used avatar-related stimuli to measure brain responses in order to obtain neurobiological data whereas the other identification studies were based on self-report measures. Accordingly, and given the notably different methods employed and the subsequent form of research evidence obtained, these fMRI studies are presented in a separate and bespoke fMRI category.

### *Identification studies*

A total of ten studies (Burleigh et al, 2018; Liew et al., 2018; Lopez-Fernandez et al., 2019; Mancini et al., 2019; Müller & Bonnaire, 2021; Sioni et al., 2017; Smahel et al., 2008; Stavropoulos et al., 2020; You et al., 2017; Zhong & Yao, 2013) focused on identification between individuals with GD or related disorders and their virtual world avatar.



Study	Sample size and population cohort	Avatar relationship domain explored	Research aims	Measures/instruments	Main results
Burleigh et al., 2017	125 MMO/MMORPG players, including: 64 online cross-sectional respondents (age range 18-29, $M = 23.34$ , $SD = 3.39$ ), 49 males and 15 females; and 61 offline face to face longitudinal respondents (age range 18-29 years, $M = 23.02$ , $SD = 3.43$ ), 29 males and 32 females	Avatar identification	Explore association between depression, gamer-avatar relationship and gaming disorder	Internet Gaming Disorder Scale–Short Form 9 (IGDS-SF9) (Pontes & Griffiths, 2015); Beck Depression Inventory–Second Edition (BDI-II) (Beck et al., 1996); Self-Presence Questionnaire (SPQ) (Ratan & Dawson, 2016)	Stronger GAR significantly associated with increased IGD risk. High depression and GAR are significantly associated with greater risk of IGD than depression with low GAR
Dieter et al., 2014	32 participants, including: 15 addicted (A) and 17 non-addicted (NA) MMORPG players, 26 males (A = 13, NA = 13) and 7 females (A = 3, NA = 4), ( $M_{age} = 26.72$ , $SD = 6.30$ )	Avatar Identification and self-concept (fMRI)	Explore differences in brain activations during avatar-reflection relative to self-reflection and during ideal self-reflection relative to avatar reflection	Checklist for the Assessment of Internet and Computer Game Addiction (AICA_30) (Wölfling et al., 2010); Giessen Test (GT) (Beckmann et al., 1990)	A showed significantly higher bilateral angular gyrus brain activation while reflecting on their avatar during both avatar versus actual self-reflection and significantly higher left-angular gyrus activation reflecting on their avatar during avatar versus ideal self-reflection.

Table 1

Study	Sample size and population cohort	Avatar relationship domain explored	Research aims	Measures/instruments	Main results
Green et al., 2021	991 videogame players recruited from online gaming forums. 725 males and 266 females (18+ years old, $M = 26.4$ , $SD = 8.1$ )	Self-concept and avatar identification	Explore relationship between avatar identification, self-concept clarity and problematic gaming (PG)	Problematic Gaming Checklist (PGC) (Petry et al., 2014); Player Identification Scale (PIS) (van Looy et al., 2012); Self-Concept Clarity Scale (SCS) (Campbell et al., 1996)	Avatar identification was significantly positively associated with PG and significantly negatively associated with self-concept clarity, and self-concept clarity was significantly negatively associated with problematic gaming. There was a significant indirect relationship between avatar identification on problematic gaming mediated through self-concept clarity
Leménager et al., 2013	45 participants, with 15 addicted (A), 15 non-addicted (NA) and 15 naïve/inexperienced (N). 30 males and 15 females evenly distributed between groups ( $M_{age} = 26.33$ , $SD = 4.9$ )	Self-concept	Explore differences in self-concept dimensions between N, NA and N participants	GT (Beckmann et al., 1990); Fragebogen zum Körperbild (body image questionnaire) (FKB-20) (Clement & Löwe, 1996); Emotional Competence Questionnaire (EKF) (Rindermann, 2009); Rosenberg Self Esteem Scale (RSES) (Rosenberg, 2015)	A demonstrated a significantly more negative body appraisal and lower self-esteem compared to N and NA. A showed significantly higher discrepancy between ideal self and actual self as well as significantly lower discrepancy between avatar and ideal self compared to NA and N across nearly all dimensions

Table 1 (Continued)

Study	Sample size and population cohort	Avatar relationship domain explored	Research aims	Measures/instruments	Main results
-------	-----------------------------------	-------------------------------------	---------------	----------------------	--------------

Leménager et al., 2016	38 participants, with 19 pathological gamers (PG) (14 males and 5 females, $M_{age} = 25.68$ , $SD = 6.69$ ) and 19 non-addicted internet users (NA) (7 males and 12 females, $M_{age} = 27.68$ , $SD = 7.95$ ). Recruited through advertisements and clinical patients	Avatar identification (fMRI)	Explore the neural basis of avatar and self-identification in addictive use	AICA (Wölfling et al., 2010); FKB-20 (Clement & Löwe, 1996); Social Anxiety and Social Competence questionnaire (SASKO) (Kolbeck & Maß, 2009); GT (Beckmann et al., 1990)	PG showed significantly greater rejection of own-body image and rated themselves as less attractive compared to NA. PG showed significantly greater social anxiety symptoms compared to NA and significantly higher brain activation in left angular gyrus compared to NA during avatar and self-reflection
Liew et al., 2018	125 participants (64 online and 61 face-to-face) (online composed of 49 males and 15 females aged 18-29 years old, $M = 23.34$ years, $SD = 3.29$ ) (face-to-face composed of 45 males and 16 females aged 18-29 years old, $M = 22.53$ years, $SD = 3.04$ )	Avatar Identification	Explore relationship between IGD, avatar identification and physical activity	IGDS-SF9 (Pontes & Griffiths, 2015); Proto-Self-Presence subscale SPQ (Ratan & Dawson, 2016); active minutes assessed with FitBit Flex (FBF)	Cross sectional and longitudinal data both indicated a significant positive association between PSP and IGD. Longitudinal data also showed PA and PSP significantly interacted (buffering effect) in predicting IGD

Table 1 (Continued)

Study	Sample size and population cohort	Avatar relationship domain explored	Research aims	Measures/instruments	Main results
-------	-----------------------------------	-------------------------------------	---------------	----------------------	--------------

Lopez-Fernandez et al., 2019	625 female gamers (n = 6 addicted) ( $M_{age} = 26.87, SD = 6.9$ ). Recruitment via online posts on game related online forums.	Avatar identification	Explore female gamer profiles, prevalence and characteristics	IGDS-SF9 (Pontes & Griffiths, 2015); Embodied Presence (EP) Subscale of PIS (van Looy et al., 2012); Antecedents of Identification (AOI) (Cohen, 2001)	Significant positive association between IGD scores and EP and IGD scores and AOI.
Mancini et al., 2019	770 participants, with 530 male and 240 females (age range 14-62 years old, $M = 27.48, SD = 9.30$ ). Recruited through online gaming forums and social media sites. 119 participants, with 46 male and 73 female university students (age range 19-35 years old, $M = 23.71, SD = 3.86$ ). Recruited from within Italian university	Avatar identification	Explore relationships among virtual self-discrepancy (VSD), avatar identification (AI), and gaming addiction (GA); Explore relationships among virtual self-discrepancy (VSD), AI, and GA	Embodied Presence subscale of PIS (van Looy et al., 2012); Inclusion of the Avatar in the Self (IAS) (Gabbadini et al., 2014); intention to continue playing game additional item; Big Five Inventory (BFI-10) (Rammstedt & John, 2007); Avatar Identification subscale (AIS) (van Looy et al., 2012); Gaming Addiction Scale (GAS) (Hussain & Griffiths, 2009)	High avatar identification significantly associated with likelihood to continue playing game irrespective of avatar type. Intention to continue to play the game was higher in the participants that customised an idealized avatar and identified with it than those that customised a utopian avatar and did not identify with it; AI and VSD both had a positive significant effect on GA, whereas using a utopian avatar did not unless the participant highly identified with the utopian avatar

Table 1 (Continued)

Study	Sample size and population cohort	Avatar relationship domain explored	Research aims	Measures/instruments	Main results
-------	-----------------------------------	-------------------------------------	---------------	----------------------	--------------

Morcos et al., 2019	404 World of Warcraft players, with 299 females and 83 males ( $M_{age} = 25.56$ years, $SD = 7.61$ ). Online survey using posts on relevant forum sites and social media to recruit gamers	Self-concept	Explore association between <i>Draenei</i> race, compensation of real-life deficits through gaming and IGD	IGDS-SF9 (Pontes & Griffiths, 2015); User-Avatar Questionnaire (UA-Q) (Blinka, 2008)	Significant positive relationship between compensation and IGD. Choosing the <i>Draenei</i> race was significantly associated with increased compensatory behaviour, which in turn associated to higher IGD risk
Müller & Bonnaire, 2021	140 young adult participants (53 females and 87 males) (age range 18-25, $M = 21.02$ , $SD = 1.65$ ) and 61 adolescents (21 females and 40 males) (age range 12-17, $M = 14.43$ , $SD = 2.90$ ). Recruited through Facebook groups and a Parisian school	Avatar identification	Explore the relationships between the process of identity formation, emotion regulation, avatar identification, and gaming	Player-Avatar Identification Scale (PAIS) (Li et al., 2013); Dimension of Identity Development Scale (DIDS) (Zimmerman et al., 2015); Utrecht-Management of Identity Commitments Scale (U-MICS) (Zimmerman et al., 2012); Identity subscale of the Erikson Psychosocial Stage Inventory (EPSI) (Rosenthal et al., 1981); Difficulties in Emotion Regulation Scale (DERS) (Gratz & Roemer, 2004); Emotion Regulation Questionnaire for Children and Adolescents (ERQ-CA) (Gullone & Taffe, 2012); Interpersonal Regulation Questionnaire (IRQ) (Williams et al., 2018); GAS (Hussain & Griffiths, 2009)	Factors associated with high avatar identification were consistently significantly associated with game addiction, as well as across various emotional and social factors detailed in scales

Table 1 (Continued)

Study	Sample size and population cohort	Avatar relationship domain explored	Research aims	Measures/instruments	Main results
-------	-----------------------------------	-------------------------------------	---------------	----------------------	--------------

Sioni et al., 2017	394 participants, with 197 males and 197 females (age range 18-77, $M = 34.3$ , $SD = 11.6$ ). Recruited from online gaming forums	Avatar identification	Explore relationships between social phobia and player-avatar identification	IGD and PAIS (Li et al., 2013); Internet Gaming Disorder scale (IGDS) (Lemmens et al., 2015); Social Phobia Scale-Short Form (SPS-SF) (Peters et al., 2012);	Significant positive relationship between social phobia, avatar identification and IGD
Smahel et al., 2008	548 MMORPG player participants (84 females, 464 males) divided into 3 age groups (adolescents, 12–19 years and 26.9% of the sample; young adults, 20–26 years and 36.3% of the sample; and adults 27+ years and 36.8% of the sample). Recruited from international game servers	Avatar identification	Explore how player relationship to their character affected potential gaming addiction	Custom made questionnaire composed of 64 items, including 14 items related to potential MMORPG addiction, and 10 items on user-avatar relationship (Smahel et al., 2008)	Significant relationship between avatar identification and addiction scores. Measures of avatar pride and shame were both significantly associated with game addiction

Table 1 (Continued)

Study	Sample size and population cohort	Avatar relationship domain explored	Research aims	Measures/instruments	Main results
-------	-----------------------------------	-------------------------------------	---------------	----------------------	--------------

Stavropoulos et al., 2020	1022 World of Warcraft players, with 202 females and 820 males ( $M_{age} = 28.60$ years, $SD = 9.90$ ). Online survey using posts on relevant forum sites and social media to recruit gamers	Avatar identification	Proteus effect profiles and the link to disordered gaming	Proteus Effect Scale (PES) (van Looy et al., 2012); IGDS-SF9 (Pontes & Griffiths, 2015)	Three PE classes identified, including: non-influenced gamers (NIGs), perception-cognition influenced gamers (PCIGs), and emotion and behaviour influenced gamers (EBIGs). Reported disordered gaming symptoms were lower for the NIGs and then progressively higher for PCIGs and EBIGs
You et al., 2017	163 participants, with 71 male and 92 female students. Recruited from third-year middle school at two South Korean schools	Avatar identification	Explore the relationship of various psychosocial variables and avatar identification (AI) to online game addiction (GA)	The Self-esteem Scale (SE-S) (Rosenberg, 1965); Centre for Epidemiology Studies Depression Scale (CED-S) (Radloff, 1977); Interpersonal communication Inventory (ICI) (Bienvenu, 1971); Avatar Identification measurement (AI) (You et al., 2017); Game Addiction measurement (GA) (Lee & Ahn, 2002)	Self-esteem and social skills had significant negative link with GA and AI. Depression had a significant positive relationship with GA and AI. Depression had an indirect effect on GA via AI. Social skills had both indirect (via AI) and direct effects on GA

Table 1 (Continued)

Study	Sample size and population cohort	Avatar relationship domain explored	Research aims	Measures/instruments	Main results
-------	-----------------------------------	-------------------------------------	---------------	----------------------	--------------

Zhong & Yao, 2013	217 student participants, with 94 male, 97 female and 28 undisclosed gender (age range 18-37 years, $M_{age} = 21.64$ , $SD = 2.29$ ). Recruited from two Hong Kong universities	Avatar identification	Explore the effects of gaming motivations and avatar self-identification (ASI) on symptoms of online game addiction (GA)	Gaming Motivation questionnaire) (Zhong & Yao, 2013); Avatar Self-Identification Scale (ASIS) (Zhong & Yao, 2013); Game Addiction Test (GAT) (Huh & Bowman, 2008)	ASI is significantly positively associated with the problems and salience dimension as well as the uncontrollable game-play dimension of GA. ASI also significantly associated with relaxation and socialisations gaming motives.
-------------------	----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-----------------------	--------------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------	-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

---

Table 1 (Continued)



Burleigh et al. (2018) explored depression and the gamer-avatar relationship (GAR) as potential risk factors for the development of IGD for young and emerging adults (aged 18-29 years old) using both cross-sectional and longitudinal data across three time points over a three-month period. The results of this study indicated that stronger GAR and higher depression scores were significantly associated with increased IGD risk, GAR moderating the relationship between depression scores and IGD. In addition, longitudinal data indicated that an increase in GAR score at time one significantly predicted an increase in IGD score at time three. These results indicate that GAR and depression may both act as risk factors for the development of IGD, and GAR increases the effects of depression scores in the development of IGD.

This suggests that emerging adults who identified strongly with their online avatar and who experienced greater depression symptoms appeared to be at greater risk of developing IGD, indicating that these individuals have a strong bond with their virtual world avatar. In particular, the researcher's measurement of GAR was the Self-Presence Questionnaire (Ratan & Dawson, 2016), which examines different areas of avatar identification. High scores across these three domains were significantly associated to IGD, suggesting that the relationship between individuals with IGD and their online avatar transcended beyond a mere superficial closeness or attachment to this virtual character. Instead, the separation between user and avatar becomes distorted and begins to merge, transforming the avatar into a virtual representation of the user rather than simply controlling a character.

The next study was conducted by Liew et al. (2018) and was focused on the interplay between the user-avatar relationship and physical activity on IGD. Similar to the previous study by Burleigh et al. (2018), this study also focused on IGD among emerging adults and used both cross-sectional and longitudinal data. However, although this study also used the Self-Presence Questionnaire, only one aspect of avatar identification was explored, namely proto self-presence which considers user-avatar physical body identification. The results of the study demonstrated a significant positive association between proto-self presence scores and IGD behaviours using the cross-sectional data. This association was further supported by the longitudinal data which also found a positive significant relationship between proto-self presence and IGD. In addition, a significant interaction effect was identified between proto-self presence and physical activity in affecting IGD behaviours. More specifically, it was found that the IGD scores of individuals with high proto-self presence scores decreased if they also presented with high physical activity scores.

Furthermore, the results of this study found a significant moderating effect of physical activity on IGD among individuals who scored highly on avatar identification, indicating higher physical activity had a buffering effect and weakened the risk of IGD behaviours amongst individuals with high proto-self presence scores. Potentially, this may be due to physical world activity being a distraction to the virtual world, and thereby separating the user from their virtual self in favour of their physical self. In addition, elements often associated with physical activity, such as goal achievement, initiation, and strengthening of personal relationships, and pleasure derived from being active may compete with the rewards and benefits seemingly proffered by virtual world participation (Liew et al., 2018). This suggests that potentially the relationship between the user and avatar in the context of IGD may be based on compensatory measures, and that users with low PA may use the virtual world accessed via their avatar to gain these benefits seemingly associated with physical world PA. Accordingly, the avatar becomes the means with which factors such as goal achievement, personal relationships and even pleasure are obtained, therefore reinforcing the bond between user and avatar. However, this relationship is also seemingly weak and compensatory in the face of an alternative

opportunity of deriving these benefits, as can be seen by the lowering of IGD and PSP through the introduction of physical activity.

The next study was conducted by Lopez-Fernandez et al. (2019), and explored female gamer profiles and the predictors, prevalence, and characteristics of IGD among this population. While many aspects of this study were not specifically relevant to GD or the user-avatar relationship, several parts of this study's analysis were pertinent to these elements. In particular, the results indicated a positive significant association between IGD scores and embodied presence, which refers to how connected an individual feels to their avatar. In addition, the study also reported a positive significant association between IGD scores and antecedents of identification, which refers to an individual's experiences with their avatar during gameplay. These results indicate that female gamers who score highly on IGD have a strong and highly connected bond to their avatar. Furthermore, in a field of research often dominated by male participants, the study's results provide a unique perspective into the user-avatar relationship among female gamers, and this bond between a user and their virtual world avatar in the context of disordered gaming appears relatively stable across genders based on the available evidence.

The next study identified was conducted by Mancini et al. (2019) focused on avatar identification and gaming addiction in the context of utopian and idealised avatars, and comprised two studies (i.e., a survey and an experiment). In both studies, idealised avatars were defined as avatars designed to reflect an individual's idealised version of their self, whereas utopian avatars were defined as having traits or characteristics that the user could not have in the physical world. The survey study explored avatar identification, gaming addiction (GA) and virtual self-discrepancy, which refers to the difference between the virtual and physical world selves of the gamer. The results indicated that avatar identification and virtual self-discrepancy both had a positive significant relationship with GA scores, whereas using a utopian avatar did not unless the participant highly identified with the utopian avatar. This suggests that identifying strongly with an avatar, irrespective of whether this is an idealised or utopian avatar, is associated with higher gaming addiction risk.

The second part of Mancini et al.'s (2019) paper also explored avatar identification through an experimental design. Here, participants were asked to play a Massively Multiplayer Online Role-Playing Game (i.e., *World of Warcraft*) and completed measures assessing personality, avatar identification as well as their intention to continue playing after finishing the experiment which was designed to be indicative of potential gaming addiction risk. The results indicated that participants who identified with their avatar were more likely to continue playing the online game irrespective of using either idealised or utopian avatar, but this result was not significant ( $p = .054$ ). In addition, intention to continue to play the game was higher among participants who customised an idealized avatar and identified with it than among participants who customised a utopian avatar and did not identify with it. However, it should be noted that the assessment of future gaming disorder risk in the study by Mancini et al. (2019) relied on intention to continue to play the game. While intention to continue playing a game may be a precursor to gaming disorder for some individuals, it is certainly not the case for most gamers and is a potentially poor indicator of future gaming disorder risk. Nevertheless, the results across both studies by Mancini et al. (2019) indicate that identification with an avatar is not necessarily predicated on perceived similarity with the avatar, but can still occur when the avatar holds characteristics that extend even beyond the idealised version of the self. This means that a strong relationship may still develop between a user and avatar irrespective of whether that avatar conforms to an idealised vision of the individual or is constructed using a utopian image (Mancini et al., 2019).

The next study was conducted by Müller and Bonnaire (2021) and also explored avatar identification as well as the relationships between the process of identity formation, emotion regulation and problematic gaming (PG) among young adults (18-25 years old) and adolescents (12-17 years old). The results indicated that factors associated with high avatar identification were consistently significantly associated with problematic gaming, as well as significantly lower emotional regulation across age groups. This suggests that there is a positive association between high avatar identification and PG risk. Furthermore, an association was identified between PG and lower emotional regulation. However, based on these data alone, it is impossible to determine the existence or direction of the causal link (i.e., whether PG negatively impacts emotional regulation or whether poor emotional regulation makes individuals more susceptible to PG).

The next study by Sioni et al. (2017) also investigated the relationships between IGD and player-avatar identification as well as social phobia. The results indicated that social phobia was significantly positively associated with both avatar identification and IGD, and that avatar identification was also significantly positively associated with IGD. In addition, further analysis indicated that avatar identification mediated the relationship between social phobia and IGD.

The study by Sioni et al. (2017) provides important insight concerning the relationship between individuals with social phobia and their avatar in the context of IGD. Previous research has indicated that individuals with social phobia have a wide discrepancy between their perceived actual self and ideal self (Moore & Johnson, 2009). In a videogame, an individual has the ability to create a new version of themselves through their virtual world avatar that is more closely aligned to their ideal self, and, through this, socially phobic individuals can reduce this self-discrepancy and adopt a more idealised version of themselves as their identity. This may help to explain the high levels of avatar identification among this group, and indicates that for these individuals the relationship they have with their avatar is based on assuming a new identity that is more closely aligned with their ideal self. As such, this transcends a mere relationship with a character seen as separate from the individual, but rather signals a merging of the physical world and virtual world identities of the game player to achieve a state of contentment with their identity.

The next study identified was conducted by Smahel et al. (2008) examined how player identification to their character affected potential gaming addiction. The results indicated a significant positive association between avatar identification and game addiction. In addition, there was a significant positive relationship between game addiction and feelings of pride and shame towards the avatar. This identified tendency for individuals who scored highly for IGD to experience greater levels of shame as well as pride towards their avatar is particularly noteworthy in the context of the user-avatar relationship for two key reasons. Firstly, it suggests that individuals with IGD may have a tendency to experience stronger emotional ties to their in-game avatar, which may be indicative of a closer bond or relationship with their in-game character. Secondly, the indication that individuals who score highly for IGD experience seemingly opposing emotions, namely pride and shame, suggests this relationship is highly nuanced and multi-faceted.

In particular, the findings of Smahel et al. (2008) indicate a fluctuating and contradictory relationship with the avatar. On the one hand, feelings of pride may be interpreted as being a result of time spent nurturing and honing this character to excel within the game world, potentially leading to both a vicarious experience of goal achievement through their avatar as well as a reduction in self-discrepancy through creating and perfecting what may be perceived as an idealised version of the individual's self. Conversely, feelings of shame may occur in

parallel to this through acknowledgement that the virtual representation of their self is indeed separate to the physical world self, in which case the avatar becomes both a vehicle to realise an individual's ideal self as well as being a staunch reminder of the inadequacies of their physical world self and their dependence on the virtual world to achieve their ideal self.

The next study was conducted by Stavropoulos et al. (2020), and examined avatar identification in the specific context of the Proteus Effect (PE) and how this associated with disordered gaming. The PE refers to the phenomenon whereby individuals are influenced attitudinally or behaviourally by the perceived characteristics of their avatar (Yee & Bailenson, 2007). This process is heavily reliant on the user's identification with their avatar, which can lead to disruption to the individual's self-concept and assimilation of the attributes or characteristics of their controlled avatar, and can affect the user both during and after gameplay (Yee & Bailenson, 2009; Peña et al., 2009). The results of Stavropoulos et al.'s (2020) study indicated three separate classes comprising: non-influenced gamers (NIGs), perception-cognition influenced gamers (PCIGs), and emotion and behaviour influenced gamers (EBIGs). Of these three classes, disordered gaming symptoms were lower for the NIGs and then progressively higher for PCIGs and EBIGs. More specifically, (i) NIGs reported lower perception-cognition and lower emotional and behavioural influences from avatars compared to the other two groups, (ii) PCIGs reported some instances of out of game influences related to avatar use, but without high avatar-related emotional or behavioural influences, and (iii) EBIGs were the most likely to report out of game feelings and behaviours being influenced by their in-game avatars.

These results suggest that avatar identification seen through PE activation is associated with IGD behaviours and symptoms, and high susceptibility to the PE is positively associated with an increased risk of IGD. In particular, it indicates that gamers who are more influenced by their avatar become increasingly more likely to exhibit IGD symptoms. Furthermore, the results highlight another interesting facet of the user-avatar relationship, namely a double-sided permeability in terms of influence in both the avatar and user. More specifically, whereas previous research (e.g., Burleigh et al, 2018; Liew et al., 2018; Lopez-Fernandez et al., 2019; Mancini et al., 2019; Müller & Bonnaire, 2021; Sioni et al., 2017; Smahel et al., 2008) indicated that the avatar can be influenced and moulded to become a means for an individual to live out their ideal self, the research by Stavropoulos et al. (2020) suggests that the avatar can in turn also influence the user. This suggests that as an individual becomes more closely connected to their avatar, the avatar itself becomes a potentially more dominant force over the user.

The next study conducted by You et al. (2017) investigated the relationship between a number of psychosocial variables (e.g., self-esteem, social skills, depression) and avatar identification on online game addiction. The results indicated that self-esteem and social skills both had a significant negative association with gaming addiction. In addition, depression had a significant positive relationship with both gaming addiction and avatar identification. Finally, depression had an indirect effect on gaming addiction through avatar identification, and social skills had both an indirect effect through avatar identification and a direct effect on gaming addiction. These results indicate that both high avatar identification and gaming addiction are positively associated with depression and poor social skills and low self-esteem. Furthermore, through mediation analysis, it appears that depression is associated with gaming addiction through avatar identification, which suggests that gaming addiction alone is not indicative of depression, but is in fact associated with avatar identification which is associated with depression. This suggests that individuals with depression are more likely to identify with their avatar and then this in turn may increase their vulnerability to develop gaming addiction.

As discussed, You et al. (2017) found that social skills were both directly and indirectly associated with game addiction through avatar identification. In terms of the user-avatar

relationship, this suggests that individuals may use their avatar or time in a virtual world to compensate for (or distract from) potential social inadequacies found in the physical world. Individuals with poor social skills may turn to the virtual world in order to obtain relationships that are difficult to find and manage in the physical world or simply to divert their attention away from any social problems they may have (Goodman et al., 2018; Kuss et al., 2013). Here, the avatar becomes either a conduit for relationships or a means of coping with a lack of social contacts, which may in turn lead to the development or maintenance of an addictive or disordered relationship with videogame playing.

The final study in this section examining avatar identification was conducted by Zhong and Yao (2013) who explored the effects of gaming motivations and avatar self-identification in relation to symptoms of gaming addiction. The results indicated that avatar identification was significantly positively associated with both the salience and uncontrollable game-play dimensions of gaming addiction. This indicates that gaming is an important activity for individuals with gaming addiction and that they find it hard to control the amount of time they spend gaming. In addition, Zhong and Yao. (2013) identified that avatar identification was also significantly associated with both relaxation and socialisation motives for gaming. These results concerning an association with socialisation fit well with the findings by both You et al. (2017) and Sioni's (2017). More specifically, Sioni et al. (2017) indicated that individuals with social phobia may use their avatar as a means of socialising in a controlled and easier to manage environment found in the virtual world, and You et al. (2017) found evidence that high avatar identification was associated with poor social skills. When the findings of these three studies are combined, it may be argued that gamers may use their avatar and virtual relationships as an alternative to physical world relationships. In this way, the avatar becomes more than a player-controlled virtual character, and can be seen as the primary key to obtaining and managing relationships for these individuals.

### ***Self-concept studies***

Three studies (Green et al., 2021; Leménager et al., 2013; Morcos et al., 2019) were based on aspects of the user self-concept and the association this has with their online game avatar, including: self-concept (Green et al., 2021), compensation through an avatar (Morcos et al., 2019), and self-image and self-esteem (Leménager et al., 2013). While several of these studies also included some measure of avatar identification, the primary focus of each of these studies was based on elements of self-concept or considered avatar identification within the context of self-concept.

The first study was conducted by Green et al. (2021), and explored the relationship between self-concept clarity and problematic gaming as well as avatar identification. More specifically, the study focused on whether avatar characteristics affected identification, and whether this was mediated by self-concept clarity. The results indicated that avatar identification was significantly positively associated with problematic gaming and significantly negatively associated with self-concept clarity. In addition, self-concept clarity was significantly negatively associated with problematic gaming. There was also a significant direct and indirect relationship between avatar identification and problematic gaming mediated through self-concept clarity. Self-concept clarity here refers to the extent to which individuals hold beliefs or schemas concerning themselves that are clear, stable, and confidently defined (Green et al., 2021). This indicates that individuals with a poorer sense of self are more likely to identify with their avatar potentially as a mean to compensate for instability or deficiencies in their physical world identity, which in turn leads these individuals to become more vulnerable to problematic gaming. This may mean that individuals rely on their avatar as a means of personal identity confirmation due to a maladaptive physical world self-concept, and highlights the

importance of avatar identification as a process as well as the potential reasons for this process to occur, namely to achieve a more stable and clearly defined self-concept.

In addition, Green et al. (2021) found that avatar identification was not significantly associated with the type of avatar in terms of being human or a non-human creature. However, identification was found to be significantly higher among females than males, higher among gamers utilizing both first-person and third-person camera perspectives compared to just one option, and higher among gamers who customised and had the option to customise their avatars.

The next study identified was conducted by Leménager et al. (2013) and examined self-concept deficits in the context of Massively Multiplayer Online Role-Playing Game and gaming addiction among addicted players, non-addicted players, and individuals who did not have any prior experience with Massively Multiplayer Online Role-Playing Games. The results indicated that addicted players demonstrated a significantly more negative body appraisal and lower self-esteem compared to non-addicted and naïve players. In addition, addicted players showed significantly lower discrepancies between ideal self and avatar ratings as well as a higher discrepancy between their actual and ideal self on nearly all domains of the self-concept compared to non-addicted and naïve players.

These results suggest that addicted or disordered players have both lower self-esteem and a more negative body image than non-addicted or naïve players. Furthermore, addicted players create and use avatars that are more closely aligned with their image of an ideal self and there is considerable distance between their ideal and actual self compared to non-addicted and naïve players (Leménager et al., 2013). These results suggest that individuals with game addiction may demonstrate a substantial distance between their actual self and their vision of their ideal self, and that this distance is reduced through creation and customisation of an avatar that aligns with this ideal self. Accordingly, the avatar may be a means of achieving and maintaining an ideal self, and thereby reducing the distress that occurs through self-discrepancy (Higgins, 1987).

The final study that explored aspects of the self-concept was conducted by Morcos et al. (2019). In this study, the researchers investigated the association between playing as the *Draenei* race (i.e., blue, anthropomorphised beast-creatures), compensation of real life deficits through gaming, and IGD. The results showed a significant positive relationship between compensation behaviours and IGD. In addition, choosing to play as the *Draenei* race was significantly associated with increased compensatory behaviour, which in turn was associated with higher IGD risk. These results indicate that individuals who rely on their avatars as a means of compensating for physical world deficits or inadequacies are at greater risk of developing IGD, and this can occur even when playing as an avatar which does not visually reflect the game player's physical world self.

Moreover, the study by Morcos et al. (2019) also indicated a significant association between playing as the *Draenei* race in *World of Warcraft*, compensatory behaviour and IGD, which provides a link to the studies by Green et al. (2021) and Mancini et al. (2019). More specifically, Green et al. (2021) found that avatar identification was not significantly associated with the type of avatar in terms of being a human or a non-human creature, and Mancini et al. (2019) found that playing as a utopian avatar, that is an avatar that does not resemble how a user looks in the physical world, did not negatively affect risk of IGD providing the user was able to identify with this avatar type. The blue, anthropomorphised beast creatures of the *Draenei* race in *World of Warcraft* appear to have relatively little in common visually with physical world humans. Consequently, the identified result that playing as this race of creatures

is significantly associated with avatar-user compensatory behaviour (Morcos et al., 2019) appears to provide some support for both Green et al.'s (2021) and Mancini et al.'s (2019) findings, and suggests that using a physical world template of an ideal self is not the only form of avatar that a user can develop a close bond with that can compensate for physical world inadequacies and deficits.

### ***Functional magnetic resonance imaging studies***

Two papers (Dieter et al., 2014; Leménager et al., 2016) were identified that explored the user-avatar relationship in the context of online videogames and GD using fMRI. More specifically, both of these studies examined the neural basis and regions of brain activation during avatar and self identifications.

Firstly, Dieter et al. (2014) examined differences between addicted and non-addicted videogame players during reflection of their avatar and versions of their self-concept using fMRI scans. The results indicated that addicted gamers showed significantly higher bilateral angular gyrus brain activation while reflecting on their avatar during both avatar versus actual self-reflection and significantly higher left-angular gyrus activation reflecting on their avatar during avatar versus ideal self-reflection. The left-angular gyrus is a brain region often associated with self-identification, processing and distinguishing individuals from others (Decety & Chaminade, 2003; Decety & Grezes, 2006) and has previously been shown to demonstrate increased activation during long-term Massively Multiplayer Online Role-Playing Game player's reflection of their avatar compared to their self, their friends, or individuals distant to the participant (Ganesh et al., 2012). This results obtained by Dieter et al. (2014) suggest that addicted gamers identify more strongly with their avatar compared to either their actual self or their ideal self.

The second fMRI study by Leménager et al. (2016) explored the neural basis of avatar and self-identifications among pathological internet gamers. The results indicated that pathological gamers showed significantly greater rejection of own-body image and rated themselves as less attractive compared to the control group. Pathological gamers also showed significantly greater social anxiety symptoms compared to control group gamers. Finally, pathological gamers demonstrated significantly higher brain activation in the left angular gyrus compared to healthy controls during avatar and self-reflection.

In both of these studies, greater neural activity was identified in regions of the brain during reflection of a user's avatar compared to both their actual self (Dieter et al., 2014; Leménager et al., 2016) as well as compared to reflection of a user's ideal self (Dieter et al., 2014). This offers support for the previously discussed studies identified in the present review concerning avatar identification by providing fMRI-based data that corresponds with the conclusions drawn from studies using self-report methods. The fMRI research appears to indicate that users with GD identify more strongly with their virtual world avatar than both their actual self and even their vision of an idealised self. This suggests that to these users their virtual world identity experienced through an avatar is their primary identity, to which their physical world self assumes a subservient and perhaps even superfluous position. This indicates the important role the avatar has in the user-avatar relationship, providing not only an opportunity for an individual to realise their vision of an ideal self unrestricted by the constraints of the physical world, but also potentially subjectively more 'real' to the user.

## **Discussion**

The present systematic literature review identified and organised the psychological literature relating to virtual world avatar research in the context of GD in order to provide a detailed account of the relationship that develops between a user and their in-game virtual character, which were discussed in terms of avatar identification, self-concept, and fMRI studies.

The ten studies included in this review relating to avatar identification (Burleigh et al., 2018; Liew et al., 2018; Lopez-Fernandez et al., 2019; Mancini et al., 2019; Müller & Bonnaire, 2021; Sioni et al., 2017; Smahel et al., 2008; Stavropoulos et al., 2020; You et al., 2017; Zhong & Yao, 2013) consistently demonstrated an association between high avatar identification and high GD using various different instruments and scales to assess these factors. This indicates that the avatar is something substantially more personal than simply a means for a player to complete in-game goals and objectives or a vehicle with which to navigate a virtual environment, although it also certainly encompasses these elements. Instead, the avatar may be seen as a virtual world extension of the player's identity.

In addition to avatar identification, three studies were identified in this review paper that focused on the self-concept in the context of GD and avatars (Green et al., 2021; Leménager et al., 2013; Morcos et al., 2019). While each of these studies individually provided some insight into the user-avatar relationship in the context of GD, they become particularly insightful when combined with the previously discussed research concerning avatar identification.

For example, results obtained by Green et al. (2021) found that low-self-concept clarity was associated with GD. When combined with the research by Sioni et al. (2017) concerning social phobia, a clearer picture of the user-avatar relationship begins to emerge. Videogame users with social phobia or similar anxiety may create an avatar that reflects their ideal self (Leménager et al., 2013) which is held as a truer representation of their self that is unconstrained by perceived physical world limitations and inadequacies, and this process is facilitated by a poor self-concept clarity. As such, a user may then increasingly identify with their avatar as a truer representation of their self and consequently be progressively reliant on their virtual world alter ego as a form of compensatory measure for physical world shortcomings. This aligns well with consistent results relating to avatar identification and the association this has with GD (Burleigh et al., 2018; Liew et al., 2018; Lopez-Fernandez et al., 2019; Mancini et al., 2019; Müller & Bonnaire, 2021; Sioni et al., 2017; Smahel et al., 2008; Stavropoulos et al., 2020; You et al., 2017; Zhong & Yao, 2013). In addition, further support for this comes from research by Leménager et al. (2013). In this study, it was found that players with GD create and use avatars that are more closely aligned with the user's image of an ideal self and that there is considerable distance between their vision of their ideal and perceived actual self. This supports the argument that the avatar is a means with which an individual can create and merge with their vision of their ideal self, and is therefore a likely compensatory measure for physical world inadequacies and perceived personal limitations.

However, there is also a further and unexplored aspect to the user-avatar relationship in the context of avatar creation using an ideal self template that is tentatively hinted at when various studies included in the present review are combined, namely the amalgamation of utopian and idealised avatars. An idealised version of the self is described as how an individual would ideally like to be (Higgins, 1987), whereas Mancini et al. (2019) describe a utopian avatar as possessing characteristics that the user could not have in the physical world. As such, utopian avatars are detailed as being beyond the idealised self and therefore should be separate and unaffected by self-discrepancy theory (Mancini et al., 2019). Consequently, the results in the study by Mancini et al. (2019) which indicated that the type of avatar an individual uses (be it utopian or idealised) is irrelevant in terms of GD risk as identification, and the subsequent emotional bond that occurs, appeared to be the prevailing factor for GD risk.



This research by Mancini et al. (2019) concerning avatar type initially appears to simply provide support the importance of the role of identification in terms of a user developing a relationship with their avatar. However when this is viewed alongside the research by Morcos et al. (2019) and Green et al. (2021), a further interesting component of the ideal self and the user-avatar relationship emerges. Green et al. (2021) found that avatar identification was not significantly associated with the type of avatar in terms of being a human or non-human creature, which initially appears to support the conclusions drawn by Mancini et al. (2019). However, this association becomes more complicated when considered alongside the research by Morcos et al. (2019) who found that playing as the *Draenei* race (i.e., anthropomorphised beast creatures present in *World of Warcraft*) was significantly associated with increased compensatory behaviour which in turn was associated with higher GD risk.

As aforementioned, an idealised avatar is likely a means with which an individual compensates for physical world inadequacies and perceived personal limitations in relation to the self. However, Morcos et al. (2019) indicated that playing as the *Draenei* is significantly associated with compensatory behaviours, despite being unrepresentative of how an individual could appear as in the physical world and would therefore be described as a utopian avatar. This may mean that within the virtual world the distinction between utopian and ideal self avatars does not necessarily exist for all users, and that an individual's vision of their ideal self may take on characteristics that are impossible to achieve in the physical world. This is supported by the findings of Green et al. (2021) indicating that identification with an avatar can appear irrespective of avatar appearance in terms of physical world human characteristics.

Consequently, Mancini et al.'s (2019) findings suggesting that avatar type was irrelevant in terms of GD development and risk may in fact mean that those users involved in the study saw their utopian avatar as an idealised version of their self. If this is the case, then it means that an avatar is not only a means to achieve an idealised version of the self, but that this ideal self has a much broader template in the virtual world than the physical world and may incorporate elements of fantasy derived from the game world. One possible explanation for this may be an error in defining what an ideal self is, and that there is in fact no such thing as a utopian avatar. While early research concerning types of self and self-discrepancy (Higgins, 1987) does not pre-date computer games, it does harken back to a time of limited computer graphics, capabilities, and audiences. Furthermore, it does not necessarily incorporate the merging of the virtual, and inherently fantasy, world and physical world, evidence of which has directly or indirectly been provided by all the studies included in the present review as well as numerous other studies exploring avatars and gaming more generally. As such, with the amalgamation of virtual world fantasy and physical world reality, either of which can appear as 'real' as the other depending on the perceptions of the individual, it is perhaps limiting to think of the ideal self as only being able to conform to the template of what is possible in the physical world. With this in mind, a further dimension is added to the user-avatar relationship, chiefly that an avatar can be a vehicle to not only achieve an ideal self that conforms to the realities of what can be achieved in the physical world, but also a vision of an ideal self that is no longer constrained by these restrictions.

In addition, research concerning the *Draenei* race by Morcos et al. (2019) also opens up an element of the user-avatar relationship not yet explored in the research identified in this review, namely the assimilation of the pre-existing identity of the avatar. It is perhaps assumed that all avatars begin as a blank canvas and are then moulded and shaped in their entirety according to the desires and intention of the user. However, this is not the case for all videogames, and in fact many such videogames offer a selection of different species or factions as possible characters, often with deep and intricate in-game histories and backstories. While players can

choose how much attention they pay to their avatar's racial or faction history and backstory, if this is a consideration for individuals who are creating an idealised version of themselves, then this may impact the user-avatar relationship in a multi-directional manner when considered alongside research based on the PE. More specifically, an individual may choose an avatar race with characteristics that align with their vision of their ideal self, but rather than simply mirroring this ideal self the perceived characteristics of the avatar may in fact then influence the user attitudinally and behaviourally. In this way, the user not only chooses an avatar to align with their ideal self, but the avatar itself then begins to exert influence on the user through the PE, thereby potentially reinforcing these desired characteristics and creating a stronger and more stable ideal self. This potentially means that the user-avatar relationship is not necessarily only one-dimensional, and that the avatar is not just a template on which to draw an idealised self, but also a means of actively reinforcing this version of the self via the PE.

Finally, two studies examined the user-avatar relationship in the context of GD using fMRI methods (Dieter et al., 2014; Leménager et al., 2016). Specifically, in explaining the user-avatar relationship, the findings from Dieter et al. (2014) and Leménager et al. (2016) are particularly noteworthy for two key reasons. Firstly, they support the previously aforementioned discussed studies that focus on avatar identifications and self-concept by providing data that are arguably more objective in nature and less susceptible to participant manipulation or unintentional inaccuracy. The common theme inherent in studies focused on exploring the user-avatar relationship included in the present review is the reliance on self-report measures and scales. This is potentially problematic while assessing the validity of such studies because it requires the individuals involved to be both honest and introspective. While it seems unlikely that any participants would be motivated to answer such questions in a dishonest manner and the degree of introspection and self-reflection required would be arguably largely minimal in the measures and scales often employed, validity nevertheless remains a consideration, albeit a small one. However, the inclusion of concurring research based on fMRI data provides some additional credibility to these studies and strengthens the conclusions drawn concerning avatar identifications and self-concept. Secondly, the results obtained by Dieter et al. (2014) indicated higher angular gyrus activity during reflection of an individual's avatar compared to their ideal self. This suggests that the avatar may not only be a realisation of an individual's ideal self, but that this arguably more tangible version of the ideal self is identified with more strongly than the incorporeal mental image of an individual's ideal self, which further illustrates the close bond between user and avatar.

In addition, the results from Leménager et al. (2016) appear to support a number of previously discussed studies pertaining to specific elements of avatar identifications or self-concept, including the association between social anxiety, GD, and identifications (Sioni et al., 2017; You et al., 2017), and issues with body-image (Leménager et al., 2013). This consequently strengthens the credibility of this previous research relating to these areas of avatar identifications and self-concept by providing fMRI data that support the results seen in self-report-based studies.

However, while the present review was able to highlight a number of features of the user-avatar relationship in the context of GD, a number of limitations consistent throughout the research were also identified. Firstly, the majority of the studies included in the review neither comment on the specific game world being investigated, nor whether a number of different game worlds were included within a single study. This is potentially problematic as it seemingly treats all videogame players homogeneously, with no attempt to distinguish between different game players and game worlds. More specifically, identification with an individual's character or the bond that develops between user and avatar may be affected by factors such as gameplay

mechanics (Papale, 2014), customisation options (Li & Lwin, 2016), and even graphical fidelity (Gorisse et al., 2019), and the differences in these factors could vary substantially between games. Of the relatively few studies that provided some indication as to the game world being investigated, these were solely based on the game *World of Warcraft*. This may signal a further issue given the potential for differences between games and the as yet largely unexplored effect this may have on the user-avatar relationship.

Related to this point, a second limitation may be seen in relation to the type of game being investigated by GD research. The majority of research relating to GD or any similar term are based on online games such as the Massively Multiplayer Online Role-Playing Game *World of Warcraft*. However, these games represent only a fraction of potentially relevant videogame environments that include an avatar and in which a user may develop a relationship with their virtual world character. Furthermore, it seems likely that differences may exist between these online and offline virtual worlds in terms of both GD and the user-avatar relationship. For example, in a Massively Multiplayer Online Role-Playing Game, a user's avatar is frequently viewed and interacted with by other players, but this would clearly not be the case in an offline game where the virtual world is a private environment. As such, the presence of other players may influence how an individual customises their avatar and which version of their self an individual chooses to display or to what extent they are prepared to experiment with their virtual world identity, which in turn could affect factors such as avatar-identification, the user-avatar relationship and potentially even GD. Accordingly, this indicates a notable gap in the current literature base, and future research will benefit from exploring GD in the context of offline games and the differences that may exist between online and offline virtual worlds.

Finally, a further limitation present in the research identified in the current review relates to study characteristics. Although specific aspects of the study characteristics of this collection of research provide strength to the overall conclusions drawn, such as the wide range of participant samples and recruitment methods employed, one particular and consistent issue is present among this research that presents a notable limitation, namely the use of different measurements and terms for GD and related disorders. As previously discussed, a myriad of different terms for GD are used in this field of study (Pontes & Griffiths, 2014), and despite largely pointing to the same condition (Petry et al., 2015) these often have varying conceptualisations and diagnostic criteria. For example, the description of GD in the ICD-11 (WHO, 2018) and IGD in the DSM-5 (American Psychiatric Association, 2013) seemingly describe the same condition. However, the ICD-11 presents GD as an addictive disorder, and removes the biological components such as withdrawal introduced by the DSM-5 and provides a different set of diagnostic criteria (Jo et al., 2019). Within the present review, a range of different measurements for IGD, GD and various other forms of videogame-related disorders are present, all seemingly pointing to the same condition but each using a different assessment tool. Whilst it is difficult to precisely determine to what extent this may have affected the results from each individual study, this lack of uniformity in the field of videogame-related disorders and addiction does present a limitation when synthesising and drawing conclusions from a large body of research.

### ***Limitations and future research***

This present literature reviewed a number of key findings relating to the user-avatar relationship in the context of GD. However, the review also contained a number of limitations that should be acknowledged. Firstly, the search terms used in this paper may have potentially limited the number of relevant studies included, in particular given the wide variety of different

terms for GD. Consequently, although care was taken to include a number of different terms for GD, it is possible that potentially relevant studies were not included.

Secondly, the eligibility criteria used in this review paper to separate relevant from non-relevant papers may have limited the number of studies included in this review. This paper strictly determined only studies that focused on the user-avatar relationship were included. However, this meant that a large number of studies that investigated videogames but did not specifically mention the avatar were not included. While this ensured that only studies strictly relevant to the user-avatar relationship were included, it may be argued that excluded studies may have provided the opportunity to infer some insight concerning this relationship dynamic even if this was indirect or assumed rather than explicitly relevant. In addition, the present review focused specifically on peer-reviewed journal papers and did not include any 'grey literature' or non-English, French or German texts, unpublished PhD theses, and papers published in non-peer reviewed outlets. This may have led to an under-representation of the available research on this topic and may have increased the risk of publication bias.

Finally, and based on the findings presented in the present review paper, several avenues for future research have been identified. Firstly, and in line with the identified limitations present in the present review, future research may benefit from using a less restricted search strategy. In particular, future research may identify a larger number of relevant studies using appropriate synonyms for an avatar, such as 'character' or 'icon'. Whilst these are not used as widely or extensively as the term 'avatar' in videogames, they may nevertheless be present in the literature. In addition, and as previously discussed, the present review only included studies that were published in peer-reviewed journals, and future research may also benefit from exploring relevant papers from a wider set of outlets to include unpublished PhD theses, and papers published in non-peer reviewed outlets. However, some care should be taken when utilising this 'grey literature' as the quality of these papers cannot be as readily assured as those found in peer-reviewed journals.

Secondly, in terms of utopian and idealised avatar types, this review indicates a potential overlap between these two avatar templates that is as yet unexplored. Based on the combined findings from Mancini et al. (2019), Morcos et al. (2019) and Green et al. (2021), an argument may be made that within the context of avatars and the virtual world, an individual's vision of their ideal self may have substantially greater freedom in available desirable characteristics compared to the ideal self of the physical world. If this is the case, then there are likely important implications concerning the user-avatar relationship, the self-concept and self-discrepancy and the role of the virtual world specifically in how this environment may allow individuals to experiment with and achieve a sense of self that cannot occur in the physical world. While this assertion is largely speculative given the available evidence, this may prove an interesting avenue of future research that may hold important implications to the user-avatar relationship and avatar research more generally.

Thirdly, throughout the review, avatar identification was consistently strongly associated with GD, and which also forms a critical role in the occurrence of the PE. In all the studies identified here, only one paper (Stavropoulos et al., 2020) explored GD in this context. The results indicated an association between GD symptom severity and PE susceptibility, suggesting that individuals who score highly on a measure of GD are more likely to experience some form of PE consequence from gaming.

This association between GD and the PE is supported by the array of included literature concerning avatar identification present in this review (Burleigh et al., 2018; Dieter et al., 2014; Leménager et al., 2016; Liew et al., 2018; Lopez-Ferdandez et al., 2019; Mancini et al., 2019;

Müller & Bonnaire, 2021; Sioni et al., 2017; Smahel et al., 2008; Stavropoulos et al., 2020; You et al., 2017; Zhong & Yao, 2013), and how avatar identification is often associated as a critical component of the PE (Li & Lwin, 2016; Ratan & Dawson, 2016; Song et al., 2014)). This suggests that any research focused on exploring the consequences of the PE may benefit from using individuals with GD as their sample for two key reasons. Firstly, as has been aforementioned, individuals with GD have a tendency to influence their avatar to align with the user's version of their ideal self. However, in line with the PE, it may be that the avatar is also simultaneously exerting influence on the user and may affect them attitudinally and behaviourally both in-game and outside of the game-world. This means an interesting component of the user-avatar relationship in the context of GD remains unexplored, but may play a critical role in influencing behaviour and attitudes among these individuals.

Finally, researchers focused on exploring the PE may find using a sample of individuals with GD beneficial to strengthening the observed consequences of this phenomenon. More specifically, any study investigating an aspect of the PE may potentially see results more extreme while using a sample of GD compared to comparatively healthy individuals due to their recorded increased susceptibility to this phenomenon. The extant research combining GD and the PE is as yet largely unexplored, with only one such study identified here (Stavropoulos et al., 2020). Consequently, given the relationship between GD and the PE, this signals a potentially informative avenue of future research that may benefit both topic areas.

### ***Conclusion***

The present systematic literature review has built on and expanded the extant literature relating to factors such as avatar identification and self-concept domains and processes in the context of GD by specifically considering this research in terms of the user-avatar relationship in virtual world environments. Through the review of the available literature, several key aspects of this relationship dynamic have been uncovered. This includes the indication that users with GD will often design an avatar to resemble their vision of their ideal self, and through playing as this virtual world character, players reduce the discrepancy between their physical world actual self and ideal self as well as compensate for perceived physical world inadequacies. Furthermore, research shows this virtual world self inhabited through an avatar is identified with more deeply and meaningfully than the user's physical world identity, and occurs even at a neurophysiological level through greater activation of the angular gyrus region of the brain. In addition, this review provides tentative evidence that in the context of videogame avatars, an individual's concept of their ideal self may incorporate elements of fantasy inherent to game worlds but unobtainable in the physical world, and thereby potentially adding a new dimension to theories on self-concept. Finally, several limitations present in this area of research were discussed as well as different avenues of future research to expand the knowledge base of GD and avatar research as well a potential and largely unexplored association to PE research which may yield valuable research data and expand both these fields of study.

## References

- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA.
- Bavelier, D., & Green, C. S. (2019). Enhancing attentional control: Lessons from action video games. *Neuron*, *104*(1), 147-163. <https://doi.org/10.1016/j.neuron.2019.09.031>
- Beck, A., Steer, R., & Brown, G. (1996). *BDI-II, Beck depression inventory: Manual*. San Antonio: The Psychological Corporation. <https://doi.org/10.1037/t00742-000>
- Beckmann D, Brähler E, & Richter H.E. (1990): *Der Gießen -Test (GT)*. Bern: Huber.
- Biennu Sr, M. J. (1971). An interpersonal communication inventory. *Journal of Communication*, *21*(4), 381-388. <https://doi.org/10.1111/j.1460-2466.1971.tb02937.x>
- Blinka, L. (2008). The relationship of players to their avatars in MMORPGs: Differences between adolescents, emerging adults and adults. *Cyberpsychology: Journal of Psychosocial Research on Cyberspace*, *2*(1), 1–7. <https://cyberpsychology.eu/article/view/4211>.
- Bowman, N. D., Schultheiss, D., & Schumann, C. (2012). “I'm attached, and I'm a good guy/gal!”: How character attachment influences pro-and anti-social motivations to play massively multiplayer online role-playing games. *Cyberpsychology, Behavior, and Social Networking*, *15*(3), 169-174. <https://doi.org/10.1089/cyber.2011.0311>
- Boyle, E. A., Connolly, T. M., Hainey, T., & Boyle, J. M. (2012). Engagement in digital entertainment games: A systematic review. *Computers in Human Behavior*, *28*(3), 771-780. <https://doi.org/10.1016/j.chb.2011.11.020>
- Burleigh, T. L., Stavropoulos, V., Liew, L. W., Adams, B. L., & Griffiths, M. D. (2018). Depression, internet gaming disorder, and the moderating effect of the gamer-avatar relationship: An exploratory longitudinal study. *International Journal of Mental Health and Addiction*, *16*(1), 102-124. <https://doi.org/10.1007/s11469-017-9806-3>
- Campbell, J. D., Trapnell, P. D., Heine, S. J., Katz, I. M., Lavalley, L. F., & Lehman, D. R. (1996). Self-concept clarity: Measurement, personality correlates, and cultural boundaries. *Journal of Personality and Social Psychology*, *70*(1), 141–156. <https://doi.org/10.1037/0022-3514.70.1.141>
- Clement, U., & Löwe, B. (1996). The validation of the Body-Image Questionnaire (BIQ): A German-language instrument for assessing body image disturbances in patients with psychosomatic disorders. *PPmP: Psychotherapie Psychosomatik Medizinische Psychologie*, *46*(7), 254–259. <https://psycnet.apa.org/record/1996-94184-002>
- Cohen, J. (2001). Defining identification: A theoretical look at the identification of audiences with media characters. *Mass Communication & Society*, *4*(3), 245-264. [https://doi.org/10.1207/S15327825MCS0403\\_01](https://doi.org/10.1207/S15327825MCS0403_01)
- Cole, S. H., & Hooley, J. M. (2013). Clinical and personality correlates of MMO gaming: Anxiety and absorption in problematic internet use. *Social Science Computer Review*, *31*(4), 424-436. <https://doi.org/10.1177/0894439312475280>
- Collins, E., Freeman, J., & Chamarro-Premuzic, T. (2012). Personality traits associated with problematic and non-problematic massively multiplayer online role playing game use. *Personality and Individual Differences*, *52*(2), 133-138. <https://doi.org/10.1016/j.paid.2011.09.015>

- Decety, J., & Chaminade, T. (2003). When the self represents the other: A new cognitive neuroscience view on psychological identification. *Consciousness and Cognition*, *12*(4), 577-596. [https://doi.org/10.1016/S1053-8100\(03\)00076-X](https://doi.org/10.1016/S1053-8100(03)00076-X)
- Decety, J., & Grèzes, J. (2006). The power of simulation: Imagining an individual's own and other's behavior. *Brain Research*, *1079*(1), 4-14. <https://doi.org/10.1016/j.brainres.2005.12.115>
- Dieter, J., Hill, H., Sell, M., Reinhard, I., Vollstädt-Klein, S., Kiefer, F., Mann, K., & Leménager, T. (2015). Avatar's neurobiological traces in the self-concept of massively multiplayer online role-playing game (MMORPG) addicts. *Behavioral Neuroscience*, *129*(1), 8-17. <https://doi.org/10.1037/bne0000025>
- Denisova, A., Cairns, P., Guckelsberger, C., & Zendle, D. (2020). Measuring perceived challenge in digital games: Development & validation of the challenge originating from recent gameplay interaction scale (CORGIS). *International Journal of Human-Computer Studies*, *137*, 1-46. <https://doi.org/10.1016/j.ijhcs.2019.102383>
- Floros, G., Siomos, K., Stogiannidou, A., Giouzevas, I., & Garyfallos, G. (2014). Comorbidity of psychiatric disorders with Internet addiction in a clinical sample: The effect of personality, defense style and psychopathology. *Addictive Behaviors*, *39*(12), 1839-1845. <https://doi.org/10.1016/j.addbeh.2014.07.031>
- Frostling-Henningsson, M. (2009). First-person shooter games as a way of connecting to people: "Brothers in blood". *Cyberpsychology & Behavior*, *12*(5), 557-562. <https://doi.org/10.1089/cpb.2008.0345>
- Gabbiadini, A., Mari, S., Volpato, C., & Monaci, M. G. (2014). Identification processes in online groups: Identity motives in the virtual realm of MMORPGs. *Journal of Media Psychology*, *26*(3), 141–152. <https://doi.org/10.1027/1864-1105/a000119>.
- Ganesh, S., Van Schie, H. T., De Lange, F. P., Thompson, E., & Wigboldus, D. H. (2012). How the human brain goes virtual: Distinct cortical regions of the person-processing network are involved in self-identification with virtual agents. *Cerebral Cortex*, *22*(7), 1577-1585. <https://doi.org/10.1093/cercor/bhr227>
- Gentile, D. A., Choo, H., Liau, A., Sim, T., Li, D., Fung, D., & Khoo, A. (2011). Pathological video game use among youths: a two-year longitudinal study. *Pediatrics*, *127*(2), 319-329. <https://doi.org/10.1542/peds.2010-1353>
- Goodman, F. R., Doorley, J. D., & Kashdan, T. B. (2018). Well-being and psychopathology: A deep exploration into positive emotions, meaning and purpose in life, and social relationships. In E. Diener, S. Oishi, & L. Tay (Eds.), *Handbook of well-being*. Salt Lake City, UT: DEF Publishers. DOI:nobascholar.com
- Gorisse, G., Christmann, O., Houzangbe, S., & Richir, S. (2019). From robot to virtual doppelgänger: Impact of visual fidelity of avatars controlled in third-person perspective on embodiment and behavior in immersive virtual environments. *Frontiers in Robotics and AI*, *6*(8), 1-14. <https://doi.org/10.3389/frobt.2019.00008>
- Gratz, K.L., & Roemer, L. (2004). Multidimensional assessment of emotion regulation and dysregulation: Development, factor structure, and initial validation of the difficulties in Emotion Regulation Scale. *Journal of Psychopathology and Behavioral Assessment*, *26*(1), 41–54. <https://doi.org/10.1023/B:JOBA.0000007455.08539.94>

- Green, R., Delfabbro, P. H., & King, D. L. (2020). Avatar-and self-related processes and problematic gaming: A systematic review. *Addictive Behaviors, 108*, 106461. <https://doi.org/10.1016/j.addbeh.2020.106461>
- Green, R., Delfabbro, P. H., & King, D. L. (2021). Avatar identification and problematic gaming: The role of self-concept clarity. *Addictive Behaviors, 113*, 106694. <https://doi.org/10.1016/j.addbeh.2020.106694>
- Griffiths, M. D., Davies, M. N., & Chappell, D. (2004). Demographic factors and playing variables in online computer gaming. *CyberPsychology & Behavior, 7*(4), 479-487. <https://doi.org/10.1089/cpb.2004.7.479>
- Griffiths, M. D., Kuss, D. J., & Pontes, H. M. (2016). A brief overview of Internet gaming disorder and its treatment. *Australian Clinical Psychologist, 2*(1), 20108. <https://acp.scholasticahq.com/article/787-a-brief-overview-of-internet-gaming-disorder-and-its-treatment>
- Guglielmucci, F., Monti, M., Franzoi, I. G., Santoro, G., Granieri, A., Billieux, J., & Schimmenti, A. (2019). Dissociation in problematic gaming: a systematic review. *Current Addiction Reports, 6*(1), 1-14. <https://doi.org/10.1007/s40429-019-0237-z>
- Gullone, E., Taffe, J., (2012). Emotion regulation questionnaire for children and adolescents (ERQ-CA): A psychometric evaluation. *Psychological Assessment 24*(2), 409–417. <https://doi.org/10.1037/a0025777>
- Higgins, E. T. (1987). Self-discrepancy: A theory relating self and affect. *Psychological Review, 94*(3), 319-340. <https://doi.org/10.1037/0033-295X.94.3.319>
- Huh, S., & Bowman, N. D. (2008). Perception of and addiction to online games as a function of personality traits. *Journal of Media Psychology, 13*(2), 1-31. <https://doi.org/10.3352/jeehp.2008.5.1>
- Hussain, Z., & Griffiths, M. D. (2009). Excessive use of massively multi-player online role-playing games: A pilot study. *International Journal of Mental Health and Addiction, 7*(4), 563-571. <https://doi.org/10.1007/s11469-009-9202-8>
- Jeong, E. J., & Kim, D. H. (2011). Social activities, self-efficacy, game attitudes, and game addiction. *Cyberpsychology, Behavior, and Social Networking, 14*(4), 213-221. <https://doi.org/10.1089/cyber.2009.0289>
- Jo, Y. S., Bhang, S. Y., Choi, J. S., Lee, H. K., Lee, S. Y., & Kweon, Y. S. (2019). Clinical characteristics of diagnosis for internet gaming disorder: comparison of DSM-5 IGD and ICD-11 GD diagnosis. *Journal of Clinical Medicine, 8*(7), 945-958. <https://doi.org/10.3390/jcm8070945>
- Kolbeck, S., & Maß, R. (2009). SASKO: *Fragebogen zu sozialer Angst und sozialen Kompetenzdefiziten*. Göttingen: Hogrefe.
- Kuss, D. J., & Griffiths, M. D. (2012b). Online gaming addiction in children and adolescents: a review of empirical research. *Journal of Behavioral Addictions, 1*(1), 3–22. <https://doi.org/10.1556/jba.1.2012.1.1>
- Kuss, D. J., Shorter, G. W., van Rooij, A. J., Griffiths, M. D., & Schoenmakers, T. M. (2014). Assessing internet addiction using the parsimonious internet addiction components model—a preliminary study. *International Journal of Mental Health and Addiction, 12*(3), 351-366. <https://doi.org/10.1007/s11469-013-9459-9>



- Lee, H. C., & Ahn, C. Y. (2002). Development of the internet game addiction diagnostic scale. *Korean J Health Psychol*, 7(2), 211-39. <https://doi.org/10.1016/j.addbeh.2014.01.020>
- Leménager T, Dieter J, Hill H, Hoffmann S, Reinhard I, Beutel M, Vollstädt-Klein S, Kiefer F, Mann K. (2016). Exploring the neural basis of avatar identification in pathological internet gamers and of self-reflection in pathological social network users. *Journal of Behavioral Addictions*, 5(3), 485-499. <https://doi.org/10.1556/2006.5.2016.048>
- Leménager, T., Gwodz, A., Richter, A., Reinhard, I., Kämmerer, N., Sell, M., & Mann, K. (2013). Self-concept deficits in massively multiplayer online role-playing games addiction. *European Addiction Research*, 19(5), 227-234. <https://doi.org/10.1159/000345458>
- Leménager, T., Neissner, M., Sabo, T., Mann, K., & Kiefer, F. (2020). “Who am I” and “How should I be”: A systematic review on self-concept and avatar identification in gaming Disorder. *Current Addiction Reports*, 7(2), 166-193. <https://doi.org/10.1007/s40429-020-00307-x>
- Lemmens, J. S., Valkenburg, P. M., & Gentile, D. A. (2015). The Internet Gaming Disorder Scale. *Psychological Assessment*, 27(2), 567–582. <https://doi.org/10.1037/pas0000062>
- Li, D.D., Liao, A.K., Khoo, A., 2013. Player-avatar identification in video gaming: Concept and measurement. *Computers in Human Behavior*. 29, 257–263. <https://doi.org/10.1016/j.chb.2012.09.002>
- Li, B. J., & Lwin, M. O. (2016). Player see, player do: Testing an exergame motivation model based on the influence of the self avatar. *Computers in Human Behavior*, 59, 350-357. <https://doi.org/10.1016/j.chb.2016.02.034>
- Lin, H., & Wang, H. (2014). Avatar creation in virtual worlds: Behaviors and motivations. *Computers in Human Behavior*, 34, 213-218. <https://doi.org/10.1016/j.chb.2013.10.005>
- Liew, L. W., Stavropoulos, V., Adams, B. L., Burleigh, T. L., & Griffiths, M. D. (2018). Internet gaming disorder: The interplay between physical activity and user–avatar relationship. *Behaviour & Information Technology*, 37(6), 558-574. <https://doi.org/10.1080/0144929X.2018.1464599>
- Lopez-Fernandez, O., Williams, A. J., & Kuss, D. J. (2019). Measuring female gaming: Gamer profile, predictors, prevalence, and characteristics from psychological and gender perspectives. *Frontiers in Psychology*, 10, 898-911. <https://doi.org/10.3389/fpsyg.2019.00898>
- Mancini, T., Imperato, C., & Sibilla, F. (2019). Does avatar's character and emotional bond expose to gaming addiction? Two studies on virtual self-discrepancy, avatar identification and gaming addiction in massively multiplayer online role-playing game players. *Computers in Human Behavior*, 92, 297-305. <https://doi.org/10.1016/j.chb.2018.11.007>
- Melodia, F., Canale, N., Griffiths, M. D. (2021). The role of avoidance coping and escape motives in problematic online gaming: A systematic literature review. *International Journal of Mental Health and Addiction*. Advance online publication. <https://doi.org/10.1007/s11469-020-00422-w>
- Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & Prisma Group. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *PloS Medicine*, 6(7), e1000097. <https://doi.org/10.1371/journal.pmed.1000097>

- Morcos, M., Stavropoulos, V., Rennie, J. J., Clark, M., & Pontes, H. M. (2019). Internet gaming disorder: Compensating as a Draenei in World of Warcraft. *International Journal of Mental Health and Addiction*, 1-17. <https://doi.org/10.1007/s11469-019-00098-x>
- Moore, K., & Johnson, A. (2009). Social anxiety: Prevalence, types and coping among adolescent girls. In K.A. Moore, & P. Buchwald (Eds.), *Stress and anxiety: Application to adolescence, job stress and personality* (pp. 37-45). Berlin: Logos Publishers.
- Müller, T., & Bonnaire, C. (2021). Intrapersonal and interpersonal emotion regulation and identity: A preliminary study of avatar identification and gaming in adolescents and young adults. *Psychiatry Research*, 295, 113627. <https://doi.org/10.1016/j.psychres.2020.113627>
- Niemz, K., Griffiths, M., & Banyard, P. (2005). Prevalence of pathological Internet use among university students and correlations with self-esteem, the General Health Questionnaire (GHQ), and disinhibition. *Cyberpsychology & Behavior*, 8(6), 562-570. <https://doi.org/10.1089/cpb.2005.8.562>
- Nowak, K. L., & Fox, J. (2018). Avatars and computer-mediated communication: A review of the definitions, uses, and effects of digital representations. *Review of Communication Research*, 6, 30-53. <https://doi.org/10.12840/issn.2255-4165.2018.06.01.015>
- Ortiz de Gortari, A. B., & Griffiths, M. D. (2014). Altered visual perception in Game Transfer Phenomena: An empirical self-report study. *International Journal of Human-Computer Interaction*, 30(2), 95-105. <https://doi.org/10.1080/10447318.2013.839900>
- Papale, L. (2014). Beyond identification: Defining the relationships between player and avatar. *Journal of Games Criticism*, 1(2), 1-12. Retrieved May 7, 2021, from <http://gamescriticism.org/articles/papale-1-2>
- Peña, J., Hancock, J. T., & Merola, N. A. (2009). The priming effects of avatars in virtual settings. *Communication Research*, 36(6), 838-856. <https://doi.org/10.1177/0093650209346802>
- Peters, L., Sunderland, M., Andrews, G., Rapee, R. M., & Mattick, R. P. (2012). Development of a short form Social Interaction Anxiety (SIAS) and Social Phobia Scale (SPS) using nonparametric item response theory: The SIAS-6 and the SPS-6. *Psychological Assessment*, 24(1), 66–76. <https://doi.org/10.1037/a0024544>
- Petry, N.M., Rehbein, F., Gentile, D.A., Lemmens, J.S., Rumpf, H.J., Mößle, T., Bischof, G., Tao, R., Fung, D.S., Borges, G. & Auriacombe, M. (2014). An international consensus for assessing internet gaming disorder using the new DSM-5 approach. *Addiction*, 109(9), 1399-1406. <https://doi.org/10.1111/add.12457>
- Petry, N. M., Rehbein, F., Ko, C. H., & O'Brien, C. P. (2015). Internet gaming disorder in the DSM-5. *Current Psychiatry Reports*, 17(9), 1-9. <https://doi.org/10.1007/s11920-015-0610-0>
- Pontes, H. M., & Griffiths, M. D. (2014). Internet addiction disorder and internet gaming disorder are not the same. *Journal of Addiction Research & Therapy*, 5(4), e124. <https://doi.org/10.4172/2155-6105.1000e124>
- Pontes, H. M., & Griffiths, M. D. (2015). Measuring DSM-5 internet gaming disorder: Development and validation of a short psychometric scale. *Computers in Human Behavior*, 45, 137–143. <https://doi.org/10.1016/j.chb.2014.12.006>
- Pontes, H. M., Schivinski, B., Sindermann, C., Li, M., Becker, B., Zhou, M., & Montag, C. (2019). Measurement and conceptualization of gaming disorder according to the World Health

- Organization framework: The development of the Gaming Disorder Test. *International Journal of Mental Health and Addiction*, 1-21. <https://doi.org/10.1007/s11469-019-00088-z>
- Pontes, H. M., Stavropoulos, V., & Griffiths, M. D. (2019). Emerging insights on internet gaming disorder: Conceptual and measurement issues. *Addictive Behaviors Reports*, 11, 100242. <https://doi.org/10.1016/j.abrep.2019.100242>
- Pront, L., Müller, A., Koschade, A., & Hutton, A. (2018). Gaming in nursing education: A literature review. *Nursing Education Perspectives*, 39(1), 23-28. <https://doi.org/10.1097/01.NEP.0000000000000251>
- Radloff, L. S. (1977). The CES-D scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement*, 1(3), 385-401. <https://doi.org/10.1177/014662167700100306>
- Raith, L., Bignill, J., Stavropoulos, V., Milllear, P., Allen, A., Stallman, H. M., Mason, J., De Regt, T., Wood, A., & Kannis-Dymand, L. (2021). Massively multiplayer online games and well-being: a systematic literature review. *Frontiers in Psychology*, 12, 2369. <https://doi.org/10.3389/fpsyg.2021.698799>
- Rammstedt, B., & John, O. P. (2007). Measuring personality in one minute or less: A 10- item short version of the Big five inventory in English and German. *Journal of Research in Personality*, 41(1), 203–212. <https://doi.org/10.1016/j.jrp.2006.02.001>
- Ratan, R. A., & Dawson, M. (2016). When Mii is me: A psychophysiological examination of avatar self-relevance. *Communication Research*, 43(8), 1065-1093. <https://doi.org/10.1177/0093650215570652>
- Reynaldo, C., Christian, R., Hosea, H., & Gunawan, A. A. (2021). Using Video Games to Improve Capabilities in Decision Making and Cognitive Skill: A Literature Review. *Procedia Computer Science*, 179, 211-221. <https://doi.org/10.1016/j.procs.2020.12.027>
- Rindermann, H. (2009). *EKF: Emotionale-Kompetenz-Fragebogen*. Göttingen: Hogrefe.
- Rosenberg, M. (2015). *Society and the adolescent self-image*. New Jersey: Princeton University Press.
- Rosenthal, A.A., Gurney, M.R., Moore, S.M. (1981). From trust to intimacy: A new inventory for examining Erikson's Stages of psychosocial development. *Journal of Youth and Adolescence*, 10, 525–537. <https://doi.org/10.1007/BF02087944>
- Sibilla, F., & Mancini, T. (2018). I am (not) my avatar: A review of the user-avatar relationships in massively multiplayer online worlds. *Cyberpsychology: Journal of Psychosocial Research on Cyberspace*, 12(3), Article 4. <https://doi.org/10.5817/CP2018-3-4>
- Sioni, S. R., Burlison, M. H., & Bekerian, D. A. (2017). Internet gaming disorder: Social phobia and identifying with your virtual self. *Computers in Human Behavior*, 71, 11-15. <https://doi.org/10.1016/j.chb.2017.01.044>
- Smahel, D., Blinka, L., & Ledabyl, O. (2008). Playing MMORPGs: Connections between addiction and identifying with a character. *CyberPsychology & Behavior*, 11(6), 715-718. <https://doi.org/10.1089/cpb.2007.0210>
- Song, H., Kim, J., & Lee, K. M. (2014). Virtual vs. real body in exergames: Reducing social physique anxiety in exercise experiences. *Computers in Human Behavior*, 36, 282-285. <https://doi.org/10.1016/j.chb.2014.03.059>

- Statista (2020). *Digital media report 2020: Video games*.  
<https://www.statista.com/outlook/212/100/online-games/worldwide#market-revenue>
- Statista (2020). *Global digital populations as of October 2020*.  
<https://www.statista.com/statistics/748044/number-video-gamers-world/#:~:text=While%20there%20were%20almost%20two,three%20billion%20gamers%20by%202023.>
- Stavropoulos, V., Pontes, H. M., Gomez, R., Schivinski, B., & Griffiths, M. (2020). Proteus effect profiles: How do they relate with disordered gaming behaviours? *Psychiatric Quarterly*, *91*(3), 615-628. <https://doi.org/10.1007/s11126-020-09727-4>
- Stevens, M. W., Dorstyn, D., Delfabbro, P. H., & King, D. L. (2020). Global prevalence of gaming disorder: A systematic review and meta-analysis. *Australian & New Zealand Journal of Psychiatry*. <https://doi.org/10.1177/0004867420962851>
- Toma, C. L., Hancock, J. T., & Ellison, N. B. (2008). Separating fact from fiction: An examination of deceptive self-presentation in online dating profiles. *Personality and Social Psychology Bulletin*, *34*(8), 1023-1036. <https://doi.org/10.1177/0146167208318067>
- Triberti, S., Durosini, I., Aschieri, F., Villani, D., & Riva, G. (2017). Changing avatars, changing selves? The influence of social and contextual expectations on digital rendition of identity. *Cyberpsychology, Behavior, and Social Networking*, *20*(8), 501-507. <https://doi.org/10.1089/cyber.2016.0424>
- van Looy, J., Courtois, C., De Vocht, M., & De Marez, L. (2012). Player identification in online games: Validation of a scale for measuring identification in MMOGs. *Media Psychology*, *15*, 197–221. <https://doi.org/10.1080/15213269.2012.674917>
- Villani, D., Carissoli, C., Triberti, S., Marchetti, A., Gilli, G., & Riva, G. (2018). Videogames for emotion regulation: a systematic review. *Games for health journal*, *7*(2), 85-99. <https://doi.org/10.1089/g4h.2017.0108>
- Vlachopoulos, D., & Makri, A. (2017). The effect of games and simulations on higher education: A systematic literature review. *International Journal of Educational Technology in Higher Education*, *14*(1), 1-33. <https://doi.org/10.1186/s41239-017-0062-1>
- Wartberg, L., Kriston, L., Zieglmeier, M., Lincoln, T., & Kammerl, R. (2019). A longitudinal study on psychosocial causes and consequences of Internet Gaming Disorder in adolescence. *Psychological Medicine*, *49*(2), 287-294. <https://doi.org/10.1017/S003329171800082X>
- Williams, W.C., Morelli, S.A., Ong, D.C., Zaki, J. (2018). Interpersonal Emotion Regulation: Implications for Affiliation, Perceived Support, Relationships, and Well-Being. *Journal of Personality and Social Psychology*, *115*(2), 224–254. <https://doi.org/10.1037/pspi0000132>
- Wölfling, K., Müller, K., & Beutel, M. (2010). *Diagnostic measures: Scale for the Assessment of Internet and Computer Game Addiction (AICA-S)*. In D. Mücken, A. Teske, F. Rehbein, & B. TE. Wild (Eds.), *Prevention, Diagnostics, and Therapy of Computer Game Addiction* (pp. 212–215). Lengerich: Pabst Science.
- World Health Organisation (2018). *Addictive disorders: Gaming disorder*. Retrieved March 3, 2021, from: <https://www.who.int/news-room/q-a-detail/addictive-behaviours-gaming-disorder>

- Yee, N. (2006). The demographics, motivations, and derived experiences of users of massively multi-user online graphical environments. *Presence: Teleoperators and Virtual Environments*, 15(3), 309-329. <https://doi.org/10.1162/pres.15.3.309>
- Yee, N., & Bailenson, J. (2007). The Proteus effect: The effect of transformed self-representation on behavior. *Human Communication Research*, 33(3), 271-290. <https://doi.org/10.1111/j.1468-2958.2007.00299.x>
- Yee, N., Bailenson, J. N., & Ducheneaut, N. (2009). The Proteus effect: Implications of transformed digital self-representation on online and offline behavior. *Communication Research*, 36(2), 285-312. <https://doi.org/10.1177/0093650208330254>
- You, S., Kim, E., & Lee, D. (2017). Virtually real: Exploring avatar identification in game addiction among massively multiplayer online role-playing games (MMORPG) players. *Games and Culture*, 12(1), 56-71. <https://doi.org/10.1177/1555412015581087>
- Zhong, Z. J., & Yao, M. Z. (2013). Gaming motivations, avatar-self identification and symptoms of online game addiction. *Asian Journal of Communication*, 23(5), 555-573. <https://doi.org/10.1080/01292986.2012.748814>
- Zimmerman, G., Biermann Mahaim, E., Mantzouranis, G., Genoud, P.A., Crocetti, E. (2012). Brief report: The identity style inventory (ISI-3) and the Utrecht-Management of Identity Commitments Scale (U-MICS): Factor structure, reliability, and convergent validity in French-speaking university students. *Journal of Adolescence*. 35, 461-465. <https://doi.org/10.1016/j.adolescence.2010.11.013>
- Zimmerman, G., Lannegrand-Willems, L., Safond-Mottay, C., Cannard, C. (2015). Testing new identity models and processes in French-speaking adolescents and emerging adult students. *Journal of Youth and Adolescence*, 44, 127-141. <https://doi.org/10.1007/s10964-013-0005-7>