A systematic review and investigation of avatar- and self-related processes and problematic gaming

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DECLARATION

This report contains no material which has been accepted for the award of any other degree or diploma in any University, and, to the best of my knowledge, this report contains no materials previously published* except where due reference is made.

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Raquel Green

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Abstract

Many games feature avatars that enable adoption of, and experimentation with, roles and identities. How avatar- and self-related processes develop and maintain gaming disorder (GD) is unclear. This review examined 18 quantitative studies of avatar- and self-related concepts and problematic gaming, including 13 survey-based and 5 neuroimaging studies. Survey-based studies consistently reported that negative self-concept, avatar identification, and large self-avatar discrepancies were associated with problematic gaming. Poor self-concept appears to be a GD risk factor. Further research should explain how avatars relate to GD's addictive mechanisms (e.g., cognitive distortions, reward-seeking), amid calls for GD-related interventions to focus on avatar identification.

Keywords:

gaming disorder; problematic gaming; self; self-concept; self-discrepancy; avatar

Avatar- and self-related processes and problematic gaming: A systematic review

In one of the first published psychiatric case reports of gaming disorder (GD), Allison et al. (2006) described the case of Mr. A, an 18-year old male. Apart from being "addicted" to games, Mr. A. had created a "playful extension of himself" (p. 384) (an avatar) when playing a game called *Diablo II.* The avatar appeared to provide a way of realizing an ideal version of himself and/or expressing aspects of himself that he perceived he was unable to in his real-world life. Since this report, the study of avatars and self-related processes in problematic gaming has increased as fueled by researchers' interest in the growing complexity and idiosyncrasies of video game structural characteristics that enable role-playing and character creation (King, Koster, & Billieux, 2019b; Li, Liau, & Khoo, 2013; Przybylski, Weinstein, Murayama, Lynch, & Ryan, 2012). Research on the clinical characteristics and risk factors for problem gaming has also been advanced by the acknowledgement of 'internet gaming disorder' in Section III of the DSM-5 in 2013 and the inclusion of gaming disorder (GD) in the ICD-11 in 2019 (King et al., 2018; Saunders et al., 2017; World Health Organization, 2019).

Emerging research on avatar- and self-related processes among problematic gamers has not been limited only to conceptual or basic research on the mechanisms of excessive gaming (King et al., 2019b). This research base has also provided a platform for researchers to advance recommendations that these phenomena should be considered important proximal influences on problematic gaming behavior that require attention in clinical practice and other interventions. Morcos, Stavropoulos, Rennie, Clark, and Pontes (2019), for example, concluded that "virtual demographics, such as the Draenei race [in the game World of Warcraft], and their interplay with compensatory behaviors should be carefully considered when creating prevention and intervention policies targeting excessive gaming, especially when it involves the use of avatars". Along a similar line, Sioni, Burleson, and Bekerian (2017) commented that "assessment of avatar identification may facilitate IGD diagnosis" (p.15). Thus, the aim of this review was to evaluate the current state of research evidence on

avatar- and self-related processes as potential psychological mechanisms that develop or underlie problematic gaming and gaming disorder.

Online gaming activities have become increasingly sophisticated in the types of experiences offered to players, particularly in regard to creating and animating complex characters in immersive environments. Historically, in the 1980s and 1990s, video games had mainly featured diverse but rather simplistic and fixed (i.e., unchangeable) virtual representations of the playable character (Burleigh, Stavropoulos, Liew, Adams, & Griffiths, 2018). In contrast, modern gaming characters can be highly realistic or stylized, with many customization options that alter personal attributes, abilities, and appearance. These features are thought to enable players to develop a unique identity (Przybylski et al., 2012) and provide opportunities to act out roles of who they might aspire or wish to be in real life (King & Delfabbro, 2014, 2019a). Certain types or genres of game that emphasize avatar creation are generally referred to as 'role-playing' games, such as massively multiplayer online role-playing games (MMORPGs) (Smahel, Blinka, & Ledabyl, 2008). However, games of all kinds (e.g., sports and racing, shooters, strategy and puzzle games) are now including avatar and other role-playing options (Ducheneaut, Wen, Yee, & Wadley, 2009; King & Delfabbro, 2019a; Trepte & Reinecke, 2010), and thus these features seem to be becoming more relevant to the general phenomenon of excessive gaming (Wan & Chiou, 2006).

Psychological perspectives have advanced the view that, for some players, the in-game avatar represents an idealized version of the player's self-concept that motivates persistent playing (Mancini & Sibilla, 2017). For other players, the avatar may not be idealized but may serve various functions, such as enabling exploration, expression, or extension of the self via interaction with the avatar as a kind of tool, product, or toy (Mancini & Sibilla, 2017). Of relevance to these interactions is the player's perception of the avatar relative to the self. According to Higgins' (1987) self-discrepancy theory, there are three self domains: *actual-self* (i.e., traits one actually possesses), *ideal-self* (i.e., traits one would ideally like to possess), and *ought-self* (i.e., traits one believes they should possess). Discrepancies between these aspects of the self (i.e., *self-discrepancy*) causes negative affect, including sadness,

disappointment, and dissatisfaction (Li, Liau, & Khoo, 2011). Individuals are naturally motivated to reduce this emotional discomfort by employing one or more strategies, including avoiding the actual-self; improving the actual-self; restructuring perceptions of the actual-self; lowering ideal-self standards; or attaining the ideal-self. However, gaming is thought to enable another domain of the self: *avatar-self* (i.e., traits one possesses online). Through avatar creation, gamers can develop and experiment with their self-concept (Li et al., 2011), and provide an alternative means of reducing self-discrepancy. By constructing the avatar-self that can be maintained in a persistent virtual world (i.e., to escape from or avoid the real world) and which features idealized characteristics and skills, players are able to compensate for their perceived real-world deficiencies and/or escape from situations that elicit negative affect associated with self-discrepancy (Lemenager et al., 2014).

Research on players' perceptions of avatars has provided some general support for these assertions. Bessière, Seay, and Kiesler (2007) surveyed 51 *World of Warcraft* gamers' perceptions of their actual-, ideal-, and avatar-self attributes. Participants tended to describe their avatar as having more favorable attributes than their actual-self (i.e., more extraverted and conscientious, and less neurotic). However, these attribute ratings did not significantly differ between the avatar and ideal-self, suggesting that gamers viewed their avatar in similar terms to their idealized self. Subsequently, researchers have contended that players may develop a type of bond to their virtual persona, which may function similarly to a virtual friendship and/or idolization or provide a means of merging self-characteristics with an idealized self (i.e., *avatar identification*). Lemenager et al. (2013) found that addicted gamers reported significantly poorer self-concept compared to nonaddicted and inexperienced gamers. Additional studies have reported significant positive correlations between avatar identification and excessive gaming (Mancini, Imperato, & Sibilla, 2019; Smahel et al., 2008; You, Kim, & Lee, 2017). However, while these are promising findings, these investigations have adopted varied methodological approaches and there has not yet been an attempt to systematically present their findings.

The Present Review

There is a need to better understand the individual-level determinants and risk factors of problematic gaming and GD. Negative self-concept, self-discrepancies, and avatar identification are proposed mechanisms of excessive gaming. To date, there has been no systematic review of this literature, which includes self-report surveys and emerging studies that employ neuroimaging techniques. This review aimed to provide a critical summary of the peer-reviewed quantitative studies of avatar- and self-related processes in relation to GD symptomatology. The aim was to determine the consistency and significance of the reported findings to consider recent recommendations calling for avatar-related processes to be addressed in GD assessment and interventions.

Method

Identification of Empirical Studies

This review aimed to identify peer-reviewed quantitative studies of avatar- and self-related processes in relation to problematic gaming and/or GD. Five databases were searched: *PsycINFO*, *Scopus*, *Web of Science*, *Academic Search Complete,* and *Google Scholar.* The following keywords were used: (self OR self-discrepanc* OR avatar OR player-avatar OR character OR cyber-self) AND (patholog* OR problem* OR addict* OR Internet Gaming Disorder OR compulsive OR dependen* OR disorder* OR excessive) AND (gaming OR game). All searches included full-text articles published in English from 1st January 2004 to 7th May 2019. This 15-year timeframe was chosen to focus on more recent implementations of avatar creation, coinciding with the popular uptake of the massively multiplayer online (MMO) genre that enabled sophisticated avatar creation.

The search parameters yielded the following number of results, including duplicates: *PsycINFO* (382), *Scopus* (2,655), *Web of Science* (4,662), *Google Scholar* (~19,400), and *Academic Search Complete* (420). Given the large number of irrelevant results on *Google Scholar*, the first 30 pages of results were examined on this database. Figure 1 summarizes

the selection process, according to Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher et al., 2009).

[INSERT FIGURE 1 HERE]

Selection of Empirical Studies

Figure 1 provides a PRISMA summary of the selection process. The initial search identified 27,519 records using the search logic, resulting in 5,173 records after excluding extraneous *Google Scholar* records. The titles, subjects and abstracts (where necessary) of these records were screened for potential relevance to gaming and avatar- and self-concepts, which resulted in 61 records (including 26 duplicates). Full-text articles (n=35) were then screened based on the following inclusion criteria: (1) peer-reviewed studies published in English; (2) presented quantitative results; (3) assessment of GD symptomatology; and (4) measurement of avatar- and self-related processes (e.g., avatar identification, avatar-self discrepancy). The first two authors independently analyzed the 35 articles for eligibility and reached total agreement. Single case reports and studies that did not present quantitative results (*n*=3) were excluded. Studies that did not assess problematic gaming symptoms (*n*=11) were excluded. Finally, diverse terminology was evident regarding the various self-related cognitions involved in gaming. Articles that focused on self-efficacy, self-worth, and/or self-esteem only (i.e., without reference to game avatars) were excluded (*n*=3). A total of 18 studies remained and were included for review.

Results

Table 1 provides a summary of the following characteristics of the reviewed studies: (1) location, (2) study design, (3) sample, (4) measure of GD, and (5) relevant measure of avatar- and self-related process (e.g., avatar identification). Table 2 provides a summary of each study's: (1) theory or conceptual framework (e.g., self-discrepancy theory); (2) aims/hypotheses, and (3) main findings. These tables form the basis of discussion in the

following subsections. Cited references in these tables have been assigned a number (1-18) for parsimony in citation for the results.

[INSERT TABLE 1 HERE]

[INSERT TABLE 2 HERE]

Conceptualization and Measurement

Studies varied in their conceptualization of self-related domains and subdomains. Nine studies (including all neuroimaging studies) referred to self-concept [5, 6, 7, 8, 9, 13, 15, 16, 17]. This construct was defined as multidimensional, encompassing an individual's perception of their skills, interests, desires, emotions, values, actions, and physical attractiveness. Mills, Mettler, Sornberger, and Heath [9] examined six subdomains (athletic competence, behavioral conduct, close friendships, physical appearance, social competence, and scholastic competence), whereas Choi et al. [17] examined three (general self, physical self, and social self). Lemenager et al. [8, 13] treated self-esteem as a component of self-concept, whereas You et al. [11] considered self-esteem as a correlate of self-concept. Some studies assessed social competence as distinct from self-concept [10, 11, 15]. Seven studies referred to Higgins' (1987) self-discrepancy theory and attempted to measure at least some of the self-discrepancies proposed in the theory. Actual-ideal self-discrepancy was examined in six studies [2, 3, 5, 8, 12, 15]. Five studies investigated discrepancies between actual-self and avatar-self [1, 6, 7, 8, 18]. Finally, four studies examined discrepancies between ideal-self and avatar-self [5, 7, 12, 18].

Self-concept and self-discrepancies were primarily measured by continuous, self-report ratings of statements pertaining to the self, including adjectives and self-descriptions. Lower scores on items assessing actual-self were interpreted as indicating poorer self-concept. Three studies discussed lower scores as 'deficits' in self-concept [5, 6, 7]; however, this term was

applied loosely. Self-discrepancy scores were yielded by comparing evaluations of actual-self (*I am attractive*), ideal-self (*I want to be attractive*), and avatar-self (*my avatar is attractive*). Studies generally did not report cut-off scores or norms for self-discrepancies or self-concept evaluations.

Self-related instruments included the Self Attribute Statement Scale, adapted from Dittmar (2005) [3], Giessen Test (Beckmann, Brähler, & Richter, 1990) [5, 7, 8], Big Five Inventory (Rammstedt & John, 2007) [18], as well as some unnamed, self-developed scales [2, 15]. Only one study [3] directly asked participants to assess their self-discrepancy (*I am…, and/but I would like to…)*, how much they would like to change, and perceived competence in changing. All other scales presented separate statements for actual-self, ideal-self, and/or avatar-self. The studies that used the Giessen Test did not report how discrepancies between actual-self, ideal-self, and avatar were scored [5, 7, 8]. Avatar identification was examined in 10 studies [1, 4, 6, 8, 10, 11, 12, 14, 17, 18]. Avatar identification measures included the Player-Avatar Identification Scale (Li et al., 2013) [10], Avatar Identification Scale (adapted from Mael & Ashforth, 1992) [11], Self-Presence Questionnaire (Ratan & Dawson, 2016) [12, 14], and the Avatar Identification Subscale (van Looy, Courtois, De Vocht, & De Marez, 2012) [18]. Zhong and Yao [4] created five items, some of which seemed to assess self-avatar discrepancy instead (*My avatar is more successful than I am*). Three functional magnetic resonance imaging (fMRI) studies assessed avatar identification by measuring brain responses to avatar-related stimuli [6, 7, 17].

Studies also varied with respect to their choice of screening instrument for problematic gaming. The most commonly used tools were the Checklist for the Assessment of Internet and Computer Game Addiction (Wolfling, Beutel, & Muller, 2012) [6, 7, 8, 13], the Internet Gaming Disorder-9: Short Form (Pontes & Griffiths, 2015) [12, 14], the Internet Gaming Disorder Scale (Lemmens, Valkenburg, & Gentile, 2015) [10, 16], and the Young Internet Addiction Scale (Young, 1998) [2, 17]. All other studies employed a measure not that was not used in any other study, which included new composite measures. For a comprehensive review of these measures, see King et al. (2020).

Study Characteristics

Most studies employed cross-sectional designs. Two studies from Australia incorporated longitudinal data that were collected over three months [12, 14]. Studies were conducted across a range of countries: Germany (*n*=2), South Korea (*n*=2), Australia (*n*=2) Italy (*n*=1), Croatia (*n*=1), United States (*n*=1), Canada (*n*=1), China (*n*=1), Singapore (*n*=1), and The Czech Republic (*n*=1). Five studies employed fMRI [6, 7, 8, 15, 17], including three in Germany and two in South Korea.

Sample Characteristics

Most cross-sectional surveys employed convenience sampling (*n*=11). Surveys were administered to adolescents from schools (*n*=4), university students (*n*=2) and members of online gaming communities (*n*=6). All fMRI studies (*n*=5) and two survey studies [8, 13] recruited individuals with clinician-verified gaming addiction. One clinical sample involved adolescents [17]. Most studies (*n*=12) involved MMORPG players [1, 4, 5, 6, 7, 8, 10, 11, 17, 13, 16, 18] or players of other MMO-style (non-role-playing) games [3, 12, 14]. Comorbidities were largely excluded from the clinical studies. Four fMRI studies excluded participants with comorbid symptoms, such as a pre-existing psychiatric disorder or substance use issues [6, 7, 8, 17]. Kim et al.'s [15] fMRI study included participants with GD who had histories of depressive disorder or ADHD.

Main Findings

Survey-based studies consistently reported that GD was related to poor self-concept, large self-discrepancies, and high avatar identification. GD symptomology was significantly negatively related to self-concept clarity [16] and perceptions of scholastic competence, behavioral conduct, close friendships, and self-worth [9]. Addicted gamers reported poorer social competence, emotional competence, self-esteem, and body image than healthy controls [6, 13]. Lemenager et al. [13] reported that addicted gamers had lower self-esteem, poorer body image, and lower social competences than problematic gamers. GD severity was significantly positively related to actual-ideal self-discrepancies [2]. Addicted gamers

reported a significantly larger actual-ideal self-discrepancy and lower discrepancy between ideal-self and avatar-self than non-addicts [6]. Three studies found significant positive associations between GD and avatar identification [1, 10, 11]. Correlations were generally modest (r=.22), with some exceptions (r=.59) [10].

Neuroimaging studies yielded results consistent with the survey studies. Addicted gamers reported poorer body image [8, 13], social competence [7, 8], and emotional competence [8]. Addicted gamers evaluated their actual and ideal selves more negatively than controls [15]. Dieter et al. [7] found addicted gamers evaluated avatars more positively than their actual-self, but not significantly different from their ideal-self, whereas nonaddicted gamers rated their actual-self more highly than avatars. However, Kim et al. [15] found no group differences on these variables.

Neurobiological Data

Tables 3 and 4 provide a summary of the fMRI within-group and between-group differences during self-related tasks. Four studies involved presenting a series of statements about the actual-self [7, 8, 15 17], ideal-self [7, 8, 15], other person [17], and avatar [7, 8, 17]. In Lemenager et al. [6], participants were presented with whole body images of themselves, their avatar, and unfamiliar persons. Addicted gamers exhibited greater activity during avatar-reflection [6, 7, 8, 17] and less activity during self-reflection [15, 17] compared to controls. There was greater activation in the left angular gyrus among problematic gamers when viewing avatar-related stimuli [6, 7, 8, 15]. GD was significantly positively related to activation in the left AG [8] and anterior cingulate cortex (ACC) [17].

[INSERT TABLE 3 HERE]

[INSERT TABLE 4 HERE]

Avatar Identification as a Mediator/Moderator

Avatar identification was implicated in various mediation analyses. Avatar identification mediated the following relationships: (1) social phobia and GD [10]; (2) social skills and GD [11]; (3) depression and GD [11]; (4) self-discrepancy and GD when using idealized avatars [18]; and (5) self-discrepancy and GD when using utopian avatars [18]. Burleigh et al. [12] reported that avatar identification moderated the relationship between depression and GD. Physical activity weakened the association between physical-avatar identification and GD [14].

Discussion

This review aimed to evaluate GD research on avatar- and self-related processes. Despite variability in the conceptualization and measurement of avatar- and self-related concepts, survey-based studies have consistently reported that negative self-concept, avatar identification, and large self-avatar discrepancies are significantly associated with excessive gaming. Emerging neurobiological evidence reports significantly poorer self-concept among problematic and addicted gamers as compared to controls. Individuals with GD reported larger actual-ideal self-discrepancies than controls (Lemenager et al., 2013) and greater discrepancies between actual- and avatar-self (Dieter et al., 2015). Neuroimaging studies reported greater activation in the left angular gyrus among problematic gamers when viewing avatar-related stimuli as compared to self-related stimuli. These findings suggest that poor self-concept may be a risk factor for developing GD in games that facilitate online identity formation.

Avatar identification was modestly positively associated with GD in bivariate and multivariate analyses. This was a consistent finding across numerous survey studies and demonstrates the potential of this variable to explain how problematic gaming is maintained. Sioni et al. (2017) presented the strongest correlations between these variables and concluded that “the findings presented here provide preliminary validity for the use of avatar identification as a DSM-5 IGD criterion” (p.14). As a psychological mechanism, Smahel et

al. (2008) concluded that avatar identification causes negative emotions when the avatar is faced with adversity (e.g., feeling ashamed after losing a battle). Other researchers have highlighted the importance of avatars to the gaming experience but have also noted that identifying with avatars can often be a positive experience too (Whang & Chang, 2004; Klimmt, Hefner, & Vorderer, 2009). Stavropoulos, Gomez, Mueller, Yucel, and Griffiths (2020), in a study published shortly after this review was completed, reported that players who viewed their identity as being 'fused' with their avatar were more likely to be problematic gamers than those who perceived their avatar as being differentiated from their identity. Another noteworthy finding from survey studies was the relationship between avatar identification and comorbidity. There was evidence, for example, that avatar identification was a mediator between GD and mood symptoms, including depression and social phobia (Sioni et al., 2017; You et al., 2017), which has implications for conceptualizing the conditional links between GD and other common mental disorders. Such findings may help to explain the higher rates of GD among gamers who become involved in MMO games (i.e., games that facilitate avatar functionality) (King et al., 2019b).

Addicted gamers exhibited significantly greater brain activity during avatar-related than self-related tasks (Lemenager et al., 2014, 2016; Dieter et al., 2015; Choi et al., 2018), while healthy controls did not exhibit this activity. Similarly, healthy controls demonstrated greater AG activation during self-related tasks than during avatar-related tasks (Dieter et al., 2015). The AG region is related to self-identification processing, empathy, and distinguishing the self from others (Ganesh, van Schie, de Lange, Thompson, & Wigboldus, 2011). Four studies identified AG activation differences that suggested addicted gamers identified less with their real-world-self than their avatar-self (Lemenager et al., 2014, 2016; Dieter et al., 2015; Kim et al., 2018). Choi et al. (2018) reported, however, that addicted gamers' medial prefrontal cortex (MPFC) and ACC were significantly activated during avatar-related tasks. These differences in neural correlates may be attributable to the fact that Choi et al. (2018) had employed adolescents instead of adults. The ACC is related to affective processes and selective attention (Shenhav, Botvinick, & Cohen, 2013), whereas the MPFC is integral to

self-reflection (Sebastian, Burnett, & Blakemore, 2008). There is significant anatomical development between adolescence and adulthood, with a shift in activity from the MPFC to the temporal and parietal regions (Sebastian et al., 2008).

Prevention and treatment of GD is still developing its evidence base (King et al., 2017; Király et al., 2018). The findings of this review inform proposals for GD interventions to incorporate a greater focus on addressing avatar identification. For example, Stavropoulos et al.'s (2020) survey study of problematic gamers concluded that clinicians should address "the user-avatar bond in the treatment of disordered gaming, by inviting gamers to talk about their virtual personas, and their game-related achievements and investigating ways that such avatar aspects of their 'in-game' avatar life can be transferred to real life" (p.9). Similarly, King and Delfabbro (2019a) described a practical strategy for engaging adolescents with GD in therapy that involved using a visual representation of the client's 'two selves' or identities when gaming versus in the real world. Such advice on assessment and interventions should be justified by a sufficiently strong evidence base on the efficacy of such practice and techniques. This review suggests that avatar identification may be a promising area for interventions to consider, with some important caveats. For example, avatar-related processes (e.g., avatar identification) appear to be implicated in GD but much of the available research is tentative and composed of non-treatment studies in populations without verified GD.

Another issue to consider is that the avatar-self relationship may be complex and demand a high degree of client insight to explore effectively, and therefore may not be feasible to attempt to address in the context of a brief therapeutic engagement. Given that treatment engagement is often low among individuals with GD (Humphreys, 2019), particularly among adolescents, clinicians should be guided by evidence-based guidelines to optimize what can be delivered within a very limited period of engagement (e.g., 1 or 2 sessions, including an assessment). Speculatively, for example, brief behavioral therapy designed to establish new non-gaming routines may be more feasible than brief therapy involving challenging cognitive distortions about avatars. Cognitive-behavioral therapy is currently the recommended treatment approach to GD (Stevens, King, Dorstyn, & Delfabbro, 2019), but it is not yet clear

whether or how effectively avatar-related processes may be accommodated within this approach (e.g., addressing avatar identification as a cognitive distortion, or reducing avatar-related urges to play), and whether the avatar is just one of many salient game-related stimuli that contribute to maladaptive player-gaming experiences. Similarly, avatar-related processes may not be relevant to all types of problematic gaming in the same way, such as for games without avatars or for gamers who play across many types of games, which may make avatars an unreliable focal point for an intervention.

Limitations

This review had several limitations. First, video games are continually changing with new technological innovations and market demands, which limits the validity of comparisons of avatar and role-playing systems over time. Another issue is that studies did not consistently examine comorbidity, as well as other typical addictive processes (e.g., impulsiveness), and thus the relationships between avatar- and self-related processes and GD may have been accounted for by these other variables. Similarly, there was variability across studies in terms of terms of design, measurements, approaches and conceptualizations, which compromises their direct comparability. The review protocol only selected published quantitative studies and excluded case report studies, grey literature, and older studies. 'Avatar' may be a limited unit of analysis as it is not clear what playable representations this may (and may not) include (e.g., humans vs non-humans, including animals, vehicles, and so on). This review did not evaluate indicators of study quality. Other standard limitations included: (1) the lack of inclusion of non-English literature (e.g., Chinese and Korean papers); (2) the adequacy of search protocol for searching a broad topic; and (3) exclusion of non-peer-reviewed work.

Future Directions

Research on avatar- and self-related processes appears to be promising given consistent findings across both survey and fMRI studies. However, there is a need for further studies with a broader focus on different types of avatars and game genres (i.e., not only MMO-style

and role-playing games). It may also be worthwhile to consider the role of online streaming channels with live audiences in the formation of online characters and personas. More importantly, there is a need for more unified measurement approaches to the study of avatar-self relationships that harmonize across survey-based, neuroimaging, as well as intervention studies. Longitudinal studies would assist in identifying how avatar/self-concept-related processes begin and progress in the course of long-term play, including their contribution to the sunk cost and emotional investment in games that maintain persistent gaming behaviors despite harms. Future research on avatars should incorporate measures of comorbidity as well as known correlates of addictive disorders, including impulsivity and personality traits.

Further issues for avatar-related research include understanding potential relationships between avatar-identification and self-related processes and other affective and cognitive processes likely to be involved in gaming disorder. For example, how may avatar identification and self-related processes be linked to craving, using motives, coping mechanisms? Speculatively, individuals with stronger avatar identification may experience stimuli-specific urges to play games that are linked to their avatar's needs and states. Reward expectancies and gratification may be dependent on how certain outcomes of play relate to the avatar. For example, completion of in-game activities may only be gratifying or relieve urges or negative mood under highly specific reward circumstances determined by avatar-related considerations. These possibilities warrant further study, such as experimental studies that manipulate player mood and avatar identification and evaluate inhibitory control and subsequent desire to play.

Conclusions

Survey-based and neurobiological evidence suggests that individuals with GD report greater negative self-concept and avatar identification than non-problematic gamers. These are compelling findings that warrant further studies, particularly studies with clinical samples, to determine whether avatar-related processes form a central mechanism of problematic gaming or may be an interesting byproduct of other more primary player-game

interactions. In particular, there is a need to better understand these processes and how they develop and operate in the context of other addictive processes (Brand et al., 2016, 2019). GD has been proposed to have some distinct motivational and cognitive-behavioral features that distinguish it from other behaviors, such as gambling and shopping. However, it is important that researchers in search of unique phenomenological characteristics do not overlook and adequately account for the fundamental components and processes that appear to underlie addictive behaviors, and that new psychological processes such as avatar identification are thoroughly investigated prior to recommending specific assessment and interventions.

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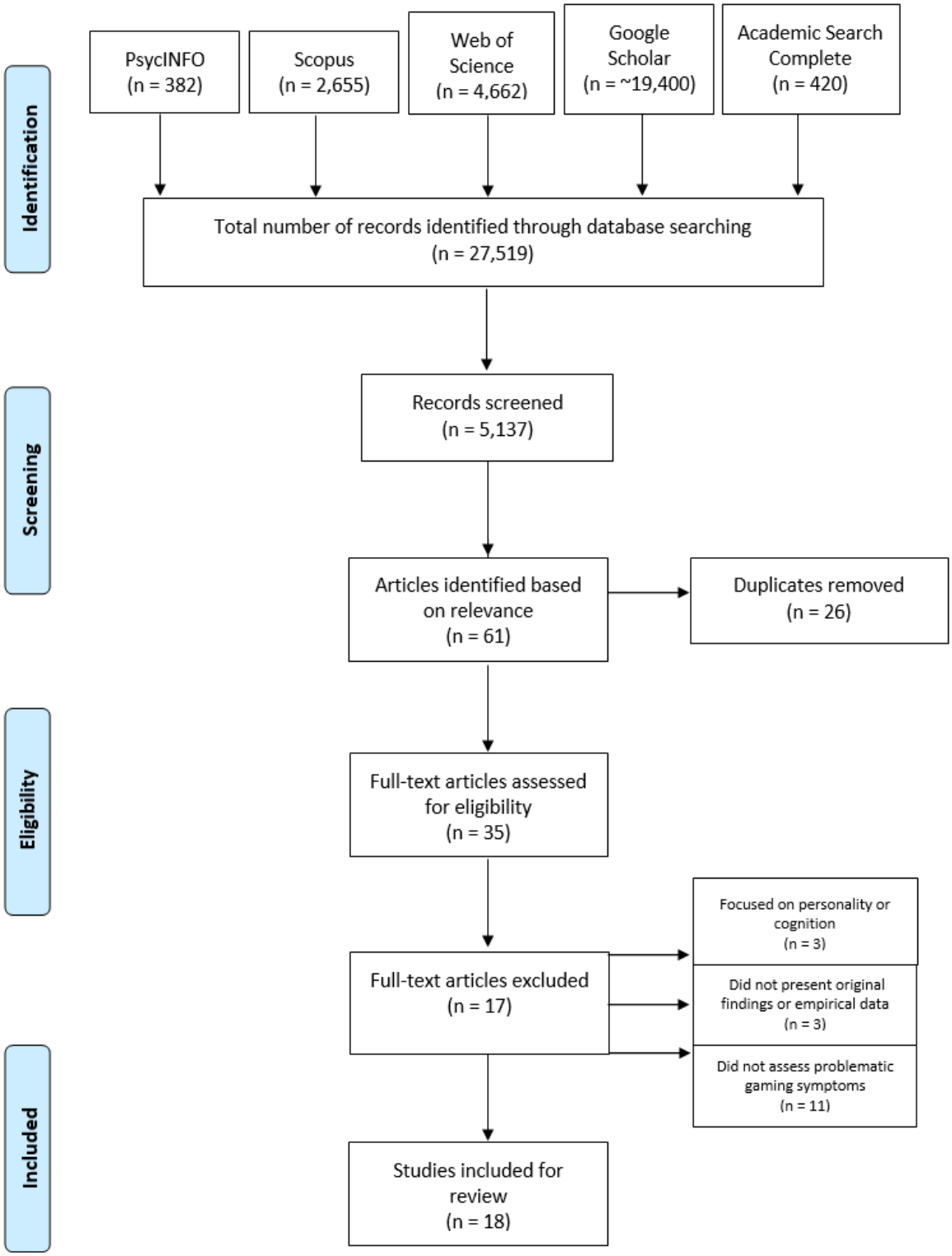

Figure 1. Database search results and screening process, according to PRISMA guidelines.

Table 1
Design characteristics of studies (n=18) of self-concept and/or avatar identification in relation to gaming disorder

Study[1]	Location	Study design	Sample (N)	Measure of GD	Measure of self and/or avatar identification
1. Smahel et al. (2008)	The Czech Republic	Survey	MMORPG adolescent and adult gamers (N=548)	Created 14 items related to MMORPG addiction (based on salience, tolerance, withdrawal, conflicts)	Authors created 10 items on the player's relationship with their avatar; Authors created 4 questions on avatar identification
2. Kwon et al. (2011)	South Korea	Survey	Adolescents (N=1,136)	Young Internet Addiction Scale	Authors created real-self and ideal-self ratings; The Escape from Self Scale
3. Li et al. (2011)	Singapore	Survey	Adolescent gamers (N=161)	Created 10-item scale based on DSM-IV-TR pathological gambling	The Self Attribute Statement Scale
4. Zhong & Yao (2013)	China	Survey	Adult gamers (N=217)	Game Addiction Test (composite)	Authors created 5-item measure for avatar identification
5. Lemenager et al. (2013)	Germany	Survey	Adults: inexperienced (n=15), nonaddicted (n=15), and addicted gamers (n=15)	Diagnostic Criteria of Internet Addiction for College Students; The Chen Internet Addiction Scale	Giessen Test; Body Image Questionnaire; Emotional Competence Questionnaire; Rosenberg Self-Esteem Scale
6. Lemenager et al. (2014)	Germany	Survey; fMRI	MMORPG adult gamers: addicted (n=16), nonaddicted (n=17)	The Checklist for the Assessment of Internet and Computer Game Addiction	Body Image Questionnaire
7. Dieter et al. (2015)	Germany	Survey; fMRI	MMOPRG adult gamers: addicted (n=15), nonaddicted (n=17)	The Checklist for the Assessment of Internet and Computer Game Addiction	Giessen Test
8. Lemenager et al. (2016)	Germany	Survey; fMRI	Adults: controls (n=19), pathological gamers (n=19) and pathological social network users (n=19)	The Checklist for the Assessment of Internet and Computer Game Addiction; The Scale for Online Addictive Behaviour	Giessen Test; Body Image Questionnaire; Visual analogue scale for attractiveness of self and avatar; Social Anxiety and Social Competence Questionnaire; Emotional Competence Questionnaire
9. Mills et al. (2016)	Canada	Survey	Adolescents (N=758)	Pathological Video Game Use Questionnaire	Self-Perception Profile for Adolescents
10. Sioni et al. (2017)	United States	Survey	Adult gamers (N=394)	Lemmens Internet Gaming Disorder Scale-9 item	The Player-Avatar Identification Scale
11. You et al. (2017)	South Korea	Survey	Adolescent MMORPG gamers (N=163)	Game Addiction Scale	Avatar Identification Scale
12. Burleigh et al. (2018)	Australia	Survey (longitudinal)	Adult MMORPG gamers (N=125, 64 online respondents, 61 face-to-face participants)	Internet Gaming Disorder Scale–Short Form 9	The Self-Presence Questionnaire
13. Lemenager et al. (2018)	Germany	Survey	Adults: n=79 controls, n=35 problematic Internet users, n=93 addicted Internet users, including n=32 gamers	The Checklist for the Assessment of Internet and Computer Game Addiction; The Scale for Online Addictive Behaviour	Rosenberg Self-Esteem Scale; Body Image Questionnaire; Emotional Competence Questionnaire; Social Anxiety and Social Competence Deficits

14. Liew et al. (2018)	Australia	Survey; Mixed methods	Adult MMO gamers (N=125, 64 online respondents, 61 face-to-face participants)	Internet Gaming Disorder Scale–Short Form 9	Self-Presence Questionnaire (Proto-Self-Presence subscale only)
15. Kim et al. (2018)	South Korea	Survey; fMRI	Male adults (n=19 with IGD, n=20 controls)	DSM-5 criteria for Internet Gaming Disorder via interview; Internet Addiction Test	Authors created a self-concept task (actual and ideal self)
16. Šporčić & Glavak-Tkalić (2018)	Croatia	Survey	Adult gamers (N=509)	Lemmens Internet Gaming Disorder Scale-9 item	Self-Concept Clarity Scale
17. Choi et al. (2018)	South Korea	Survey; fMRI	Male adolescents (n=12 internet game addicted, n=15 without addiction)	Young Internet Addiction Scale	Modified items from the Self-Perception Profile for Children and the Self-Description Questionnaire
18. Mancini et al. (2019)	Italy	Study 1: Survey; Study 2: Experiment	1: Adolescent and adult MMORPG players (N=770); 2: Adults (N=100)	1: Game Addiction Scale 6-item; 2: Three items on intention to continue playing World of Warcraft	1: Big Five Inventory (repeated for actual self, ideal self, avatar); Avatar Identification subscale; 2: Ten Item Personality Inventory; The Inclusion of the Avatar in the Self; Embodied Presence subscale in the Player Identification Scale

[1]Note: Studies are numbered from 1 to 18 in order of publication date; these numbers are referenced accordingly throughout this review. Abbreviations: DSM-IV-TR: Diagnostic and Statistical Manual of Mental Disorders (4th edition, Text Revision); DSM-5: Diagnostic and Statistical Manual of Mental Disorders (5th edition); fMRI: Functional magnetic resonance imaging; GD: Gaming disorder; IGD: Internet Gaming Disorder; MMO: Massively Multiplayer Online; MMORPG: Massively Multiplayer Online Role-Playing Game.

Table 2
Main findings of studies (n=18) of self-concept and/or avatar identification in relation to gaming disorder[1]

Study	Conceptual framework	Research question/hypothesis[2]	Main findings and effect size
1. Smahel et al. (2008)	Avatar attachment/ identification	Does attachment to the avatar increase attachment to the game?	Avatar identification in adolescent and young adults is higher than older adults; GD was sig. related to avatar identification (r(392)=.22**), pride (r(398)=.24**), and shame towards avatar (r(399)=.30**)
2. Kwon et al. (2011)	Real-ideal self-discrepancy; Escape from self theory	(1) GD would be positively associated with real-ideal self-discrepancy; (2) Real-ideal self-discrepancy would lead to negative mood, then escape motivations, and, in turn, GD	GD sign. related to real-ideal self-discrepancy (r=.14**); GD had strongest correlation with escape (r=.43**); Escape from self was the strongest predictor of GD (F=263.24**, R^2=.19, β=.43); Effect of real-ideal self-discrepancy on GD (F=14.93**, R^2=.21, β=.10); Sig. paths from self-discrepancy to negative mood; from Negative mood to Escape; and Escape to GD
3. Li et al. (2011)	Self-discrepancy theory (actual-ideal discrepancy)	(1) Depression would mediate the relationship between actual-ideal self-discrepancy and escapism; (2) Escapism would mediate the relationship between depression and GD	Escapism had sig. direct effect on GD (β=0.34); actual-ideal self-discrepancy had sig. indirect effect on GD through escapism (β=0.10)
4. Zhong & Yao (2013)	Self-concept; self-discrepancy theory (actual-ideal and ideal-avatar discrepancy)	Compared to nonaddicted and naïve gamers, addicted gamers would: (1) evaluate their self-concept more negatively; (2) have larger discrepancies between real and ideal self; (3) create their avatar to more closely resemble their ideal self	Compared to nonaddicted and inexperienced gamers, addicted gamers scored lower** on all self-concept scales (except dominance and self-control) on the Giessen Test, poorer** body appraisal and self-esteem, sig. higher** discrepancy between actual and ideal self on all Giessen Test subscales (except self-control), and sig. lower discrepancies between ideal and avatar on all Giessen Test subscales (except general mood)
5. Lemenager et al. (2013)	Self-discrepancy theory; avatar identification	Avatar-self identification would be positively related to GD	Avatar-self-identification was sig. related to GD symptoms of problems/salience (β=.2**) and uncontrollable play (β=.36**)
6. Lemenager et al. (2014)	Self-concept; avatar identification	Addicted gamers would show: (1) decreased activations in the left AG during self-perception; (2) increased activations in the left AG during avatar-perception	Addicted gamers exhibited decreased bilateral brain activations in the AG (effect size = .37) and middle occipital gyrus during self-perception, and higher activations in the left AG during avatar-perception (effect size = .30); No sig. between-group differences in brain activations
7. Dieter et al. (2015)	Self-concept; actual-avatar and avatar-ideal discrepancy	Addicted gamers would show: (1) higher left AG activations during avatar-reflection compared to self-reflection, (2) similar left AG activations during avatar-reflection and ideal-self-reflection; (3) Nonaddicted gamers would show higher left AG activations during ideal-self-reflection relative to their avatar	Addicted gamers rated avatars as superior to actual self (χ^2=15.76**), but not sig. diff to ideal self (α=.017, p=.056); Nonaddicted gamers rated their actual self higher than avatars (χ^2=17.28**); Addicted gamers showed sig. higher brain activations in the (bilateral) AG during avatar-reflection compared to self-reflection; No sig. brain activations were found in nonaddicted gamers for avatar vs. self-reflection; Addicted gamers showed sig. higher brain activations in the left AG during avatar-reflection than the ideal-self-reflection, while nonaddicted gamers showed sig. higher activations in the bilateral AG during ideal-self-reflection than avatar-reflection
8. Lemenager et al. (2016)	Self-concept; avatar identification	Addicted gamers would show a larger difference in left AG activity during avatar-reflection vs. self-reflection, compared to problematic gamers and healthy controls	Compared to controls, addicted and problematic gamers showed poorer body image (z=-2.69, p=.007) emotion recognition (z=-3.54**), and emotion expression (z=-2.32, p=.02), and more anxiety with social interaction (z=-3.41, p=.001); Sig. correlation between GD severity and left AG activation (r=.35, p=.032); Addicted and problematic gamers showed higher activations in the MPFC and left AG in avatar-reflection vs. self-reflection, whereas controls did not show this activation; Addicted gamers showed sig. higher activity in the left AG during avatar-reflection compared to controls, but no

			sig. diff in avatar-related brain activation between problematic and addicted gamers, nor problematic gamers and controls
9. Mills et al. (2016)	Self-perception (recognized as self-concept)	GD would be associated with a poorer perception of self in at least one self-perception domain	Sig. correlations between GD and scholastic competence (r= -.15**), Behavioral conduct (r= -.33**), close friendship (r= -.18**), and self-worth (r= -.18**); Behavioral conduct (β= -.31**) and close friendships (β= -.08, p=.04) were the strongest predictors of GD
10. Sioni et al. (2017)	Avatar identification	Avatar identification would: (1) be positively associated with social phobia and (2) GD; and (3) partially mediate the relationship between social phobia and GD	Avatar identification was sig. related to GD (r=.59**) and social phobia (r=.50**); GD and social phobia were sig. related (r=.51**); Avatar identification (R^2=.25) partially mediated the relationship between social phobia and GD (R^2=.43)
11. You et al. (2017)	Avatar identification	Avatar identification would mediate the relationship between GD and (1) social skills, (2) depression, and (3) self-esteem	Avatar identification had sig. relationship to GD (r=.25); Depression had an indirect effect on GD via avatar identification; Self-esteem and social skills had sig. correlations with GD; Social skills had both an indirect (via avatar identification) and direct effect on GD
12. Burleigh et al. (2018)	Avatar identification; self-discrepancy theory	Gamers with higher depression scores and gamer-avatar-relationship would be at greater risk of developing GD; (2) Higher gamer-avatar-relationship would exacerbate the effect of depression on GD	Depression (b=.43, β=.56**) and the gamer-avatar-relationship (b=.36, β=.49**) were individual risk factors of GD over time; Gamer-avatar-relationship moderated the relationship between depression and GD (R^2=.48)
13. Lemenager et al. (2018)	Self-concept; avatar identification	Different neural activity would be observed in the addicted vs. nonaddicted group when they thought about themselves, others, and game characters	During the self-reflection task, occipital lobe and right inferior frontal gyrus were sig. more active** in nonaddicted than in addicted adolescents; During the avatar-reflection task, sig. more activations were observed in addicted than nonaddicted adolescents in postcentral, inferior frontal, and precentral gyri, cerebellum, occipital lobe, ACC, temporal pole, and MPFC; this activation for addicted adolescents was greater when thinking of game characters than themselves or another person; ACC activation correlated with GD severity (r=.43, p<.05)
14. Liew et al. (2018)	Self-concept; self-discrepancy theory (actual-ideal discrepancy)	Individuals with GD would show: (1) higher self-discrepancy; (2) impairment in actual self-concept and ideal self-guide; and (3) dysfunction in the striatum and MPFC	During self-discrepancy contrast, brain activity in the inferior parietal lobule was sig. decreased in GD relative to controls; No group diff. in self-discrepancy scores (t= -.18, p=.9); GD group evaluated ideal self (t= -4.6*) and actual self (t= -2.2, p=.03) more negatively than controls; In both groups, basic psychological needs were sig. related to actual self-concept (GD: r=.7*; controls: r=.6*) and self-discrepancy (GD: r= -.8*; controls: r= -.5, p=.01); In the ideal self condition compared to the actual self condition, controls showed sig. higher activity in the left calcarine cortex, whereas the GD group did not show sig. activity
15. Kim et al. (2018)	Self-concept	Are there differences in comorbidities and self-concept-related characteristics between addicted and problematic Internet users?	Compared to controls, addicted internet users showed more self-concept related deficits (sig. lower body image**, higher social anxiety**, lower social competence**, lower emotional competences**, lower self-esteem**); Compared to problematic users, addicted users showed sig. more self-concept deficits on all variables, except emotional recognition in self/others; Addicted internet users showed sig. more comorbidities with ADHD, depressive and current anxiety disorders than controls
16. Šporčić & Glavak-Tkalić (2018)	Physical-body avatar identification	(1) Higher levels of physical avatar identification would increase the risk of GD; (2) Physical activity would decrease the effect of physical-body identification on GD	Identification functioned as an GD risk factor (cross-sectional data: R^2_{change}=.25**, b=.81; longitudinal data: R^2_{change}=.36*, b=.76); Physical activity weakened the association between physical-body identification and GD

17. Choi et al. (2018)	Self-concept; self-concept clarity; self-discrepancy theory	Do gaming motives mediate the relationship between self-concept clarity and GD?	GD positively correlated with social (r=.22*), competition (r=.15*), coping (r=.30*), fantasy (r=.31*), and escape motives (r=.45*), and negatively with self-concept clarity (r= -.39*); Sig. predictors of GD: escape motives (β=.27*, strongest) and self-concept clarity (β= -.23*); Self-concept clarity was directly (β= -.26*) and indirectly (via escape motive, β= -.1*) associated with GD
18. Mancini et al. (2019)	Self-discrepancy theory; Virtual identity discrepancy model; avatar identification	(1) Using a utopian avatar (distant from ideal self) would not be related to GD, but identifying with it would increase GD; (2) Avatar identification would mediate the relationship between avatar self-discrepancy and GD	Avatar identification (β=.33**) had a stronger effect on GD than the discrepancy between avatar and actual self (β=.12*) (Study 1); Using a utopian avatar did not have a sig. effect on GD (β=.01, p>.05), but identifying with it had a sig. effect on GD (β=.37**) (Study 1 and 2); Using idealized avatars (r=.21**) and avatar identification (r=.37**) sig. related to GD (Study 1); Avatar identification mediated both relationships of idealized and utopian avatars with GD (Study 1 and 2)

[1]Note: Gaming disorder encompasses all problematic gaming-related terminology, including 'gaming addiction', 'internet gaming disorder', and 'pathological gaming'

[2]Research question included when specific hypotheses are not provided. NB: Only gaming and/or self-related hypotheses are listed.

Terms: β: Standardized beta value; ACC: Anterior cingulate; ADHD: Attention-deficit/hyperactivity disorder; AG: Angular gyrus; GD: Gaming disorder; MPFC: Medial prefrontal cortex; Sig: Indicates statistical significance. *p<.01. **p<.001.

Table 3

Summary of fMRI within-group differences during self-related tasks

Study	Target comparisons (reflection tasks)	Clinical sample Stimulus: Activation	Control group Stimulus: Activation
Lemenager et al. (2014)	Avatar vs. actual-self	Avatar: more activity in the bilateral AG, middle occipital gyrus, the cuneus	No significant activations
	Unfamiliar person vs. actual-self	Unfamiliar person: more activity in the bilateral AG, precuneus	No significant activations
Dieter et al. (2015)	Avatar vs. actual-self	Avatar: more activity in the bilateral AG	Self: more activity in left AG
	Avatar vs. ideal-self	Avatar: more activity in left AG	Ideal: more activity in the bilateral AG
Lemenager et al. (2016)	Avatar vs. actual-self	Avatar: more activity in left AG, MPFC, and the frontal, temporal, occipital regions	No significant activations
	Actual-self vs. ideal-self	Ideal: more activity in addicted gamers' inferior parietal lobe; more activity in addicted gamers' bilateral AG	Self: more activity in MPFC, IFG, parietal regions, ACC
Choi et al. (2018)	Actual-self vs. baseline	No significant activations	Self: more MPFC activity
	Other-person vs. baseline	No significant activations	Other: DMPFC activity
	Avatar vs. baseline	Avatar: more activity in MPFC, ACC, DMPFC	Avatar: DMPFC activity ("similar to the other condition")
Kim et al. (2018)	Actual-self vs. ideal-self	Self: more activity in the right MPFC; Ideal: no significant activity in the left calcarine cortex	Self: more activity in the bilateral MPFC; Ideal: more activity in the left calcarine cortex

Note: Lemenager et al.'s (2016) sample included addicted gamers and problematic gamers. Abbreviations: ACC: Anterior cingulate cortex; AG: Angular gyrus; DMPFC: Dorsal medial prefrontal cortex; MPFC: Medial prefrontal cortex.

Table 4

Summary of fMRI between-group differences

Study	Target comparisons (reflection tasks)	Clinical vs. control group
Lemenager et al. (2014)	Unfamiliar person vs. actual-self	No significant difference
	Avatar vs. actual-self	No significant difference
Dieter et al. (2015)	Avatar vs. actual-self	Addicted gamers: more avatar-related activity in the left inferior frontal gyrus
	Avatar vs. ideal-self	Addicted gamers: more left AG activations during avatar-reflection
Lemenager et al. (2016)	Avatar vs. actual-self	Addicted gamers: more avatar-related activity in the left AG than controls; No significant differences in avatar-related activity between 1) problematic and addicted gamers, and 2) problematic gamers and controls
	Actual-self vs. ideal-self	No significant difference
Choi et al. (2018)	Actual-self vs. baseline	Addicted: less activity in occipital lobe and right inferior frontal gyrus during actual-self reflection
	Other-person vs. baseline	No significant difference
	Avatar vs. baseline	Addicted: more activity in the postcentral, inferior frontal, and precentral gyri, cerebellum, occipital lobe, ACC, temporal pole, and MPFC during avatar-reflection
Kim et al. (2018)	Ideal-self vs. actual-self	Addicted: less activity in the right inferior parietal lobule (including AG) during "self-discrepancy contrast"
	Actual-self vs. baseline	Addicted: more activity in the inferior parietal lobule (including AG) during actual-self reflection
	Ideal-self vs. baseline	No significant difference

Abbreviations: ACC: Anterior cingulate cortex; AG: Angular gyrus; DMPFC: Dorsal medial prefrontal cortex; MPFC: Medial prefrontal cortex.

Avatar identification and problematic gaming: The mediating role of self-concept clarity

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Contributors

Raquel Green designed the study, recruited participants, and analyzed the data. Raquel Green wrote the draft of the manuscript and approved the final manuscript.

Conflict of Interest

The author declares no competing interests. The author alone is responsible for the content and writing of the paper[1].

[1]This article has been submitted to Addictive Behaviors and is currently under revision. This journal has no strict formatting requirements or referencing styles, although APA formatting is required for in-text citations. APA formatting has been used throughout the paper. The article meets the Master of Psychology (Clinical) thesis requirement of 5000-8000 words (including tables, figures, references). The maximum word limit for article submission is 3500 words, excluding tables, figures, references.

Highlights

- Survey of 993 gamers explored avatar identification, self-concept clarity, and problem gaming
- Avatar identification did not differ greatly based on avatar features or game type
- Wishful identification was the only significant avatar identification predictor of problem gaming
- Avatar identification was related to higher problem gaming and poorer self-concept clarity
- Significant indirect effect of avatar identification on problem gaming through self-concept clarity

Abstract

Some video-gaming activities feature customizable avatars that enable users to fulfil self-identity needs. Research evidence (e.g., fMRI and survey studies) has suggested that poorer self-concept and stronger avatar identification are associated with problematic gaming. Player-avatar relationships have thus been proposed to require attention in gaming disorder assessment and interventions. To examine the interplay of player-avatar interactions in problematic gaming, this study investigated whether avatar identification differed according to avatar characteristics and game types, and whether the association between avatar identification and problem gaming was mediated by self-concept clarity. A total of 993 adult respondents completed an online survey that assessed problematic gaming, avatar identification, and self-concept clarity. The results indicated that avatar identification scores were generally unrelated to avatar characteristics (e.g., human resemblance, degree of customizability, and in-game perspective). Avatar identification was significantly positively related to problematic gaming and significantly negatively related to self-concept clarity. Consistent with models of avatar identification and self-concept, there was a significant indirect relationship between avatar identification on problem gaming mediated through self-concept clarity. These findings suggest that poorer self-concept clarity may be one mechanism by which avatar identification affects problem gaming. Future research with clinical samples may help to gain a better understanding of avatar-related processes and psychological vulnerabilities related to problematic gaming.

Keywords:

Gaming disorder; problematic gaming; avatar identification; self-concept; identity; Proteus effect

1. Introduction

Online gaming activities have become increasingly sophisticated in terms of the interactive experiences offered to players (Billieux et al., 2015; King, Herd, & Delfabbro, 2018; King, Koster, & Billieux, 2019; Lemenager, Neissner, Sabo, Mann & Kiefer, 2020). An important element of gaming that enhances this interactivity is the playable avatar projected into an immersive digital environment (Bailey, West, & Kuffel, 2013; Bessière, Seay, & Kiesler, 2007; Burleigh, Stavropoulos, Liew, Adams, & Griffiths, 2018; Trepte & Reinecke, 2010). An avatar is the representation of the player that is projected to other players (Bailey et al., 2013; Bessière et al., 2007; Burleigh et al., 2018; Trepte & Reinecke, 2010). Such playable avatars can be realistic or stylized and come with customization options that allow players to alter personal attributes, abilities, and their appearance. Certain games that emphasize avatar creation are generally referred to as 'role-playing' games, such as massively multiplayer online role-playing games (MMORPGs) (Smahel, Blinka, & Ledabyl, 2008), but avatar elements can be found in many types of games. Avatar features have attracted increasing attention to explain the popularity of gaming as well as the development and maintenance of problematic gaming (Wan & Chiou, 2006).

Problematic gaming, in its most serious form, has been recognized as gaming disorder (GD) in the ICD-11 and as a condition for further study in the DSM-5. The conceptualization of gaming disorder shares features and symptoms (e.g., loss of control and continuation despite awareness of harm) with other addictive behaviors (e.g., gambling disorder), substance use disorders (SUDs), impulse control disorders (e.g., compulsive buying disorder [CBD]) and obsessive-compulsive disorder (OCD). This condition is characterized by persistent involvement in gaming activities, impaired control over gaming, and continued use despite harm to multiple areas of functioning, including psychological and physical health, relationships, and work or study (King, Delfabbro, et al., 2018; Saunders et al., 2017). We employ the term 'problematic gaming' to encompass the DSM-5 and ICD-11 classifications,

and to refer to the broader spectrum of problematic gaming behaviors that fall below the clinical threshold.

Research suggests that players form an attachment to, or identify with aspects of, their avatar (Li, Liau, & Khoo, 2013; Liew, Stavropoulos, Adams, Burleigh, & Griffiths, 2018). This has been described in the literature as a "strong emotional bond" (Mancini, Imperato, & Sibilla, 2019, p.297), "powerful psychological component of the gaming world" (Stavropoulos, Pinches, Morcos, & Pontes, 2019), and important to an "individual's personal narrative, psychological wellbeing, and self-conception" (Wolfendale, 2007, p.115). Further, avatars have been proposed to fulfil important needs of the user and represent "far more than mere online objects" (Wolfendale, 2007, p.114), allowing gamers to express suppressed versions of their psyche (Stavropoulos, Gomez, Mueller, Yucel, & Griffiths, 2020). 'Avatar identification', a common term in this literature, refers to "the temporary alteration in self-perception of the player induced by the mental association with their game character" (van Looy, Courtois, De Vocht, & De Marez, 2012, p.206). Avatar identification is described as a positive or desired experience, as avatars enable identity expression, creativity, and immersion in the virtual world (Klimmt, Hefner, & Vorderer, 2009; van Looy, 2015; Whang & Chang, 2004).

Avatar identification has also been linked to excessive gaming (Sioni, Burleson, & Bekerian, 2017; Mancini & Sibilla, 2017; Smahel et al., 2008; You, Kim, & Lee, 2017; Mancini et al., 2019) and depressive mood (Bessière et al., 2007; You et al., 2017; Burleigh et al., 2018). Neuroimaging (fMRI) studies have reported consistently that problematic gamers exhibit greater brain activity during avatar-reflection (Lemenager et al., 2014, 2016; Dieter et al., 2015; Choi et al., 2018) and less brain activity during actual-self-reflection, compared to controls (Kim et al., 2018; Choi et al., 2018). Burleigh et al. (2018) examined cross-sectional and longitudinal data and reported that gamer-avatar relationships were a significant individual risk factor for problematic gaming over time. Such evidence has been cited to support proposals to add avatar identification to the definitional criteria for gaming disorder (e.g., in the DSM-5 or ICD-11) (Sioni et al., 2017) and as a target to address in

treatment (Stavropoulos, Gomez, et al., 2020). For instance, clinicians have been encouraged to explore the "relationship between their client's identity inside and outside of the game in relation to their use of avatars" (Burleigh et al., 2018, p.116), to examine an avatar's characteristics to "provide a subtle (or obvious) glimpse into players' unconscious processes" (Sioni et al., 2017, p.15), and to carefully consider "virtual demographics, such as the Draenei race" [in the game *World of Warcraft*] when preventing and treating problem gaming (Morcos, Stavropoulos, Rennie, Clark, & Pontes, 2019, p.13).

Despite these findings, avatar identification is not generally considered inherently problematic (i.e., it can often be an important part of the 'fun' and appeal of gaming; Neustaedter & Fedorovskaya, 2009; Yee & Bailenson, 2007). Therefore, researchers have attempted to identify the potential mechanisms or important conditions that may interact with avatar identification to increase the risk of problem gaming (e.g., Stavropoulos, Gomez, et al., 2020). Much of this work has drawn heavily from Yee and colleagues' (e.g., Yee & Bailenson, 2007; Yee, Bailenson, & Ducheneaut, 2009) seminal work on avatars, specifically the 'Proteus Effect'. The Proteus Effect refers to the phenomenon of an individual's gaming behavior being influenced by their digital self-representation. Yee and colleagues' studies reported that characteristics of the avatar – including, for example, its physical attributes (height, attractiveness) – can influence the user's in-game choices and behaviors. It has also been found that certain Proteus Effect 'profiles', such as users who reported that their emotions and behaviors were more strongly affected by their avatar, were more at risk of problem gaming (Stavropoulos, Pontes, Gomez, Schivinski, & Griffiths, 2020).

Other researchers have proposed that some aspects of avatar identification may more readily elicit problem gaming among vulnerable individuals, particularly those with identity needs related to the avatar experience. Van Looy's (2015) multidimensional model of avatar identification provides useful points of reference to distinguish these important aspects of avatar identification. His model proposes three basic dimensions, including similarity identification, wishful identification, and embodied presence. Of particular relevance to understanding gamers' personal vulnerabilities is the concept of wishful identification, which

refers to a process whereby a person desires to emulate or vicariously live through the avatar. Drawing on Higgins' (1987) self-discrepancy theory, van Looy (2015) argues that wishful identification relates to a desire to compensate for perceived discrepancies between their real-world and virtual selves. According to van Looy (2015), avatar identification involves a process of temporarily experiencing an altered sense of self due to the mental association with an avatar, which can lead to a tendency to use the avatar to escape from reality and one's problems. This tendency, in turn, may lead to gaming that generates negative consequences.

Extending on this concept, Šporčić and Glavak-Tkalić (2018) proposed that a poorly defined sense of self was a risk factor for overuse of avatar-based games. They argued that players with poorer self-concept engaged in gaming to become immersed in different roles offered within a game, or to create an avatar as a representation of one's ideal self to develop a clearer concept of themselves. These avatar-related experiences could provide a "temporary detachment from reality and their actual self, and therefore may lead to excessive and problematic video game playing" (p.8). Šporčić and Glavak-Tkalić surveyed 509 adult gamers and reported that poorer self-concept clarity was related to problematic gaming. The results of their mediation model showed that self-concept clarity was both directly and indirectly (via escape motive) associated with problematic online gaming. These findings were consistent with other studies that reported that some players created an avatar with idealized attributes to compensate for perceived inadequacies (Bessière et al., 2007; Lemenager et al., 2014, 2020), and studies reporting significant positive correlations between avatar identification and excessive gaming (Lemenager et al., 2013; Mancini et al., 2019; Smahel et al., 2008; You et al., 2017).

Despite the ongoing discussion of avatar identification in the literature, there has been little work on the avatar characteristics themselves and how these may relate to avatar identification. Research on the Proteus Effect has examined how specific characteristics of avatars can shape the user's behaviors (e.g., a taller avatar increases the user's aggressiveness; Yee et al., 2009); however, there has been limited work on how such aspects may affect avatar identification and problem gaming. Research has often focused on

MMORPG players (Collins, Freeman, & Chamarro-Premuzic, 2012; Hyun et al., 2015), despite the prominence of avatars across many types of games, including first-person shooter (FPS) and multiplayer online battle arenas (MOBAs). Most MMORPGs are long-played games (usually with one avatar), featuring options for character development, customization, emphasis on group play and social functionality, and have been identified as a 'high-risk' game for problematic use (Eichenbaum, Kattner, Bradford, Gentile, & Green, 2015; Stavropoulos, Gomez, et al., 2020). Mancini et al. (2019) reported that MMORPG players' intention to play was higher among those who customized and identified with an idealized avatar. While studies have examined gaming motivations (Hussain, Williams, & Griffiths, 2015; King, Delfabbro, Deleuze, et al., 2019; Zhong & Yao, 2013), little research has examined avatar features and customizability in relation to avatar identification and problem gaming.

1.1 The Present Study

The present study was guided by van Looy's (2015) multidimensional model of avatar identification and Yee and Bailenson's (2007) Proteus Effect theory, which propose that players develop an attachment to their avatar which affects their in-game choices, emotions, and behaviors, and this may increase their desire to play to escape from problems and reality. As outlined by the concept of wishful identification in van Looy's (2015) model, and based on recent research (Šporčić & Glavak-Tkalić, 2018), we predicted that poorer self-concept may be a mechanism by which avatar identification is related to problematic gaming. We also sought to examine potential differences in avatar identification according to the avatar's characteristics, as suggested by research on the Proteus Effect. Specifically, avatars may be more influential if the player can customize avatar characteristics to match preferences for attributes, such as their gender, race, attitude, background, and current situation (van Looy, 2015).

The following hypotheses were proposed: (1) humanoid, personalized, and customizable avatars would be associated with stronger avatar identification than non-human,

non-customizable ‘default’ avatars; (2) stronger avatar identification and poorer self-concept clarity would be significantly related to problem gaming; (3) wishful identification would have a stronger relationship to problem gaming than similarity identification and embodied presence; and (4) the expected positive association between avatar identification and problem gaming would be mediated by poorer self-concept clarity.

2. Method

2.1 Participants

A total of 993 adult participants (73% male; *n*=725), with a mean age of 26.4 years (*SD*=8.1), completed an online survey advertised on online gaming-related forums (Reddit, Games Spot, Games Planet, and PC Gamer Forum). Most respondents reported being Caucasian (75.4%), single (59.5%), engaged in employment (61.3%) and/or further study (45.3%). Based on GD checklist scores, there were 162 (16.3%) problem gamers. The sample comprised of players of MMORPG (*n*=419, 42.2%), single-player role-playing games (RPG) (*n*=253, 25.5%), FPS (*n*=125, 12.6%), MOBA (*n*=80, 8.1%), and other games (*n*=116, 11.7%). Missing/incomplete data (*n*=646) and ineligible participants were excluded (e.g., aged under 18 years old [*n*=4]).

2.2 Measures

2.2.1 Demographic and gaming-related information. Each participant provided socio-demographic information (e.g., gender, age, other details). Participants reported the typical number of hours spent gaming each day in the last three months. Participants reported their preferred gaming genre, including MMORPG, MOBA, FPS, single-player RPG, or Other. Questions about avatar characteristics referred to the main game currently played. Participants reported the number of avatars they controlled (1 avatar; 2 or more avatars; no identifiable avatar), avatar type (human; non-human creature; non-human non-creature), avatar perspective (first-person only; third-person only; both first-person and third-person perspective), pre-game avatar customizability (default avatar; choice from multiple defaults;

fully customizable avatar), and in-game avatar customization (none; some options; many options).

2.2.2 Problematic gaming. Petry et al.'s (2014) checklist is a 9-item self-report measure to assess the DSM-5 gaming disorder (APA, 2013). Response options are dichotomous (Yes/No). A score of 5+ indicated problematic status. The checklist has been used in clinical and neurobiological studies of GD, and shown solid psychometric qualities (King, Billieux, Carragher, & Delfabbro, 2020; King, Chamberlain, et al., 2020). Internal consistency of the scale in this study was .68, which was relatively low but consistent with other studies (Evans, King, & Delfabbro, 2018; Jeromin, Rief, & Barke, 2016; King, Herd, Delfabbro, 2018), and which may be attributed to the variable sensitivity of the nine DSM-5 criteria (Ko et al., 2014).

2.2.3 Player identification. The Player Identification Scale (van Looy et al., 2012) is a 28-item measure with three subscales: *avatar identification* (e.g., "my character is an extension of myself"), *group identification* (e.g., "I feel connected with the members of my guild"), and *game identification* (e.g., "the game is more than a hobby to me"). In addition, there are three subscales for avatar identification: *similarity identification* (e.g., "my character resembles me"), *embodied presence* (e.g., "I feel like I am inside my character when playing"), and *wishful identification* (e.g., "my character is a better me"). Each statement is rated on a 5-point Likert scale from 1 (*strongly disagree*) to 5 (*strongly agree*). Avatar identification scores range from 17 to 85, with higher scores indicating stronger identification. The measure has demonstrated adequate to excellent psychometric properties (van Looy et al., 2012). Cronbach's alpha was .92 in this study.

2.2.4 Self-concept clarity. Self-concept clarity refers to the extent to which an individual holds self-beliefs or schema that are stable, clearly, and confidently defined (Usborne & Taylor, 2010). Greater self-concept clarity has been reported to buffer against depression and stress (Bigler, Neimeyer, & Brown, 2001), and poorer self-concept clarity has been identified as increasing one's vulnerability to mental health problems, including trauma

response severity (Evans, Reid, Preston, Palmier-Claus, & Sellwood, 2015), alcohol use issues (Corte & Zucker, 2008) and problematic gaming (Šporčić & Glavak-Tkalić, 2018). The Self-Concept Clarity Scale (Campbell et al., 1996) presents 12 statements (e.g., "In general, I have a clear sense of who I am and what I am") and asks participants to indicate their level of agreement. Responses range from 1 (*strongly disagree*) to 5 (*strongly agree*). Higher scores (i.e., sum of all items) indicate greater self-concept clarity. Campbell et al. (1996) reported that the scale had excellent reliability and validity. This sample yielded a Cronbach's alpha of .89.

2.3 Procedure

Ethics approval was granted by the School of Psychology Human Research Ethics Subcommittee (approval number: 20/18). Participants who were aged 18 or older and played games weekly were eligible to participate. Upon completion of the survey, participants entered a prize draw for a $50 AUD voucher.

2.4 Statistical Analysis

Analyses were conducted using IBM SPSS Version 26 software. Spearman's rank-order correlations were used to assess bivariate associations, as problematic gaming scores were positively skewed. One-way ANOVAs and Bonferroni tests compared avatar identification across gender, game genres, and avatar-related characteristics and features. An exploratory multiple regression examined the predictive value of each variable on GD scores. Version 3.5 of the PROCESS macro for SPSS (Hayes, 2013) was used to conduct the mediation analyses.

3. Results

3.1 Descriptive Statistics and Mean Comparisons

Table 1 presents a summary of group differences in avatar identification according to participants' gender and avatar characteristics. Avatar identification was significantly higher among: (1) female gamers as compared to male gamers; (2) participants who used fully customizable avatars as compared to a default avatar or one of multiple default avatar

options; (3) participants who had many in-game avatar customization options as compared to some or no customization options; (4) participants who used one main avatar as compared to multiple or no discernible avatars; (5) participants whose avatar had both first- and third-person perspective compared to only one of either perspective; and (6) MMORPG and RPG users as compared to MOBA users. However, avatar identification did not differ according to whether the avatar was human, a non-human creature, or non-human non-creature. All significant comparisons yielded only small effect sizes. Thus, there was limited support for the hypothesis that humanoid, personalized, and customizable avatars would be associated with stronger avatar identification than non-human, non-customizable avatars.

[INSERT TABLE 1 HERE]

3.2 Correlations

Table 2 summarizes the Spearman's rank-order correlations between the main variables. In support of Hypothesis 2, avatar identification was significantly positively related to problem gaming (r=.26) and significantly negatively related to self-concept clarity (r=-.27). Self-concept clarity was significantly negatively correlated with problem gaming (r=-.39). Avatar identification was not related to gaming time, suggesting that the player-avatar bond may not change greatly as a function of time spent playing.

[INSERT TABLE 2 HERE]

3.3 Multiple Regression

Table 3 presents a simultaneous multiple regression examining the three subscales of avatar identification (similarity identification, embodied presence, wishful identification), self-concept clarity, and gaming time as predictors of problem gaming. The model explained 20.6% of the variance in GD. Of the three avatar identification subscales, wishful

identification (β=.18) was the only significant predictor of problem gaming. Hypothesis 3 was therefore supported because wishful identification had a stronger relationship to problem gaming than similarity identification and embodied presence.

[INSERT TABLE 3 HERE]

3.4 Mediation Analysis

Figure 1 presents a summary of the mediation analysis, including the regression weights for paths a, b, c, and c′. The model assessed whether self-concept clarity mediated the relationship between avatar identification and problem gaming. The 95th percentile confidence intervals (CI) for the indirect effects were estimated with bias-corrected bootstrap analyses (5,000 samples). There was a significant indirect effect of avatar identification on problem gaming through self-concept clarity, *b*=0.1, 95% CI [0.008, 0.016]. Therefore, Hypothesis 4 was supported because the positive association between avatar identification and problem gaming was mediated by poorer self-concept clarity.

[INSERT FIGURE 1 HERE]

Two additional mediation analyses (Figures 2 and 3) examined game identification (i.e., another subscale of the Player Identification Scale with comparable associations to self-concept clarity and problem gaming) and wishful identification in place of avatar identification. These analyses reported a similar pattern of results (i.e., comparable direct and indirect effects). Specifically, there was a significant indirect effect of game identification on problem gaming through self-concept clarity, *b*=0.03, 95% CI [0.028, 0.05]. The indirect effect of wishful identification on problem gaming through self-concept clarity was also significant, *b*=.03, 95% CI [.027, .047].

[INSERT FIGURE 2 HERE]

[INSERT FIGURE 3 HERE]

4. Discussion

This study examined avatar identification and self-concept clarity in problematic gaming, as well as differences in avatar identification according to avatar characteristics. Avatar identification was modestly associated with problematic gaming in bivariate and multivariate analyses. This finding was consistent with past studies (Mancini et al., 2019; Smahel et al., 2008; Sioni et al., 2017; You et al., 2017). Further, the wishful identification subscale of avatar identification was the only significant avatar-related predictor of problem gaming. Wishful identification refers to the process whereby a person desires to emulate or live vicariously through the avatar (van Looy, 2015). For example, wishful identification items refer to experiencing the avatar as a "better me", and as having "characteristics that I would like to have". Thus, while avatar identification was a significant predictor of problem gaming, it appears that the most important aspect of avatar identification in relation to problem gaming involves the avatar providing the means of compensating for the player's perceived self-deficiencies in the real world. This result was consistent with the mediation analysis, which found a significant indirect effect of avatar identification on problem gaming through self-concept clarity. Self-concept clarity may be a psychological mechanism or vulnerability by which avatar identification, and particularly wishful identification, affects problem gaming. Overall, these results suggest that avatar identification and poor self-concept clarity may be modest predictors of GD which can interact, as suggested by the Proteus Effect and van Looy's (2015) model of avatar identification.

This study found only limited support for the notion that personalized and customizable avatars are more strongly associated with greater avatar identification than non-customizable avatars. Differences in avatar identification scores across avatar types were statistically

significant (due to large sample size) but constituted small effects only. Avatar identification was also slightly higher among those who controlled a single avatar (versus multiple avatars) and those who viewed their avatar from both first and third-person perspectives. MOBA users reported slightly lower avatar identification than MMORPG and RPG users. However, avatar identification did not differ greatly according to whether the participant's avatar was a human, a non-human creature, or non-human non-creature. Avatar identification was not associated with time spent playing the game, suggesting that stronger avatar identification may not be the product of mere exposure (i.e., repeatedly viewing the avatar) (Zajonc, 1968) or the target of cognitive dissonance (i.e., a need to rationalize one's investment in the gaming activity as being worthwhile) (Festinger, 1957). These results suggest that player-avatar bonds may form relatively quickly and that different implementations of avatar features may not greatly affect or inhibit potential avatar identification.

The present study's findings add to the continuing discussion of problem gaming interventions that refer to the need to address avatar-related phenomena. For instance, Lemenager et al. (2016) describes a therapy that focuses on achieving emotional detachment from the avatar, where "addicted gamers discuss in a group setting all positive characteristics of their avatar and how they can transfer some of them into their own personality" (p.496). Similarly, Burleigh et al. (2018) argued that "prevention and treatment initiatives should target the gamer-avatar relationship…to guide cognitive and self-reflective interventions" (p.116). Stavropoulos, Gomez, and colleagues (2020) refer to inviting gamers "to talk about their virtual personas, and their game-related achievements and investigating ways that such avatar aspects of their 'in-game' avatar life can be transferred to real life" (p.9). The extent to which guided exploration of the avatar may aid therapy objectives warrants further examination. As noted in our review (Green, Delfabbro, & King, 2020), treatment engagement is often low among individuals with GD, particularly among adolescents (Humphreys, 2019), and therefore clinicians should apply evidence-based guidelines to optimize what can be delivered within a typically limited period of engagement. Brief cognitive-behavioral therapy (see Stevens, King, Dorstyn, & Delfabbro, 2019; Wölfling et

al., 2019) designed to establish new non-gaming routines, including identifying personal barriers and employing harm minimization strategies, may be the most feasible and effective option.

The present study was not without limitations. First, although the study recruited a very large and diverse sample of regular gamers, the recruitment approach was purposive (i.e., to select more individuals with relevant gaming and avatar-related experiences) and therefore these findings may not generalize to the wider gaming population, nor to individuals with more severe gaming problems, such as those described in case reports (Allison et al., 2006). Another limitation is the potential transience of gaming for many participants, which may have affected the specificity of measurement. It is possible, for example, that some individuals may play numerous games and sometimes take extended 'breaks' from their main game. The study's questions provided only a 'snapshot' and thus did not systematically gather data on the player's history with specific games and avatars. Acquiring such information may be a worthwhile follow-up project, which could also examine the predictive value of avatar identification to habit formation or predicting future gaming behaviors.

This study employed measures with abstract concepts requiring insight and English language competency that may preclude the comprehension of some populations (e.g., individuals with low verbal comprehension). This study also did not examine identity issues (e.g., gender dysphoria) or personality traits (e.g., conscientiousness, perfectionism) that may influence avatar and in-game goal motivations. This work should be considered preliminary and in need of replication, particularly in clinical samples, and using alternative methods of data collection, such as interviews, to confirm experiences. Finally, this study was conducted during the COVID-19 pandemic and, while most variables would be relatively stable constructs, it is possible that participants may have responded differently due to pandemic-related stress and uncertainties (King, Delfabbro, Billieux, & Potenza, 2020).

4.1 Conclusions

This study found a significant relationship between avatar identification and problem gaming that was mediated by self-concept clarity. Gamers with poor self-concept may be more vulnerable to relying on avatar features in games to meet their identity-related needs (i.e., compensate for lack of real-world identity), which may, in turn, increase the risk of problem gaming. Players who have a stronger need to be like their avatar, or who view their avatar as the ideal version of themselves, appear to be more at risk of problematic gaming. Avatar identification was not generally related to features of the avatar itself, including whether it was humanoid or customizable. These data will hopefully contribute to continuing efforts to identify potential mechanisms of problematic gaming. At a time when the validity of GD is criticized for 'pathologizing' gaming (Bean, Nielsen, van Rooij, & Ferguson, 2017), the notion that avatar identification underlies and maintains GD may attract similar scrutiny. In our view, despite these and other promising findings, it may be premature for avatar identification to be considered a symptom of GD. However, the concept may nevertheless be a useful psychological process (see Brand, Rumpf, King, Potenza, & Wegmann, 2020) for understanding the importance of in-game rewards that some players desire and seek out excessively. This study emphasizes the important role of player vulnerabilities in understanding the formation of problem gaming. Future research may gain a better understanding of avatar-related processes, including how avatar-stimuli preferences develop and operate in connection to established addictive processes, such as approach bias and inhibitory control (Brand et al., 2019).

Author Statement

The following author statement is provided using the relevant CRediT roles. Raquel Green: Conceptualization, Methodology, Investigation, Formal analysis, Resources, Writing – Original Draft.

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Table 1

Avatar identification scores according to gender and avatar characteristics

		Avatar identification[a]			
Group	*n*	*M* (*SD*)	*F*(2,992)	Partial η^2	Post-hoc[b]
Gender					
1. Male	725	40.77 (15.39)			
2. Female	243	46.61 (13.76)	15.40*	.03	2 > 1
3. Other	25	44.16 (14.62)			
Avatar type					
1. Human	897	42.45 (15.15)			
2. Non-human creature	82	41.48 (15.49)	1.06	-	-
3. Non-human non-creature	14	36.86 (15.19)			
Number of avatars controlled					
1. 1 main avatar	435	44.36 (14.88)			
2. 2+ avatars	511	40.87 (15.19)	7.81*	.02	1 > 2-3
3. No main avatar	47	38.53 (15.68)			
Avatar perspective					
1. First-person only	128	40.07 (16.06)			
2. Third-person only	675	41.60 (15.09)	8.57*	.02	3 > 1-2
3. Both perspectives	190	46.22 (14.30)			
Initial avatar customizability					
1. Single default	212	39.54 (15.55)			
2. Multiple defaults	196	40.52 (15.86)	8.11*	.02	3 > 1-2
3. Fully customizable	585	43.87 (14.63)			
In-game avatar customization					
1. No option	133	38.99 (17.15)			
2. Some options	383	40.51 (14.50)	11.24*	.02	3 > 1-2
3. Many options	477	44.63 (14.80)			
Game genre					
1. MMORPG	419	43.60 (15.22)			
2. RPG	253	43.38 (14.67)			
3. MOBA	80	37.64 (16.37)	3.95*	.02	3 < 1-2
4. FPS	125	40.34 (15.08)			
5. Other	116	40.48 (14.64)			

* $p<.01$. [a]Higher scores indicated stronger avatar identification (Range: 17-85). Total score on the main subscale. [b]Bonferroni post-hoc analyses, except for gender and avatar customization options when there were unequal variances assumed (Games-Howell). MMORPG: Massively Multiplayer Online Role-Playing Game; RPG: Role-Playing Game; MOBA: Multiplayer Online Battle Arena; FPS: First Person Shooter.

Table 2

Descriptive statistics and correlations (p-value) between main study variables

Variable	*M* (*SD*)	1	2	3	4	5	6	7	8
1. Problem gaming	2.68 (1.93)								
2. Weekly gaming time	25.85 (8.55)	.19* (<.01)							
3. Avatar identification (AI)	42.29 (15.18)	.26* (<.01)	.02 (.44)						
4. Group identification	20.37 (5.93)	.16* (<.01)	.24* (<.01)	.15* (<.01)					
5. Game identification	13.72 (4.69)	.32* (<.01)	.23* (<.01)	.33* (<.01)	.32* (<.01)				
6. AI: Similarity identification	14.79 (6.27)	.16* (<.01)	-.04 (.28)	.84* (<.01)	.09* (<.01)	.18* (<.01)			
7. AI: Embodied presence	14.47 (6.55)	.20* (<.01)	.001 (.97)	.85* (<.01)	.14* (<.01)	.34* (<.01)	.58* (<.01)		
8. AI: Wishful identification	13.03 (5.56)	.31* (<.01)	.08* (<.01)	.78* (<.01)	.14* (<.01)	.32* (<.01)	.51* (<.01)	.51* (<.01)	
9. Self-concept clarity	38.90 (10.05)	-.39* (<.01)	-.07 (.02)	-.27* (<.01)	-.06 (.05)	-.27* (<.01)	-.14* (<.01)	-.23* (<.01)	-.32* (<.01)

Table 3

Multiple regression predicting problem gaming from similarity identification, embodied presence, wishful identification, self-concept clarity, and gaming time

Predictor	*B*	*Beta (β)*	*p*
Similarity identification	.01	.03	.376
Embodied presence	.01	.02	.682
Wishful identification	.06	.18	<.01
Self-concept clarity	-.06	-.32	<.01
Weekly gaming time	.02	.11	<.01
R^2 = .206, F(5,987) =51.10, p<.01			

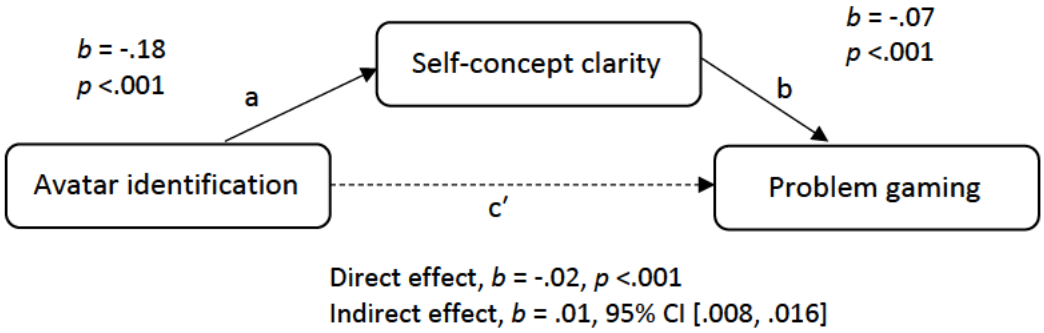

Figure 1. The direct and indirect effects of self-concept clarity on the relationship between avatar identification and problem gaming.

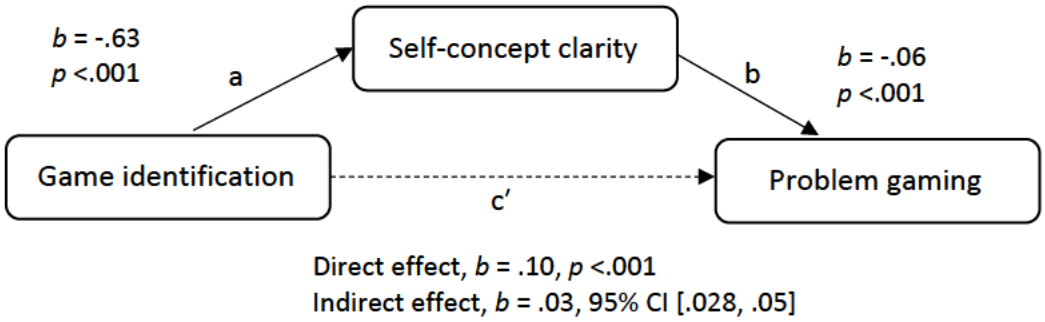

Figure 2. The direct and indirect effects of self-concept clarity on the relationship between game identification and problem gaming.

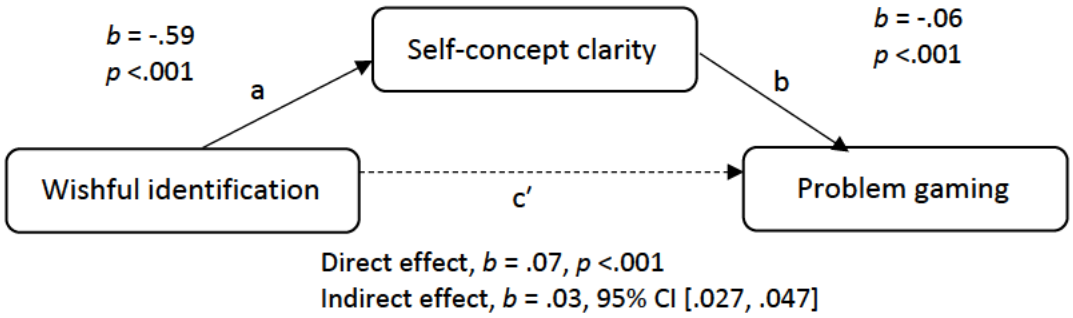

Figure 3. The direct and indirect effects of self-concept clarity on the relationship between wishful avatar identification and problem gaming.

Appendix

Instructions to Authors/Contributors

ADDICTIVE BEHAVIORS

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AUTHOR INFORMATION PACK

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DESCRIPTION

Addictive Behaviors is an international peer-reviewed journal publishing high quality human research on addictive behaviors and disorders since 1975. The journal accepts submissions of full-length papers and short communications on substance-related addictions such as the abuse of alcohol, drugs and nicotine, and behavioral addictions involving gambling and technology. We primarily publish behavioral and psychosocial research, but our articles span the fields of psychology, sociology, psychiatry, epidemiology, social policy, medicine, pharmacology and neuroscience. While theoretical orientations are diverse, the emphasis of the journal is primarily empirical. That is, sound experimental design combined with valid, reliable assessment and evaluation procedures are a requisite for acceptance. However, innovative and empirically oriented case studies that might encourage new lines of inquiry are accepted as well. Studies that clearly contribute to current knowledge of etiology, prevention, social policy or treatment are given priority. Scholarly commentaries on topical issues, systematic reviews, and mini reviews are encouraged. We especially welcome multimedia papers that incorporate video or audio components to better display methodology or findings.

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AUDIENCE

Psychiatrists, psychologists, pharmacologists, sociologists, social workers.

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INTRODUCTION

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