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Review

Maladaptive player-game relationships in problematic gaming and gaming disorder: A systematic review

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HIGHLIGHTS

- Gaming disorder involves maladaptive player-game relationships.
- We reviewed 23 empirical studies of player-game interactions related to GD.
- MMORPG play had the strongest positive association with GD as compared to other games.
- Higher impulsivity, risk-taking, comorbidity, and game motivations predicted GD.
- Some player vulnerabilities may selectively increase risk of GD for certain games.

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ABSTRACT

While certain player vulnerabilities are known to increase risk of gaming disorder (GD), the topic of maladaptive player × game relationships in GD has received limited attention. This review aimed to: (1) identify game types associated with GD symptomatology; and (2) evaluate individual differences (e.g., age, personality, depression) in the relationship between gaming and GD symptomatology. A systematic review of six databases identified 23 studies of the relations between game types and GD, including 13 studies employing multivariate analyses. Player vulnerabilities implicated in GD included impulsivity, risk-taking, psychopathological symptoms (e.g., depression, anxiety), and stronger gaming motivations (e.g., escapism, achievement). MMORPG involvement had the strongest positive association with GD. Problematic MMORPG players tend to have a socially anxious profile and may be attracted to the work-like roles and conventions of this genre. Problematic players of shooters tend to score higher on measures of sensation-seeking and impulsivity than other players. These findings suggest that GD may develop more readily and at more severe levels in complex, endless, socially driven games, irrespective of person-level characteristics. Some player vulnerabilities may selectively increase risk of GD for certain game types. Further research should investigate different player-game interactions to refine current models and interventions for GD.

1. Introduction

Millions of people enjoy playing video games in moderation, but gaming can also have adverse impacts and generate harms among vulnerable individuals and their families. The World Health Organization (WHO) has formally recognized these harms and the addictive potential of gaming, with the inclusion of the diagnostic categories of 'Hazardous gaming' and 'Gaming disorder' (GD) in the International Classification of Diseases-11 (ICD-11). This move has followed the American Psychiatric Association's recognition of 'Internet

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gaming disorder' (IGD) as a condition for further study in the Diagnostic and Statistical Manual of Mental Disorders, 5th Edition (DSM-5) (American Psychiatric Association, 2013). While gaming disorder has attained greater legitimacy in psychiatry, clinical psychology, and public health, the causes of the disorder are less well established in the academic literature. Multidimensional models (e.g., Brand, Young, Laier, Wölfling, & Potenza, 2016; Dong & Potenza, 2014) refer to factors that may increase a player's risk of developing GD including personal vulnerabilities (e.g., low self-esteem), social influences (e.g., peers, online networks), and constant accessibility to gaming activities (e.g., bedroom access). However, the important influence of the game activity itself (i.e., game type) on problematic gaming behavior and GD has received relatively little in-depth analysis. To establish a clearer direction for this field (see King, Koster, & Billieux, 2019), this review aimed to provide a critical appraisal of the empirical literature on video game activities and design features and their potential relation to the onset, symptom severity, and negative impacts of GD.

1.1. The complexity of game design

To understand the role of video game types in GD, a useful starting point is to delineate some of the broad parameters that define the gaming products and experiences available to players. This task is not straight-forward because modern video games have evolved to become arguably the most complex, dynamic, and varied form of digital entertainment (King, Delfabbro, & Griffiths, 2010). In basic terms, players use a game's control scheme (e.g., keyboard, controller, or motion sensors) to manipulate images on a visual display to reach an outcome usually defined as success or failure (Salen & Zimmerman, 2004). Games differ according to genre (e.g., shooting, role-playing, and strategy), platforms (e.g., personal computer, smartphone), modes (e.g., player versus player [PVP], player versus environment [PVE]), online connectivity (i.e., playing online or offline), and objectives (e.g., building, capturing, destroying, racing). Modern games offer unlimited experiences of winning and losing, usually contextualized by intricate narratives and characters, large open worlds to explore, and opportunities to socialize with other players (King et al., 2010; King et al., 2017). In addition, games often include content and activities that aim to engage the player at less 'intense' times (i.e., game-play moments with low player demands and less emphasis on winning or making progress) to fulfil players' desires to experience different emotions, satisfy psychological needs, or pass time, explore, and escape reality (Ryan, Rigby, & Przybylski, 2006). Increasing market competition has also led to some game developers adapting or 'hybridizing' the design of their games (e.g., the adoption of features such as larger worlds and role-playing elements, more randomness, episodic content, and/or systems that 'gate' and 'throttle' progression) to keep users playing longer and more regularly (King & Delfabbro, 2018a). In effect, these systems appear to offer players more 'entertainment value' (i.e., longer playing time for their money) while limiting the player's available time to play games offered by rival game designers.

Games also have features that encourage psychological attachment to virtual items, actions, and identities, particularly in persistent online games (Bailey, West, & Kuffel, 2013; King & Delfabbro, 2016). Research has shown, for example, that some gamers value their digital collections of games and virtual achievements in the same way that people tend to value material goods or real-world relationships. Molesworth and Watkins (2016) reported that adult gamers with collections of hundreds of games often regarded their games as 'special' because they provided a sense of completeness as a record of personal, technological, and economic progress. Collecting and completing games was not only seen as a leisure pursuit but also a conscious process of acquiring 'sacred' items to achieve psychological fulfilment. In clinical psychology, studies have found that problematic players' attachment to video games may manifest as maladaptive cognitions, including the tendency to overvalue the importance of game rewards and an overreliance on gaming for self-worth and identity (Allison, von Wahlde, Shockley, & Gabbard, 2006; Beard & Wickham, 2016; King & Delfabbro, 2016).

Another important technological innovation in gaming products and services has been the monetization of virtual goods in video games ('microtransactions') (Balakrishnan & Griffiths, 2018; King, Delfabbro, Gainsbury, Dreier, Greer, & Billieux, 2019). In-game purchasing schemes may be considered a business strategy that aims to convince players that purchased gaming items have greater value than items acquired through skilful play (see *endowment effect*; Kahneman, Knetsch, & Thaler, 1990). Some in-game monetization schemes are also often designed to repeatedly solicit the player to make in-game purchases of virtual content (Civelek et al., 2018). King and Delfabbro (2018b) argued that some of these in-game purchasing schemes may be viewed as 'predatory' in that they disguise or withhold the true long-term cost of the activity until players are already financially and psychologically committed. Predatory monetization schemes in games appear to exploit the players' desire for in-game completion and may complement other design elements that incentivize users to continue playing. Moreover, these features may also contribute to problematic gaming, particularly among younger users who are less capable of self-regulating their gaming and appraising the cost-benefit of these schemes.

Drawing upon similar developments in the field of gambling studies in relation to concerns about electronic gaming machines (e.g., Dixon, Harrigan, Sandhu, Collins, & Fugelsang, 2010; Griffiths, 1993; Ladouceur & Sévigny, 2005; Peters, Hunt, & Harper, 2010), this review aims to identify the specific types of video games that may be more problematic than others for certain users. So far this research area has had a broad focus, including studies that report that there are likely to be characteristics of games that heighten player enjoyment or increase the time spent gaming (e.g., Griffiths & Nuyens, 2017; Kim et al., 2010; King et al., 2010; King, Delfabbro, & Griffiths, 2011; Laconi, Pirès, & Chabrol, 2017; Wood, Griffiths, Chappell, & Davies, 2004). A difficulty faced in this area of research, however, is that it remains unclear how to differentiate between the 'popularity' of features as opposed to their potential to cause harm. Certain game elements (e.g., realistic graphics, intermittent reinforcement, resource management) are features of most games and not specific features which can be implicated in problematic gaming. Researchers also face the conundrum of whether certain games or features tend to be problematic only for certain types of players; whether there is an interaction of player characteristics and game features under certain playing conditions; or whether certain game features simply appeal to all types of players.

1.2. Individual differences and risk factors

A critical review of the influence of game types on GD must also consider the important role of individual differences that influence users' interactions with certain games. An emerging body of research shows that individuals differ broadly in their perceptions of the costs and benefits of gaming and their behavioral reactions to gaming stimuli (Griffiths & Nuyens, 2017; Hamari & Keronen, 2017; Smyth, 2007). Individual differences may be demographic (e.g., age, sex); some are psychological (e.g., personality, psychopathological symptoms), whereas some may be neurobiological in nature. These differences can operate at different levels and/or in combination. Some differences have also been linked to behavioral dysregulation and psychopathology more broadly.

Studies of demographic differences consistently report that males are at greater risk of developing GD (Andreassen et al., 2016). Males are more likely than females to report GD in prevalence studies by a factor of at least 2 to 1 (Durkee et al., 2012), and males tend to report playing games more frequently and for longer periods than females. Age is a well-documented risk factor that has an inverse u-shaped relationship with problematic gaming (Tejeiro et al., 2012), with the risk of GD peaking in adolescence and usually decreasing as individuals approach

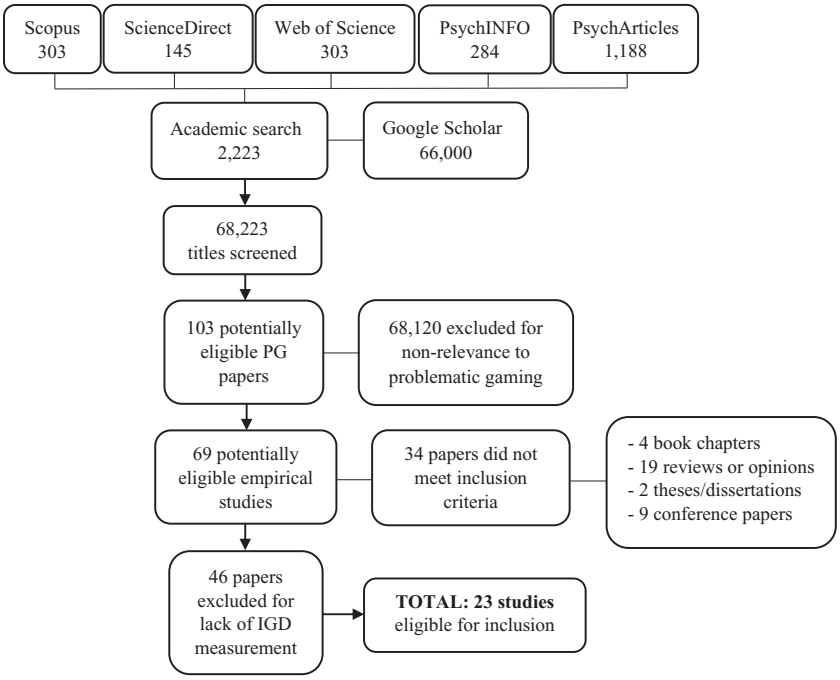

Fig. 1. Search results and study selection in accordance with PRISMA guidelines.

their late 20s (Kuss & Griffiths, 2012). GD risk is viewed as higher in adolescence due to neurobiological (i.e., still developing pre-frontal cortex), developmental (i.e., needs for social belonging and identity, and challenging authority) and cultural (e.g., stressful transition to high school, new responsibilities, and greater independence) reasons. In addition, many young people in industrialized societies live at home with access to gaming in their bedroom or living room (Bayrakdar & Coulter, 2017).

Personality factors and other psychological characteristics are often implicated in GD and these include: greater impulsivity (Billieux, Thorens, et al., 2015; Lee et al., 2012; Rho et al., 2017); neuroticism (Peters & Malesky, 2008); introversion (Cole & Hooley, 2013); lower agreeableness (Collins et al., 2012); lower conscientiousness (Braun et al., 2016); lower self-esteem (Ko, Yen, Chen, Chen, & Yen, 2005); low openness to experience (Wang et al., 2017); aggressiveness (Gervasi et al., 2017), rule-breaking (Müller et al., 2015); depression (Bonnaire & Baptista, 2019); trait anxiety (Mehroof & Griffiths, 2010); schizotypy (Schimmenti, Infanti, Badoud, Laloyaux, & Billieux, 2017), and narcissism (Stopfer et al., 2015). Studies have also shown that comorbid psychopathological symptoms, especially anxiety and depression symptoms, are a major contributing factor to GD and other behavioral addictions (Laconi et al., 2017; Sioni et al., 2017; Wang et al., 2017), based on data obtained from the general population and also in clinical samples (i.e., GD treatment-seekers) (Han et al. 2015; Thorens et al., 2014).

In parallel with studies based largely on self-report methodologies, neurobiological research has identified individual differences that may contribute to poor self-regulation and decision-making biases (Schiebener & Brand, 2017). The findings suggest that problem gamers differ from controls on neurocognitive tasks of executive functions, attention, processing, and decision-making (Decker & Gay, 2011; Ko et al., 2009, 2017). Problematic players also tend to: make poorer decisions under risky conditions (Yao et al., 2015); fail to account for objective probabilities (Wang et al., 2017); demonstrate prepotent response inhibition deficits (Argyriou, Davison, & Lee, 2017), and be less capable of delaying gratification for a larger reward (Pawlikowski & Brand, 2011). Many of these deficits worsen with repeated engagement in gaming over time (Brand et al., 2016).

1.3. The present review

The present review was guided by models that conceptualize the development of problematic gaming and GD as owing to interactions between the player's personal characteristics and the wider social and environmental context in which gaming occurs (Brand et al., 2016; Dong & Potenza, 2014). This review aimed to summarize evidence that may extend current models by examining the associations between video game types and problematic gaming and GD symptomatology. This review uses the term "GD" to encompass both the ICD-11 and DSM-5 conceptualisations of gaming disorder, and acknowledges the caveat that there is not total agreement in the field on symptoms and measurement (Kardefelt-Winther, 2015; Starcevic, 2016) and some scholars oppose the disorder (Aarseth et al., 2017). The term 'problematic gaming' is used in this review to refer to individuals who may be at risk of GD, which is usually determined by meeting some but not all symptoms of GD. In this way, this review has attempted to be inclusive of different psychological terms and measurement approaches, but was bound by the conventions and common usage of terminology in this field.

While previous narrative reviews in this area (e.g., Griffiths & Nuyens, 2017; King et al., 2010; Király et al., 2018) have reported that games have certain features (i.e., *structural characteristics*, such as realistic graphics and intermittent reward systems) that reinforce playing behavior, these reviews have been limited by the lack of distinction between: (1) features that are simply appealing and/or extend playing time; and (2) features that contribute to symptoms of GD and resultant harm. Some game elements that function to increase the duration of the gaming session (e.g., loading times, cooldowns, fixed interval schedules), for example, may not affect the 'addictiveness' of the game. Another limitation of past reviews has been the lack of focus on the player × game relationship, or the interaction of game types with personal characteristics or vulnerabilities. With these considerations in mind, this review aimed to: (1) identify game types that are positively related to GD; and (2) evaluate the empirical contribution of individual differences (e.g., age, personality, comorbid psychopathological symptoms) to the relationship between game types and problematic gaming and/or GD.

2. Methods

2.1. Identification and selection of empirical studies

This review aimed to examine peer-reviewed quantitative studies of video game types in relation to problematic gaming and/or GD. Fig. 1 presents a summary of all combined database search results and study selection processes, according to PRISMA guidelines. The initial database search was conducted on 6 November 2018 (and updated on 4 April 2019) by the first author (DLK) and verified by a co-author (OK) who also checked the results presented in the tables. The *Google Scholar* and academic databases, including *PsychINFO*, *PsychArticles*, *ScienceDirect*, *Scopus*, and *Web of Science*, yielded a total of 68,223 results (including duplicate results). The following keywords and protocol were used: (video game OR gam*) AND (feature OR mechanics OR structur* OR propert*) AND (addict* OR disorder OR prob.*). The titles and subject or discipline area of all results generated by each database were screened for relevance to problematic gaming and game design, which yielded 103 relevant results. Non-relevant results in *Google Scholar* were primarily concerned with gaming in media or communication studies, economics (game theory), information technology, and industrial design. All searches included full-text articles published in English. There was no restriction on publication date or study methodological shortcomings. The abstracts and methodology sections of the yielded results were then screened. Articles that did not present original quantitative findings or were not peer-reviewed (e.g., conference presentations) were excluded ($n = 34$). Studies that did not screen or assess problematic gaming symptoms or the negative consequences of gaming ($n = 46$) were excluded. A total of 23 studies remained and were included for review.

2.2. Study assessment

All 23 quantitative studies were summarized according to the following characteristics: (1) *study design* (e.g., cross-sectional survey, in-game data extraction); (2) *sample characteristics* (i.e., size, source of recruitment); (3) *instruments for assessing problematic gaming or GD*; (4) *classification and measurement of video game type* (e.g., game genre, game features, player motivation with specific reference to a game feature); (5) *units of analysis for game type* (i.e., how game-related variables were discriminated and handled in the study's analysis); (6) *the type of statistical analysis*; and (7) *main findings* (e.g., relationship between game type and GD, and effect size).

The second task of this review involved selecting studies that examined individual differences in the relationship between game type and GD in more detail. Variables of interest included: (1) *personal characteristics* (i.e., demographic and psychological profile); (2) *social influences* (i.e., peer, family, online social network); and (3) *environmental influences* (e.g., accessibility, context of use). Studies ($n = 13$) that met the inclusion criteria were coded according to their measurement of the three types of individual differences (i.e., personal, social, environmental) and then their main findings were summarized. Studies that examined gaming-related variables only (i.e., game feature/genre and motives for playing games; $n = 6$) or did not conduct a relevant multivariate analysis ($n = 4$) were excluded. Effect sizes (e.g., Cohen's *d* values) were identified in-text or calculated manually for this review; these values are presented in Tables 1 and 2. For comparisons involving multiple game types, a ranged effect size (i.e., smallest to largest difference) has been reported.

3. Results

3.1. Overview of empirical studies

Table 1 presents a summary of the key characteristics of the 23 empirical studies of video game design. Most research studies ($n = 20$) employed a cross-sectional survey approach, and only two studies (conducted by the same lead author, i.e., Billieux et al., 2013; Billieux, Thorens, et al. 2015) included player data (i.e., behavioral tracking data). Only 1 study included a clinical sample assessed by a psychiatric interview (Park et al., 2016). Only 1 study employed a repeated measures design (Smyth, 2007), however the two studies that analysed behavioral data included players' historical records of gaming. Most studies ($n = 19$) involved self-report measures administered to an exclusively adult-age population. The most commonly used measurement tools for problematic gaming or GD (or Internet gaming disorder, for studies referring to the DSM-5) included Young's *Internet Addiction Test* (IAT) or *Internet Addiction Scale* (YIAS) ($n = 6$ studies) (Young, 1998) or the *Game Addiction Scale* (GAS) ($n = 3$) (Lemmens, Valkenburg, & Peter, 2009). The remaining 12 studies screened for problematic gaming or GD used unique measures, including some previously unpublished composite measures.

Studies evaluated the influence of video game design on users according to one of three approaches: (1) *Platform* (i.e., hardware) *and/or genre* (i.e., broad style or category of game), which were combined in this analysis because they were combined in some studies; (2) *Structural features* (i.e., in-game characteristics, including graphics, sound, controls, and narrative; Griffiths & Nuyens, 2017; King et al., 2010); and (3) *Motivations related to game content* (i.e., motivations to interact with a specific game feature, including advancement [increase rank, pass levels], role-playing [create a character and participate in an interactive narrative], and competition [win matches against players]). Most studies examined game genres ($n = 12$), however studies differed in their definition and coverage of genres. The most consistently included genre ($n = 9$ studies) was the Massively Multiplayer Online Role-Playing Game (MMORPG), referring to a persistent online game that involves the creation of a character (or 'avatar') in a virtual world (e.g., fantasy/sci-fi setting) where the player completes tasks or 'quests' usually with other players (Nagygyörgy et al., 2013; Yee, 2006). There were 6 studies that compared involvement in MMORPGs to non-MMO role-playing games (RPGs).

3.2. Video game type and GD

Although the 23 studies were difficult to synthesize due to major differences in design, the most consistent finding was MMORPG and RPG playing were more strongly positively associated with GD scores than other game types, with small to large effect sizes across studies. Notably, in Park et al.'s (2016) sample of 352 patients referred to the Online Game Clinic Center in Seoul, Republic of Korea, all patients played 'online' games and the two most common types were MMORPGs ($n = 83$) and Real-Time Strategy (RTS) games ($n = 74$), compared to all other game types combined ($n = 55$). This was consistent with Eichenbaum, Kattner, Bradford, Gentile, and Green's (2015) finding that RPG and RTS games were disproportionately related to GD symptoms compared to other games, including mobile games (e.g., puzzle games).

Studies that examined differences on measures of general health and psychological well-being according to genre preferences reported consistently that MMORPG players scored significantly lower on these measures, with small to moderate effect sizes, than players of other genres (Berle et al., 2015; Király et al., 2015; Park et al., 2016). The only study that employed a repeated measures design (Smyth, 2007) reported that MMORPG playing was moderately to strongly associated with greater life interference (i.e., poorer sleep quality and academic performance) as compared to other game types (offline computer games, arcade games, console games). Donati et al. (2015) reported that involvement in a greater number of game genres was positively but weakly associated with problematic gaming. Eichenbaum et al. (2015) reported that the probability of endorsing DSM-5 IGD criteria increased both linearly and exponentially with time spent in RPGs, RTS games, and action games, but this association was weaker for other genres.

Table 1
Characteristics of studies (n = 23) of video game types in relation to problematic gaming or GD.

Study	Study design	Sample (N)	Instruments[†]	Game units of analysis	Analysis	Relationship to GD/problems[1]
Leung (2004)	Cross-sectional survey	General population (N = 699)	IAT; self-developed measure of 'seductive properties of the Internet'	Motivations: pleasure of control; fluidity of online identity	Bivariate correlations	r: control: 0.20*; identity: 0.09*
Smyth (2007)	Randomized, repeated measures study	Adults (N = 100)	Overall health, sleep quality, academic performances, social life, and well-being	Platform/Genre: MMORPG; console; solo computer; arcade	Between-group comparison	MMORPG group > other groups on hours (d = 1.5), health (d = 0.5), sleep quality (d = 0.6), academic interference (d = 0.7)
Hsu, Wen, and Wu (2009)	Cross-sectional survey	University students (N = 418)	Game addiction composite scale; user experience in MMORPGs	Motivations: challenge, fantasy, curiosity, control, reward, role-play, competition, cooperation, recognition, belonging, obligation	Hierarchical regression	Sig. predictors: Curiosity (β = 0.15), role-play (β = 0.30), belonging (β = 0.28), obligation (β = 0.21), reward (β = 0.26)
Kim et al. (2010)	Cross-sectional survey	University students (N = 565)	YIAS; list of game genres	Genre: RPG; FPS; RTS; sports	Between-group comparison	The RPG group scored higher on the YIAS than other groups (d = 0.2–0.4).
King et al. (2011)	Cross-sectional survey	Adult online gamers (N = 421)	Adapted IAT; video game features survey (24-item)	Features: social; manipulation and control; narrative and identity; reward and punishment; presentation	Hierarchical regression	The top 15 structural characteristics explained 15%* of unique variance in IAT scores
Stetina, Kothgassner, Lehenbauer, and Kryspin-Exner (2011)	Cross-sectional survey	Online gamers (N = 468)	Adapted ISS-20; list of genres	Genre: MMORPG; OES; RTS	Between-group comparison (ANCOVA)	The MMORPG group scored sig. higher than OES and RTS groups on the ISS-20 (d = 0.5)
Elliott, Ream, McGinsky, and Dunlap (2012)	Cross-sectional survey	Adult online gamers (N = 3380)	PVGP; Free responses for genre (16 categories)	Genre: action-adventure; MMO; other RPG; FPS; other shooter; RTS; other strategy; sports; board/card; platformer, etc.	Linear regression	Sig. predictors: MMORPG (β = 0.20*), RPG (β = 0.19*), FPS (β = 0.31*), and gambling games (β = 0.17*)
Bailey et al. (2013)	Cross-sectional survey	University students (n = 149)	Problematic gaming questions (13-item); list of genres	Genre: FPS; strategy	Bivariate and canonical correlations	r: FPS: 0.20*; strategy: 0.24*; FPS gaming was more strongly related to impulsivity and risk-taking than Strategy gaming
Billieux et al. (2013)	Cross-sectional survey with longitudinal player data	MMORPG adult players (N = 690)	WoW adapted IAT; MPOGQ; in-game achievements (quest, exploration, PVP, dungeons/ raids, misc.)	Motivations: advancement; mechanics; competition; socializing; relationship; teamwork; escapism; discovery; role-play, customization	Bivariate correlations	Problematic use sig. related to motivations of Advancement (r = 0.47*) and Escapism (r = 0.48*)
Hull, Williams, and Griffiths (2013)	Cross-sectional survey	Adult online gamers (N = 110)	GAS; video game features survey (24-item)	Features: social; manipulation and control; narrative and identity; reward and punishment; presentation	Bivariate correlations and linear regression	r: Social: 0.24*; control: 0.19*; reward: 0.17*. social features were the strongest feature predictor of GAS (β = 0.20*)
Ream, Elliott, and Dunlap (2013)	Interview with structured survey	Adults in real-world gaming contexts (N = 692)	PVGP; free responses for genre (15 categories)	Genre: action-adventure; MMO; other RPG; FPS; other shooter; RTS; other strategy; sports; board/card; platformer, etc.	Multi-level modelling	MMORPG and RTS problem play higher among older players[2]; problem play of FPS and other genres peaked in adolescence
Hagström and Kaldo (2014)	Cross-sectional survey	Adult online gamers (N = 201)	YIAS; User motivations in MMORPGs (39-item)	Motivations: achievement; social; immersion; escapism	Bivariate correlations	Socializing and Mechanics were not sig. related to YIAS scores
Kirby, Jones, and Copello (2014)	Cross-sectional survey	Adult online gamers (N = 565)	WoW specific problematic usage/engagement questionnaire; user motivations in MMORPGs	Motivations: achievement; social; immersion; escapism	Multiple mediator model	Immersion motivation mediated the relationship between game time and wellbeing (β = −0.01; SE = 0.01; z = 2.41; p < 0.05)
Tone, Zhao, and Yan (2014)	Interviews and surveys (2 studies)	University student samples (Study 1: N = 180, 892; Study 2: N = 635)	CIAS; OGAS; OAI	Features: freedom; vividness; rewards; technical; group identity; recreation; artistry; systematic; regularity	Bivariate correlations; SEM	r: Total OAI: 0.50*; OAI components: 0.40–0.52*; SEM: Online game attraction was the strongest predictor of IA (r = 0.40*), and mediated the contribution of family factors, personality, and life events to IA score
Berle, Starcevic, Porter, and Fenech (2015)	Cross-sectional survey	Adult online gamers (N = 1945)	Problematic gaming questions (8-item); SC-90; VGUQ	Genres: MMORPG; non-MMORPG: RPG; FPS; strategy; sport; adventure; other	Chi-Square; canonical correlation	MMORPG players were more likely than non-MMORPG players to endorse GD items (χ^2 = 23.1–35.6*) and life interference items (χ^2 = 9.2–41.8*)
Billieux, Thorens, et al. (2015)	Cross-sectional survey and player data	Online gamers (N = 1057)	WoW adapted IAT; MPOGQ; player data	Motivations: advancement; mechanics; competition; socializing; relationship;	Cluster analysis	The most problematic player group (Hardcore gamers) were mainly motivated by game achievements and escapism

(*continued on next page*)

Table 1 (*continued*)

Study	Study design	Sample (N)	Instruments[†]	Game units of analysis	Analysis	Relationship to GD/problems[1]
				teamwork; escapism; discovery; role-play, customization		
Chen and Leung (2016)	Cross-sectional survey	Adult online gamers (N = 409)	YIAS; User motivations in relation to game content	Motivations: mobility; entertainment; sociability; achievement; relaxation	Bivariate correlations	Non-significant results
Donati, Chiesi, Ammannato, and Primi (2015)	Cross-sectional survey	Male secondary students (N = 701)	GAS; list of genres	Genres: MMO; FPS; RPG; RTS; browser; management; action; simulation; fighting; arcade; retro; indie; sports; casual	Bivariate correlations; stepwise regression	r: Total genres played: 0.21*; greater number of genres played sig. predicted GAS score (β = 0.2*)
Király et al. (2015)	Cross-sectional survey	Online gamers (N = 3186)	POGQ; game type preference	Genres: MMORPG; MOFPS; MMORTS; sport; puzzle; other	Between-groups comparisons; SEM	MMORPG players scored higher on POGQ than MOFPS players (d = 0.15*).
Lemmens and Hendriks (2016)	Cross-sectional survey	Representative sample of adults and adolescents (N = 2442)	IGD Scale; self-reported game titles; online/offline play	Genres: action/adventure; sports; RPG; simulation; puzzle; shooter; racing; fighting Online play: 5-point scale	Linear regression	Time playing RPG (β = 0.15*) and shooter games (β = 0.11*), online and offline, were sig. predictors; Online games had stronger associations with GD than offline types (d = 0.15* vs 0.78*)
Müller et al. (2015)	Cross-sectional survey	Representative sample of adolescents aged 14–17 years (N = 12,938)	AICA-Sgaming, game type preference	Genres: single player; MMORPGs; FPS; strategy	Linear regression	All four genres were significant predictors of GD symptoms (β = 0.04–0.27*)
Park, Han, Kim, Cheong, and Lee (2016)	Clinical interview and cross-sectional survey	Patients with GD (N = 212)	YIAS; list of genres	Genres: MMORPG; RTS; FPS; other	Between-group comparisons (ANOVA)	More patients played MMORPGs and RTS (157 vs 55); No differences in YIAS by genre
Männikkö, Billieux, Nordström, Koivisto, and Kääriäinen (2017)	Cross-sectional survey	Online population survey (N = 271)	GAS; composite game motive scale; list of genres	Genres: MMORPG; MMO; RPG; strategy; action/adventure; adventure; FPS; fighting; sports; music; driving; simulation; puzzle; classic; mobile; facebook	Factor analysis; linear regression	A game genre factor including RPG, Action, and Adventure components was a significant predictor of GAS score (β = 0.42*)

[1]Effect size estimates included. NB: For 3 or fewer comparisons, a ranged effect size is provided. For > 3 group comparisons, the most conservative effect is reported. [2]The authors did not provide sufficient information for specific effect size estimates. *$p < 0.01$. [†]Includes GD-related and game type measures, in that order. Abbreviations: d: Cohens'd effect size index; β: standardized beta value; CIAS: Chen internet addiction scale; FPS: first person shooter; GAS: Game addiction scale; IA: internet addiction; IAT: internet addiction test; ISS-20: internet addiction scale-20; MMO: massively multiplayer online; MOFPS: multiplayer online first person shooter; MMORPG: massively multiplayer online role-playing game; MMORTS: massively multiplayer real-time strategy; MPOGQ: motivation to play in online games questionnaire; OAI: online game attraction inventory; OGAS: online game addiction scale; OES: online ego shooter; POGQ: Problematic online gaming questionnaire; PVP: player versus player; Pathological Video PVGP: 9-item problem video game play scale (Salguero & Moran, 2002); RTS: real time strategy (game); SC-90; symptom checklist-90; SEM: Structural equation modelling; Sig: indicates statistical significance; VGUQ; video game use questionnaire; WoW: World of Warcraft (video game); YIAS: young internet addiction scale.

Table 2
Empirical studies (n = 13) of the player × game interaction in GD by Category (1–4).

		Variable type				
Category: study	Aim	Demographic	Psychological	Social	Environmental	Main findings[1]
1: Kim et al. (2010)	Assess relations among biogenetic traits, problem gaming, and game genre	Age; sex; education; socio-economic status	Novelty-seeking; self-directedness; psychiatric symptoms	–	–	Problematic RPG players reported higher novelty-seeking than other problem gamer types (d = 0.4–0.5); RTS players reported higher self-directedness than other problem gamer types (d = 0.4–0.5)
1: Park et al. (2016)	To assess differences in psychiatric symptoms among four different gamer types	Age; sex	Impulsivity; self-esteem; mood disorder; attention; cognitive function	Family interactions; social avoidance	–	Sociality and self-esteem levels among problematic online gamers varied according to game genre. The MMORPG group reported higher social anxiety and avoidance than the other groups (d = 0.5–0.8). Social anxiety was lowest for FPS group (d = 0.4); Self-esteem was highest for RTS group (d = 0.7)
1: Stetina et al. (2011)	Assess differences in depression, self-esteem, and GD by genre	Age	Depression; self-esteem; gaming motives	–	–	MMORPG users show more severe problematic gaming (d = 0.5), depression (d = 0.3), and lower emotional self-esteem (d = 0.2–0.4) compared to other gamer types
2: Billieux et al. (2013)	Explore associations between problematic gaming, game motives, and in-game actions	Age; sex	Gaming motives	Guild affiliation	Gaming context (cybercafé/work); game server type	Problematic MMORPG use was not related to game progression. Guild affiliation (β = 0.11*), teamwork (β = 0.11*), and discovery (β = 0.17*) predicted game progression
2: Chen and Leung (2016)	To assess differences in psychological factors among problematic Candy Crush players	Sex; occupation	Playing motives; loneliness; self-control; boredom	–	Playing location	Student status (β = 0.14*), loneliness (β = 0.18*) and lack of self-control (β = 0.11*) predicted mobile game addiction
2: Elliott et al. (2012)	Assess whether genre predicts GD after controlling for demographic factors	Age; sex; education; income; employment	Enjoyment of games	–	–	Genre explained significant unique variance (10%*) in problematic gaming score after controlling for other study variables
2: Hull et al. (2013)	To test whether game feature preference, flow, and unhappiness predict problematic gaming	Age; sex	Flow; happiness	–	–	Decreased happiness (β = 0.47*) and social features (β = 0.20*) were the strongest predictors of GD. Flow states were not predictive of GD, except for distortion of time perception (β = 0.34*)
3: Bailey et al. (2013)	To determine whether the effects of time spent playing and the co-occurrence of pathology moderate other variables' relations to genre	Sex	Impulsivity; risk-taking; temporal discounting	–	–	Playing FPS games was positively related to impulsivity and risk-taking. The interaction between hours and GD was related to impulsivity. Sample sizes not reported[2]
3: Berle et al. (2015)	To assess life interference associated with MMORPG and other game types, controlling for other gaming variables	Age; sex; relationship status; place of residence; employment	Psychiatric symptoms	Friends (online/offline)	–	Gaming time mediated the relationships between game type, and each of problematic use and life interference (CI = 0.14–0.33). MMORPG use was not sig. associated with greater psychopathology
3: Király et al. (2015)	To examine psychiatric distress and GD, including gaming motives as mediators and gender and game types as moderators	Sex	Psychiatric symptoms; Gaming motives	–	–	Psychiatric distress had significant direct and significant indirect effects on GD via the gaming motives of escape and competition (standardized effects of 0.26 and 0.21, RMSEA = 0.05). Models did not differ according to MMORPG and MOFPS
3: Ream et al. (2013)	To explore the relationship between age and problematic gaming, including genre, diet, and personality as covariates	Age; sex; ethnicity	Personality (sensation-seeking, shyness, sociability)	–	Life course factors (e.g., living away from home)	Problem play remained stable during years of engagement with a genre. Problem play often develops in a context of sustained engagement with multiple games/genres (R^2 < 0.11). Sensation-seeking predicted problematic play across genres (r = 0.18*–0.29*), except for MMORPG and RPGs
3: Tone et al. (2014)	To examine the interactions of family, personality, game features in predicting GD	Age; sex	Personality (extraversion, neuroticism, psychoticism)	Social support; family cohesion and adaptability	–	Low family cohesion and adaptability may first attract individuals to online games. Personality variables influence attraction to online games (r = 0.34). Attraction to online games mediated the relationship between family (β = −0.10), personality (β = 0.16) and life event (β = 0.06) factors and GD

(*continued on next page*)

Table 2 (*continued*)

		Variable type				
Category: study	Aim	Demographic	Psychological	Social	Environmental	Main findings[1]
4: Billieux, Thorens, et al. (2015)	To identify problematic gamer subtypes based on motives and psychopathological profile	Age; sex	Impulsivity; motives to play; self-esteem; mood	–	–	Problem MMO players fall into subtypes. The most problematic subtype plays for escape, advancement, and sensation-seeking. Non-problematic MMO players have lower impulsivity ($\eta^2 = 0.30$) and higher self-esteem ($\eta^2 = 0.28$)

[1]Effect size estimates included. NB: For 3 or fewer comparisons, a ranged effect size is provided. For > 3 group comparisons, the most conservative effect is reported. [2]The authors did not provide sufficient information for specific effect size estimates. Abbreviations: CI: confidence interval; FPS: first person shooter; RPG: role playing game; MMO: massively multiplayer online; MMORPG: massively multiplayer online role-playing game; MOFPS: multiplayer online first person shooter; GD: gaming disorder.
Category 1: Between-group analysis of correlates across engagement in different genres;
Category 2: Examination of genre/feature as a predictor of problematic gaming score;
Category 3: Mediation analysis or multi-level modelling including game type as a main variable;
Category 4: Cluster analysis of gaming motives and other variables to identify player subtypes.

Lemmens and Hendriks (2016) and Männikkö et al. (2017) identified positive associations, reporting small and moderate sized effects in their respective studies, between playing RPGs and problematic gaming.

The remaining studies of game features reported inconsistent approaches to conceptualization and measurement. Some studies of general features (e.g., Hull et al., 2013; King et al., 2011), and studies of MMORPGs specifically (e.g., Berle et al., 2015; Park et al., 2016), reported small- to moderate-sized associations between the social features of the game (e.g., competition, cooperation, and social interaction features) and problematic gaming. However, studies of gaming motivations (e.g., Billieux et al., 2013; Billieux, Thorens, et al., 2015; Hsu et al., 2009; Király et al., 2015; Kirby et al., 2014) reported that other factors, including role-playing, advancement, escapism, and immersion, were stronger predictors of GD than socializing motives. This was consistent with Hagström and Kaldo's (2014) and Chen and Leung's (2016) findings that socializing motivations were not significantly related to problematic gaming.

3.3. The maladaptive player-game relationship

The second aim of this review was to summarize studies of problematic gaming and GD that examined the interaction of individual differences and video game type. Table 2 presents a summary of the empirical studies ($n = 13$) that examined the player × game interaction using multivariate analysis, including effect sizes. All 13 studies examined psychological variables (e.g., comorbidity, personality, and motives for gaming) but relatively few examined social factors ($n = 4$) or environmental/ecological factors ($n = 3$). Given that studies varied in their inclusion of certain variables (e.g., game genre/features, psychological factors, social influences), and their aims and analytic plans varied, these results could not be aggregated for meta-analysis. However, as detailed in Table 2, all 13 studies were grouped into the following four categories based on comparability of analysis plan. These categories were:

Category 1: Between-group analysis of correlates across engagement in different genres;
Category 2: Examination of genre/feature as a predictor of problematic gaming score;
Category 3: Mediation analysis or multi-level modelling including game type as a main variable;
Category 4: Cluster analysis of gaming motives and other variables to identify player subtypes.

Three Category 1 studies compared MMORPG players to players of other genres; these studies reported that MMORPG players had more severe GD scores and scored significantly higher on novelty-seeking (moderate effect), depression (moderate effect), social anxiety (moderate to large effect) and lower on self-esteem (small to moderate effect). The only study in this review (i.e., 1/23 studies) to employ a clinical sample (i.e., Park et al., 2016) was a Category 1 study, which reported that MMORPG players with GD tended to score higher on social anxiety than other player types, which was a moderate to large effect. The consistent finding from Category 1 studies was that RPG-type games tended to attract more anxious gamers who were lacking in real-world skills and confidence, who seemed to be attracted to this game type for its capacity to support socializing and identity needs.

Category 2 studies had a greater focus on psychological factors but lacked the range of variables of Category 1 and 3 studies. Elliott et al. (2012) reported that game genre in general was a significant predictor of problematic playing, with a small effect size, whereas Hull et al. (2013) reported that psychological variables (i.e., lower happiness [moderate effect] and seeking online social relationships [moderate effect]) were positively related to problematic play. Billieux et al. (2013) reported that problematic MMORPG playing was positively related to achievement and escapism motives, with moderate effect sizes,

but it was not significantly related to game progression. Chen and Leung (2016) reported that problematic mobile gamers tended to be students who scored higher on measures of loneliness and boredom, with small effect sizes for these two associations.

Category 3 studies employed more advanced analysis plans and included more variables than other studies. Tone et al.'s (2014) study employed structural equation modelling to perform a wider examination of individual differences in problematic gaming. A model including personality factors, family structure and relationships, and life events showed these variables were significant mediators of the relation between players' attraction to online games and problematic gaming, with a moderate effect size and an excellent overall model fit. The other four Category 3 studies examined psychological factors in problematic play, including a small effect for impulsivity (Bailey et al., 2013), a small effect of motives for escape and competition (Király et al., 2015); and a small effect of having an interest in multiple genres (Ream et al., 2013).

The notion of player-game subtypes was further examined in the single Category 4 study (Billieux, Thorens, et al., 2015), which reported that MMORPG players who were more at-risk of problematic play tended to score higher on measures of psychological motives for escape and advancement, which were moderate-sized effects. These individuals were also characterized as having specific impulsivity-related traits, including emotion-laden impulsivity (i.e. "urgency trait") and sensation-seeking. The authors presented a series of profiles of gamers, including non-problematic and GD players, and their study also identified protective factors to further understanding of non-problematic gaming.

4. Discussion

The aim of this review was to critically evaluate the empirical research on potential links between specific types of video games and problematic gaming and GD, and to evaluate the potential contribution of individual differences in any such relationships. This review was distinct from previous papers on this topic, focusing on GD symptomatology as the primary outcome measure rather than less clinically specific outcome variables, such as time spent gaming or motives for gaming. This analysis extended upon previous reviews by examining the interactions of variables within the maladaptive player-game relationship. It was found that playing online role-playing games (e.g., MMORPGs) had the strongest positive association with problematic gaming and GD compared to other video game genres, with effect sizes ranging from small to large across studies. However, the association between MMORPG and GD was also mediated by time spent gaming (Berle et al., 2015), consistent with current views that gaming-related harm relates to heavy use that causes life interference (Baggio et al., 2016; King & Delfabbro, 2018c; Király, Tóth, Urbán, Demetrovics, & Maraz, 2017). There was limited evidence that concurrent involvement in multiple genres of games had a small but significant association with GD (Ream et al., 2013). Players with higher impulsivity, risk-taking, comorbid psychopathological symptoms, and stronger motivations to play games (especially achievement and escapism motives) tend to be at greater risk of GD, irrespective of their game preferences. However, some specific player vulnerabilities or risk profiles may selectively increase risk of GD for certain game types or genres. It was not clear from the available research whether any specific structural features of games are related directly to gaming-related harm.

This review found that some psychological vulnerabilities tend to co-occur with problem involvement in certain game types. Problematic gaming in general was found to have moderate-to-strong links to depression and anxiety, impulsivity and sensation-seeking, and motives to play for winning and achievement, but not all games share the same individual risk profile. For example, problematic users of MMORPGs and other strategy-oriented games had lower scores on sensation-seeking (Ream et al., 2013), self-esteem (Stetina et al., 2011), and impulsivity (Bailey et al., 2013), and higher scores on social anxiety and sociality (Park et al., 2016), as compared to players of shooting games. As Bailey et al. (2013) noted, these differences may be related to the complexity and social demands of MMORPGs which tend to be more appealing to individuals who are lonely, have poor self-concept, and feel socially anxious in real world situations. MMO games tend to necessitate greater pre-planning and working patiently as part of a group; therefore, players must usually conform to work-like roles and conventions to be successful (e.g., developing a plan with others, following instructions and turn-taking, responding to player requests, and volunteering to help). Impulsive individuals who seek 'big wins' in MMORPGs and some other game genres (e.g., RTS, RPG, puzzle games) by taking risks through individual efforts may be less satisfied (and may be punished) by these games. Impulsive, sensation-seeking players may therefore be more susceptible to problematic gaming and GD through their experiences in games like online first-person shooters. Such games may cater to their needs with elements such as rapid pacing or short rounds; game events where losing has few, if any, meaningful long-term consequences; a competitive reward structure that emphasizes individual efforts over teamwork; and immediate rewards for successful execution of high-risk actions (Bailey et al., 2013; Park et al., 2016). These observations may also apply to game types such as multiplayer online battle arenas (MOBAs) and Battle Royale games, given their similarities to competitive shooting games.

Together these findings suggest that, while there may be some general risk factors for gaming disorder irrespective of game type (e.g., being male, adolescent, gaming on a daily basis for long periods, lacking social support), there may also be specific risk factors that tend to align with certain game types (e.g., novelty-seeking among RPG players; Kim et al., 2010). Current models of gaming disorder (e.g., Brand et al., 2016; Dong & Potenza, 2014) do not refer to the heterogeneity of games and how certain gaming experiences may increase risk of GD. This contrasts with models that have been developed for other addictive behaviors, such as the pathways model in the field of problem gambling (Blaszczynski & Nower, 2002), for example, which recognizes different configurations of gambling behaviors and episodes (e.g., fluctuating use, binges, and chasing heavy losses) in connection with certain psychopathological factors. Greater recognition of GD subtypes may improve clinical formulation and management (Billieux, Thorens, et al., 2015), such as addressing symptoms that are specific to certain maladaptive player-game relationships (e.g., withdrawal as frustration arousal among shooter players vs. fear of missing out among MMORPG players).

This review shows that studies have tended to examine individual differences in the maladaptive player-game relationship as a simple bivariate association (e.g., score on depression scale × number of hours spent playing). Studies have not yet considered whether psychological factors and psychopathological symptoms affect problematic gaming behavior in certain games over time, such as within the course of a gaming session or over the period of a week. The reviewed studies have reported there are some bivariate relationships between personal vulnerabilities and GD symptomatology, but they are not clear on how individuals may be more vulnerable to excessive play under different game circumstances (e.g., winning/losing, group play, story/character elements). Examining within-session player-game dynamics, such as how depressed problematic gamers respond to continual losing in the game, for example, may provide new insights into the maintaining factors of GD (e.g., player rationalizations and other cognitive processes, mood states, motives for playing). It is possible that players with GD may have some initial reasons, expectancies, and/or justifications for playing (e.g., "to be among my friends") that then shifts over time (e.g., "to finish this level/quest" or "to forget about my problems") that contributes to problem playing.

A recent review by Griffiths and Nuyens (2017) concluded that "structural features that take a long time to achieve in-game are the ones most associated with problematic video game play (e.g., earning experience points, managing in-game resources, mastering the video

game, getting 100% in-game)" (p. 272). The present review did not identify any specific game feature that was uniquely related to problematic gaming or GD. Distinguishing specific features in games that are salient to problematic gaming appears to be challenging for researchers. It is possible that taking an overly reductionist approach to game analysis may have questionable validity, particularly if such an approach does not also consider how each feature relates to other features in the game and the genre of the game. There was some support, however, for the notion that GD was more prevalent among players of more complex, endless, and socially driven games, which tend to include features reported by Griffiths and Nuyens (2017). There was also some limited evidence that involvement in a higher quantity and/or multiple genres of games may be associated with excessive play (Ream et al., 2013). However, further work is needed to assess individual differences in these basic relationships and confirm these effects in clinical samples. One line of future investigation may be to examine whether problematic players of a specific game (e.g. MMORPGs) demonstrate similar playing behaviors and psychophysiological and neurobiological reactions when playing other game types.

This review suggests that, given the complexity and multiple demands within and across types of games, loss of control over gaming may encompass a wide range of activities, which differ according to game type. While the same argument could be advanced for gambling (e.g., there are structural differences between electronic gambling machines and betting on horse races), most gambling activities share the fundamental aspect of betting on an uncertain event to win money. This contrasts with gaming activities where players may become invested in systems and activities that are largely unrelated to winning or making progress. Many of the authors of the 23 reviewed studies have commented, for example, on the notion that problematic MMORPG use involves attachment to online character and identity, which enables an escape from real-world problems (Billieux et al., 2013) and a sense of inclusion within the social structures of the virtual world (Hull et al., 2013). It may be speculated, then, as one example, that loss of control among MMORPG players with GD may encompass an inability to resist pursuing in-game rewards (e.g., quests on intermittent reinforcement schedules), as well as an inability to regulate behaviors related to avatar representation, story completion, and social status in the game world. A conceptual question thus arises: Should all behaviors that involve and/or implicate gaming products be strictly defined as 'gaming' behavior? For example, should gaming disorder include identity-related behaviors in games (e.g., obsession with character creation, self-expression through avatars and virtual reality space), excessive spending in games (e.g., buying, trading, or gambling using monetized virtual items) and/or game-based socializing behaviors (e.g., chatting in game lobbies, watching eSports or gameplay videos on YouTube, and streaming)? If so, then the boundaries of 'gaming' as an addictive behavior may loosen and provide justification for other new addictive disorders involving similar behaviors (Billieux, Schimmenti, et al., 2015).

This review has identified multiple limitations of the research base. The majority of studies are cross-sectional and therefore lack insight into causality. Studies vary greatly in terms of their scope and analysis, which may not be a weakness but it does affect the cohesion of this literature. Research has often been a theoretical and variables of interest have not been evaluated consistently in relation to other factors. There is often ambiguity in how studies measure game features versus gaming motives. Relatedly, the concept of 'genre' is imprecise and may fail to represent hybrids. An alternative approach may be to specify actual game titles in studies (e.g., *World of Warcraft*, *Fortnite*, *League of Legends*), but current available data unfortunately prevents such an approach. It is important to note that the research base on gaming is often several years behind technological developments, and therefore the current available research emphasizing MMORPGs as associated with GD reflects the larger body of work on this game type. Recent highly popular game types, such as MOBAs and Battle Royale-style games (e.g., *Fortnite*), have not yet been studied. This review also shows that the literature on player-game relationships is based almost exclusively on adult populations, which overlooks the most vulnerable subgroup of problematic players and the typical age of onset of problematic gaming. Another limitation has been the lack of consideration of the social and ecological influences on players. While many players report motives of achievement and escape in online games, this may be influenced by social groups, particularly for adolescents who play in groups of real-world friends and may feel bound by peer pressures and gaming norms. There is also a lack of clinical studies examining player-game interactions among treatment-seeking individuals.

4.1. Limitations of the review

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 games over time. There have also been changes in the conceptualization and screening approaches to GD over time (Deleuze, Long, Liu, Maurage, & Billieux, 2018; King, Haagsma, Delfabbro, Gradisar, & Griffiths, 2013; Lortie & Guitton, 2013). The review protocol only selected studies with problematic gaming or GD outcome measures, but this approach may have omitted studies that assessed other relevant harm indicators (e.g., school or sleep interference) or variables of relevance to addiction (e.g., response inhibition; see Deleuze, Christiaens, Nuyens, & Billieux, 2017). The review also did not include non-peer-reviewed literature (e.g., conference proceedings), which may have omitted some promising work. 'Genre' may be a limited unit of analysis as many games fall into hybrid genres. 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-empirical studies.

4.2. Conclusions and future directions

This review suggests that GD may develop more readily and at more severe levels in complex, endless, socially driven games, irrespective of person-level characteristics. Certain player vulnerabilities may also selectively increase risk of GD for certain game types or genres, including impulsivity, risk-taking, comorbidity, and stronger motivations to play games. However, the current research base is largely cross-sectional and therefore lacks insight into how problems develop among vulnerable players of certain game types, including the types of behaviors and perceptions that accompany the onset and progression of GD symptoms. The next phase of GD research should examine different types of gaming experiences and their association with GD, particularly among individuals with clinically verified gaming-related problems. It is particularly important that studies are focussed on the period of adolescence, the developmental period known to be associated with more intense gaming behaviors and the onset of GD-related problems, to identify the risk profiles and gaming activities that are associated with emerging GD or higher levels of risk of problematic gaming. While the literature often refers to MMORPGs, it should be noted that many new types of games (e.g., MOBAs, Battle Royale, and mobile games) have become extremely popular and much more so than MMORPGs. For example, according to Statista.com industry statistics, the MMORPG *World of Warcraft* had a player base of 12 million players at its peak in 2012, as compared to the MOBA *League of Legends* having 100 million players in 2012 and the Battle Royale game *Fortnite* having 125 million players in 2018. Psychological models of player-game relationships should be regularly updated to adequately capture the changes in game products and their impacts for problematic players. Some recent innovations, for example, include reward systems that adjust dynamically to players' skill level, adaptive in-game monetization schemes, and immersive user interface technologies (e.g., virtual and augmented reality) (King & Delfabbro, 2018b).

A major challenge for GD researchers has been identifying valid and innovative methods to study the in-game perceptions and behaviors of individuals with GD (James & Tunney, 2017). Unfortunately, few studies have had access to player data or made use of available sources of player data. There has also been a lack of academic studies of player-game relationships related to GD undertaken in collaboration with the gaming industry. Aside from potential ethical concerns (e.g., conflicts of interest), one obstacle to any such collaboration appears to be that the global gaming industry does not recognize that some players experience gaming-related harm and opposes the concept of gaming disorder in principle (King & Gaming Industry Response Consortium, 2018). As gaming technologies continue to develop, there will be a continual need to understand how problematic players interact with different video game types. Such knowledge will help to ensure that our clinical descriptions are consistent with the activities implicated in GD, and treatment approaches are relevant to these maladaptive player-game interactions.

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Contributors

The first author designed the review and conducted literature searches and provided summaries of the identified content. All authors contributed to revisions of the analysis and paper. The first author wrote the first draft of the manuscript, and all authors contributed to and approved the final manuscript.

Declaration of competing interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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