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REVIEW ARTICLE

Investigating gaming structural features associated with gaming disorder and proposing a revised taxonomical model: A scoping review

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ABSTRACT

Background and aims: Gaming disorder (GD) is a mental health concern that has been heavily contested by experts. This scoping review synthesizes the literature to identify the structural features of video game design that can contribute to GD. Furthermore, a taxonomy of the structural features implicated with GD is proposed, revised from earlier work. *Methods:* Seven databases, in addition to Google Scholar, were searched. Peer-reviewed studies were included if they assessed a link between gaming structural characteristics and GD or a proxy. The final pool included 105 articles. *Results:* Avatar creation and customizability, multiplayer characteristics, and reward and punishment features were highly represented in the literature. There was no evidence for three categories in the original taxonomy: support network features, sexual content, and explicit language. Furthermore, structural feature sub-categories emerged that were absent from the previous taxonomy, such as general socialization features, type of virtual world, and in-game currency. Manipulation and control features and presentation features were less represented than social features, narrative and identity features, and reward and punishment features. The reviewers propose two broad classes of addictive gaming structural features: 'features enhancing in-game immersion and realism' and 'gambling-like features'. *Discussion and conclusions:* Numerous studies found a relationship between social, narrative and identity, and reward and punishment structural characteristics with GD. Two broad classes of gaming structural features were associated with addiction. The first, 'features enhancing in-game immersion and realism,' including social gameplay, avatar creation, storytelling, and graphics/sound. The second, 'gambling-like features,' included different mechanisms of rewards-and-punishment.

KEYWORDS

gaming disorder, structural features, problematic gaming behavior, scoping review, video game addiction, taxonomy

INTRODUCTION

Video gaming is an increasingly popular activity that can provide benefits for players, such as in the field of education, training, and socialization (de Freitas & Griffiths, 2007; Hussain & Griffiths, 2008). However, video gaming has nonetheless been shown to manifest as an addictive behavior that can have life-altering consequences for the player in their social and work lives (Baer, Saran, & Green, 2012; Griffiths & Meredith, 2009). Internet Gaming Disorder (IGD) was included in the Diagnostic and Statistical Manual (DSM-5) as a condition requiring further study (American Psychiatric Association [APA], 2013). Similarly, Gaming Disorder (GD) was included in the recent revision of the International Classification of Diseases (ICD-11), although as a formal diagnosis (ICD-11 for Mortality and Morbidity, 2022). GD is characterized by diminished regulation over the player's own gaming behavior, the player placing greater priority on the gaming behavior over other life interests and daily activities, and a continuation of the gaming behavior despite adverse consequences (ICD-11 for Mortality and Morbidity, 2022). Some have contested the DSM-5 and ICD-11 diagnoses

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as lacking sufficient evidence of their validity and being potentially stigmatizing (Aarseth et al., 2017; van Rooij et al., 2018). Views supporting their inclusion highlight the clinical and public health relevance of GD (Rumpf et al., 2018). Likewise, scholars dichotomize pathological and casual gaming by arguing this distinction is akin to healthy versus pathological alcohol use (Griffiths, Kuss, Lopez-Fernandez, & Pontes; Király & Demetrovics, 2017). Struggling to reach a consensus, this active debate highlights the need for more evidence elucidating GD as a recently acknowledged disorder.

Past literature has examined individual player characteristics associated with GD etiopathology. For example, evidence substantiates a correlation of GD with dysfunctional impulsivity, depression, anxiety, lower life satisfaction, sleep problems, and declining academic performance (Bargeron & Hormes, 2017; Blinka, Škařupová, & Mitterova, 2016; Brunborg, Mentzoni, & Frøyland, 2014; Lam, 2014; Metcalf & Pammer, 2014; Wang et al., 2014). In addition, studies have found associations of GD symptomatology with personality constructs such as low conscientiousness, low openness, and distressed traits (Kim, Hughes, Park, Quinn, & Kong, 2016; Wang, Ho, Chan, & Tse, 2015). Moreover, GD has been implicated in other mental health disorders, such as depression, anxiety, and ADHD, as a comorbidity (Griffiths & Meredith, 2009; Kietglaiwansiri & Chonchaiya, 2018; Marmet, Studer, Grazioli, & Gmel, 2018; Mathews, Morrell, & Molle, 2019).

Over the past decade, the video game industry has undergone a revolutionary transformation in its monetization mode. The landscape has shifted towards in-game monetization, with a surge in the popularity of loot boxes and cosmetic microtransactions (Zendle, Ballou, & Meyer, 2019). In addition, video game live-streaming services have added another layer of complexity thereby creating an additional monetization source. Consequently, games are becoming more sophisticated at analyzing player behavior to customize the delivery of in-game purchases and streaming activities to maximize revenue (King et al., 2019). In this vein, it is imperative to comprehend the design elements of games and their prospect of escalating problematic gaming behaviors in a rapidly evolving gaming industry. With the increasing sophistication of monetization models and the blurring of lines between virtual and real economies, it is more important than ever to be aware of the impact of game design on player behavior.

Video games comprise a broad range of games genres, a few examples including massively multiplayer online role-playing games (MMORPG), role-playing games (RPG), first person shooter (FPS), real-time strategy (RTS), and massively online battle arena (MOBA). While many games can allow for a healthy pass-time, certain problematic games may vary in terms of their potential for causing harm. In particularly problematic games, identified aspects of the video game design exist that have been shown to possess the potential to be problematic, independent of players' psychological or biological predispositions (Choi et al., 2018; Hull, Brunelle, Prescott, & Sargent, 2014; Wood, Griffiths, Chappell, & Davies, 2004). In 2010, King et al. (King, Delfabbro, & Griffiths, 2010) proposed a taxonomy of five categories of video game structural characteristics that may contribute to excessive playing behaviors for certain players, which may be pathological and are thus worthy of further study. These include: social features (e.g., leader board features), manipulation of control features (e.g., user input features), narrative and identity features (e.g., avatar creation features), reward and punishment features (e.g., near miss features), and presentation features (e.g., graphics and sound features) (King et al., 2010). Prior to this effort, Wood et al. (Wood et al., 2004) proposed a framework of structural characteristics that induce or promote continued gaming, including realism and multiplayer features. Likewise, frameworks from the designer's perspective of what contributes to more enjoyable games highlight the importance of design elements such as microtransactions, multiplayer mechanics, goals, rewards, and downloadable content (DLC) (Ahmad, Barakji, Shahada, & Anabtawi, 2017; Dondlinger, 2007).

With the taxonomy by King et al. (2010) having been conceived more than a decade ago, an updated taxonomy constructed by systematically surveying the existing literature may be beneficial. The gaming industry has rapidly changed and evolved; therefore, new structural features may have emerged, such as with the rapid proliferation of free-to-play (F2P) games and online multiplayer mechanics across genres. Furthermore, some research examines "genre," or the type of game, as a structural feature; doing so fails to recognize the specific structural elements that constitute each game, each of which may or may not be problematic. A recent systematic review by Rehbein et al. (Rehbein, King, Staudt, Hayer, & Rumpf, 2021) found that 32 of 46 studies examined genre and GD symptoms, whereas only 14 focused on specific structural features.

The present research

With GD only being formally recognized as a legitimate disorder recently, and given that a narrow search strategy limited the Rehbein et al. (Rehbein et al., 2021) review, there is a need to broadly survey the current landscape of GD literature to discern all the possible evidence. The present research takes a systematic approach to review studies that have identified structural characteristics of video games associated with GD. An updated framework of the structural features associated with increased risk of GD can help inform future efforts in studying GD. In addition, the study aims to identify the facets within the game design that contribute to GD to direct future efforts. Finally, these findings will be used to develop a revised taxonomical model for structural features associated with GD that can inform future works.

METHODS

Design and materials

Scoping reviews are advantageous for their inclusiveness of a broader array of scientific literature, which allows the review

to be open to texts that would be otherwise excluded in a systematic review. The five-stage methodological framework for scoping studies devised by Arksey and O'Malley (Arksey & O'Malley, 2005) was used: identifying the research question, identifying relevant studies, study selection, charting the data, and collating, summarizing, and reporting the results (Kietglaiwansiri & Chonchaiya, 2018).

This study was registered under the Open Science Framework on January 16, 2021, after the initial search in June 2020; this can be found at 10.17605/OSF.IO/23BZ7.

Search and screening strategy

A search strategy was developed with the guidance of a librarian. Seven databases (Medline, PsycInfo, Embase, Academic Search Complete, Social Work Abstracts, Scopus, and Web of Science) were investigated with an additional gray literature search conducted through Google Scholar. An initial search was performed on June 29, 2020 and updated on November 26, 2021. The search strategy included variations and synonyms of the key terms "Gaming Disorder" AND "Structural Characteristics" AND "Video Games." Variations of this search strategy were employed for each database. The comprehensive search string can be found in Supplementary material B.

Studies were eligible if they were primary qualitative or quantitative psychology, psychiatry, or medical research published in English using human participants. Studies that: reported secondary data without further analysis, were not peer-reviewed, or were not published in an academic journal were eliminated, except for dissertations. In addition, review papers, commentaries, book chapters, letters, editorials, and meta-analyses were excluded from the study pool.

Two independent reviewers conducted a title and abstract eligibility screening of the initial pool. Full texts were rated by three independent reviewers, with conflict resolved through discussion meetings. If the Cohen's Kappa coefficient was lower than 0.70 during review meetings, the strategy for assessing the eligibility of the texts was refined. In most cases, the eligibility of studies was refined by making the inclusion criteria more inclusive. For instance, the research team had decided to exclude studies examining 'in-game socialization' to avoid conflating extrinsic motives with video game design. However, this was amended, and studies were included under the category of "General/Unspecified Socialization Features," as they suggested including multiplayer or collaborative in-game mechanisms. In this way, the inclusion of relevant literature was an iterative process through which the approach, strategies, and definitions for screening were modified and improved. Finally, an independent reviewer was consulted to resolve any additional conflicts.

Data extraction

Seven independent reviewers charted the data from the final pool of studies. Studies were independently extracted by two raters. Conflicts were resolved through group consensus or the guidance of a third reviewer. The charting process was iterative and subject to slight modifications.

General characteristics of the study were identified, including the title of study, author(s), year of publication, experimental design, country, sample characteristics, and sample size. How the study assessed GD or a proxy of GD (i.e., willingness to continue, willingness to return to play, excitement, engagement, enjoyment, fun, motivation, time spent gaming, flow, immersion, preference, unsure) was included. Scoping reviews are valuable in providing a comprehensive overview of nascent fields with potential ambiguity. In contrast to systematic reviews, scoping reviews aim to identify and collate all potential evidence broadly. Therefore, given that the emergence of GD as a recently recognized mental health concern has prompted divisive opinions within the scholarly community, this indicates a need for elucidating the existing knowledge base. To address this, potential proxies of gaming disorder were incorporated into the review process to capture all pertinent findings and advance future research.

In addition, the broad structural characteristics (social features, manipulation and control features, narrative and identity features, reward and punishment features, and presentation features, unclear) were charted. The sub-category of each broad structural feature was then identified using the categories proposed in the King taxonomy as a foundation. These categories were revised and modified iteratively during the review process. The research team also charted whether structural features had positive, negative, or no associations with the outcome variable. The characteristics of each study, in addition to a summary of their relevant results, are presented in Supplementary material A.

The decision to utilize the King taxonomy for assessing game design structural features was founded on two primary considerations. First and foremost, the King taxonomy stands apart from other taxonomical frameworks in that it considers potentially problematic game design mechanisms from a psychological perspective. Unlike other taxonomies that focus on outcome variables such as "motivation," the King taxonomy specifically assesses game design mechanisms that are conducive to problematic behaviors. Similarly, other taxonomies are often narrowly focused on specific aspects of games, and all are conducted from a computer science perspective without focusing on problematic gaming behaviors. The second unique benefit of using the King taxonomy was its age which provided a baseline framework for this investigation while leaving room for novel insights into this emerging field. This allowed the team to comprehensively review the literature in a manner that avoided potential biases that could arise from using more contemporary conceptualizations.

The scoping review methodology used in this study, by virtue of being inclusive, required the inclusion of proxies for GD. Considering the development of multiple measures of GD, there is still a lack of consensus in the field. Therefore, we included potentially debated features to remain comprehensive. While specific motivations and immersion have been associated with GD, controversial proxies such as time-spent gaming, flow, excitement, enjoyment, fun, willingness to continue, engagement, preference, and willingness to return to play were also included (Johnston, 2021; Wang & Cheng, 2022; Zhai et al., 2021).

RESULTS

General characteristics of included studies

Figure 1 outlines the search strategy results, which initially yielded 4,771 studies. Ultimately, this process concluded with a pool of 91 studies for data extraction. On November 26, 2021, an updated search yielded 15 additional studies, yielding a total of 105 studies.

The studies included in this review were published from 2004 to 2021. 57.1% of the studies were published after 2016, while 88.6% were published after 2011. Studies largely recruited samples from the United States (n = 23), China (n = 5), Australia (n = 4), South Korea (n = 4), and Turkey (n = 4). However, the sample nationality of many studies was unclear because they were conducted online.

Most studies were cross-sectional and quantitative in design (n = 70; 67.0%), followed by qualitative (n = 12; 11.3%) and randomized control trial (RCT) designs (n = 10; 9.5%). A smaller majority of papers were mixed methods (n = 4; 3.8%), non-randomized control trial (nRCT; n = 4; 3.8%), or prevalence studies (n = 2; 1.9%). No studies were longitudinal.

Sixty-one of the studies (58.1%) directly measured the association between a structural feature intrinsic to a video game and a specific measure of GD (or a similar construct). As shown in Table 2, the most widely assessed proxy variables for GD were time spent gaming (n = 30) and motivation to play (n = 26). Several studies also found relationships between a video game structural feature and enjoyment (n = 14), preference to play the game (n = 12), engagement (n = 11), and immersion (n = 8).

Gaming genres

Video game genres were the most prevalent structural feature discussed (Beranuy, Carbonell, & Griffiths, 2013; Choi et al., 2018; Columb, Griffiths, & O'Gara, 2020; de Albuquerque & Fialho, 2015; Dieris-Hirche et al., 2020; Eichenbaum et al., 2015a, 2015b; Elliott, Ream, McGinsky, & Dunlap, 2012; Entwistle, Blaszczynski, & Gainsbury, 2020; Ferreira et al., 2021; Ghuman & Griffiths, 2012; Haagsma, Pieterse, & Peters, 2012; Han, Jeong, Jo, Son, & Yim, 2020; Hussain & Griffiths, 2014; Kuss, Louws, & Wiers, 2012; Laconi, Pires, & Chabrol, 2017; Lee et al., 2006; Lemmens & Hendriks, 2016; Lewis, 2016; Lopez-Fernandez, Williams, & Kuss, 2019; Mannikko, Billieux, Nordstrom, Koivisto, & Kaariainen, 2017; Männikkö, Ruotsalainen, Tolvanen, & Kääriäinen, 2019; Nagygyörgy et al., 2013; Oflu & Yalcin, 2019; Ream, Elliott, & Dunlap, 2013; Smyth, 2007; Stetina, Kothgassner, Lehenbauer, & Kryspin-Exner, 2011; Vayisoglu, Mutlu, & Oncu, 2021; Westwood & Griffiths, 2010). As shown in Table 1, most studies examining the relationship of GD with gaming genres highlighted MMORPG and RPG as largely problematic, with 18 directly related to

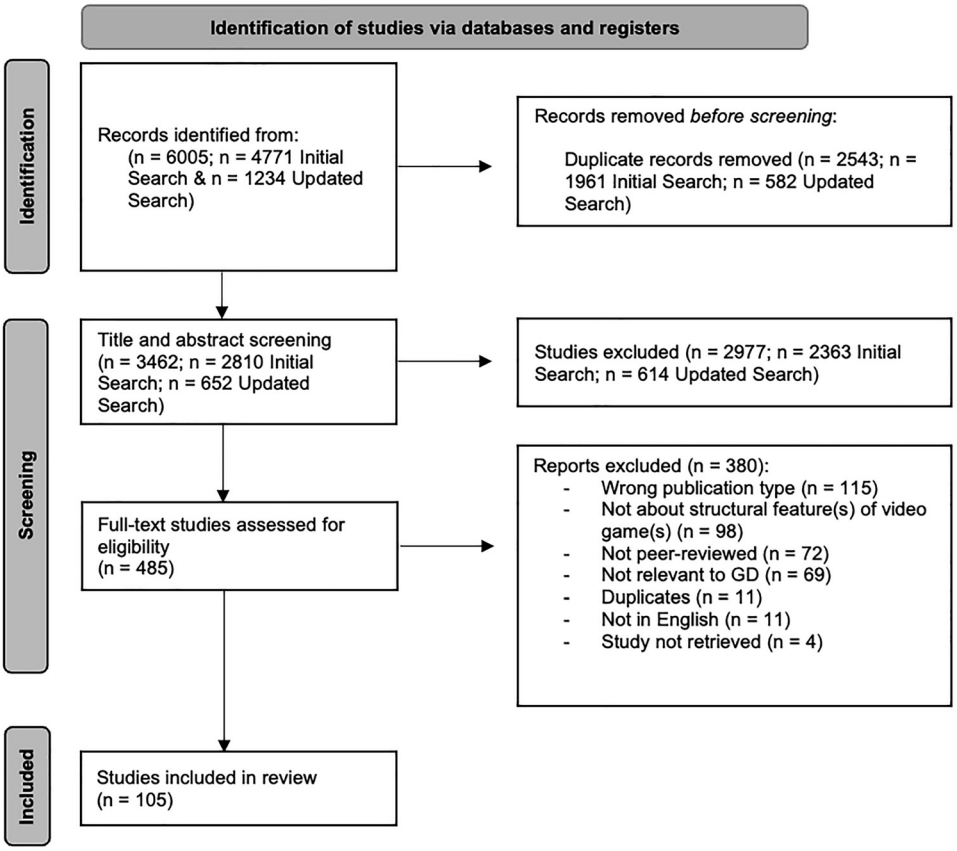

Fig. 1. Study selection process for the initial and updated searches

GD and 23 related to a proxy (Beranuy et al., 2013; Choi et al., 2018; de Albuquerque & Fialho, 2015; Dieris-Hirche et al., 2020; Eichenbaum et al., 2015a, 2015b; Elliott et al., 2012; Entwistle et al., 2020; Ferreira et al., 2021; Ghuman & Griffiths, 2012; Haagsma et al., 2012; Han et al., 2020; Hussain & Griffiths, 2014; Kuss et al., 2012; Laconi et al., 2017; Lee et al., 2006; Lemmens & Hendriks, 2016; Lewis, 2016; Lopez-Fernandez et al., 2019; Mannikko et al., 2017; Na et al., 2017; Nagygyörgy et al., 2013; Ream et al., 2013; Smyth, 2007; Stetina et al., 2011). Of these studies, 16 addressed the association of a structural feature with both GD and a proxy (Dieris-Hirche et al., 2020; Eichenbaum et al., 2015a, 2015b; Elliott et al., 2012; Entwistle et al., 2020; Ferreira et al., 2021; Haagsma et al., 2012; Han et al., 2020; Hussain & Griffiths, 2014; Kuss et al., 2012; Laconi et al., 2017; Lee et al., 2006; Lewis, 2016; Lopez-Fernandez et al., 2019; Na et al., 2017; Ream et al., 2013). An exception to these findings was Ream et al. (2013), observing that MMORPG engagement was associated with problem play, while people who play RPGs at problematic levels tend to be younger. Similar to this finding, Lopez-Fernandez et al. (Lopez-Fernandez et al., 2019) distinguished RPGs as having a negative correlation with IGD and MMORPG as having a positive correlation.

FPS and other shooting games were the second-most discussed game genre, with 13 studies finding FPS having significant positive correlations with GD and 14 studies with a proxy (Columb et al., 2020; de Albuquerque & Fialho, 2015; Dieris-Hirche et al., 2020; Elliott et al., 2012; Ferreira et al., 2021; Ghuman & Griffiths, 2012; Han et al., 2020; Lee et al., 2006; Lemmens & Hendriks, 2016; Lopez-Fernandez et al., 2019; Mannikko et al., 2017; Na et al., 2017; Nagygyörgy et al., 2013; Ohno, 2021; Ream et al., 2013; Stetina et al., 2011). Following FPS and other shooting games, a substantial number of studies identified strategy games as problematic with 6 studies directly relating such games to GD and 9 studies relating them to a proxy (de Albuquerque & Fialho, 2015; Eichenbaum et al., 2015a, 2015b; Elliott et al., 2012; Ghuman & Griffiths, 2012; Nagygyörgy et al., 2013; Oflu & Yalcin, 2019; Ream et al., 2013; Stetina et al., 2011; Vayisoglu et al., 2021). There was a moderate level of evidence for the addictive nature of massively online battle arena (MOBA) and action-adventure games (Columb et al., 2020; Eichenbaum et al., 2015a, 2015b; Elliott et al., 2012; Han et al., 2020; Laconi et al., 2017; Lemmens & Hendriks, 2016; Lopez-Fernandez et al., 2019; Mannikko et al., 2017; Männikkö et al., 2019; Ohno, 2021; Vayisoglu et al., 2021). 9 of these studies found associations of MOBA and action-adventure games directly with GD and 10 with a proxy. Other genres, including sports, fighting, puzzles, music/rhythm, simulation, casual, card, and racing/driving, were less represented in the body of literature (de Albuquerque & Fialho, 2015; Eichenbaum et al., 2015b; Elliott et al., 2012; Ferreira et al., 2021; Han et al., 2020; Laconi et al., 2017; Lee et al., 2006; Lemmens & Hendriks, 2016; Mannikko et al., 2017; Oflu & Yalcin, 2019; Ohno, 2021; Ream et al., 2013). However, Elliott et al. (Elliott et al., 2012), however, found FPS and other shooting games, racing/driving, action-adventure, sports, music/rhythm, card, platformer, and strategy genre games were not significantly related to problematic gaming behavior. Moreover, Männikkö et al. (Mannikko et al., 2017) similarly found card, simulation, music/rhythm, fighting, and sports genre games were not significantly related. These same findings were underscored by Oflu and Yalcin (Oflu & Yalcin, 2019), demonstrating a lack of significance for racing/driving, action-adventure, and sports genre games. Entwistle et al. (Entwistle et al., 2020) failed to find significant findings for the FPS, action-adventure, and strategy genres.

Social features

As seen in Table 2, 44 studies found an association of a social structural feature with either GD and/or a proxy variable. The most studied associations within this category were between general socialization features and GD ($n = 10$) or a proxy ($n = 23$) (Beranuy et al., 2013; Chang, 2013; Cheng, 2019; Dietrich, Mulcahy, & Knox, 2018; Elliott et al., 2012; Ghuman & Griffiths, 2012; Heng, Zhao, & Wang, 2020; Hsu, Lee, & Wu, 2005; Hull, Williams, & Griffiths, 2013; Kang, Lu, Guo, & Zhao, 2020; Karlsen, 2011; King et al., 2011, 2017; Klimmt, Schmid, & Orthmann, 2009; Laconi et al., 2017; Land, 2015; Lee & Schoenstedt, 2011; Lewis, 2016; Mao, 2021; McLean & Griffiths, 2013; Quick & Atkinson, 2014; Smyth, 2007; Wood et al., 2004, 2007). General socialization features were within games features related to in-game socialization as a motive without clearly delineating the specific structural feature. Interestingly, this was a structural feature not explicitly described in the original King taxonomy. Only one study (Lee, Cheung, & Chan, 2020) found that general socialization features were not significantly associated with any outcome variable. Most of these studies addressed socially based motivation factors (Dietrich et al., 2018; Elliott et al., 2012; Hsu et al., 2005; Karlsen, 2011; King et al., 2017; Klimmt et al., 2009; Laconi et al., 2017; Land, 2015; Lee & Schoenstedt, 2011; Quick & Atkinson, 2014; Ream et al., 2013).

Among all the sub-features related to the broader social feature category, the presence of multiplayer features was the second most widely reported characteristic, with all studies finding a positive association of multiplayer features and GD ($n = 6$) and/or a proxy of GD ($n = 19$) (Banks, 2015; Blinka & Mikuška, 2014; Heng et al., 2020; Herodotou, Winters, & Kambouri, 2015; Hu, Stavropoulos, Anderson, Scerri, & Collard, 2019; Hussain & Griffiths, 2014; Oflu & Yalcin, 2019; Quick & Atkinson, 2014; Quick, Atkinson, & Lin, 2012; Schmierbach, Xu, Oeldorf-Hirsch, & Dardis, 2012; Tavakkoli et al., 2014, 2015; Wang et al., 2014; Westwood & Griffiths, 2010; Wood et al., 2004). Multiplayer features, like general socialization features, were not explicitly discriminated from social formation/institutional features in the original King taxonomy. In the context of the King taxonomy, social formation/institutional features referred to long-term, stable social bonds within the game (King et al., 2010). In this study, multiplayer features generally refer to player-to-player bonds within the game, regardless of their

Table 1. Gaming disorder and/or proxy associated with Video Game Genres

Structural Characteristic	Positive		Unrelated		Negative	
	Related to GD	Related to Proxy of GD	Related to GD	Related to Proxy of GD	Related to GD	Related to Proxy of GD
FPS/Shooting	Columb et al. (2020) Dieris-Hirche et al. (2020) Elliott et al. (2012) Ferreira et al. (2021) Han et al. (2020) Lee et al. (2006) Lemmens and Hendriks (2016) Lopez-Fernandez et al. (2019) Ream et al. (2013) Mannikko et al. (2017) Na et al. (2017) Ohno (2021) Stetina et al. (2011)	de Albuquerque and Fialho (2015) Dieris-Hirche et al. (2020) Elliott et al. (2012) Ferreira et al. (2021) Ghuman and Griffiths (2012) Han et al. (2020) Lee et al. (2006) Lemmens and Hendriks (2016) Lopez-Fernandez et al. (2019) Ream et al. (2013) Na et al. (2017) Nagygyörgy et al. (2013) Ohno (2021) Stetina et al. (2011)	Elliott et al. (2012)	Elliott et al. (2012)		
Racing/ Driving	Elliott et al. (2012)	Elliott et al. (2012)	Elliott et al. (2012) Oflu & Yalcin (2019)	Elliott et al. (2012)		
Casual	Laconi et al. (2017) Oflu & Yalcin (2019)	Laconi et al. (2017)				
Action/ Action-Adventure	Columb et al. (2020) Eichenbaum et al., (2015a) Eichenbaum et al., (2015b) Han et al. (2020) Lemmens and Hendriks (2016) Mannikko et al. (2017) Elliott et al. (2012) Lopez-Fernandez et al. (2019) Ohno (2021)	Eichenbaum et al., (2015a) Eichenbaum et al., (2015b) Han et al. (2020) Lemmens and Hendriks (2016) Elliott et al. (2012) Lopez-Fernandez et al. (2019) Ohno (2021) Vayisoglu et al. (2021)	Elliott et al. (2012) Entwistle et al. (2020) Oflu & Yalcin (2019)	Elliott et al. (2012) Entwistle et al. (2020)		
MOBA	Columb et al. (2020) Han et al. (2020) Laconi et al. (2017) Lopez-Fernandez et al. (2019) Männikkö et al. (2019)	Han et al. (2020) Laconi et al. (2017) Lopez-Fernandez et al. (2019) Männikkö et al. (2019)				
Serious						
MMORPG/ RPG	Choi et al. (2018) Dieris-Hirche et al. (2020) Eichenbaum et al., (2015a) Eichenbaum et al., (2015b) Elliott et al. (2012) Entwistle et al. (2020)	Beranuy et al. (2013)[#] de Albuquerque and Fialho (2015) Dieris-Hirche et al. (2020) Eichenbaum et al., (2015a) Eichenbaum et al., (2015b)			Ream et al. (2013) Lopez-Fernandez et al. (2019)	Ream et al. (2013) Lopez-Fernandez et al. (2019)

(continued)

Table 1. Continued

Structural Characteristic	Positive		Unrelated		Negative	
	Related to GD	Related to Proxy of GD	Related to GD	Related to Proxy of GD	Related to GD	Related to Proxy of GD
	Ferreira et al. (2021) Haagsma et al. (2012) Han et al. (2020) Hussain & Griffiths (2014)# Kuss et al. (2012) Laconi et al. (2017) Lee et al. (2006) Lewis (2016) Lopez-Fernandez et al. (2019) Ream et al. (2013) Mannikko et al. (2017) Na et al. (2017)	Elliott et al. (2012) Entwistle et al. (2020) Ferreira et al. (2021) Ghuman and Griffiths (2012) Haagsma et al. (2012) Han et al. (2020) Hussain & Griffiths (2014)# Kuss et al. (2012) Laconi et al. (2017) Lee et al. (2006) Lemmens and Hendriks (2016) Lewis (2016) Lopez-Fernandez et al. (2019) Ream et al. (2013) Na et al. (2017) Nagygyörgy et al. (2013) Smyth (2007) Stetina et al. (2011)				
Sports	Elliott et al. (2012) Lee et al. (2006) Ream et al. (2013)	de Albuquerque and Fialho (2015) Elliott et al. (2012) Lee et al. (2006) Ream et al. (2013)	Elliott et al. (2012) Mannikko et al. (2017) Oflu & Yalcin (2019)	Elliott et al. (2012)		
Fighting	Mannikko et al. (2017)	de Albuquerque and Fialho (2015)	Mannikko et al. (2017)			
Puzzles	Eichenbaum et al., (2015a) Elliott et al. (2012) Ferreira et al. (2021) Lemmens and Hendriks (2016) Ream et al. (2013)	de Albuquerque and Fialho (2015) Eichenbaum et al., (2015a) Elliott et al. (2012) Ferreira et al. (2021) Lemmens and Hendriks (2016) Ream et al. (2013)	Elliott et al. (2012) Mannikko et al. (2017)	Elliott et al. (2012)		
Music/ Rhythm	Eichenbaum et al., (2015b) Elliott et al. (2012)	Eichenbaum et al., (2015b) Elliott et al. (2012)	Elliott et al. (2012) Mannikko et al. (2017)	Elliott et al. (2012)		
Simulation	Ferreira et al. (2021) Han et al. (2020) Lee et al. (2006)	Ferreira et al. (2021) Han et al. (2020) Lee et al. (2006)	Mannikko et al. (2017)		Lopez-Fernandez et al. (2019)	Lopez-Fernandez et al. (2019)
Solo	Männikkö et al. (2019)	Männikkö et al. (2019) Westwood and Griffiths (2010)				
Card	Elliott et al. (2012) Ohno (2021)	Elliott et al. (2012) Ohno (2021)	Elliott et al. (2012) Mannikko et al. (2017)	Elliott et al. (2012)		

(continued)

Table 1. Continued

Structural Characteristic	Positive		Unrelated		Negative	
	Related to GD	Related to Proxy of GD	Related to GD	Related to Proxy of GD	Related to GD	Related to Proxy of GD
Platformer			Elliott et al. (2012)	Elliott et al. (2012)		
Strategy	Eichenbaum et al., (2015a) Eichenbaum et al., (2015b) Ream et al. (2013) Elliott et al. (2012) Oflu & Yalcin (2019) Stetina et al. (2011)	de Albuquerque and Fialho (2015) Eichenbaum et al., (2015a) Eichenbaum et al., (2015b) Ream et al. (2013) Elliott et al. (2012) Ghuman and Griffiths (2012) Nagygyörgy et al. (2013) Stetina et al. (2011) Vayisoglu et al. (2021)	Elliott et al. (2012) Entwistle et al. (2020)	Elliott et al. (2012) Entwistle et al. (2020)		

Note: "#" indicates studies being qualitative in nature.

transiency. Two different motives for engaging in multiplayer gaming were competition and cooperativity. There was substantial evidence of player-to-player competition as being more enjoyable than playing alone (de Albuquerque & Fialho, 2015; Dietrich et al., 2018; Klimmt et al., 2009; Laconi et al., 2017; Land, 2015; Lee & Schoenstedt, 2011; Nadolny, Alaswad, Culver, & Wang, 2017; Schmierbach et al., 2012). Nonetheless, several studies found cooperation and an in-game community to foster increased gameplay behavior (Blinka & Mikuška, 2014; Heng et al., 2020; Hussain & Griffiths, 2014; Schmierbach et al., 2012).

Only one study (Hussain, Williams, & Griffiths, 2015) investigated social utility features, ultimately finding a positive association and in-game chat. Several studies found evidence for social formation/institutional features: the capacity of games to allow players to engage in guilds, clans, and teams. Consequently, four studies showed a positive association with GD and seven with a proxy including motivation and time spent gaming (Banks, 2015; Beranuy et al., 2013; Duman & Ozkara, 2019; Heng et al., 2020; Herodotou et al., 2015; Hu et al., 2019; Hussain et al., 2015; McLean & Griffiths, 2013). Six studies found a positive association between leaderboard features with a proxy for GD; interestingly, no studies found a direct association with GD itself (Dietrich et al., 2018; Goh and Pe-Than EPPLee, 2017; Hsu & Wang, 2018; Laffan, Greaney, Barton, & Kaye, 2016; Quick & Atkinson, 2014; Westwood & Griffiths, 2010).

A few studies found structural features with positive associations that did not clearly fall into the structural features proposed in the King taxonomy (de Albuquerque & Fialho, 2015; Dietrich et al., 2018; Laconi et al., 2017; Lemmens & Hendriks, 2016; Lewis, 2016; McLean & Griffiths, 2013; Nadolny et al., 2017). Notably, in-game social interactions were found to be more fun (de Albuquerque & Fialho, 2015). Several studies likewise broadly discussed social gameplay features associated with RPG games (Lemmens & Hendriks, 2016; Lewis, 2016). While the five-feature model taxonomy included support network features, the present scoping review did not find any studies supporting this category.

Manipulation and control features

There were 18 studies that found a relationship between GD and manipulation and control features. The sub-features of manipulation and control features were relatively equally represented, as noted in Table 3. While one study found that user input device was positively associated with GD, five studies found an association of this feature with a proxy such as enjoyment, time spent gaming, and enjoyment (King et al., 2011; Lau, Lau, Wang, rak, & Kim, 2017; Lin & Peng, 2015; McGloin & Embacher, 2018; Wood et al., 2004). The user-input device was a sub-feature category absent from the King taxonomy and referred to how a player could interact with their game. This could include video game controllers, touch screens, or other unconventional methods of gameplay, such as using a microphone. While there was evidence by Wood et al. (Wood et al., 2004) that joysticks tend to be important for gamers (although, not necessarily problematic), a study by Lin and Peng (Lin & Peng, 2015) found that motion-based games facilitate a higher level of enactive realism, thereby enhancing engagement and enjoyment. In accordance with these results, one study (McGloin & Embacher, 2018) found that controller naturalness predicted increased immersion, enjoyment, and desire to keep playing exercise games. Three studies identified a positive association of the platform on which the game was played as both related to GD, engagement, time spent gaming, and preference (Kang et al., 2020; Kim & Lee, 2021; Männikkö et al., 2019; Oflu & Yalcin, 2019). Oflu and Yalcin (Oflu & Yalcin, 2019), in particular, identified game consoles

Table 2. Gaming disorder and/or proxy associated with video game social sub-features

Structural Characteristic	Positive		Unrelated		Negative	
	Related to GD	Related to Proxy of GD	Related to GD	Related to Proxy of GD	Related to GD	Related to Proxy of GD
General Socialization Feature	Cheng (2019) Heng et al. (2020) Hull et al. (2013) Karlsen (2011)# King et al. (2010) King et al. (2017) Laconi et al. (2017) Lewis (2016) Ream et al. (2013) McLean and Griffiths (2013)	Beranuy et al. (2013)# Chang (2013) Cheng (2019) Dietrich et al. (2018)# Ghuman and Griffiths (2012) Hull et al. (2013) Hsu et al. (2005) Kang et al. (2020) King et al. (2010) King et al. (2017) Klimmt et al. (2009) Klimmt et al. (2009) Laconi et al. (2017) Land (2015)# Lee and Schoenstedt (2011) Lewis (2016) Ream et al. (2013) Mao (2021) McLean and Griffiths (2013) Nadolny et al. (2017) Quick & Atkinson (2014) Smyth (2007) Wood et al. (2004) Wood et al. (2007)	Lee et al. (2020)	Lee et al. (2020)		
Social Utility Feature	Hussain et al. (2015)	Hussain et al. (2015)				
Social Formation Institutional Features	Duman and Ozkara (2019) Heng et al. (2020) Hu et al. (2019) Hussain et al. (2015)	Banks (2015)# Beranuy et al. (2013)# Duman and Ozkara (2019) Herodotou et al. (2015)# Hu et al. (2019) Hussain et al. (2015) McLean and Griffiths (2013)				
Multiplayer	Blinka and Mikuška (2014) Heng et al. (2020) Hu et al. (2019) Hussain & Griffiths (2014)# Oflu & Yalcin (2019) Wang et al. (2014)	Banks (2015)# Blinka and Mikuška (2014) Herodotou et al. (2015)# Hu et al. (2019) Hussain & Griffiths (2014)# Quick & Atkinson (2014) Quick et al. (2012) Schmierbach et al. (2012) Tavakkoli et al. (2014) Tavakkoli et al. (2015) Wang et al. (2014) Westwood and Griffiths (2010) Wood et al. (2004)				

(continued)

Table 2. Continued

Structural Characteristic	Positive		Unrelated		Negative	
	Related to GD	Related to Proxy of GD	Related to GD	Related to Proxy of GD	Related to GD	Related to Proxy of GD
Leaderboard		Dietrich et al. (2018)[#] Goh, Pe-Than EPP, and Lee (2017) Hsu and Wang (2018) Laffan et al. (2016) Quick & Atkinson (2014) Westwood and Griffiths (2010)				
Does Not Fall In Sub-Feature Category	Laconi et al. (2017) Lemmens and Hendriks (2016) Lewis (2016) - 1537	de Albuquerque and Fialho (2015) Dietrich et al. (2018)[#] Laconi et al. (2017) Lemmens and Hendriks (2016) Lewis (2016) – 1537 McLean and Griffiths (2013) Nadolny et al. (2017)				

Note: "#" indicates studies being qualitative in nature.

Table 3. Gaming disorder and/or proxy associated with video game manipulation and control sub-feature

Structural Characteristic	Positive		Unrelated		Negative	
	Related to GD	Related to Proxy of GD	Related to GD	Related to Proxy of GD	Related to GD	Related to Proxy of GD
User Input Device	King et al. (2010)	King et al. (2010) Lau et al. (2017)[#] Lin and Peng (2015) McGloin & Embacher (2018) Wood et al. (2004)				
User Input Controls/ Combos/Hot Keys		Laffan et al. (2016)				
Save Features		Laffan et al. (2016) Westwood and Griffiths (2010) Wood et al. (2004)				
Virtual World	Barnes and Pressey (2014)	Barnes and Pressey (2014) Quick & Atkinson (2014)	Quick & Atkinson (2014)			
In-Game Resource Feedback Features	King et al. (2010)	Hsu et al. (2005) King et al. (2010)				
Scripted Events	King et al. (2010)	King et al. (2010) Westwood and Griffiths (2010)				
Platform (PC/ Console/Mobile)	Kim and Lee (2021) Männikkö et al. (2019) Oflu & Yalcin (2019)	Kang et al. (2020) Kim and Lee (2021) Männikkö et al. (2019)	Siste et al. (2021)	Siste et al. (2021)	Oflu & Yalcin (2019)	
Artificial Intelligence/NPC Presence		Tavakkoli et al. (2014) Wood et al. (2004)				
Does Not Fall In Sub-Feature Category	Hull et al. (2013)	Chang (2013) Hull et al. (2013) Hsu et al. (2005)				

Note: "#" indicates studies being qualitative in nature.

as being correlated with higher scores on the Videogame Addiction Scale for Children, while tablet and mobile gameplay were negatively associated with addiction. Siste et al. (Siste et al., 2021) observed that while the device of choice of participants was smartphone, the device of choice had no significant relationship to IGD. The capacity to save the game was identified by three studies to be associated only with proxies of GD: flow, engagement, motivation, and time-spent gaming (Laffan et al., 2016; Westwood & Griffiths, 2010; Wood et al., 2004). Two types of problematic save features appeared in the literature: quicksaves and checkpoints (Laffan et al., 2016).

In 2014, Barnes and Pressey (Barnes & Pressey, 2014) identified two types of virtual worlds associated with GD, goal-oriented and experience-oriented. Notably, goal-oriented were found to have addiction levels significantly higher than experience-oriented virtual worlds (Barnes & Pressey, 2014). Quick and Atkinson (Quick & Atkinson, 2014) found evidence that partially supported the results by Barnes and Pressey (Barnes & Pressey, 2014). Crucially, the type of in-game virtual world is a sub-feature that was not introduced within the King taxonomical model. It was found that exploring the in-game world and discovering unexpected things were associated with GD and engagement; exploring unfamiliar places showed no significant relationship (Quick & Atkinson, 2014). In 2010, King et al. found evidence of player management features as contributors to gaming addiction. These results were consistent with those of Hsu et al. (Hsu et al., 2005) and Westwood and Griffiths (Westwood & Griffiths, 2010) who had found evidence of in-game resource feedback features and scripted events being related to engagement, motivation, and time spent gaming. Only one study (Laffan et al., 2016) found evidence for in-game combos (user input controls) being related to engagement and motivation. Wood et al. (Wood et al., 2004) and Tavakkoli et al. (Tavakkoli et al., 2014) found artificial intelligence game features related to motivation but not GD, a sub-feature not included in the original King taxonomy.

Some studies identified relationships that did not clearly fall under the sub-features of the manipulation and control category (Chang, 2013; Hsu et al., 2005; Hull et al., 2013). Hull et al. (Hull et al., 2013) broadly found that the Gaming Addiction Scale had a low significant positive correlation with manipulation and control features. Likewise, a study by Chang (Chang, 2013), identified human-computer interaction as positively associated with the continuance intention of playing social networking games. Finally, Hsu et al. (Hsu et al., 2005) observed that participants viewed powerful in-game weapons as more fun because players felt empowered by being equipped with powerful weapons.

Narrative and identity features

The literature widely and strongly supported the player's capacity to play as an avatar as having positive associations with GD (n = 15) and/or a proxy (n = 13) (Banks, 2015; Beranuy et al., 2013; Choi et al., 2018; Green, Delfabbro, & King, 2021; Hao, Lv, Zhang, Jiang, & Ping, 2020; Herodotou et al., 2015; Hsu et al., 2005; Konijn, Nije Bijvank, & Bushman, 2007; Laconi et al., 2017; Lee et al., 2020; Li, Li, & Castano, 2020; Liew, Stavropoulos, Adams, Burleigh, & Griffiths, 2018; Lopez-Fernandez et al., 2019; Mancini, Imperato, & Sibilla, 2019; McLean & Griffiths, 2013; Quick et al., 2012; Sioni, Burleson, & Bekerian, 2017; Stavropoulos, Dumble, Cokorilo, Griffiths, & Pontes, 2019; Stavropoulos et al., 2020a; Stavropoulos et al., 2020b; T'ng & Pau, 2020; Yang, Huang, & Wong, 2021). As shown in Table 4, numerous studies identified physical avatar identification as potentially problematic (Green et al., 2021; Hao et al., 2020; Li et al., 2020; Lopez-Fernandez et al., 2019; Mancini et al., 2019; Sioni et al., 2017; Stavropoulos et al., 2019; Stavropoulos et al., 2020b; T'ng & Pau, 2020; Yang et al., 2021). In particular, Mancini et al. (Mancini et al., 2019) found that identifying with an idealized or utopian avatar did not affect the intention to continue to play. Stavropoulos et al. (Stavropoulos et al., 2020b) notably found that avatar identification was not associated with GD for the gamers categorized as "non-influenced gamers" (Stavropoulos et al., 2020b). The capacity to customize the player's avatar was also largely represented in the literature, with two studies finding a direct relation to GD and six with a proxy (Jin, 2009; Kim et al., 2015; Mancini et al., 2019; Morcos, Stavropoulos, Rennie, Clark, & Pontes, 2019; Quick & Atkinson, 2014; Tavakkoli et al., 2015; Westwood & Griffiths, 2010; Wood et al., 2004). Likewise, numerous studies supported the contribution of storytelling devices within video games to the onset of GD (n = 3) or a proxy (n = 9) (Cheng, 2019; Hall, 2019; King et al., 2011, 2017; McLean & Griffiths, 2013; Tavakkoli et al., 2014, 2015; Westwood & Griffiths, 2010; Wood et al., 2004, 2007). Most substantially, Hall (Hall, 2019) found that the player's ability to make choices as the character of a story contributed to greater enjoyment and engagement.

Reward and punishment features

From a broader perspective, the reward and punishment category of structural features was one of the most widely reported in the overall literature pool, with 34 studies making up 32.08% of the included papers (see Table 5). A substantial number of the studies included discussed evidence related to general reward features with 5 studies associated with GD and 20 associated with a proxy (Aggarwal, Saluja, Gambhir, Gupta, & Satia, 2020; Banks, 2015; Cruz, Hanus, & Fox, 2017; de Albuquerque & Fialho, 2015; Dietrich et al., 2018; Finserås et al., 2019; Goh and Pe-Than EPPLee, 2017; Herodotou et al., 2015; Hsu & Wang, 2018; Karlsen, 2011; King, Herd, & Delfabbro, 2018; Laffan et al., 2016; Land, 2015; Lee et al., 2020; Lewis, 2016; McKernan et al., 2015; Nadolny et al., 2017; Tavakkoli et al., 2014; Westwood & Griffiths, 2010; Wood et al., 2004; Wood et al., 2007; Yang & Quadir, 2018). Within the general reward features categorization, eight studies found evidence of experience points being potentially problematic (Dietrich et al., 2018; Goh and Pe-Than EPPLee, 2017; Herodotou et al., 2015; Hsu & Wang, 2018; Land, 2015; Nadolny et al., 2017; Westwood & Griffiths, 2010;

Table 4. Gaming disorder and/or proxy associated with video game narrative and identity features sub-features

Structural Characteristic	Positive		Unrelated		Negative	
	Related to GD	Related to Proxy of GD	Related to GD	Related to Proxy of GD	Related to GD	Related to Proxy of GD
Avatar Presence	Choi et al. (2018) Green et al. (2021) Hao et al. (2020) Herodotou et al. (2015)# Laconi et al. (2017) Lee et al. (2020) Li et al. (2020) Liew et al. (2018) Mancini et al. (2019) Sioni et al. (2017) Stavropoulos et al. (2019) Stavropoulos, Gomez, Mueller, Yucel, and Griffiths (2020) Stavropoulos, Gomez, et al. (2020) T'ng and Pau (2020) Yang et al. (2021)	Banks (2015)# Beranuy et al. (2013)# Green et al. (2021)# Hsu et al. (2005) Konijn et al. (2007) Laconi et al. (2017) Lee et al. (2020) Lopez-Fernandez et al. (2019) Mancini et al. (2019) McLean and Griffiths (2013) Quick et al. (2012) T'ng and Pau (2020) Yang et al. (2021)	Green et al. (2021) Stavropoulos, Gomez, et al. (2020)			
Avatar Creation/ Customizability	Mancini et al. (2019) Morcos et al. (2019)	Jin (2009)# Kim et al. (2015) Quick & Atkinson (2014) Tavakkoli et al. (2015) Westwood and Griffiths (2010) Wood et al. (2004)				
Storytelling Device Feature	Cheng (2019) King et al. (2010) King et al. (2017)	Hall (2019) King et al. (2010) King et al. (2017) McLean and Griffiths (2013) Tavakkoli et al. (2015) Tavakkoli et al. (2014) Westwood and Griffiths (2010) Wood et al. (2004) Wood et al. (2007)				
Does Not Fall In Sub-Feature Category			Hull et al. (2013)	Hull et al. (2013)		

Note: "#" indicates studies being qualitative in nature.

Wood et al., 2004). Cruz et al. (Cruz et al., 2017) found mixed results: it was observed that badge systems could be motivating for players, depending on the person.

There was sufficient evidence for most of the categories in King et al. (King et al., 2010). Evidence by Finserås et al. (Finserås et al., 2019) and Laffan et al. (Laffan et al., 2016) supported that punishment features *may* be associated with potentially problematic gaming behavior through their relationship with proxies (willingness to continue, willingness to return to play, and flow). There was also evidence of intermittent rewards being associated with GD or a proxy (Dietrich et al., 2018; Land, 2015; Nadolny et al., 2017; Westwood & Griffiths, 2010). Numerous studies addressed near-miss features as related to GD ($n = 1$) and proxies ($n = 2$) (Finserås et al., 2019; Karlsen, 2011; Quick & Atkinson, 2014). Likewise, the literature showed evidence for event frequency features, event duration features, and meta-game rewards (Cruz et al., 2017; Hussain & Griffiths, 2014; King et al., 2011; Westwood & Griffiths, 2010; Wood et al., 2004). Of these studies Wood et al. (Wood et al., 2004), Westwood and Griffiths (Westwood & Griffiths, 2010), and Cruz et al. (Cruz et al., 2017) found associations with a proxy, such as motivation and time spent gaming.

Table 5. Gaming disorder and/or proxy associated with video game reward and punishment sub-features

Structural Characteristic	Positive		Unrelated		Negative	
	Related to GD	Related to Proxy of GD	Related to GD	Related to Proxy of GD	Related to GD	Related to Proxy of GD
General Reward Type Features	Aggarwal et al. (2020) Karlsen (2011)# King et al. (2018) Lee et al. (2020) Lewis (2016)	Banks (2015)# Cruz et al. (2017)# de Albuquerque and Fialho (2015) Dietrich et al. (2018)# Finserås et al. (2019) Goh et al. (2017) Herodotou et al. (2015)# Hsu and Wang (2018) King et al. (2018) Laffan et al. (2016) Land (2015)# Lee et al. (2020) Lewis (2016) McKernan et al. (2015) Nadolny et al. (2017) Tavakkoli et al. (2014) Westwood and Griffiths (2010) Wood et al. (2004) Wood et al. (2007) Yang and Quadir (2018)		Cruz et al. (2017)#		
In-Game Currency			Columb et al. (2020)			
Random Chance Purchases/Loot Banks	Brooks and Clark (2019) Carey et al. (2021) Columb et al. (2020) Drummond et al. (2020) Ide et al. (2021) King et al. (2020) Li et al. (2020)	Brooks and Clark (2019) King et al. (2020) Li et al. (2020)				
Punishment Features		Finserås et al. (2019) Laffan et al. (2016)				
Intermittent Rewards		Dietrich et al. (2018)# Land (2015)# Nadolny et al. (2017) Westwood and Griffiths (2010)				
Payout Intervals						
Negative Reward Features	Columb et al. (2020)	Chumbley & Griffiths (2006)				
Near Miss Features	Karlsen (2011)#	Finserås et al. (2019) Quick & Atkinson (2014)				
Event Frequency Features	King et al. (2010)	King et al. (2010)				
Event Duration Features	Hussain & Griffiths (2014)#	Hussain & Griffiths (2014)# Wood et al. (2004)				
Meta-Game Rewards	King et al. (2010)	Cruz et al. (2017)# King et al. (2010) Westwood and Griffiths (2010)				
Size of Reward		Finserås et al. (2019)				
Does Not Fall In Sub-Feature Category	Aggarwal et al. (2020) Hull et al. (2013) Lewis (2016)	Dietrich et al. (2018)# Hull et al. (2013) Lewis (2016)				

Note: "#" indicates studies being qualitative in nature.

Three sub-categories relevant to reward and punishment features emerged that were not in the original taxonomy: random chance purchases, size of reward, and in-game currency. Random chance purchases were defined as methods of arbitrarily obtaining in-game items differing in value, such as through loot boxes. Seven studies found associations of GD with random chance purchases (Brooks & Clark, 2019; Carey, Delfabbro, & King, 2021; Columb et al., 2020; Drummond, Sauer, Ferguson, & Hall, 2020; Ide et al., 2021; King, Wong-Padoongpatt, Barrita, Phung, & Tong, 2020; Li et al., 2020). Of these, the studies by King et al. (King et al., 2020), Banks and Clark (Brooks & Clark, 2019), and Li et al. (Li et al., 2020) also addressed associations of random chance purchases with proxies such as excitement and time spent gaming. Alternatively, the size of reward referred to the relative amounts of rewards and was supported by one study. Notably, there was a more negligible correlation between the size of wins and losses compared to simply winning or losing (Finserås et al., 2019). Finally, in-game currency was addressed by Columb et al. (Columb et al., 2020) and referred to the capacity for players to use a system of money specific to the game, such as V-bucks in Fortnite. According to Columb et al. (Columb et al., 2020), in-game currencies were the most common micro-transactions made by individuals with GD.

There was no evidence of structural features relevant to payout intervals in the literature included in the final pool of the present scoping review. However, a few studies had findings that did not clearly fall under the King taxonomy (Aggarwal et al., 2020; Dietrich et al., 2018; Hull et al., 2013; Lewis, 2016).

Presentation features

For the present scoping review, the graphics and sound sub-feature within the King taxonomy was separated into graphic features and sound features. Crucially, while twelve studies found video game graphics were associated with a proxy of GD, only one study by King et al. found a direct relationship with GD (de Albuquerque & Fialho, 2015; King et al., 2011; Laffan et al., 2016; Land, 2015; Lau et al., 2017; Quick & Atkinson, 2014; Quick et al., 2012; Takatalo, Kawai, Kaistinen, Nyman, & Häkkinen, 2011; Tavakkoli et al., 2014, 2015; Westwood & Griffiths, 2010; Wood et al., 2004). A nearly comparable number of studies identified sound features within games, as seen in Table 6. Numerous studies highlighted that the popularity of a video game depends largely on a high degree of realism in graphics and sound (de Albuquerque & Fialho, 2015; Tavakkoli et al., 2014; Wood et al., 2004). Alternatively, Lin and Peng (Lin & Peng, 2015) found that graphic realism was not a salient predictor of enjoyment in the context of exercise games. Among the explicit content features classification in the original five-factor model, only violence was reported to have a relationship with GD (n = 2) and/or a proxy (n = 3) (Aggarwal et al., 2020; Ferguson & Olson, 2013; Irmak & Erdogan, 2019; Konijn et al., 2007; Wood et al., 2004). By contrast, sexual content and explicit language were not addressed in the literature pool. Wood et al. (Wood et al., 2004) and De Albuquerque and Fialho (de Albuquerque & Fialho, 2015), however, had similar findings that some groups of people may have preferences for non-violent video games. Only one study found evidence for in-game advertising (Westwood & Griffiths, 2010). Hull et al. (Hull et al., 2013) broadly found that presentation features were not significantly correlated with the Gaming Addiction Scale (Table 6).

DISCUSSION

This scoping review examined the literature investigating video game structural features implicated in GD, either measured directly or as indicated by proxies for GD. The findings are consistent with the more limited review by Rehbein et al. (Rehbein et al., 2021): Certain gaming genres (MMORPG, FPS, RTS) and reward and punishment features were most studied in the literature. Expanding from this, the results of this review suggest that the most widely reported structural features implicated with GD are avatar presence, avatar creation, specific genres, multi-player, general socialization features, different reward features, graphics, and sound. The vast representation of these structural features suggests that they can be potentially problematic for two reasons: they enhance the player's sense of in-game realism, and they use reward features like those in gambling. For the former, some structural features may enhance the player's sense of immersion within a virtual world that feels organically alive and stimulating, contributing to problematic dependency. This category encompasses the broader classes of social features, manipulation and control features, narrative and identity features, and presentation features. For instance, avatar features seem to include the capacity to play and customize the player avatar to appear like the player in physical appearance and personality traits or as an avatar representing an idealized version of the player's sense of self. By having the capability to establish a robust in-game identity and playing with other players in an environment that seems naturalistic and stimulating, players can immerse themselves within a game.

The second broader class of structural features that contributes to increased risk of gaming disorder are gambling-like features. This category includes reward and punishment features such as general rewards, punishments, and intermittent rewards. It is difficult to discriminate which are more problematic than others with a near-equal representation of most reward and punishment sub-structural features. Nonetheless, it appears that the general reward type features, particularly XP, seem to have the largest body of evidence supporting their being potentially problematic. This observation proffers three possible justifications for this association: firstly, researchers investigating the occurrence of reward and punishment features have not focused on the more specific gambling-related structural features; secondly that video games, unlike gambling machines, are more likely

Table 6. Gaming disorder and/or proxy associated with video game presentation sub-features

	Positive		Unrelated		Negative	
Structural Characteristic	Related to GD	Related to Proxy of GD	Related to GD	Related to Proxy of GD	Related to GD	Related to Proxy of GD
Graphics	King et al. (2010)	de Albuquerque and Fialho (2015) King et al. (2010) Laffan et al. (2016) Land (2015)# Lau et al. (2017)# Quick & Atkinson (2014) Quick et al. (2012) Takatalo et al. (2011) Tavakkoli et al. (2014) Tavakkoli et al. (2015) Westwood and Griffiths (2010) Wood et al. (2004)		Lin and Peng (2015)		
Franchise Features		Westwood and Griffiths (2010)				
Violence	Aggarwal et al. (2020) Irmak and Erdogan (2019)	Ferguson & Olson (2013) Konijn et al. (2007) Wood et al. (2004)				de Albuquerque and Fialho (2015) Wood et al. (2004)
In-Game Advertising Features		Westwood and Griffiths (2010)				
Sound	King et al. (2010)	Hallett (2016)# King et al. (2010) Laffan et al. (2016) Land (2015)# Quick & Atkinson (2014) Tavakkoli et al. (2014) Tavakkoli et al. (2015) Westwood and Griffiths (2010) Wood et al. (2004)				
Explicit Language						
Sexual Content						
Does Not Fall In Sub-Feature Category			Hull et al. (2013)	Hull et al. (2013)		

Note: "#" indicates studies being qualitative in nature.

to utilize general reward features than the other sub-features; finally, that the inclusion of gambling machine structural features is not explicitly salient in video games.

The "themes and genre" sub-feature from the King five-feature model is redundant in that it is a broad category that encompasses specific structural characteristics that are inherently linked to a particular genre. Games within one genre may have drastically different game structures; for instance, Call of Duty and Halo fall within the FPS genre but vary drastically in their reliance on story, mechanics, and realism. In sum, genres can be conceptualized as groups of games composed of specific shared structural characteristics; for instance, multiplayer mechanics and avatar creation are fundamental to MMORPGs. Additionally, it was observed in the current review that certain sub-features within the King taxonomy were not reported in the literature, including support network features, sexual content, and explicit language. Alternatively, new sub-features emerged that were not explicitly included in the original taxonomy, such as general socialization features, type of virtual world, and in-game currency. Ultimately, considering the present review was conducted over a decade after the taxonomy, these changes signal the rapidly proliferating shift in the gaming landscape.

The gaming industry has undergone a rapid and substantial shift in its business model toward monetization schemes such as microtransactions and the professionalization of competitive games and esports (Palma-Ruiz,

Table 7. Taxonomical categorization of gaming structural features involved with the enhancement of realism and gambling-like structural features implicated with GD

Broad Feature Classification	Structural Feature	Sub-Structural Feature	Example(s)
Structural Features Promoting Game Realism			
Socialization Features	Multiplayer	Guilds/Clans	Guilds in World of Warcraft
	Social Feedback Features	Leaderboard	Call of Duty scoreboard
		Social Utility Features	Text chat, audio chat, video chat
	General Socialization Features	—	In-game competitions
Narrative and Identity Features	Storytelling Device	—	Game plotline
	Avatar Features	Avatar Creation Features	Idealized avatar or actualized avatar
		Avatar Roleplay	Playing as the main character in Pokémon
Manipulation and Control Features	User Input Features***	User Input Device***	Motion controllers, touch screen, joystick, controller
		User Input Controls***	Combos, hotkeys
	Platform	—	Touch screen, personal computer, console
	Save Features***	Checkpoints***	Checkpoint flags in Mario
		Quicksaves***	Auto-saves in Skyrim
	Player Management Features	—	Managing multiple resources
	Virtual World	Experience-Oriented	Exploring the world in Minecraft
		Goal-Oriented	Completing missions in Grand Theft Auto
	Scripted Events	—	Cutscenes prior to objectives
	In-Game Complexity	Artificial Intelligence***	Adaptability of non-playable enemies
		Item/Weapons	Guns in Fortnite
Presentation Features	Graphics	—	Realistic graphics
	Sound	—	Music, in-game dialogue
	In-Game Advertising***	—	Real life brands, sponsors
	Franchise Features***	—	Trademarked names, e.g., Mario
	Violence	—	Shooting characters in Call of Duty
Gambling-Like Structural Features			
Reward and Punishment Features	In-Game Currency	—	V-bucks in Fortnite
	Random Chance Purchases	Loot Boxes	Loot boxes in Star Wars Battlefront II
	Event Duration Features	—	Subway Surfers requires continuous gameplay, without an endpoint
	Meta-Game Rewards	—	The PlayStation Trophy system or progress bar on the console before the game is started.
	Size of Reward***	—	Earning small or large points for achieving a given objective
	General Reward Features	Experience Points	Earning points for completing a mission
		Banks System	Badges earned in Roblox
	Intermittent Rewards***	—	Immediate (kill in a shooting game) or delayed feedback (score after game round)
	Near Miss	—	Difficult boss battle at the end of a stage
	Event Frequency Features	—	Replayability of game
	Punishment Features***	—	Losing a life, losing in-game currency, or restarting the level

Note: Features demarcated with '***' indicate features that were found to be related only to a proxy and NOT directly to GD.

Torres-Toukoumidis, González-Moreno, & Valles-Baca, 2022). Modern video games have taken advantage of mobile devices, generating more than 1.78 billion dollars in the United States alone due to their easy and accessible point-of-entry (Liang, 2022). This change has enabled the widespread adoption of in-game purchasing, offering considerable profit potential. Developers have, for instance, adopted the strategy of "cannibalizaiton" to promote in-game purchasing to make progress, incentivizing actions to distract them from in-app purchasing (Sheng, Ryan, Nagarajan, Cheng, & Tong, 2022). Consequently, this minimizes attrition and maximizes revenue (Sheng et al., 2022). This shift towards monetization is consistent with the findings presented in the study because it suggests that game developers are intentionally designing games to be engaging to keep players invested for longer periods of time. Ultimately, freemium

models and gambling-like mechanisms incentivize players to stay invested and continuously spend money, contributing to addictive gameplay features (Brock & Johnson, 2021; Petrovskaya & Zendle, 2022; Whitson & French, 2021).

Based on the findings mentioned earlier, it is essential to realize that there may be a propensity to excessively classify healthy gaming behaviors as pathological. That is, gaming can be a hobby that engenders passion and commitment while still maintaining a healthy balance. Therefore, while this study identifies gaming features that have the potential to be problematic, it is essential to acknowledge that problematic gaming may arise from a multifaceted interplay between engaging in games that possess certain structural features, the player's inherent tendencies, and the surrounding environmental factors.

The assessment of proxies in addition to GD serves as a double-edged sword: While it allows for broadness, it is also a major limitation. However, due to the inclusion of proxies of GD, this inclusion, while offering a broadness that can be constructive, can likewise confound the results by not entirely translating to GD symptomatology. For instance, time spent gaming and enjoyment may not sufficiently predict GD. Thus, this can exacerbate potential Type I errors. Nonetheless, these proxies, even if only distally related, were included to inform future works about *potentially* problematic features—this study does not intend to suggest that such features are necessarily related to GD. As well, examining the reliability and validity of the variety of measures of GD used was beyond the scope of the scoping review methodology. Therefore, due to these considerations being pertinent in the study of GD, a systematic review design could be implemented in the future to assess the reliability and validity of GD measures. In addition, the measurement and conceptualization of GD has shifted over time (Feng, Ramo, Chan, & Bourgeois, 2017). Similarly, using the King taxonomy as a backbone for the data charting process could have contributed to confirmation bias. Furthermore, the exclusion of non-English texts further limits the results. Although not common practice for scoping reviews, a meta-analysis could be advantageous in determining the relative strength of the associations uncovered. Likewise, because scoping reviews do not include a critical appraisal, this may be beneficial. While the present scoping review is broad in scope, its search strategy is restricted to psychology, psychiatry, and medical literature; there may be merit in expanding this approach to include literature from the field of Human-Computer Interaction (HCI) and modern technologies. Lastly, it is worth noting that research on GD has been rapidly evolving. Therefore, by including studies conducted before the inclusion of GD in the DSM and ICD, this paper may consist of data based on false positives and different theoretical frameworks.

Interestingly, while smartphones were the most preferred mode for gaming, this feature was not associated with GD. This finding may be best explained by recalling that even though preference was used to serve as a proxy for GD, this need not be the case. Therefore, it is crucial to distinguish between pathological and casual gaming—preference could predict heavier, but not pathological, gaming in this instance. It was also peculiar that studies included in this review did not find the audio-visual presentation of rewards problematic in gaming—these are commonly associated with loot boxes and in-game items. Thus, this suggests that future reviews should expand inclusion criteria to capture the relevant findings.

Gaming has rapidly evolved in the last decade; it is paramount to account for the advancements made in game design. With the rise of monetization schemes, such as loot boxes, across all genres, future work may benefit from a nested analysis of genre and year. Additionally, it may be helpful to establish an assessment tool to quantitatively measure the addictive potential of various video games to establish which may be problematic. Doing so can be useful in understanding how certain video games can be potentially addictive, thereby providing a greater shared understanding of GD. Such an approach can have large-scale implications regarding consumer ethics, informing buyers of the addictive potential of different games prior to consumption.

This review finds evidence of multiple different structural features implicated with GD and its proxies. While not all these features may contribute to addiction in every player, the player's intrinsic dispositions in conjunction with the game's intrinsic structural features can exacerbate problematic behavior. These findings are crucial in elucidating the addictive potential of video games depending on their intrinsic design features. It is important, however, to discern features associated with GD directly and those from proxies. Though proxies may only have a remote association with GD, they were included to inform future studies about potentially problematic features. It is important to note that this study does not intend to suggest a direct correlation between such characteristics and GD. The authors also offer a revised taxonomical approach developed through an iterative, systematic examination of the current body of literature. This taxonomy can be used to inform future work and organization in the field. Furthermore, an assessment tool to numerically assign the addictive potential of gaming disorder based on their intrinsic structural features is suggested.

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SUPPLEMENTARY MATERIAL

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