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The Role of Structural Characteristics in Problematic Video Game Play: An Empirical Study

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Abstract The research literature suggests that the structural characteristics of video games may play a considerable role in the initiation, development and maintenance of problematic video game playing. The present study investigated the role of structural characteristics in video game playing behaviour within a sample of 421 video game players aged between 14 and 57 years. Players were surveyed via an online questionnaire containing measures of video game playing behaviour, player interaction with structural characteristics of video games, and problematic involvement in video games. The results showed that the reward and punishment features, such as earning points, finding rare game items, and fast loading times, were rated among the most enjoyable and important aspects of video game playing. There was some evidence that certain structural characteristics were stronger predictors of problematic involvement in video games than factors such as gender, age, and time spent playing. This research supports the notion that some structural characteristics in video games may play a significant role in influencing problem playing behaviour. Implications for theory and future research are discussed.

Keywords Problem video game play · Structural characteristics

Video game playing is an increasingly popular leisure activity in many developed countries, including the United States, United Kingdom, Germany, The Netherlands, China, Japan, South Korea, Taiwan, and Australia. Video game technology is also being used increasingly

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within educational contexts to assist teaching and learning (e.g., de Freitas and Griffiths 2008), within medical and other therapeutic settings to aid patient recovery (e.g., Kato et al. 2008) and in various work contexts for training purposes (e.g., Gee 2003).

Despite the many reported positive aspects of video game playing, there has been some concern among health professionals over the last two decades that video games, when played excessively, may have a negative impact on an individual's school or work productivity, sleep patterns, social relationships, and psychological health and wellbeing (e.g., Griffiths 2000; Ng and Wiemer-Hastings 2005; Salguero and Moran 2002; Grüsser et al. 2007). To date, numerous studies have identified both adolescents and adults who spend over 50 h per week playing video games, often online, jeopardising their work, education, personal relationships and/or personal health. This has prompted some concerns that such high levels of video game involvement may be classified as an "addiction" (e.g., Chappell et al. 2006; Chui et al. 2004; Fisher 1994; Lemmens et al. 2009).

The psychological concept of "video game addiction" has attracted significant controversy. There is considerable debate among academics with regard to whether the concept of addiction may be applied to the activity of playing video games. A key aspect of this debate concerns how addiction is defined, and whether it is possible for some excessive video game playing behaviours to meet this definition. Griffiths (2005, 2008) states that any repetitive behaviour may be considered "addictive" if a person demonstrates all of the key features or "components" of addiction. These components include: (a) *salience*, meaning the activity is the most important thing in the person's life, and causes preoccupations and cravings at all times of the day, (b) *tolerance*, the process whereby the person must spend increasing amounts of time engaged in the activity to achieve former mood-modifying effects, (c) *withdrawal*, the unpleasant emotional state or physical effects that occur when the activity in suddenly discontinued or reduced, (d) *relapse*, the tendency for repeated reversions to earlier patterns of use, and for even extreme patterns of use to be restored quickly after long periods of abstinence or regulation, (e) *mood modification*, the mood-altering experience (e.g., an exciting "buzz" or tranquilising "numbing") associated with engaging in the activity, and (f) *harm*, the conflict between the user and other commitments, including work, education, social life, and/or hobbies.

On the other hand, it has been suggested that some of the core addiction criteria simply tap high engagement with video games, rather than indicate an addictive involvement in video games. Some studies have shown that cognitive salience, tolerance and mood modification are not unique to video game addiction and may also indicate "high engagement" in the activity (Charlton 2002; Charlton and Danforth 2007). The components model maintains, however, that any activity, including gambling, shopping, exercise, sex, Internet use or video game playing, may be considered potentially addictive if a person meets all of the criteria. Griffiths (2008) has argued that, in reality, very few people appear to meet all of the criteria for video game addiction. Thus, the actual prevalence of video game addiction is often argued to be so low as to be clinically insignificant. For example, West's (2006) comparative analysis of activities commonly referred to as "addictive" ranked video game playing as "very low" in terms of risk of addiction, below all chemical-based addictions as well as gambling.

The concept of video game addiction has been criticised for two main reasons. First, it has been argued that classifying harmful repetitive behaviours like excessive video game playing as a bona fide addiction may trivialise the concept of addiction, and erode public sympathy and political support for the most damaging of known addictions, like heroin addiction and cocaine addiction (Jaffe 1990). The second criticism of video game addiction is levelled at its assumption that, among excessive video game users, the video game

playing itself is the primary problem, rather than a secondary symptom of a pre-existing psychological disorder, like depression or anxiety (Shaffer et al. 2000). Wood (2007) argues that, for some individuals, excessive video game playing behaviour may occur in response to a major life crisis, but this pattern of use is not often sustained and therefore not indicative of an addiction. Similarly, Blaszczynski (2008) has argued that research on video game addiction has tended to overlook the key addiction concepts of dependency and impaired control in favour of highlighting the adverse consequences of excessive playing. Attributing some individuals' poor life circumstances to their video game playing, rather than underlying psychological issues, may have lead to an overestimation of video game-related behavioural problems.

Given the premature nature of in-depth, clinical data on video game playing populations, it is difficult to conclusively resolve this debate on the nature and validity of video game addiction. Nevertheless, the available empirical literature has consistently shown that a minority of video game players report various psychosocial problems directly related to their video game playing. King and Delfabbro (2009b) have argued that many of these players may be termed, with minimal controversy, "problem" players of video games. Irrespective of how this problem behaviour should be classified within the established clinical nomenclature, the research question remains: what factors influence an individual to play video games at problematic levels?

In the problem gambling literature, it is understood that, in addition to individual factors that promote problem gambling (e.g., personality traits, biological processes, and learning and conditioning factors), the structural characteristics of gambling activities play an influential role in initiating, developing and/or maintaining a person's gambling habit (Parke and Griffiths 2007). For example, electronic gaming machines feature sound and lighting effects, near miss events, and winnings paid out at irregular intervals, which have been shown empirically to influence gambling behaviours (e.g., Griffiths 1991, 1999; Blaszczynski et al. 2005). Fisher and Griffiths (1995) observed that there are a number of structural similarities between electronic gambling machines (EGMs) and video games, such as the requirement of response to stimuli which are predictable and governed by a software loop, the provision of aural and visual rewards for a win, the provision of an incremental reward for a winning move, and digitally displayed scores of correct behaviour. Examining the structural characteristics in video games may therefore contribute to our understanding of whether some individuals play video games to excess in similar ways to problem gamblers (Johansson and Gotestam 2004).

Empirical research to date has suggested some links between certain video game features and video game playing behaviour. Griffiths et al.'s (2004) study of 540 players of the game *Everquest* identified various features in online video games that sustain players' interest and motivation to play. The most commonly reported "favourite" reasons for playing were related to social interaction, such as "the game is a social game" (24%), "group together with others" (10%), and "being part of a Guild" (10%). In another study, Wood et al.'s (2004) players rated the most "important" features of video games as being: realistic sound, graphics and setting, rapid absorption rate, rapid advancement rate, a "medium" duration, and being able to save one's progress in the game. Chumbley and Griffiths (2006) conducted an experiment to assess players' willingness to continue to play a video game based on the degree of reinforcement in a video game. Players were generally more motivated to play a video game that offered frequent rewards and fewer obstacles. Similarly, King and Delfabbro (2009a) found that overlapping quests and objectives (i.e., concurrent schedules of reinforcement) in video games kept players playing for longer periods than games without these features.

The available research suggests that there are certain aspects of video games that make them appealing to players. However, there have been few empirical attempts to explain how these features may relate to problematic involvement in video games. The lack of research may be partly attributed to the lack of a theoretical model for conceptualising the structural features of video games and how they may relate to problem playing behaviour. Recently, King et al. (2010a) put forward a five-factor taxonomy of video games, containing (a) social features, (b) manipulation and control features, (c) narrative and identity features, (d) reward and punishment features, and (e) presentation features. King et al. provided explanations of how each taxonomic category may relate to various aspects of problematic video game play.[1] For example, the "social" taxonomic category encompassed various social utility features that enable player communication (e.g., text, picture-messaging, recorded speech, real-time speech, webcam, etc.) as well as the competitive and cooperative aspects of video game play. The "mere presence" of other players who are winning (see Rockloff and Dyer 2007), in addition to social obligations incumbent on the player when playing in a group, may influence some individuals to play video games longer than intended.

King et al. (2010a) suggested that investigation of the five categories of video game features may provide some insight into the mechanisms that underlie problem video game playing. In particular, they highlighted the reward delivery and social features of video games because these two broad aspects of video games tend to feature in qualitative accounts of problem video game playing (e.g., Chappell et al. 2006). As Charlton and Danforth (2007) state:

> Players take on the role of a character in a virtual environment in which a story line evolves over time and the time frame in which an event will occur is unpredictable. Thus, these games may be addictive because they are particularly good at inducing operant conditioning via variable-ratio reinforcement schedules (p. 1534).

Additionally, King et al. (2010a) argued that researchers should consider not only those features that players report to enjoy in video games, but also the ways in which game features shape their playing behaviour. Numerous features in video games that players do not necessarily enjoy may still serve to lengthen and sustain the playing experience over time. For example, in King and Delfabbro's (2009a) study, players reported that they often engaged in a repetitive series of actions in order to maximise their odds of obtaining a certain reward. These players reported to be bored while doing this, but felt that it was the only way to feel satisfied when playing the game. Similar observations have been made of problem gamblers who continue to gamble even when they are bored by (or no longer enjoy) the activity, and report irritation on winning because it lengthens the gambling session (Blaszczynski et al. 1990). Psychological reactions other than enjoyment may therefore be important to understanding problem video game playing behaviour.

The Present Study

The proposed relationship between structural features in video games and problem playing has received little empirical attention. Qualitative research suggests that the social aspects and reward features in video games are appealing for both regular and problem players.

[1] A full discussion of all five taxonomic categories can be found in King et al. (2010a), but not reported here due to space limitations.

However, this basic assertion has not been subjected to empirical investigation. Thus, the aim of the present study was to investigate the association between various video game features and video game playing behaviour. It was hypothesised that problem video game players would report higher levels of interaction with all types of structural characteristics. Further, it was hypothesised that the reward-based and social aspects of video games would play a significant role in influencing problem video game playing. These predictions were based on previous research that reported that frequent video game players tend to report greater knowledge and recognition of video game content (Wood et al. 2004) and report a higher level of motivation to learn about and play video games than less frequent players (King and Delfabbro 2009b).

Method

Participants

The total sample comprised 421 video game players, including 367 males (87.2%) and 53 females (12.6%) with 3 individuals whose gender was not specified (0.2%). The video game players were aged 14–57 years (M=22.8 years, SD= 5.6 years). The majority of players reported as being single (53.7%), with the remainder indicating that they were married (11.2%) or in a relationship (34.9%). To confirm whether there was any possible confounding of gender and age-related effects in subsequent analyses, a t-test was conducted to compare the age of males and females. This revealed no significant difference (t (416)=1.19; p>.05).

Measures

Frequency of Video Game Play Survey This instrument measured a person's frequency of play across different video game systems as well as the duration of play for that video game system. Video game players were asked to record their typical hourly usage per day of the week (based on the last 3 months of video game playing experience). A 5×7 matrix (*video game system*: [personal computer, dedicated console, mobile phone, handheld gaming device, arcade machine]) × *days of the week*: [Monday through to Sunday]) in which video game players recorded hourly values was employed for this purpose. While this approach was not immune to self-report error, this approach may have aided players' recall of video game use by avoiding the abstract conception of a "typical sitting", which is likely to vary depending on the day and situational context. Another advantage of this measure was that it yielded an overall number of hours spent playing video games each week by adding all values within the matrix. This instrument also asked players how many different video games they were concurrently playing, how many video games they had played in the last 6 months, and how long (in years) they had played video games.

Problematic Video Game Playing Test (PVGT) The PVGT is an adapted version of the Internet Addiction Test (IAT), a 20-item questionnaire designed by Young (1998) to measure clinical features of Internet use. Each item was scored on a five-point Likert scale, ranging from "1 = Never" to "5 = Always". Thus, total scores ranged from 20 to 100. King et al. (2010b) modified the IAT to measure aspects of problematic involvement in video games. The modified test was termed the Problematic Video Game Playing Test (PVGT). PVGT items were based on the six core features of addiction within Brown's (1997)

addiction components model, including preoccupation, withdrawal, tolerance, mood modification, harm and relapse. Preliminary validation by King et al. (2010b) reported that the PVGT has high internal consistency and good convergent validity. They advised that the PVGT be used as a continuous measure of problem video game play, rather than a diagnostic instrument, with higher scores indicating a greater level of problematic involvement.

Video Game Structural Characteristics Survey This 37-item instrument assessed three aspects of a player's relationship to the structural characteristics in video games. This measure was based on King et al.'s (2010a) five-factor taxonomy of video games, including: (a) social features, (b) manipulation and control features, (c) narrative and identity features, (d) reward and punishment features, and (e) presentation features. For each question, players were asked to rate (1) how much they enjoyed that feature of the video game ("enjoyment"), (2) how important they believed that feature was to the playing experience ("perceived importance"), and (3) the extent to which that feature contributed to longer playing time ("behavioural impact"). A complete list of all 37 structural characteristics is provided in Appendix 1. Each response was scored along a 5-point Likert rating scale, ranging from the lowest to the highest possible response (e.g., 1 = 'Not important at all' to 5 = 'High importance').

Procedure

Participants were a self-selected sample of video game players who responded to an advertisement on the public forums of Australian video game-related websites. The questionnaire was hosted online for 2 months. A range of video game-related Internet sites were chosen so as to obtain player representation (i.e., to minimise bias toward particular video game types, such as online role-playing games). Twelve websites were used, including *Overclockers Australia* (http://www.overclockers.com.au/), *Valhalla* (http://www.valhalla.net.au), and *Games On Net* (http://www.games.on.net). The survey took 20–30 min to complete. Due to some attrition in responses, some statistical analyses had fewer cases for comparison but no fewer than 220 cases in any given test.

Results

Overall Video Game Playing Patterns

All players in the study reported to have played video games to some extent in the last 3 months, although overall video game participation varied as a function of gender. Males reported playing video games significantly more hours per week (M=16.9, SD=14.9) than females (M=11.1, SD=14.3) (t (416)=2.61, p<.01). Bivariate correlation revealed no significant association between age (in years) and the total number of hours spent playing video games per week. Gamers reported: (i) to be currently playing an average of three different video games (SD=1.3), (ii) to have played, on average, between 6 and 10 games in the last 6 months, and (iii) had previous video game playing experience of 13.9 years (SD=5.7). There were no significant gender differences on these variables.

Table 1 shows the extent to which players engaged in each form of video game playing each day during a typical week in the last 3 months. Playing video games on a personal

Table 1 Players' weekly playing patterns, in hours, across each video game system

	N	Monday M (SD)	Tuesday M (SD)	Wednesday M (SD)	Thursday M (SD)	Friday M (SD)	Saturday M (SD)	Sunday M (SD)	Total M (SD)
Personal computer	263	1.8 (1.7)	1.7 (1.8)	1.9 (1.8)	1.9 (1.9)	2.3 (1.9)	2.9 (2.5)	2.9 (2.5)	15.4 (12.5)
Video game console	203	1.2 (1.5)	1.2 (1.5)	1.2 (1.5)	1.1 (1.6)	1.6 (1.8)	2.4 (1.9)	2.2 (1.9)	10.8 (9.4)
Hand-held gaming	42	.9 (.7)	.9 (1.0)	.7 (.8)	.8 (.9)	.8 (1.0)	.9 (1.1)	1.0 (1.0)	5.9 (4.5)
Mobile phone	53	1.0 (.8)	.9 (.8)	.9 (.9)	.9 (.8)	.9 (1.0)	.7 (.8)	.8 (.9)	5.9 (5.4)
Arcade machine	2	–	–	–	–	–	2.5 (2.1)	2.0 (2.8)	4.5 (4.9)

N refers to the number of players who indicated any involvement in that video game system

computer (62%) was the most popular activity, followed by playing on a video game console (48.3%) or a mobile phone (12.6%). Only two gamers reported that they played arcade machines on a regular basis. In terms of weekly playing habits, gamers tended to report to play for longer durations at weekends across all video game systems.

Separate variables measuring the mean number of hours spent playing video games during the week (i.e., from Monday to Friday) and during the weekend (i.e., Saturday and Sunday) were also computed. Gamers spent significantly more time playing video games on a personal computer during an average weekend session (M=2.9, SD=2.4) than during the week (M=1.9, SD=1.6) (t (262)=10.1, p<.01). Gamers also spent significantly more time playing video games on a dedicated games console during an average weekend session (M=2.3, SD=1.7) than during the week (M=1.2, SD=1.3) (t (203)=11.1, p<.01).

Problem Involvement in Video Games

King and Delfabbro (2009c) classified "heavy" video game playing as playing for over 30 h per week. In this study, 12% of the overall sample met this criterion. However, time spent playing video games is not directly related to problem behaviour (Charlton 2002; Shaffer et al. 2000). Therefore, PVGT scores were used to identify potentially problematic players of video games. Scores on the PVGT ranged from 24 to 90 along a relatively normal distribution, with low skewness and normal kurtosis. The mean sample score on the PVGT was 46.8 out of 100 (SD=13.1). Although males reported significantly higher levels of video game playing activity than females, Chi Square analysis revealed no significant gender differences in terms of PVGT scores. Similarly, there was no significant association between age and PVGT score.

For comparison purposes, a "potentially problematic" group (henceforth termed "problem group") was created by selecting players within the upper quartile of the PVGT score distribution. This approach was based on the assumption that players with the highest PVGT scores (i.e., in the top 25% of the distribution of scores) would be most likely to experience potential harm or negative consequences as a result of playing video games. A score of 56 on the PVGT distinguished the problem group from the rest of the sample, with a total of 61 players identified in this way. Chi Square tests revealed no significant demographic differences with regard to age, gender, relationship status, or employment

status between the problem group and the remainder of the sample. However, the problem group (M=26.5, SD=15.7) played video games for significantly longer each week than the normal group (M=14.4, SD=14.1) (t (2, 416)=6.07, p<.01).

Video Game Features: Overall Summary

Players rated a list of 37 video game structural characteristics on three variables: (1) how much they enjoyed that feature of the video game ("enjoyment"), (2) how important they believed that feature was to the playing experience ("perceived importance"), and (3) the extent to which that feature contributed to longer playing time ("behavioural impact"). For parsimony, Table 2 displays only the 15 highest rated characteristics in each rating category. Visual inspection shows that nine of these structural characteristics are present in all three response categories, with an additional eight structural features featured in two of the response categories. This suggests some overlap between the concepts of enjoyment, perceived importance, and behavioural impact. Overall, reward and punishment features scored the highest on each interaction variable, being represented in 20 out of the 45 cells (see Table 2).

Table 2 Video game features ranked according to player enjoyment, perceived importance and behavioural impact

Rank	Enjoyment	M (SD)	Perceived importance	M (SD)	Behavioural impact	M (SD)
1	Graphics	3.88 (1.0)	Sound	3.42 (1.1)	Levelling up	3.60 (1.1)
2	Sound	3.81 (1.0)	Complex story	3.38 (1.3)	Earning XP or points	3.54 (1.1)
3	Fast loading times	3.73 (1.0)	Fast loading times	3.24 (1.2)	Different story outcomes	3.49 (1.1)
4	Levelling up	3.70 (1.0)	Graphics	3.20 (1.1)	Complex story	3.48 (1.2)
5	Complex story	3.70 (1.2)	Earning XP or points	3.15 (1.2)	Fast loading times	3.24 (1.2)
6	Different story outcomes	3.65 (1.1)	Levelling up	3.14 (1.1)	Rare game items	3.20 (1.2)
7	Earning XP or points	3.64 (1.0)	Customisation options	3.09 (1.4)	Cooperation	3.18 (1.1)
8	Social interaction	3.48 (1.0)	Different story outcomes	3.00 (1.1)	Social interaction	3.12 (1.2)
9	Rare game items	3.44 (1.2)	Correcting past mistakes	2.92 (1.1)	Very difficult sections	3.10 (1.0)
10	Cooperation	3.42 (1.1)	Rare game items	2.84 (1.2)	Graphics	3.07 (1.2)
11	Customisation options	3.21 (1.2)	Cooperation	2.76 (1.1)	Sound	3.05 (1.2)
12	Getting 100%	3.13 (1.2)	Emotional investment	2.65 (1.3)	Meta-game rewards	2.98 (1.3)
13	Story cut-scenes	3.12 (1.1)	Very difficult sections	2.64 (1.1)	Correct past mistakes	2.97 (1.2)
14	Competitive aspects	3.11 (1.0)	Advanced difficulty	2.64 (1.2)	Getting 100%	2.96 (1.2)
15	Meta-game rewards	3.10 (1.2)	Story cut-scenes	2.60 (1.1)	Emotional investment	2.86 (1.2)

Video Game Features and Problem Play

Independent samples *t*-tests were conducted to assess between differences in problem and non-problem players' responses to all 37 video game structural characteristics. Of the 111 combinations of response-structural characteristic interactions (e.g., "player enjoyment-social interaction"), 46 factors emerged as significant between the two groups at the $p<.05$ level. Table 3 presents a summary of the strongest 15 factors identified by this analysis. In cases where more than one type of player response (i.e., enjoyment as well as perceived importance) produced significant group differences with regard to a single video game feature, the factor with the largest statistical difference was chosen for inclusion. The Cohen's *d* values for each of these group differences ranged from .39 to .75, suggesting moderate to large effect sizes.

Given that the problem group spent significantly more time playing video games than other players, it was possible that the link between problem play and player-structural characteristic interactions was not causal, but due to the common antecedent factor of time spent playing video games. Therefore, a series of hierarchical multiple regression analyses were conducted to examine whether problem video game play remained significantly related to various player-structural characteristics interaction after controlling for time spent playing video games. Weekly time spent playing video games was entered on the first step, and the strongest 15 structural characteristic factors were entered on the second. Neither age nor gender were significantly correlated with PVGT and were therefore not included in the analysis. Each player's PVGT score was used as the dependent measure. The first model (i.e., time spent playing) was significant (F [1, 227]= 26.85, $p<.01$), and explained 10.2% of the variance in PVGT scores. The second model, which controlled for time spent playing video games, contained the strongest 15 video game structural characteristic variables. This

Table 3 Differences in player-feature interactions among problem and non-problem video game players

Player response: Structural characteristic	Taxonomic category	Normal (N= 214) M (SD)	Problem (N= 61) M (SD)	t (273)	d
Enjoyment: Adult content, e.g., violence	Presentation	2.87 (1.1)	3.39 (1.1)	3.31	.47
Enjoyment: Finding rare items	Reward & Punishment	3.30 (1.2)	3.85 (1.2)	3.11	.45
Enjoyment: Tactile sensation of playing	Manipulation and Control	2.54 (1.2)	3.08 (1.2)	3.16	.45
Enjoyment: Story cut-scenes	Narrative & Identity	3.01 (1.1)	3.48 (1.1)	2.93	.43
Importance: Managing game resources	Manipulation and Control	2.47 (.9)	3.23 (1.1)	5.16	.75
Importance: Mastering the controls	Manipulation and Control	2.27 (1.1)	2.74 (1.3)	2.71	.39
Importance: Earning XP or points	Reward & Punishment	3.01 (1.1)	3.57 (1.2)	3.33	.49
Importance: Getting 100% in the game	Reward & Punishment	2.29 (1.1)	2.82 (1.3)	3.06	.44
Importance: Competitive elements	Social	2.30 (1.2)	2.87 (1.4)	3.16	.44
Behavioural: Sharing tips and strategies	Social	2.21 (.9)	2.74 (1.0)	3.69	.56
Behavioural: Levelling up	Reward & Punishment	3.47 (1.1)	4.0 (1.0)	3.35	.50
Behavioural: Meta-game rewards	Reward & Punishment	2.83 (1.2)	3.41 (1.2)	3.11	.48
Behavioural: Fast loading times	Reward & Punishment	3.11 (1.2)	3.64 (1.2)	3.03	.44
Behavioural: Cooperative elements	Social	3.09 (1.1)	3.51 (1.0)	2.70	.40
Behavioural: Graphics	Presentation	2.96 (1.2)	3.43 (1.2)	2.65	.39

model was also significant but to a lesser extent (F [16, 212]= 4.71, p<.01). Collectively, the structural characteristic variables explained an additional 15% of the variance in PVGT scores; however, the beta values for many of the structural characteristic variables were quite small. The association between any single player-structural characteristic variable and PVGT score was therefore minimal.

Discussion

The aim of this investigation was to examine how structural characteristics of video games relate to video game playing behaviour, including problematic involvement in video games. While the results were largely consistent with previous research (and academic conjecture) that underlines the importance of social and reward features (Charlton and Danforth 2007; Griffiths et al. 2004; Wood et al. 2004), this study was the first to distinguish between different psychological interactions with such features and quantify their effects on gaming behaviour. It was found that players tended to rate "Reward and Punishment" features, such as earning points, "levelling up", and fast loading times (i.e., high event frequency) as some of the most enjoyable aspects of playing video games. These features were also rated highly in terms of their importance to the overall video game playing experience and the extent to which these features kept players involved in the game over time. Narrative elements (e.g., an interactive story) were also rated very highly by all players, suggesting that the broad appeal of video games is the "escapism" offered by an interactive story-telling experience (Sherry et al. 2006).

This research also examined the differences between problem and non-problem players with regard to three different ratings of video game structural characteristics. Problem video game players reported significantly higher enjoyment of features such as adult content in video games, finding rare game items, watching video game cut-scenes, and the tactile sensation or "feel" of using a game controller than non-problem players. The problem group rated features such as managing in-game resources, earning points, getting 100% in the game, and mastering the game as highly important aspects of the video game playing experience, which are features that, on the whole, take up more play time than other features. In addition, the problem group identified features such as "levelling up", earning meta-game rewards (e.g., "Achievements"), and fast loading times as having a significantly greater impact on their playing behaviour than other players. The effect sizes for these differences ranged from moderate to large.

To identify the unique contribution that player interaction with video game features had on problematic video game playing (PVGT) scores, a multiple regression analysis was conducted. The results suggested that, after controlling for time spent playing video games each week, the strongest 15 structural characteristics (i.e., those with the largest between-group differences) explained an additional 15% of variance in PVGT scores. Whilst the unique contribution of each individual structural characteristic on PVGT score variance was low, this result suggests that some video game features are a stronger predictor of problem playing behaviour than hours spent playing each week. It is also worth highlighting that the structural characteristic variables were stronger predictors of problem playing than age and gender, neither of which were significantly correlated with PVGT. Based on these findings, it could be suggested that structural characteristics in video games—particularly aspects related to reward delivery—play a significant role in influencing problematic video game play.

While particular reward features in video games appear to have the greatest influence on problem video game playing, other features related to social interaction, as well as

manipulation and control, also appear to be important. A multi-theoretical approach may therefore be required to fully understand how video game features relate to problem video game playing. For example, operant conditioning theory can explain how problem players respond rapidly and persistently to the reward features in video games, such as XP and points, rare items, and meta-game rewards. These features are core components of the variable reinforcement schedule, which is known to create a persistent pattern of responding to a stimulus over time that is resistant to behavioural extinction. However, an operant conditioning model of video games may be less suitable to explain the appeal of an interactive story and/or the social facilitation of video games.

The present study had some limitations that should be taken into account in interpreting the findings. Firstly, the data collected relied on players' self-reported responses concerning their video game playing patterns and ratings of the structural characteristics of video games. Self-report is likely to contain a degree of individual bias and error, in terms of the gamers' ability to recall accurately their video game playing patterns as well as be fully aware of the structural features that influence their video game playing behaviours. An experimental design that manipulates conditions and features in video games may overcome self-report error. However, the number and complexity of structural characteristic variables in most video games makes it difficult to test the individual influence of any given video game feature. Another limitation of the study was players were self-selected, which may have created a sampling bias toward a certain type of video game player. However, given the broad variation in age, gender, playing behaviour, and PVGT score, it is difficult to say exactly how the study's sample was affected by self-selection. Another limitation of the study was its use of the PVGT in identifying "problematic" players. King et al. (2010b) recommended that the test be used continuously, rather than diagnostically. However, it was reasoned by the authors that the quartile method was justified with the added caveat that the upper quartile group was termed "potentially problematic" only. There also remains an important theoretical issue concerning the possibly flawed assumption that problem video game playing (or video game "addiction") is a legitimate and clinically relevant psychological problem in its own right. More in-depth, clinical research is required if any new progress is to be made in addressing this key conceptual problem.

In assessing the results of this study, a general criticism of the structural characteristics in video games may be put forward. The present study identified a total of 46 player-structural characteristic interactions that significantly distinguished "problem" and "non-problem" players. If this many aspects of video game playing are appealing to problem players in some way, this raises concerns about parsimony or "over-explanation" (Delfabbro and Winefield 1999). Whether video game structural characteristics are as useful in explaining problem involvement as other factors, such as personality traits and/or attitudes towards video games, remains a subject for further examination. The present study has shown that even a relatively small number of structural characteristic interactions ($n=15$) can explain a significant amount of the unique variance in PVGT.

The present study provided a preliminary examination of the role of video game features in relation to problem video game playing. It is hoped that the results of this study will be useful for behavioural researchers in gaining a better understanding of the mechanisms that underlie and sustain so-called video game "addiction". In particular, this information may be useful for individuals to raise their awareness of how structural characteristics can influence their gaming behaviour, and subsequently develop personal strategies to minimise their impact. Future studies of these video game variables, using prospective and/or experimental methods that can track specific behavioural changes in

response to features in video games, may provide a clearer understanding of the ways in which video games can initiate, develop and sustain a problem playing habit. There is also a need to explore the relationships interrelated among individual game features, and whether some of these features affect playing behaviour differently when operating together.

List of Video Game Structural Characteristics

1. Social interaction, communicating with other players
2. Belonging to a guild, clan or dedicated group
3. Competitive aspects, playing against other people, leaderboard rankings
4. Cooperation, working together to reach goals
5. Sharing tips and strategies about the video game with others
6. Positive comments from other players for skilful play
7. Making friends with other players in the game
8. Needing good reflexes to advance in the game
9. Mastering the controls, learning "combos" or "hot-keys"
10. The tactile sensation or "feel" of controlling the game (including force feedback, button mashing)
11. Managing resources in the game, such as items in your inventory
12. Being able to correct mistakes by reloading a save file
13. Customising in-game features, such as controls, rules, etc.
14. Using cheats to "break" the game
15. Creating your own content for the game, such as making your own maps
16. Taking on a new identity in the game
17. An emotional investment in an in-game character
18. Cut-scenes, extra non-playable story content
19. A complex game story, involving dialogue and narration
20. Different story outcomes based on your player actions
21. Linear story, same events happen every time
22. No endpoint or conclusion to the game
23. "Levelling up" a game character (including non-human characters, like a racing car)
24. Earning points, XP or other rewards
25. Parts of the game based on luck or chance, not skill
26. Being rewarded with rare, unique items for skilful play or playing for a long time
27. Doing the same thing over and over, in order to get a large reward ("grinding")
28. Getting 100% completion in the game
29. Unlocking meta-game rewards, like "Achievement points" or Trophies
30. Sections of the game that are very difficult and require sustained effort with few mistakes
31. Playing the game on the hardest difficulty, facing very difficult challenges
32. Fast loading times between levels or multiplayer matches, and instant respawning when your character dies
33. Visual aspects, such as high-resolution textures and lighting effects
34. Sound, including music and audio effects
35. Franchise aspects, such as recognisable characters like Mario or Master Chief
36. Adult content, including explicit violence, adult themes
37. Licensed content, including recognisable real-life brands

References

Blaszczynski, A. (2008). Commentary: a response to "problems with the concept of video game "addiction": some case study examples". *International Journal of Mental Health and Addiction, 6*, 179–181.

Blaszczynski, A., McConaghy, N., & Frankova, A. (1990). Boredom proneness in pathological gambling. *Psychological Reports, 67*, 35–42.

Blaszczynski, A., Sharpe, L., Walker, M., Shannon, K., & Coughlan, M.-J. (2005). Structural characteristics of electronic gaming machines and satisfaction of play among recreational and problem gamblers. *International Gambling Studies, 5*, 187–198.

Brown, I. (1997). A theoretical model of the behavioural addictions—Applied to offending. In J. E. Hodge, M. McMurran, & C. R. Hollins (Eds.), *Addicted to crime?* (pp. 13–65). Chichester: Wiley.

Chappell, D., Eatough, V., Davies, M. N. O., & Griffiths, M. D. (2006). *Everquest*—It's just a computer game right? An interpretative phenomenological analysis of online computing addiction. *International Journal of Mental Health and Addiction, 4*, 205–216.

Charlton, J. P. (2002). A factor-analytic investigation of computer 'addiction' and engagement. *British Journal of Psychology, 93*, 329–344.

Charlton, J. P., & Danforth, I. D. W. (2007). Distinguishing addiction and high engagement in the context of online game playing. *Computers in Human Behaviour, 23*, 1531–1548.

Chui, S.-I., Lee, J.-Z., & Huang, D.-H. (2004). Video game addiction in children and teenagers in Taiwan. *Cyberpsychology & Behavior, 7*, 571–581.

Chumbley, J., & Griffiths, M. D. (2006). Affect and the computer game player: the effect of gender, personality, and game reinforcement structure on affective responses to computer game play. *Cyberpsychology & Behavior, 3*, 308–316.

de Freitas, S., & Griffiths, M. (2008). Massively multiplayer roleplay games for learning. In R. Ferdig (Ed.), *Handbook of research on effective electronic gaming in education (vol. 1)* (pp. 51–65). Hershey: Idea Group Publishing.

Delfabbro, P., & Winefield, A. H. (1999). The danger of over-explanation in psychological research: a reply to Griffiths. *British Journal of Psychology, 90*, 447–450.

Fisher, S. (1994). Identifying video game addiction in children and adolescents. *Addictive Behaviors, 19*, 545–553.

Fisher, S., & Griffiths, M. D. (1995). Current trends in slot machine gambling: research and policy issues. *Journal of Gambling Studies, 11*, 239–247.

Gee, J. P. (2003). *What video games have to teach us about learning and literacy.* New York: Palgrave Macmillan.

Griffiths, M. D. (1991). Psychobiology of the near miss in fruit machine gambling. *The Journal of Psychology, 125*, 347–357.

Griffiths, M. D. (1999). Gambling technologies: prospects for problem gambling. *Journal of Gambling Studies, 15*, 265–283.

Griffiths, M. D. (2000). Does Internet and computer "addiction" exist? Some case study evidence. *Cyberpsychology & Behavior, 3*, 211–218.

Griffiths, M. D. (2005). A "components" model of addiction within a biopsychosocial framework. *Journal of Substance Use, 10*, 191–197.

Griffiths, M. D. (2008). Diagnosis and management of video game addiction. *Addiction Treatment and Prevention, 12*, 27–41.

Griffiths, M. D., Davies, M. N. O., & Chappell, D. (2004). Demographic factors and playing variables in online computer gaming. *Cyberpsychology & Behavior, 7*, 479–487.

Grüsser, S. M., Thalemann, R., & Griffiths, M. D. (2007). Excessive computer game playing: evidence for addiction and aggression? *Cyberpsychology & Behavior, 10*, 290–292.

Jaffe, J. H. (1990). Trivialising dependence [Commentary]. *British Journal of Addiction, 85*, 1425–1427.

Johansson, A., & Gotestam, K. G. (2004). Problems with computer games without monetary reward: similarity to pathological gambling. *Psychological Reports, 95*, 641–650.

Kato, P. M., Cole, S. W., Bradlyn, A. S., & Polloch, B. H. (2008). A video game improves behavioural outcomes in adolescents and young adults with cancer: a randomized trial. *Pediatrics, 122*, 305–317.

King, D. L., & Delfabbro, P. H. (2009a). Understanding and assisting excessive players of video games: a community psychology perspective. *Australian Community Psychologist, 21*, 62–74.

King, D. L., & Delfabbro, P. H. (2009b). Motivational differences in problem video game play. *Journal of Cybertherapy and Rehabilitation, 2*, 139–149.

King, D. L., & Delfabbro, P. H. (2009c). The general health status of heavy video game players: comparisons with Australian normative data. *Journal of Cybertherapy and Rehabilitation, 2*, 17–26.

King, D. L., Delfabbro, P. H., & Griffiths, M. D. (2010a). Video game structural characteristics: a new psychological taxonomy. *International Journal of Mental Health and Addiction, 8*, 90–106.

King, D. L., Delfabbro, P. H., & Zajac, I. T. (2010b). Preliminary validation of a new clinical tool for identifying problem video game playing. *International Journal of Mental Health and Addiction*. doi:10.1007/s11469-009-9254-9.

Lemmens, J. S., Valkenburg, P. M., & Peter, J. (2009). Development and validation of a game addiction scale for adolescents. *Media Psychology, 12*, 77–95.

Ng, B. D., & Wiemer-Hastings, P. (2005). Addiction to the internet and online gaming. *Cyberpsychology & Behavior, 8*, 110–113.

Parke, J., & Griffiths, M. D. (2007). The role of structural characteristics in gambling. In D. Smith, D. Hodgins, & R. Williams (Eds.), *Research and measurement issues in gambling studies* (pp. 211–243). New York: Elsevier.

Rockloff, M. J., & Dyer, V. (2007). An experiment on the social facilitation of gambling behavior. *Journal of Gambling Studies, 23*, 1–12.

Salguero, R. A. T., & Moran, R. M. B. (2002). Measuring problem video game playing in adolescents. *Addiction, 97*, 1601–1606.

Shaffer, H. J., Hall, M. N., & Vander Bilt, J. (2000). "Computer addiction": a critical consideration. *The American Journal of Orthopsychiatry, 70*, 162–168.

Sherry, J. L., Greenberg, B. S., Lucas, K., & Lachlan, K. (2006). Video game uses and gratifications as predictors of use and game preference. In P. Vorderer & J. Bryant (Eds.), *Playing video games: Motives, responses and consequences* (pp. 248–262). New York: Routledge.

West, R. (2006). *Theory of addiction*. Oxford: Blackwell Publishing.

Wood, R. T. A. (2007). Problems with the concept of video game "addiction": some case study examples. *International Journal of Mental Health and Addiction*, Published online 23 October 2007.

Wood, R. T. A., Griffiths, M. D., Chappell, D., & Davies, M. N. O. (2004). The structural characteristics of video games: a psycho-structural analysis. *Cyberpsychology & Behavior, 7*, 1–10.

Young, K. (1998). *Caught in the net*. New York: Wiley.