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Are Some Subtypes of Video Gamer More at Risk for Gambling Issues? A Latent Class Analysis of a Canadian Sample of University Students

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Abstract

Recently there has been growing interest in identifying links between video game playing and problem gambling. As video games continue to take on more gambling-like elements such as loot boxes, there is rising concern that they represent a potential pathway towards problem gambling. In this study, we explored video gamer profiles in a sample of Canadian undergraduate university students (n = 687) to examine whether subgroups of gamers had different risk profiles for problem video gaming and/or problem gambling. Three predominant subgroups emerged: universal, free-to-play, and general gamer classes. Whereas the free-to-play class was associated with higher average amounts of time spent playing video games, the universal class was associated with higher average scores on measures of problem video gaming, problem gambling, and impulsivity. Although motivational differences were evident, there were no significant mental health differences among subgroups in this sample.

Keywords: problem video gaming, problem gambling, impulsivity, gaming motivations, latent class analysis, quantitative research

Résumé

On s'intéresse de plus en plus depuis peu de temps à l'établissement de liens entre la pratique des jeux vidéo et le jeu compulsif. À mesure que les jeux vidéo comportent davantage d'éléments de jeux de hasard comme des coffres à butin, on s'inquiète davantage du fait qu'ils puissent mener au jeu compulsif. Cette étude a examiné le profil de joueurs de jeux vidéo parmi un échantillon d'étudiants canadiens de premier cycle (n = 687) afin de déterminer si les sous-groupes de joueurs présentaient un profil de risque différent pour le jeu vidéo compulsif et/ou le jeu compulsif. Trois sous-groupes prédominants sont ressortis : universel, gratuit et général. Le groupe des jeux

gratuits était associé à une plus grande quantité de temps consacrée à jouer à des jeux vidéo, le groupe universel était associé pour sa part à un pointage moyen plus élevé au titre des paramètres de mesure du jeu vidéo compulsif, du jeu compulsif et de l'impulsivité. Les différences de motivation étaient évidentes, mais les sous-groupes de cet échantillon ne présentaient aucune différence importante sur le plan de la santé mentale.

Introduction

The past few decades have seen significant growth in the market for online video games, and increasingly, many of these games are incorporating features that resemble the style and structure of gambling games. Loot boxes, for example, are digital products that, when purchased, provide individuals with random digital goods (Brooks & Clark, 2019; Griffiths, 2018). Loot boxes can take the form of "crates, cases, chests, bundles, and card packs," depending on the aesthetic of the game, yet, regardless of the visual form, the function is the same; players exchange real-world money for digital currency that can be exchanged for random prizes delivered via loot boxes (Griffiths, 2018, p. 52). Current research has shown an association between problem gambling and loot-box purchasing, as problem gamblers are more likely to spend money on loot-box purchases (Zendle & Cairns, 2018; Zendle et al., 2020).

Loot boxes, because of their similarity to other forms of gambling (Griffiths, 2018), are representative of the "'gamblification' of gaming" (Brooks & Clark, 2019, p. 26). Not all countries have agreed that loot boxes constitute gambling, however, and video game publisher Electronic Arts is challenging the Belgian proscription of loot boxes in the Belgium courts (Orland, 2018). Currently, the United Kingdom Gambling Commission and the North American Entertainment Software Rating Board do not view loot boxes as gambling systems and hence they remain unregulated. In contrast, in China and Japan, loot boxes fall under gambling regulations (Griffiths, 2018). Thus, although loot boxes appear to fit the description of gambling systems, there is significant resistance among European and North American regulatory bodies to classify them as such. The outcome of the legal challenge by Electronic Arts in Belgium may crystallize this discussion and could, if successful, pave the way for the future proliferation of loot boxes in video games.

Loot boxes constitute only one form of microtransaction found in video games. Free-to-play (FTP) games, for example, contain a variety of economic models that might include loot boxes, downloadable content, and advertising revenue, among others, which are all considered part of the "freemium" business model (Alha et al., 2014, p. 2). FTP games may range from casual games, which seek the attention of a wide audience and require little time and effort to engage with, to hardcore games, which

ask users to invest significant amounts of time and effort to play them (Juul, 2010). The FTP business model uses flexible pricing schemes, in order to reach "players with differing levels of willingness to pay for additional content" (Alha et al., 2014, p. 2). Consumer perceptions regarding spending in FTP games vary depending on the casual or hardcore nature of the game itself, with hardcore games often getting a pass. Most FTP games use a "double currency model," one that is free and one that is obtained through monetary purchase, with the paid currency often allowing the user to speed up progress or to gain access to exclusive content (Alha et al., 2014, p. 3).

The question remains as to whether problem video gaming can lead to future problem gambling in populations that have risk factors common to both disorders. Whether problem video gaming constitutes a pathway towards problem gambling remains largely unknown (Delfabbro et al., 2009; Molde et al., 2019). This gap in the literature is of policy interest, as gambling-like elements continue to be introduced into video games. In this study of a sample of Canadian undergraduate students, we aimed to identify whether there are subgroups of gamers at more or less risk for developing problem video gaming or problem gambling. This constitutes an important step in determining the existence of subgroup vulnerabilities to risk factors associated with behavioural addictions such as problem video gaming.

Convergence of Problem Video Gaming and Problem Gambling

A central concern is whether forms of video game play, particularly those including gambling-like features, introduce the potential for developing problem gambling. Convergence of gambling with video gaming has resulted in significantly greater opportunities for gambling activities, including esports betting and virtual casino style games (Macey & Hamari, 2019). Although debate persists (Desai et al., 2010), linkages have been suggested to exist between problem gambling and problem gaming (King et al., 2011). Evidence suggests that individuals heavily engaged in video gaming or gambling activities share similar attributes, including mental health problems, among other things (Sanders & Williams, 2019). Researchers have proposed that experiences with video gaming technologies that mimic gambling serve to familiarize youth with gambling systems, youth who are otherwise unable to gamble legally (Delfabbro et al., 2009).

Although research exploring the connections between social online gaming and problem gambling has been growing (Derevensky et al., 2013; King et al., 2011, 2013), a consensus is still lacking on how to best measure problem video gaming (Griffiths et al., 2016; Petry et al., 2015). Recently, Sanders and Williams (2019) reported that although problem gambling and problem video gaming are not necessarily comorbid, "risk factors and manifestations of problem gaming and problem gambling are similar" (p. 559). Conversely, Molde and colleagues (2019) found a direct relationship between problem video gaming and future problem gambling in their longitudinal study in which individuals participated in a survey research design in two waves, one in 2013 and again in 2015. Although this study showed a stable positive correlation between the Game Addiction Scale for

Adolescents and the Canadian Problem Gambling Index in the first wave of data collection, this relationship disappeared in the second wave, possibly because as individuals get older, they spend less time playing video games. Although the significant relationship between the two measures diminished throughout their study, Molde and colleagues (2019) reported that "scores on the gaming problem scale at wave 1 predicted the scores on the gambling problem scale at wave 2, but there was no evidence of the reverse relationship" (p. 552). Thus, the authors identified that video gaming "constituted a risk factor for gambling 2 years later" (Molde et al., 2019, p. 552).

Measures of Problem Video Gaming

Some proposed measures for problem gaming include the Game Addiction Scale (Lemmens et al., 2009), the Online Game Addiction Index (Zhou & Li, 2009), and the Problem Video Game Playing Test (PVGT; King et al., 2011), as well as assessment of Internet gaming disorder (IGD; Petry et al., 2015) as it appears in the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; American Psychiatric Association, 2013). Although IGD remains listed as an area in need of further research before video game addiction can be classified formally as an addiction, it is important to explore these proposed gaming addiction measures in their capacity to measure this phenomenon. More recently, the World Health Organization included gaming disorder (GD) in the 11th revision of the *International Classification of Diseases* (*ICD-11*), with GD characterized as "impaired control over gaming, increasing priority given to gaming over other activities to the extent that gaming takes precedence over other interests and daily activities, and continuation or escalation of gaming despite the occurrence of negative consequences" (2018, para. 1). Jo and colleagues (2019) critique this inclusion in the *ICD-11*, stating "since clinical studies on GD are lacking and diagnostic consensus is ambiguous, it was still argued that GD is not based on sufficient scientific evidence to justify its inclusion in one of the WHO's most important norm-setting tools" (p. 985). Thus, measuring and assessing problem video gaming remains a significant area in need of research as a step towards developing adequate therapy and interventions for this disorder.

Risk Factors for Problem Gaming and Problem Gambling

One avenue to understanding the possible connections between problem gaming and gambling is to examine risk factors thought to be common to both, such as depression and anxiety (Delfabbro & King, 2015; McBride & Derevensky, 2016). Stress is often included in problem gambling studies because the addictive behaviour can be associated with improving one's mood or "destressing" (Griffiths, 2005, p. 193) and has therefore been included in models that assess problem video gaming (King et al., 2011; Sim et al., 2012). Using a systematic review in which 24 studies on GD were selected, González-Bueso and colleagues (2018) calculated associations between IGD and risk factors for problematic play, including anxiety, depression, and attention deficit disorder, among others. The results showed significant positive correlations between mood disorders and IGD across these studies.

Other investigators have developed motivational models for the development of problem gaming that include elements that overlap with those for problem gambling. Some research has suggested that video games may satisfy particular human needs, and satisfaction of those needs provides a motivational force that can drive video game playing (Przybylski et al., 2010). Such motivational models link action with "emotional preferences" (Demetrovics et al., 2011, p. 814). Compulsive play occurs when these needs are largely satisfied through participation in the problematic behaviour, such as problem gaming or problem gambling (Przybylski et al., 2010).

The Motivations for Online Gaming Questionnaire (MOGQ; Demetrovics et al., 2011) is based on the premise that motives for video game playing are similar to those underlying substance abuse activities, such as alcohol consumption. Informed by the video gaming literature and interactions with the video gaming community, Demetrovics and colleagues (2011) developed the MOGQ as a seven-factor measure of video game playing motives: (1) coping (using video games as a means of alleviating negative feelings associated with mood disorders), (2) escape (escaping from everyday life problems), (3) fantasy (immersing oneself in an imaginary world), (4) skill development (mastering the controls that improve gameplay experience), (5) recreation (playing for entertainment), (6) competition (receiving satisfaction through accomplishing challenges and competing with others), and (7) social (desiring social interaction). Notably, the factors escape, coping, and recreation have been identified as motivational factors in models of the development of problem gambling (Blaszczynski & Nower, 2002; Sim et al., 2012).

Researchers have suggested that although not all gamers may be at risk for developing future problem gambling because of their playing habits, there may be subgroups of gamers who are particularly susceptible to developing problem gambling, or problem gambling may influence spending in video game gambling systems (King et al., 2011; Zendle & Cairns, 2018). This idea of subgroups of gamers shares conceptual similarities with problem gambling, where problem gamblers can also be classified by unique subgroups with distinct characteristics (Blaszczynski & Nower, 2002). King and colleagues (2013) found that a measure often used in problem video game studies, length of time playing, is not a suitable universal measure for problem video gaming, as time investment can depend on the genre of video game that a player prefers. However, the amount of time spent playing video games remains an important indicator of problem video gaming because individuals often forego real-world interactions and activities in favour of participating in the digital environment (Colwell & Kato, 2003; Przybylski et al., 2010). It is understood that addicted video gamers play more frequently than others, and thus time spent playing video games remains an important predictor of problem video gaming (Lemmens et al., 2009).

King and colleagues (2011) examined the links between problem video gaming, as measured through the PVGT (King et al., 2011); problem gambling, as measured by the Problem Gambling Severity Index (PGSI; Currie et al., 2013; Wynne, 2003); and several risk factors thought to be common to both. King and colleagues (2011)

reported linkages between each of these factors and the PVGT; however, we published a similar study with a sample of Canadian undergraduate students and found that although there was evidence for a significant connection between these items at the bivariate level, these linkages became insignificant when we controlled for other factors (Biegun et al., 2020). This result is similar to other research results that suggest a lack of direct connection between problem video gaming and problem gambling (Delfabbro et al., 2009). Although we did not find the expected associations between problem gaming and problem gambling in the undergraduate sample in our previous study, bivariate analysis suggested the potential existence of subgroups of gamers who may exhibit increased risk for problem gambling, similar to the findings of King and colleagues (2011). The existence of significant correlations between the PGSI and risk factors for problem gambling and problem gaming, and the fact that these bivariate associations disappear when other factors are controlled for in multivariate analyses, provides evidence for the existence of subgroups of video gamers with unique characteristics. These distinct subgroup characteristics may be obscured when video gamers are treated as a homogenous group: Evidence suggests that video gamers may be heterogeneous in their makeup. Risk factors for the development of problem gaming may not be universally applicable.

The current study builds on this work by examining problem gambling and problem gaming risk factors within subclasses of gamers. This study contributes to the literature by using a Canadian student sample and analysing risk factors for the development of problem gaming while including motivational factors.

Method

Data Set

The Student Leisure and Well-Being Survey is a data set that measured several variables affecting the lives of undergraduate university students. Students enrolled in introductory level sociology courses at the University of Manitoba for the 2014–15 academic year were surveyed, resulting in a total of 1,352 respondents. Participation was voluntary and informed consent obtained. The study was approved by the university's Psychology/Sociology Research Ethics Board. The final sample used for this study included all students who reported spending some time playing video games on any platform over the month prior to survey administration, which resulted in a subsample of 687 students (318 male, 366 female, 3 unstated). Among these students, the average age was 21 years, 89.9% of them were enrolled in a full-time course load, and 62.8% also reported working part- or full-time jobs. The maximum average weekly time that a student reported playing video games was 106 hr (M = 7.2, SD = 10.4).

Measures

Video Game Playing Activities

Respondents' video playing activities were indicated by their responses to nine items: playing on social networking sites, playing gambling-themed games on social

networking sites, playing video game consoles (both at home and handheld), playing PC or computer games, playing FTP games, playing mobile games on a smartphone or tablet, playing massively multiplayer online role-playing games, playing games on play-money gambling websites, and playing games on real-money gambling websites. These items were derived from the Canadian Problem Gambling Index (Ferris & Wynne, 2001) and adapted for video gaming. Each category was scored dichotomously, with a score of zero indicating that the respondent did not play that type of platform, and a score of 1 indicating that the respondent had spent time playing on that platform. This index of video game playing activities displayed acceptable internal consistency ($\alpha = .61$).

Problem Gaming and Problem Gambling Risk Factors

The following items were analysed as part of this study, the internal consistency in the sample being reported with Cronbach's alpha: problem video gaming (PVGT, $\alpha = .95$; King et al., 2011), problem gambling (PGSI, $\alpha = .89$; Currie et al., 2013), anxiety (General Anxiety Disorder scale, $\alpha = .89$; Spitzer et al., 2006), depression (Center for Epidemiological Studies Depression Scale, $\alpha = .91$; Radloff, 1977), stress (Life Events Scale for Students, $\alpha = .75$; Linden 1984), impulsivity (Barratt Impulsiveness Scale, $\alpha = .82$; Stanford et al., 2009), self-esteem (Rosenberg Self-Esteem Scale, $\alpha = .90$; Rosenberg, 1965), social alienation (Social Alienation Scale, $\alpha = .85$; Jessor & Jessor, 1977), life satisfaction (Diener's Satisfaction With Life Scale, $\alpha = .87$; Diener et al., 1985), and mental well-being (Mental Health Continuum Short Form, $\alpha = .92$; Keyes, 2002). In addition, we assessed average weekly time spent playing video games and used the items of the Motivations for Online Gaming Questionnaire (MOGQ), including the motivational factors of *escape* ($\alpha = .92$), *coping* ($\alpha = .88$), *fantasy* ($\alpha = .91$), *skill development* ($\alpha = .94$), *recreation* ($\alpha = .87$), *competition* ($\alpha = .88$) and *social* ($\alpha = .85$; Demetrovics et al., 2011).

Analytical Procedure

Latent Class Analysis

Latent class analysis (LCA) is a technique that allows for the classification of study participants into distinct subgroups or classes by modelling their response distributions across "multivariate categorical data" (Dean & Raftery, 2010, p. 11; Muthén & Muthén, 2000). In the present study, LCA was conducted in Mplus version 7.4 to identify subclasses of video gamers on the basis of their self-reported time spent playing each video gaming format. This included obtaining response probabilities extrapolated from individual probabilities associated with reporting on playing each video gaming format. To determine the optimal number of classes arising from the data, we derived several models by using step-wise inclusions of classes for each subsequent model, and each individual model was individually assessed for stability. Model stability was determined (lower values are better for each) through the Akaike information criterion (AIC), Bayesian information criterion (BIC), and adjusted Bayesian information criterion (aBIC). Overall model

probability was assessed through the entropy measure, where higher values indicate better model classification (McCutcheon, 2002).

Welch's Analyses of Variance

After the optimal number of classes was determined, independent sample *t* tests were obtained by using Welch's analyses of variance (ANOVAs) conducted in SPSS version 20. A number of purported correlates of problem online gaming and gambling (including depression, anxiety, stress, impulsiveness, self-esteem, mental well-being, life satisfaction, social alienation, gender, and time spent playing) were assessed to see whether they help distinguish between different activity-based latent classes of online gamers. Missing values were assessed through the application of Little's missing completely at random test, which suggested that missing values were not completely random ($p < 0.05$). In order to maintain the maximum number of respondents in the sample and maintain comparability between items, we conducted multiple imputation ($M = 20$) in SPSS version 20 at the scale level.

ANOVA Assumptions

First, the assumption of independence of observations was satisfied because of the uniqueness of each class member. Second, the assumption of normality for distribution of variables was not met. Outliers were maintained, as they represent the small portion of the population who experience extreme behavioural or mood disorders. Although the statistical power of the ANOVA *F*-test is not highly susceptible to data containing high skewness and kurtosis values, it remains a concern when sample sizes are small, as was the case here (Lix et al., 1996).

Third, the assumption of variance homogeneity was not met for ANOVA. Although this is not a significant concern when class sizes are similar, that was not the case for this study (Lix et al., 1996). To correct for this, we calculated the Welch's ANOVA statistic; we report it alongside ANOVA *F*-test statistics.

Finally, to enhance the interpretation of the results, we used Bonferroni correction to control the family-wise error rate. It has the effect of increasing the statistical threshold for significance and reducing the probability of Type 1 error (Lee & Lee, 2018). Because of the violation of the variance homogeneity assumption, the Games-Howell test was used in post hoc comparisons.

Results

Model Evaluation

The model fit statistics are presented in Table 1.

Although the AIC and aBIC were lowest in the five-class model (5479.588 and 5546.090, respectively), the BIC was lowest for the three-class solution (5665.939).

Table 1
Latent Class Analysis: Model Fit Statistics

Model	AIC	BIC	aBIC	Entropy	LMR-LRT	Participants in each class *n* (%)
1-class	6047.472	6088.263	6059.687	-	-	
2-class	5690.968	5777.083	5716.755	.808	.0216	136 (19.7)
						551 (80.2)
3-class	**5534.502**	**5665.939**	**5573.860**	**.913**	**<.001**	**20 (2.9)**
						154 (22.4)
						513 (74.7)
4-class	5505.013	5678.774	5554.943	.923	.1133	20 (2.9)
						12 (1.7)
						162 (23.6)
						493 (71.8)
5-class	5479.588	5701.672	5546.090	.854	.5439	120 (17.5)
						20 (2.9)
						377 (54.9)
						158 (23.0)
						12 (1.7)

Note. Bolded values are for the selected three-class model. AIC = Akaike information criterion; BIC = Bayesian information criterion; aBIC = adjusted Bayesian information criterion; LMR-LRT = Lo-Mendell-Rubin adjusted likelihood ratio test.

In addition, the entropy measure was highest in a four-class solution (0.923), which suggests that a four-class solution has the highest classification probability. However, a three-class solution presented AIC and aBIC scores that were only slightly higher than in the five-class solution, and the entropy measure for a three-class solution was only slightly smaller than in the four-class solution. To aid in making the final determination for a three-class solution, we obtained scores from the Vuong-Lo-Mendell-Rubin Likelihood Ratio test, which identifies whether there is a "statistically significant improvement in fit for the inclusion of one more class" (Nylund et al., 2007, p. 538). These scores are presented in Table 1. Notably, this test was significant for the three-class model (compared with the two-class model) but not for the four-class model (compared with the three-class model). This result indicates that moving from a three- to a four-class solution does not result in a significant improvement of model fit. The four-class solution also had a class with only 12 participants, which presents problems for the subsequent analyses. With all of these factors considered, a three-class model solution was determined to adequately describe the data.

Conditional probabilities were also obtained to determine class membership. These conditional probabilities are presented in Table 2. Conditional probabilities show the likelihood of a member of that particular class answering "yes" to each question. Descriptive statistics for the assessed risk factors for problem gaming and gambling are reported by class in Table 3. From these conditional probabilities, we can see that the first class ("universal gamers") is characterized by high rates of play across each platform and type of video game. This class was unique in that it had a high propensity for playing gambling-themed games, both play-money and real-money

Table 2
Conditional Probabilities

Variable	Variable label	Latent Class 1 (n = 20)	Latent Class 2 (n = 154)	Latent Class 3 (n = 513)
Q50A	In a typical week in the past 3 months, time spent playing online games through (or associated with) social networking sites such as Facebook	**.902**	.485	.539
Q50B	In a typical week in the past 3 months, time spent playing gambling themes games through (or associated with) social networking sites such as Facebook	**.952**	.071	.086
Q50C	In a typical week in the past 3 months, time spent playing video games on a game console or handheld game console	**.953**	.660	.601
Q50D	In a typical week in the past 3 months, time spent playing PC games purchased at a store or through an online distributor	**1**	.712	.238
Q50E	In a typical week in the past 3 months, time spent playing free-to-play (F2P) games online	.9	**.978**	.048
Q50F	In a typical week in the past 3 months, time spent playing casual video games on a smartphone or tablet	**1**	.644	.682
Q50G	In a typical week in the past 3 months, time spent playing massively multiplayer online role-playing games (MMORPGs)	**1**	.542	.046
Q50H	In a typical week in the past 3 months, time spent playing "play money" gambling games associated with a gambling site	**1**	.016	.023
Q50I	In a typical week in the past 3 months, time spent playing "real money" gambling games associated with a gambling site	**.803**	.019	.022

Note. Bolded values show highest probability across classes.

games. This class displayed the highest average scores for problem video gaming (M = 31.9, SD = 20.2) and problem gambling (M = 2.4, SD = 1.3) while having the highest average scores for many risk factors associated with problem video gaming and gambling, including anxiety (M = *10.0*, SD = 5.6), depression (M = 20.8, SD = 11.1), stress (M = 258.8, SD = 292.5), impulsivity (M = 72.6, SD = 7.8), and social alienation (M = 26.9, SD = 6.7). Among motives for online video gaming, this class displayed the highest average scores for escape (M = 5.3, SD = 4.3), cope (M = 6.1, SD = 4.3), skill development (M = 6.0, SD = 4.6), social (M = 5.7, SD = 4.8), and

Table 3
Descriptive Statistics by Latent Class

Variable	Latent Class 1 n = 20 (2.9%) Mean (*SD*)	Latent Class 2 n = 154 (22.4%) Mean (*SD*)	Latent Class 3 n = 513 (74.7%) Mean (*SD*)	Total sample n = 687 Mean (*SD*)
PVGT	**31.9 (20.2)**	21.4 (14.8)	9.9 (12.1)	13.0 (14.0)
Anxiety	**10.0 (5.6)**	8.0 (4.8)	8.8 (5.4)	8.6 (5.3)
Depression	**20.8 (11.1)**	17.4 (10.0)	17.6 (10.9)	17.6 (10.7)
Stress	**258.8 (292.5)**	228.7 (200.2)	253.5 (223.4)	248.2 (220.1)
Impulsiveness	**72.6 (7.8)**	63.1 (10.2)	62.2 (10.1)	62.7 (10.2)
Mental health	43.3 (14.3)	45.9 (11.7)	**47.0 (12.4)**	46.6 (12.3)
Life satisfaction	10.8 (3.3)	11.6 (4.3)	**12.1 (4.1)**	11.9 (4.2)
Self-esteem	17.5 (5.6)	**19.7 (5.7)**	19.6 (5.7)	19.6 (5.7)
Social alienation	**26.9 (6.7)**	25.5 (9.2)	25.2 (9.2)	25.3 (9.1)
Time playing games (hours per week)	1.8 (1.2)	**2.0 (1.1)**	1.3 (.8)	1.5 (.9)
PGSI	**4.9 (5.9)**	0.4 (1.2)	0.6 (2.1)	1.3 (.6)
Gaming motivations				
Competition	6.3 (4.1)	**6.8 (4.6)**	3.4 (4.0)	4.3 (4.4)
Escape	**5.3 (4.3)**	4.5 (4.4)	2.4 (3.8)	2.9 (4.1)
Coping	**6.1 (4.3)**	5.9 (4.3)	3.0 (3.8)	3.8 (4.2)
Social	**5.7 (4.8)**	4.2 (4.0)	1.6 (2.9)	2.3 (3.5)
Recreation	5.7 (4.0)	**9.2 (2.8)**	6.3 (3.7)	6.9 (3.7)
Fantasy	**6.1 (4.7)**	3.8 (4.3)	2.1 (3.8)	2.6 (4.1)
Skill development	**6 (4.6)**	5.8 (5.0)	2.6 (3.9)	3.5 (4.4)

Note. Bolded values show highest mean across classes. PVGT = Problem Video Game Playing Test; PGSI = Problem Gambling Severity Index.

fantasy (M = 6.1, SD = 4.7). This universal gamers class was the smallest to emerge from the data, comprising 2.9% (n = 20) of the total sample.

Class 2 was unique in its high proportion of video gamers who were most likely to play F2P games, as evidenced by the 97.8% likelihood of answering "yes" to having spent time playing F2P games. This F2P gamers class was more likely to play video games on a personal computer (70%) and also more likely to play massively multiplayer online role-playing games (54%) in comparison to the third class. However, a significant distinction between this class of gamers from the previous universal gamers class was that they were highly unlikely to play any gambling-themed games, whether they were play-money games (1.6%) or real-money games (1.9%). This class also spent the highest average amount of time playing video games during any given week (M = 2.0, SD = 1.1) and had the highest average scores for self-esteem (M = 19.7, SD = 5.7). In terms of gaming motivations, this class had the highest average scores on the motivational factors of competition (M = 6.8, SD = 4.6) and recreation (M = 9.2, SD = 2.8). This F2P gamers class represented 22.4% (n = 154) of the total sample.

Class 3 gamers displayed many conditional response probabilities that were similar to those of the class of F2P gamers. Both F2P and Class 3 gamers had very low

probabilities of playing any type of gambling-themed game, regardless of monetary structure. Class 3 gamers were just as likely as those in the F2P gamer class to play video games on consoles or smartphones. However, those in Class 3 differed from F2P gamers in that they were far less likely to play FTP online video games (4.8%). This class displayed the highest average scores for positive mental health (M = 47.0, SD = 12.4) and overall life satisfaction (M = 12.1, SD = 4.1). Class 3 comprised 74.7% (n = 513) of the overall sample and, because of the low-to-average probabilities of play across media forms in this class, was labelled the "general gamers" class.

Univariate Analyses

The final analysis conducted in this study involved the examination of several Welch's ANOVA models to compare the three classes across known correlates for problem video gaming and problem gambling. Results from the significant Welch's ANOVA models are presented in Table 4. Post hoc results with the Games-Howell test are presented in Table 5. Results for Welch's ANOVA and subsequent comparisons are reported in terms of aggregate imputation results. Only significant ($p < .05$) comparisons are discussed.

The results from the Welch's ANOVA and subsequent multiple comparisons revealed that the universal gamers class generally had higher scores related to problem online video gaming, problem gambling, and impulsivity. A large effect size was present on the PVGT between the universal gamers class and the general gamers class, $t(531) = 5.58$, $p < .001$, $d = 1.15$. The F2P gamers class similarly had a large effect size associated with PVGT scores when compared with the general gamers class, $t(665) = 9.96$, $p < .001$, $d = 0.89$. Large effect sizes were present on the PGSI measure between the universal gamers class and the general gamers class,

Table 4
Summary of Welch's ANOVAs to Examine Differences Between Video Gaming Classes

Variable	df1	df2	F	p	est. ω^2
Problem online video gaming (PVGT)	2	47.09	48.03	.000	0.12
Problem gambling (PGSI)	2	48.8	5.83	.005	0.01
Time spent gaming	2	47.4	23.33	.000	0.06
Impulsiveness (BIS-11)	2	51.2	16.11	.000	0.04
Competition (MOGQ)	2	49.2	36.62	.000	0.09
Escape (MOGQ)	2	48.7	18.84	.000	0.05
Coping (MOGQ)	2	48.8	31.02	.000	0.08
Social (MOGQ)	2	47.3	33.43	.000	0.09
Recreation (MOGQ)	2	49.5	54.89	.000	0.14
Fantasy (MOGQ)	2	48.4	15.84	.000	0.04
Skill development (MOGQ)	2	48.4	29.00	.000	0.08

Note. ANOVA = analysis of variance; PVGT = Problem Video Game Playing Test; PGSI = Problem Gambling Severity Index; BIS-11 = Barratt Impulsiveness Scale; MOGQ = Motivations for Online Gaming Questionnaire.

Table 5
Post Hoc Comparisons for Three Latent Classes

				Games-Howell comparisons	
Group	*n*	Mean	*SD*	Latent Class 1	Latent Class 2
Problem online video gaming (PVGT)					
Latent Class 1	20	31.92	20.23		
Latent Class 2	154	21.41	14.76	.344	
Latent Class 3	513	9.92	12.05	.002**	.000***
Problem gambling (PGSI)					
Latent Class 1	20	4.85	5.91		
Latent Class 2	154	0.43	1.23	.009**	
Latent Class 3	513	0.57	2.09	.012*	.558
Time spent gaming					
Latent Class 1	20	1.8	1.15		
Latent Class 2	154	2.03	1.13	.914	
Latent Class 3	513	1.33	.758	.272	.000***
Impulsiveness (BIS-11)					
Latent Class 1	20	72.63	7.81		
Latent Class 2	154	63.1	10.21	.000***	
Latent Class 3	513	62.23	10.08	.000***	.553
Competition (MOGQ)					
Latent Class 1	20	6.28	4.06		
Latent Class 2	154	6.78	4.56	.811	
Latent Class 3	513	3.41	4.02	.027*	.000***
Escape (MOGQ)					
Latent Class 1	20	5.33	4.27		
Latent Class 2	154	4.48	4.36	.729	
Latent Class 3	513	2.35	3.81	.023*	.000***
Coping (MOGQ)					
Latent Class 1	20	6.11	4.28		
Latent Class 2	154	5.91	4.32	.943	
Latent Class 3	513	3.02	3.83	.021*	.000***
Social (MOGQ)					
Latent Class 1	20	5.72	4.82		
Latent Class 2	154	4.22	3.99	.476	
Latent Class 3	513	1.62	2.92	.006**	.000***
Recreation (MOGQ)					
Latent Class 1	20	5.71	3.97		
Latent Class 2	154	9.21	2.842	.012*	
Latent Class 3	513	6.26	3.7	.909	.000***
Fantasy (MOGQ)					
Latent Class 1	20	6.06	4.73		
Latent Class 2	154	3.84	4.26	.175	
Latent Class 3	513	2.11	3.82	.006**	.000***
Skill development (MOGQ)					
Latent Class 1	20	6	4.59		
Latent Class 2	154	5.76	5.02	.945	
Latent Class 3	513	2.63	3.95	.021*	.000*

Note. PVGT = Problem Video Game Playing Test; PGSI = Problem Gambling Severity Index; BIS-11 = Barratt Impulsiveness Scale; MOGQ = Motivations for Online Gaming Questionnaire.
***$p < .001$. **$p < .01$. *$p < .05$.

$t(531) = 7.99$, $p < .001$, $d = 0.96$, and between universal gamers and F2P gamers, $t(172) = 8.11$, $p < .001$, $d = 1.03$, whereas no significant difference was found between F2P and general gamers.

Similarly, large effect sizes were present on the impulsiveness measure between universal gamers and F2P gamers, $t(172) = 3.8$, $p < .001$, $d = 1.02$, and general gamers, $t(531) = 4.42$, $p < .001$, $d = 1.14$, whereas no significant difference was observed between the F2P and general gamer classes.

Regarding motivations for online video gaming, results suggest that the universal gamers class and F2P gamers class are motivated to play on the basis of similar factors, whereas no significant differences were observed between them for factors of skill development, fantasy, social, coping, escape, and competition. The motivation of escape showed a moderate effect size between universal gamers and general gamers, $t(531) = 3.15$, $p < .001$, $d = 0.72$, and between F2P gamers and general gamers, $t(665) = 5.93$, $p < .001$, $d = 0.53$. This is similar to the motivation of coping, where a medium effect size was observed between universal and general gamers, $t(531) = 3.23$, $p < .001$, $d = 0.75$, and between F2P and general gamers, $t(665) = 7.91$, $p < .001$, $d = 0.71$. A large effect size was observed for the social motivation measure between universal and general gamers, $t(531) = 5.24$, $p < .001$, $d = 0.99$, whereas a medium effect size was present between F2P and general gamers, $t(665) = 8.62$, $p < .001$, $d = 0.74$. A large effect size was present for the fantasy motivation between universal and general gamers, $t(531) = 4.14$, $p < .001$, $d = 0.9$, whereas a small effect was observed between F2P and general gamers, $t(665) = 4.76$, $p < .001$, $d = 0.43$. Medium effect sizes were present between universal and general gamers, $t(531) = 3.37$, $p < .001$, $d = 0.77$, and between the F2P and general gamer classes, $t(665) = 7.95$, $p < .001$, $d = 0.7$, for the skill development motivation factor. The competition motivation factor revealed similar effect sizes between universal and general gamers, $t(531) = 2.86$, $p < .01$, $d = 0.69$, and between F2P and general gamers, $t(665) = 8.72$, $p < .001$, $d = 0.79$. Finally, large effect sizes were observed for the recreation motivational factor between F2P gamers and universal gamers, $t(172) = 3.93$, $p < .001$, $d = 0.91$, and between F2P and general gamers, $t(665) = 8.98$, $p < .001$, $d = 0.9$.

Both universal and F2P gamers had associations with larger amounts of time spent gaming, with no significant differences appearing between these two classes. In terms of average weekly time spent gaming, a medium effect size was observed between F2P gamers and general gamers, $t(665) = 8.84$, $p < .001$, $d = 0.73$, whereas a small effect size was present between universal gamers and general gamers, $t(531) = 2.63$, $p < .01$, $d = 0.48$. Other measures such as depression, anxiety, stress, mental well-being, life satisfaction, self-esteem, and social alienation showed no significant differences between these three gamer classes.

Discussion

The results from the LCA presented three distinct subclasses of gamers: universal gamers (Class 1), F2P gamers (Class 2), and general gamers (Class 3). Notably,

membership in the only class that played gambling-themed games (universal gamers) is associated with higher levels of problem online video gaming and problem gambling and with higher impulsivity. This class of gamer is highly motivated across all MOGQ factors except recreation. Although this class represented a small fraction of the sample (n = 20), it is important to note that this proportion is consistent with the small prevalence rates for problem gambling. Further research into the significance of this relationship should be undertaken to determine the susceptibility of problem video gamers to problem gambling.

This study revealed no significant differences between gamer subgroups in terms of overall mental well-being, life satisfaction, self-esteem, and social alienation. Nor did this study reveal any significant differences between classes for mental health measures, including depression, anxiety, and stress. Thus, there does not appear to be significant mental health associations with any subclass of gamer. Of note is that the universal class of gamer is represented by a very small subsample and this limitation may explain the lack of significant differences in mental well-being and mood disorders between gamer subgroups.

The universal gamer class is significantly associated with higher average scores for problem online video gaming, problem gambling, and impulsivity, as well as with motivation scores on the escape, cope, social, skill development, and fantasy factors. Similarly, Sanders and Williams (2019) reported a connection between impulsivity and problem gambling and problem video game playing. However, whereas Sanders and Williams (2019) found connections between problem gambling, problem video gaming, and mental health problems, we found no significant differences between classes on measures for depression, anxiety, stress, and social alienation. A lack of significant differences between this class and others may also be due to the low number of individuals who fit into this gaming subclass.

Similarly, in examining the differences between F2P and other classes, we observed that individuals who prefer F2P games spend a greater amount of time playing video games than do the other two classes. Furthermore, F2P gamers have the highest average scores on the *recreation* and *competition* motivational factors. It is important to note that a general category of FTP games can include a wide range of video games, from the popular *League of Legends* game to mobile games such as *Clash of Clans* (Chew, 2016). This wide array of game types could explain these high motivation scores. Furthermore, although the FTP umbrella spans video game genres and video game platforms, these games also vary widely in terms of their "monetization methods" while differing in the gameplay experiences that they provide (Chew, 2016, p. 229). It is also important to point out that there has been a dearth of scholarly attention paid to the characteristics of F2P games and their unique qualities, and therefore the classes of gamer remain in significant need of further study (Chew, 2016).

We are unable to draw conclusions from our study regarding whether problem video gaming constitutes a pathway towards future problem gambling, as we focused on

associations between problem video gaming and problem gambling and the associated risk factors. However, we identified two subclasses of gamers that have unique characteristics compared with the general class. Furthermore, the primary differences between the universal and F2P gamer classes relate to gambling activity and the amount of time spent playing video games. This could allow for easy migration from F2P gaming to gambling, and this relationship should be explored.

Limitations

One limitation of this study concerns the use of an undergraduate student sample to explore risk factors associated with problem gambling. There is reason to believe that student samples are not highly representative of problem gambling in general populations, and future research should explore youth gamblers and gamers outside of a university population. This could contribute to a better assessment of the risk factors that might connect populations of problem gamblers and problem gamers.

A second limitation is the nature of the categorization for video gaming platforms used in this study. Future studies could further expand on this research by examining specific modes of play for FTP games and their platforms. Distinct qualities of FTP gamers and the games they prefer, whether casual mobile games, competitive online games, or others, could not be teased out by this analysis. It is entirely possible that there exist subclasses within these categories that have specific and distinct characteristics that might have unique relationships with risk factors for problem gaming.

Because of the inclusion of outliers and subsequent violations of the ANOVA assumption of normality, the results must be interpreted with caution. The conclusions drawn must also be considered in light of the small sample size of the universal gamer class. Further investigation of this unique subclass of gamer could provide significant insights into problem video gaming and its association with risk factors for other problem behaviours.

Avenues for Future Research

LCA revealed a specific group of gamers who displayed a significant relationship with problem gambling and problem gaming. Although this class is small, it is similar to the prevalence rates typically found in Canadian problem gambling populations, where problem gambling prevalence can range from 1.5% to 3% across the provinces (Cox et al., 2005). Notably, previous research has suggested that youth who are exposed to online gaming at an earlier age are potentially at higher risk of developing future gambling problems (Derevensky & Gainsbury, 2016). It would be interesting if researchers could track heavy-use online gamers in future research to better understand this risk factor for developing future problem gambling. Thus, researchers should aim to obtain a larger sample by, for example, purposefully sampling online video gamers who participate in distinct online gaming activities.

Such increased statistical power would enhance the ability to determine the exact nature of the associations with risk factors that connect the video gaming habits of these players with problem gambling and mental health.

A growing body of research suggests that gambling-themed games found on social networking sites present a risk factor for developing future problem gambling because of the age at which individuals can participate in such games, the ease with which one can find and play them, and the structural similarities shared between these games and real-money gambling games (Griffiths et al., 2016; Hollingshead et al., 2016; King et al., 2011). Brooks and Clark (2019) found that loot-box use was associated with "problem gambling as well as problem internet gaming" and suggest that "risky loot box use" might "promote problem gambling, as seen in transitions from [social casino games] to gambling" (p. 33). Beyond the analysis of these associations, longitudinal studies aimed at youth participation in these gambling-like video game activities as they transition into young adulthood could provide insight into the relationship between problem gambling and problem gaming.

Individuals who are immersed in multiple forms of video gaming, such as those in the universal gamers class in this study, exhibit high levels of impulsivity and may be at higher risk of developing problem video gaming or problem gambling. This is an important distinction between the three classes of gamers in this study. Although general and F2P gamers differ in terms of the strength of particular motivational factors that drive online play, only the universal gamer class is significantly associated with problematic gaming and gambling behaviours. In future studies, researchers should explicitly focus on these multi-platform heavy gamers to determine the extent of their associations with risk factors that predict problematic play.

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