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The relationship between loot box buying, gambling, internet gaming, and mental health: Investigating the moderating effect of impulsivity, depression, anxiety, and stress

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ABSTRACT

There has been much debate on whether loot box (LB) buying can be considered gambling. The relationship between LB buying, gambling, and mental health has already been examined, reporting inconclusive results. Therefore, the main aim of the present study was to examine the associations between LB buying, gambling, online gaming, and other relevant constructs of mental health. In addition, moderation analyses were conducted to study the relationship between LB buying and gambling/online gaming. Analysing a relatively large sample of adults (N = 1416), the results showed positive relationship between LB buying, problem gambling, and problematic video game use. A positive relationship was found between risky LB buying and depression, anxiety, stress, and impulsivity. Moderation analyses showed that anxiety and impulsivity were associated with significant strengthening of relationships between risky LB buying and gambling symptoms. Likewise, the relationship between risky LB buying and internet gaming symptoms was also strengthened when participants had higher depression scores. Moreover, this relationship appeared to be (i) reinforced when participants engaged in higher risky LB buying while showing higher levels of impulsivity, and (ii) weakened when participants engaged in higher risky LB buying while showing higher levels of depression. Overall, the results suggest that, at least to some extent, LB buying shares similar mental health risk factors with other behavioural addictions. Furthermore, while stress did not moderate this relationship, impulsivity and anxious and/or depressive symptomatology moderated, and in most cases, strengthened the relationship between risky loot box buying and problem gambling/online gaming.

1. Introduction

A 'loot box' (LB) is a colloquial catch-all term usually used to describe software features that provide online gamers with random virtual rewards (Drummond & Sauer, 2018). It is worth noting that in this definition, as pointed out by various authors (e.g., Drummond, Sauer, Hall, Zendle, & Loudon, 2020; Garea, Sauer, Hall, Williams, & Drummond, 2023; Kim et al., 2023; Montiel, Basterra-González, Machimbarrena, Ortega-Barón, & González-Cabrera, 2022; Zendle & Cairns, 2019), one of the key elements is the uncertainty that individuals feel about the item that will be randomly gained when purchasing or opening a loot box. LBs can be purchased using virtual in-game currency, which is typically obtained or purchased using real-world money (Zendle & Cairns, 2019). Buying LBs allow gamers to personalize aspects of the in-game aesthetic (e.g., customization options for a player's avatar), improve their in-game abilities or own unique game rewards, often constituting a bonus in online multiplayer games (e.g., owning unique weapons or armor) (Zendle, Cairns, Barnett, & McCall, 2020). Moreover, there is much debate concerning whether LB buying can be considered gambling (Griffiths, 2018). It should also be noted that while some loot boxes can be played without spending money, the present paper uses the term 'loot box buying' to include all player interaction with loot boxes.

Legal definitions of gambling differ across countries and jurisdictions, but there are three key elements of commonality between them (Drummond, Sauer, Hall, et al., 2020): *consideration* (players are

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required to spend money or something of financial value to play), *chance* (all outcomes have some chance-based elements, and *prize* (players can win something of financial value). When it comes to LBs, players usually spend real-world money to get random virtual items already complying with consideration and chance elements. In terms of prizes, players can win valuable virtual items, which are often sold for less than the cost of the original loot box, therefore challenging the assumption that it is impossible for players who open a LB to make a monetary loss (Griffiths, 2018). In line with legal definitions, some authors have pointed out that those users who tend to buy LBs could also share biopsychosocial factors with those diagnosed as having gambling disorder (GD), suggesting, in turn, that LB buying could be structurally and psychologically akin to gambling (Drummond & Sauer, 2018; Griffiths, 2018). For all these reasons, some academics have argued and pointed out the need for LB buying to be regulated by existing gambling laws (Drummond, Sauer, Hall, et al., 2020; Zendle & Cairns, 2018).

Following these observations and arguments, an emerging body of studies has consistently shown that LB buying is positively associated with problem gambling severity through evidence collected around the world (see Garea, Drummond, Sauer, Hall, & Williams, 2021, for a meta-analysis, and Gibson, Griffiths, Calado, & Harris, 2022, for a systematic review) . In fact, it has been suggested that the relationship between gambling symptomology and LB buying could be at least as large as the relationship between excessive gaming symptoms and LB buying (Garea et al., 2021). When it comes to psychological distress, earlier studies have examined the relationship between GD and other comorbid disorders, finding that GD is associated with poorer mental health (Lorains, Cowlishaw, & Thomas, 2011). Among other comorbidities, depression, anxiety, and stress have been shown to play a significant role in the development and/or maintenance of GD (Rogier, Beomonte Zobel, Marini, Camponeschi, & Velotti, 2021). In addition, deficits in GD have been seen across all domains of impulsivity (see Ioannidis, Hook, Wickham, Grant, & Chamberlain, 2019, for a meta-analysis). In this sense, and as has been suggested, decision-making impulsivity might extend to problematic (at-risk) gambling (Browne et al., 2019; Ioannidis et al., 2019). Interestingly, these results were also replicated in studies examining internet gaming disorder (IGD), which have found an association between problematic gaming symptoms and other comorbid problems, including anxiety, depression, and stress (González-Bueso et al., 2018; Kim et al., 2015; Yen, Lin, Chou, Liu, & Ko, 2019). In parallel, a positive association between the development of IGD and impulsivity has also been reported (see Şalvarlı & Griffiths, 2022, for a recent systematic review).

As for LB buying, although the literature is still relatively scarce, recent studies have already explored its relationship with gambling, gaming, and mental health, reporting some heterogeneous results. While some researchers have not found an association between LB buying and psychological distress or poor mental well-being (Etchells, Morgan, & Quintana, 2022), others have shown that LB buying is associated with higher risk of experiencing severe psychological distress (Drummond, Hall, & Sauer, 2022). In a recent study conducted in Mainland China, it was found that poor mental well-being was weakly positively correlated with LB buying (Xiao, Fraser, Nielsen, & Newall, 2024). However, the authors tentatively attributed the inconsistent results with Western countries to social and cultural factors. As for other risk factors related to LB buying, in addition to problematic gaming or gambling, impulsivity has also been investigated (Garrett et al., 2023). However, according to this recent study, facets of impulsivity seen in problematic gambling (e.g., lack of premeditation or negative urgency) were not positively related to LB buying. Related to this, it has been found that obsessive-compulsive symptoms and hoarding can positively moderate the relationship between problem gambling symptoms and loot box buying (Garea et al., 2023).

Although the evidence on loot box buying and its relationship with other behavioural addictions and mental health is still heterogeneous, it has been suggested that individuals who buy loot boxes could be at heightened risk of experiencing psychological distress, as previously observed in other behavioural addictions such as GD (e.g., Drummond et al., 2022). Therefore, to investigate whether LB purchasing might be psychologically akin (including the impact on mental health) to other behavioural addictions and its relationship with them, the aim of the present study was to examine the relationships between LB buying, gambling, online gaming, and other relevant constructs underlying mental health (i.e., depression, stress, anxiety, and impulsivity). The study also examined the possible moderating effect of depression, anxiety, stress, and impulsivity on the relationship between LB buying and gambling, and on the relationship between LB buying and IGD. Previous studies have shown that some inherent features of loot boxes (Zendle, Meyer, & Over, 2019), or obsessive-compulsive symptoms (Garea et al., 2023) strengthen the relationship between LB buying and problem gambling. However, to the best of the authors' knowledge, no previous study has ever directly examined the possible moderating effects of depression, anxiety, stress, or impulsivity on the relationship between risky LB buying and gambling and online gaming severity.

It was expected that the present study's findings would replicate previous robust results reported in the literature. More specifically, it was hypothesized that there would be a positive correlation between (i) loot box buying and gambling severity (H_1) (ii) LB buying and online gaming severity (H_2), (iii) depression, anxiety, stress, and impulsivity and gambling severity, respectively (H_3), and (iv) depression, anxiety, stress, and impulsivity and online gaming severity, respectively (H_4). Similarly, it was hypothesized that there would be (v) an association between LB buying and depression, anxiety, stress, and impulsivity (H_5). In terms of moderation analysis, it was hypothesized that (vi) depression, anxiety, stress, and impulsivity would moderate the relationship between LB buying and problem gambling (H_6), and (vii) depression, anxiety, stress, and impulsivity would moderate the relationship between LB buying and problem online gaming (H_7).

2. Methods

The study used cross-sectional data collected from a self-report anonymous online survey on a secure online platform (Qualtrics, 2023). Participants were recruited through adverts posted on social media (i.e., *Reddit* and *Facebook* platforms). Earlier studies have reported that participants recruited on the *Reddit* platform are more internally motivated than others (e.g., *MTurk*) to take part in research and have a greater need for cognition, with the reliability and quality of the data comparable to other similar online recruitment means and laboratory samples in most analyses (Luong & Lomanowska, 2022). Regarding the inclusion criteria, individuals who were eligible to participate (i) were 18 years of age or older, (ii) were native or fluent English speakers, (iii) had played videogames that involved opening loot boxes (both paid for and for free) at least once during the 12 months prior to the date of the study, and/or (iv) had gambled at least once during the 12 months prior to the date of the study. On the *Qualtrics* platform, respondents were automatically filtered and only those who were 18 years or older and understood the language in which the survey was written (native/bilingual level) were able to complete the survey. In compensation for their participation, the first 150 volunteers to complete the study were offered an *Amazon* gift card worth £10 (approximately equivalent in amount to two other currencies: Euros [€] and US dollars [$]). The present study received ethical approval from the Research Ethics Committee of the University of Gibraltar and all procedures followed the ethical standards of the Declarations of Helsinki. Of the 1836 responses initially collected on the *Qualtrics* platform in two different waves in an attempt to recruit a large number of respondents, 420 with incomplete responses (23%) were discarded. The remaining 1416 responses (77%) comprised the final sample used for data analyses.

2.1. Measures

In addition to demographic data (i.e., age, gender, and country of residence), through simple screening questions included at the beginning of the survey, participants were asked about their gaming habits and the use of loot boxes, including gaming/loot box-opening frequency. Likewise, participants were also asked about their gambling habits, including gambling frequency. LB buying was assessed using the Risky Loot Box Index (RLI) (Brooks & Clark, 2019). The RLI has been used in previous studies dedicated to investigating risky loot box use and problematic behaviours and actions to acquire loot boxes, with items adapted to other cultures/languages (Cudo, Lelonek-Kuleta, & Bartczuk, 2022; Forsström, Chahin, Savander, Mentzoni, & Gainsbury, 2022). The RLI is a five-item scale that assesses risky LB buying over the past 12 months, and has high internal consistency (α = 0.915) (Drummond, Sauer, Ferguson, & Hall, 2020). The ten-item Internet Gaming Disorder Test (IGDT-10) was used to assess problem gaming severity (Király et al., 2017, 2019). In the present study, IGDT-10 was chosen over other possible instruments (e.g., nine-item IGD scale [Lemmens, Valkenburg, & Gentile, 2015]; IGDS-SF9 [Pontes & Griffiths, 2015]), due to its user-friendly wording and comprehensive coverage of all IGD criteria proposed by DSM-5, compared to other tests (Király et al., 2019). The IGDT-10 is a short screening instrument comprising 10 items, in which participants provide the extent, and how often, the statements applied to them over the past 12 months. The IGDT-10 has shown robust psychometric properties (Király et al., 2019) and has been suggested as suitable for conducting cross-cultural and gender comparisons across different languages. Problematic gambling symptoms were assessed using the Problem Gambling Severity Index (PGSI) (Ferris & Wynne, 2001). The PGSI is an instrument that was specifically developed for epidemiological prevalence studies on problem gambling among general populations (Otto et al., 2020). The PGSI is a nine-item scale that assesses a person's gambling behaviour over the past 12 months. Internal consistency of this scale is high (Cronbach's α = 0.86) (Holtgraves, 2009). The Barratt Impulsiveness Scale (BIS-11) (Patton, Stanford, & Barratt, 1995) is a 30-item scale that assesses the personality/behavioural construct of impulsiveness. In the present study, a short 10-item version (BIS-R-21-SF) (Horváth et al., 2023) of the 21-item Revised Barratt Impulsiveness Scale BIS-R-21 (Kapitány-Fövény et al., 2020) was used in order to decrease the time needed for survey completion. The 21-item Depression, Anxiety and Stress Scale (DASS-21) (Antony, Bieling, Cox, Enns, & Swinson, 1998) comprising three seven-item sub-scales was used to assess depression, anxiety, and stress. The DASS-21, is 21-item self-report measure specifically designed to assess the severity of general psychological distress and symptoms related to depression, anxiety, and stress, with psychometric properties suitable for its application in clinical practice and research among adults (Gomez, Summers, Summers, Wolf, & Summers, 2014). Items are rated on a four-point Likert scale (ranging from 0 to 3), with higher scores indicating higher levels of depression, anxiety, or stress.

2.2. Statistical analysis

Data pre-processing and statistical analyses were performed using R version 4.2.1 (R Core Team, 2022). Spearman's correlations coefficients with confidence limits were used to calculate correlations of the scores of the depression, anxiety, stress, and impulsivity measures, as well as problematic gambling, problematic gaming, and risky LB buying. To assess the moderating role of depression, anxiety, stress, and impulsivity in the relationship between the risky LB buying and problematic gambling (Model 1) and problematic online gaming (Model 2) outcomes respectively, moderation analyses were performed, one for each dependent variable (problematic gambling and problematic online gaming). Age and gender were controlled for in the data analyses. Models were tested with bootstrapping on 5000 resamples.

3. Results

Among the 1416 participants (25.8% females and 73% males; M_{age} = 28.5 years, SD = 6.97), there were individuals from 17 countries in four continents (*Europe:* United Kingdom, Bulgaria, Spain, France, Germany, Netherlands, Poland, Portugal, Serbia, and Sweden; *Americas:* United States, Canada, Brazil; *Asia:* Japan, India; and *Africa:* Nigeria, Kenya) (Table 1).

Table 2 shows the prevalence for both IGD and GD. Cut-offs (5 or more) were used to differentiate the IGD group from the non-IGD group (as suggested by Király et al. [2017]). Likewise, the GD group was differentiated from the non-GD group, using PGSI scores of 8 and above, which are considered to indicate problem gambling (e.g., Currie, Hodgins, & Casey, 2013).

At the beginning of the survey, short screening questions were asked, including items about gaming, loot boxes, and gambling habits. Almost all participants played videogames 12 months prior to the data collection (98.8%), and 63.7% played videogames more than once a week. Moreover, 96.1% had bought loot boxes in the past year, and 41% did so more than once a week with 12.9% doing this four or more times a week. Past year gambling prevalence was 79.9%, and one-third (33.7%) gambled at least once a week. The examined variables showed significant positive correlations (Table 3).

To assess the effect of depression, anxiety, stress, and impulsivity in the relationship between LB buying and problem gambling, moderation analysis was conducted. Gender and age variables were entered into the model as covariates to address possible confounding effects (Hayes, 2013). The model was tested with bootstrapping on 5000 resamples. The overall model was significant (Model 1: $F_{(11,1388)} = 59.936$, $p < 0.001$). More specifically, 32.2% of the variance in problem-gambling severity (PGSI) was explained by anxiety, and the interaction between LB buying and impulsivity ($R^2 = 0.322$, adjusted $R^2 = 0.317$; see Table 4 for the full model summary).

To assess the effect of depression, anxiety, stress, and impulsivity in the relationship between LB buying and problem online gaming, moderation analysis was conducted. Gender and age variables were entered into the model as covariates to address possible confounding effects (Hayes, 2013). The model was tested with bootstrapping on 5000 resamples. The overall model was significant (Model 2: $F_{(11,1385)} = 58.432$, $p < 0.001$). More specifically, 31.7% of the variance in problem online gaming (IGDT-10) was explained by depression, the interaction between LBs buying and impulsivity, and the interaction between LB buying and depression ($R^2 = 0.317$, adjusted $R^2 = 0.312$; see Table 5 for the full model summary).

4. Discussion

The present study examined the associations between LB buying, gambling, online gaming, and some mental health symptoms, as well as the moderating effects of depression, anxiety, stress, and impulsivity in the relationship between the LB buying, problem gambling, and problem

Table 1
Demographic characteristics of the sample by gender.

	Female (N = 365)	Male (N = 1033)	Other (N = 18)
Age (in years)			
18–24	101 (27.7%)	291 (28.2%)	7 (38.9%)
25-34	201 (55.1%)	582 (56.3%)	9 (50.0%)
35-44	43 (11.8%)	134 (13.0%)	1 (5.6%)
45-54	11 (3.0%)	18 (1.7%)	1 (5.6%)
55-64	9 (2.5%)	8 (0.8%)	0 (0%)
Continent			
Africa	2 (0.5%)	6 (0.6%)	0 (0%)
Americas	47 (12.9%)	107 (10.4%)	2 (11.1%)
Asia	0 (0%)	3 (0.3%)	0 (0%)
Europe	289 (79.2%)	850 (82.3%)	13 (72.2%)
Non-response	27 (7.4%)	67 (6.5%)	3 (16.7%)

Table 2
Prevalence of internet gaming disorder (IGD) and gambling disorder (GD) (N = 1416).

IGD	GD	Frequency	Percent (%)
Non-problem gaming	**Non-problem gambling**	222	15.68
	Problem-gambling	719	50.77
	Non-response	244	17.23
Problem-gaming	**Non-problem gambling**	10	0.71
	Problem-gambling	182	12.85
	Non-response	21	1.48
Non-response	**Non-problem gambling**	4	0.28
	Problem-gambling	11	0.78
	Non-response	3	0.21

gaming. Firstly, a positive association was found between loot box (LB) buying and gambling disorder (GD), supporting H_1, and concurring with previous research (e.g., Etchells et al., 2022; Garea et al., 2021). Secondly, a positive association was found between LB buying and internet gaming disorder (IGD), supporting H_2, also concurring with previous research (Etchells et al., 2022). Therefore, the results showed that there are not only similarities between some elements of LB buying and gambling, but that LB buying engagement was correlated with both problematic gambling behaviour and internet gaming among adult gamers. As for the strength of the relationship between LB buying and IGD, in the present study it is comparable to the strength of the positive relationship shown between LB buying and GD, as previous research has suggested (Garea et al., 2021). Thirdly, the study found an association between GD and other comorbid disorders (supporting H_3). These findings concur with previous research reporting associations between GD and depression (Chou & Afifi, 2011; Lorains et al., 2011; Parhami, Mojtabai, Rosenthal, Afifi, & Fong, 2014), anxiety (Giddens, Stefanovics, Pilver, Desai, & Potenza, 2012; Kessler et al., 2008), and stress (Roberts et al., 2017). Therefore, the results supported the association between GD with other comorbid disorders (supporting H_3) and with generally poorer mental health (Lorains et al., 2011). Additionally, a positive relationship was found between GD and impulsivity, as has been reported in meta-analytic studies (e.g., Ioannidis et al., 2019). It has been noted that patients diagnosed with GD, among other characteristics, have high impulsivity across different subdomains (Ioannidis et al., 2019), and is a relevant factor to consider when diagnosing and treating gambling disorder. The results indicated a positive relationship between IGD and depression, anxiety, and stress (supporting H_4) and concurring with previous research (e.g., Kim et al., 2015; Lopez-Gonzalez, Estévez, & Griffiths, 2018; Yen et al., 2019). Furthermore, a positive association was found between IGD and impulsivity which also supports previous research. For instance, a systematic review by Şalvarlı and Griffiths (2022) reported that 32 out of 33 studies found a significant association between IGD and impulsivity. Impulsivity and its subdomains, appear to play a crucial role in behavioural additions such as problematic gambling and problematic online gaming.

The present study found a positive association between risky LB buying and depression, anxiety, and stress respectively, supporting H_5. The results supported previous research reporting a relationship between increased risky LB buying and an increased risk of experiencing psychological distress (Drummond et al., 2022), as opposed to the results reported by others (Etchells et al., 2022; Xiao et al., 2024). The discrepant results between studies might be due to the use of different

Table 4
Regression coefficients for moderation analyses on problem-gambling severity (PGSI) including risky LB buying (RLI) as predictor variable, impulsivity (BIS-10), depression (DASS-21-D), anxiety (DASS-21-A), and stress (DASS-21-S) as moderator variables, and age and gender as covariates.

Model	β	S.E	*t*	*p*	Lower	95% CI Upper
RLI	−0.026	0.235	−0.111	0.912	−0.488	0.436
BIS-10	−0.296	0.174	−1.698	0.090	−0.637	0.046
DASS-21-D	0.113	0.092	1.229	0.219	−0.067	0.293
DASS-21-A	0.248	0.103	2.420	0.016*	0.047	0.450
DASS-21-S	−0.086	0.122	−0.707	0.480	−0.326	0.153
Age[a]	−0.011	0.024	−0.438	0.662	−0.058	0.037
Gender[a]	0.287	0.359	0.798	0.425	−0.418	0.991
RLI ✻ BIS-10	0.023	0.010	2.393	0.017*	0.004	0.042
RLI ✻ DASS-21-D	−0.006	0.006	−0.959	0.338	−0.017	0.006
RLI ✻ DASS-21-A	−0.002	0.006	−0.317	0.751	−0.015	0.011
RLI ✻DASS-21-S	0.008	0.007	1.128	0.259	−0.006	0.023

Note. β = Estimated value of unstandardized regression coefficient; S.E = Standard Error; *t* = *t*-test statistic; *p* = probability; Lower = lower-level confidence interval; Upper = upper-level confidence interval. *Statistically significant test result ($p \leq 0.05$). [a]Covariate variables; N = 5000 bootstrapping resamples.

Table 5
Regression coefficients for moderation analyses on online gaming severity (IGDT-10) including risky LB buying (RLI) as predictor variable, impulsivity (BIS-10), depression (DASS-21-D), anxiety (DASS-21-A), and stress (DASS-21-S) as moderator variables, and age and gender as covariates.

Model	β	S.E	*t*	*p*	Lower	95% CI Upper
RLI	0.006	0.066	0.096	0.923	−0.123	0.136
BIS-10	−0.065	0.049	−1.337	0.182	−0.161	0.030
DASS-21-D	0.076	0.026	2.942	0.003*	0.025	0.126
DASS-21-A	0.026	0.029	0.888	0.375	−0.031	0.082
DASS-21-S	−0.026	0.034	−0.763	0.446	−0.093	0.041
Age[a]	−0.011	0.007	−1.579	0.115	−0.024	0.003
Gender[a]	−0.016	0.101	−0.160	0.873	−0.213	0.181
RLI ✻ BIS-10	0.007	0.003	2.534	0.011*	0.002	0.012
RLI ✻ DASS-21-D	−0.004	0.002	−2.620	0.009*	−0.007	−0.001
RLI ✻ DASS-21-A	5.834×10^{-4}	0.002	0.326	0.745	−0.003	0.004
RLI ✻ DASS-21-S	0.003	0.002	1.526	0.127	-8.966×10^{-4}	0.007

Note. β = Estimated value of unstandardized regression coefficient; S.E = Standard Error; *t* = *t*-test statistic; *p* = probability; Lower = lower-level confidence interval; Upper = upper-level confidence interval. *Statistically significant test result ($p \leq 0.05$). [a]Covariate variables; N = 5000 bootstrapping resamples.

Table 3
Means and Spearman correlation coefficients for LB buying (RLI), online gaming severity (IGDT-10), gambling severity (PGSI), impulsivity (BIS-10), depression (DASS-21-D), anxiety (DASS-21-A), and stress (DASS-21-S) among all participants (N = 1416).

Variable	Mean (SD)	RLI	IGDT-10	PGSI	BIS-10	DASS-D	DASS-A	DASS-S
RLI	16.3 (4.47)	1						
IGDT-10	2.35 (2.06)	0.45***	1					
PGSI	9.95 (7.38)	0.43***	0.51***	1				
BIS-10	25.4 (3.99)	0.24***	0.28***	0.38***	1			
DASS-D	8.54 (4.96)	0.12***	0.37***	0.47***	0.31***	1		
DASS-A	8.32 (4.68)	0.18***	0.41***	0.54***	0.32***	0.75***	1	
DASS-S	8.97 (4.44)	0.17***	0.39***	0.49***	0.34***	0.78***	0.77***	1

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$. df = 1414.

instruments to assess mental health (Etchells et al., 2022) or might be due to cultural or social differences between Western and non-Western countries (Xiao et al., 2024). Depression and anxiety have been consistently associated with problem gambling (e.g., Rogier et al., 2021). In fact, it has been suggested that this association could be due to the ineffective nature of gambling in alleviating feelings of depression or anxiety. Conversely, it has also been found that individuals with problematic gambling may experience increased depressive and anxious symptoms due to their gambling behaviour (e.g., Jauregui, Onaindia, & Estévez, 2017). Therefore, this relationship between depression and anxiety, found both as a precursor or as an outcome of gambling severity, might also be similar for LB buyingbecause, although weaker, anxiety and depression were both associated with a riskier LB buying in the present study.

The present study also found a positive association between LB buying and impulsivity, stronger than between LB buying and the other constructs examined. Previously, impulsivity has been associated with LB buying, identified as a potential risk factor for problematic LB buying, although results have been heterogeneous. The present study's findings align with previous studies that have reported a positive relationship between LB buying and impulsivity (Garrett et al., 2023). However, other studies have found a negative association between impulsivity and LB buying (e.g., Xiao et al., 2024), or no association (e.g., Spicer et al., 2022; Wardle & Zendle, 2021; Zendle et al., 2019). These mixed results could be due to the type of instrument used to assess the impulsivity construct and its complex facets (Garrett et al., 2023).

The moderation analyses showed that anxiety and impulsivity were associated with significant strengthening of relationships between risky LB buying and GD in the present study, partially fulfilling H_6. More specifically, the relationship between risky LB buying and GD appeared to be strengthened when participants had greater anxiety, and when they engaged in higher risky LB buying while at the same time experiencing higher levels of impulsivity. Gambling severity has previously been associated with difficulties in emotion regulation, whose mediating role might explain psychological disorders such as anxiety or depression among those who have gambling problems (see Neophytou, Theodorou, Artemi, Theodorou, & Panayiotou, 2023, for a systematic review). Therefore, as already suggested, implementing interventions aimed at developing adaptive emotional regulation skills could be applied by practitioners when helping or treating individuals with problematic gambling (e.g., Tárrega et al., 2015). The analyses also showed that depression and impulsivity moderated the relationship between risky LB buying and IGD, partially supporting H_7. The relationship between risky LB buying and IGD was strengthened when participants had higher depression scores. Moreover, this relationship appeared to be (i) reinforced when participants engaged in higher risky LB buying while showing higher levels of impulsivity, and (ii) weakened when participants engaged in higher risky LB buying while showing higher levels of depression. Although these findings should be interpreted with caution, the results are in line with previous research suggesting that comorbid psychiatric disorders, such as obsessive-compulsive disorder (OCD) symptoms, moderate the associations between LB buying and problem gambling (Garea et al., 2023).

It should be noted that OCD symptomatology includes marked anxiety and impulse control problems (American Psychiatric Association, 2013), in addition to increased impulsivity and reward system dysfunction (e.g., Grassi et al., 2018; Prochazkova et al., 2018), showing that both OCD and GD patients experience increased impulsivity compared to healthy controls (Grassi, Makris, & Pallanti, 2020). In the case of IGD, of the constructs examined, it has been suggested that depression would be mostly associated with this population (e.g., González-Bueso et al., 2018; Sussman, Harper, Stahl, & Weigle, 2018). As has been observed in gambling, the poor emotional regulation strategies observed among individuals with IGD have been identified as a factor that could contribute to greater depression or anxiety among this population (e.g., Yen et al., 2018). As suggested, practitioners should evaluate emotional regulation strategies among those with IGD, and provide more adaptive strategies (Yen et al., 2018).

Impulsivity has also been considered as another of the most significant traits among gamers diagnosed with IGD (e.g., Lee et al., 2012). Previous studies (although few) have evaluated the interactions between impulsivity, gambling severity, and age, and have reported associations between impulsive choice and positive urgency only among young gamblers (18–30 years old) (Steward et al., 2017). Moreover, differences have been observed in the relationships between internet gaming disorder and impulsivity scores among different age groups (12–22 years old) (Xiang et al., 2021), although further research examining the influence of age on impulsivity is needed in addiction research. In the present study, considering the wide age range included in the sample, and that the age was not a variable of primary interest in the hypotheses, it was necessary (like gender) to control for this variable as a covariate in the moderation analyses.

4.1. Limitations

The present study has some limitations. Although the sample was relatively large (n = 1416), and psychometrically validated scales were used, the assessed variables were based on self-reports. Moreover, the cross-sectional nature of the study did not allow the determination of causal relationships between the explored constructs underlying mental health and gambling, online gaming, and LB buying. Therefore, for future research it is critical to further examine the causal nature of the effects observed in the present study, for instance, by conducting longitudinal and experimental studies, as noted by Yokomitsu, Irie, Shinkawa, and Tanaka (2021) in their systematic literature review. Moreover, to establish causal relationships between LB buying, other addictions and mental health, it would be advisable for the gaming industry to grant researchers access to their player databases, whose data on gambling/gaming patterns would also provide greater objectivity. The present study's sample was imbalanced in terms of gender, with a lower proportion of female participants. A higher percentage of males than female participants has also been reported in previous studies in this area (e.g., Macey & Hamari, 2019; Zendle & Cairns, 2018). However, to address this limitation commonly found in this field of study, the present study included moderation analysis adjusted for different sociodemographic variables such as age and gender. Another limitation was the fact that other potential risk factors associated with LB buying were not considered, such as substance use (e.g., alcohol or tobacco). For example, it has been reported that individuals who gamble more money tend to engage in other potentially addictive behaviours while gambling (e.g., cigarette smoking, drinking alcohol, illicit drug use). In fact, empirical evidence has shown the existence of a bidirectional causal effect between the consumption of addictive substances and gambling behaviour. In this sense, it has been found that involvement in gambling (daily amount of money spent on this activity) affects the probability of consuming alcohol or drugs during gambling, to the extent that their consumption encourages players to bet more money and, consequently, to become more involved (e.g., Bussu & Detotto, 2015). It has also been observed that in comorbidity between IGD with alcohol use disorder (AUD), more severe psychopathological impairments were shown by individuals with IGD not AUD, and that these individuals tended to spend more money on gaming than individuals only diagnosed with IGD (Na, Lee, Choi, & Kim, 2017). Although no differentiation was made between paid and free LB use in the present study, future research should take this distinction into consideration. For instance, previous research has shown that individuals with internet gaming–related and/or gambling disorder symptoms were found to spend significantly more money on LBs (e.g., Yokomitsu et al., 2021). It would also be advisable for future research to examine the potential mediating role of LB buying in this context. Recently, it has been suggested that there is a mediation effect of problematic LB buying between internet gaming disorder and online gambling disorder, among both minors and young

adults (González-Cabrera et al., 2024). The present study's cohort was limited to a population over the age of 18 years and considering recent findings on LB purchasing and opening (e.g., González-Cabrera et al., 2024) future research should also include minors under 18 years of age, for harm minimization purposes among vulnerable age groups.

7. Conclusion

As recent research has highlighted, loot box buying was associated with behavioural addictions (e.g., gambling or internet gaming) but further research is needed looking at these three behaviours. Finding potential similarities and/or relationships would ultimately be of great social and clinical relevance when it comes to minimising damage and regulating loot box buying under laws like those applied to gambling. Therefore, to examine whether problematic loot box buying can be akin to other behavioural addiction and to examine a more complete picture, the present study examined a wide spectrum of underlying mental health constructs (i.e., depression, stress, anxiety, and impulsivity) that have previously examined and related to behavioural addictions such as gambling and gaming. Both these addictive behaviours, in addition to presenting similarities at the neurobiological level (e.g, Fauth-Bühler & Mann, 2017) are positively associated with loot box buying (Etchells et al., 2022; Garea et al., 2021). Interestingly, the strength of the positive association between gambling and loot box buying is comparable to the positive relationship between internet gaming and loot box buying (Garea et al., 2021), a finding replicated in the present study. Additionally, although scarce, there is also literature on loot box opening/buying in relation to mental health, but the results are mixed, because while some studies suggested that there is no relationship between psychological distress and loot box opening/purchase (Etchells et al., 2022), others have shown that loot box opening/purchase is associated with higher risk of experiencing severe psychological distress (Drummond et al., 2022). Again, considering loot box regulation, it is important to understand the effects of opening/purchasing loot boxes on mental health and vice versa, especially among more vulnerable populations and at-risk users. In summary, the results replicate the previously reported relationship between LB buying and problem gambling and problem online gaming among a large sample of participants. Moreover, the present study examined the relationship between LB buying and other constructs underlying mental health. The findings showed a positive relationship, albeit weaker than that observed for gambling or online gaming, between LB buying and depression, anxiety, stress, and impulsivity. Overall, the results suggested that at least to some extent, LB buying might share depression, anxiety, stress, and impulsivity factors with addictions to gambling or online gaming. The moderation analyses found that factors such as impulsivity, anxiety, and depression moderated the relationship between risky LB buying and both gambling severity and problematic online gaming. The reported positive association between LB buying and the variables assessed could contribute to an increased risk of mental health problems. For all these reasons, the present study contributes to a better understanding of LB buying and its potential similarities to other behavioural addictions such as those to gambling or online gaming. This may be relevant for clinical practice and for the implementation of effective policies when it comes to preventing problematic LB buying.

CRediT authorship contribution statement

Cristina Villalba-García: Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Mark D. Griffiths:** Writing – review & editing, Conceptualization. **Zsolt Demetrovics:** Writing – original draft, Visualization, Validation, Methodology, Investigation, Data curation, Conceptualization. **Andrea Czakó:** Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Investigation, Data curation, Conceptualization.

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Data availability

Data will be made available upon reasonable request.

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