



# Associations between loot box purchasing and gambling behaviours, financial problems, and low mental wellbeing in a household sample from a British island, a cross-sectional study

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## Abstract

**Aim** This study estimated the prevalence of loot box purchasing and associated sociodemographic factors in a general population of a British island, and explored relationships between loot box purchasing and gambling behaviours, financial problems, and mental wellbeing.

**Subject and methods** A cross-sectional survey was undertaken using representative household and supplementary convenience samples with ( $n = 1,234$ ) residents of a British island aged 16+ years. The Problem Gambling Severity Index (PGSI) was used to assess gambling harm. Financial problems in the past year were defined as having been behind with payments for expenses. The Short Warwick Edinburgh Mental Wellbeing Scale was used to measure mental wellbeing. Purchasing loot boxes in the past year was measured via self-report as: ‘In the last 12 months, have you purchased in-game loot boxes (e.g. weapons, armour, players for a virtual sports team)?’. Analyses were performed using  $\chi^2$  and binary logistic regressions.

**Results** 5.9% of participants purchased loot boxes in the past year. There was no significant association between purchasing loot boxes and PGSI score. After controlling for sociodemographics and PGSI score, those who purchased loot boxes in the past year were 3.39 (1.42–8.11;  $p < 0.01$ ) times more likely to experience financial problems, and 2.99 times (1.46–6.13;  $p < 0.01$ ) more likely to have low mental wellbeing, compared to those who didn’t purchase loot boxes.

**Conclusion** Findings in the current study suggest that purchasing loot boxes is associated with increased odds of experiencing financial problems and low mental wellbeing, independently of gambling behaviours.

**Keywords** Loot boxes · Gaming · Gambling · Financial problems · Wellbeing

## Introduction

Loot boxes are in-game video game purchases made with real or in-game currency, with chance-based outcomes which randomly distribute rewards of different rarity and value (Wardle 2021). In recent years loot boxes have received considerable attention from media sources, academics, and policymakers (Department for Digital, Culture, Media & Sport 2022; Wardle 2021; Xiao 2023). Most of this attention has been due to concerns around the structural similarities between loot boxes and gambling, and that purchasing loot boxes may be a gateway into more traditional forms of

gambling. Some forms of loot boxes meet many of the defining criteria for gambling, including the exchange of money or valuable goods, an unknown future event determining the exchange, chance at least partly determining the outcome, avoiding losses if you do not participate, and winnings that can be cashed out into real world money (this can be done by using third-party websites for some games that include loot boxes) (Drummond and Sauer 2018; Wardle 2021). However, other forms of loot boxes do not meet this criteria, due to a lack of exchange of money or valuable goods in loot boxes that are earned through gameplay, or a lack of winnings that can be cashed out into real world money if the game does not have a third-party website where this can be done (Drummond and Sauer 2018; Wardle 2021). Due to this inconsistency, loot boxes are not classed as gambling in most countries, and therefore are not covered by relevant gambling legislations. Concerns have been raised due to the high proportion of young people who are exposed to loot

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boxes, both through in-game experiences and through popular social media personalities who promote the purchase of loot boxes through streaming platforms (BBC 2019; Cruz 2019; The Gambling Commission 2022).

Loot boxes are highly prevalent in video games. For example, in 2021 in the UK 77% of iPhone games contained loot boxes, and in 2020 in China 91% of the 100-highest grossing iPhone games contained loot boxes (Xiao et al. 2023). The UK Gambling Commission (2022) reported that a quarter of young people aged 11–16 years old had purchased loot boxes, with most indicating that they had done so within the last 12-months. Loot boxes can be purchased directly with money, or through in-game currency (which can also be purchased or earned). In some games, loot boxes can be earned, however this is at a far slower rate than if loot boxes are purchased (Wardle 2021). Research has indicated that giving gamers free loot boxes may build gamers' positive feelings towards loot boxes, increase familiarity with loot box mechanisms, and encourage future purchasing (Ballou et al. 2022; Xiao 2022; Zendle et al. 2019). Similarly, research on gambling demonstrates that free or practice games are used to foster positive associations with gambling, promoting familiarity with gambling, and encouraging further gambling consumption (Armstrong et al. 2018; Gainsbury et al. 2016; Wilson et al. 2022). Loot boxes may contain rewards that are purely cosmetic or contain items which give gamers a competitive edge through enhancing or upgrading their in-game abilities or skill sets. Research has shown that those who do not purchase loot boxes are put at a significant disadvantage in competitive games (Johnson 2019, cited in Wardle 2021 pp.67). This has been shown in qualitative research to be a motivating factor for why individuals purchase loot boxes (Nicklin et al. 2021). Other motivations include social factors (e.g., opening loot boxes when socialising, seeing popular streamers opening loot boxes, and the social status gained from receiving valuable items from loot boxes), in-game promotions, and the excitement of the experience of opening a loot box, mirroring some of the motivations associated with traditional forms of gambling (Nicklin et al. 2021; Zendle et al. 2019). There are also a number of structural characteristics of loot boxes which have similarities to some gambling products, including randomisation of rewards with chance-based outcomes, audiovisual displays accompanying outcomes, and the presence of 'near misses' (Ballou et al. 2022; Drummond and Sauer 2018; Griffiths 2018; Zendle et al. 2019). Loot boxes use the same reward mechanism as certain harmful forms of gambling (e.g., slot machines). Similarly to gambling, the randomisation of the rewards obtained in loot boxes means that an individual can never know how many times they will need to purchase loot boxes until they obtain a desirable reward, and as such learn that repeated loot box purchases

are required in order for loot boxes to 'pay out' the most valuable rewards (Drummond and Sauer 2018).

Meta-analysis suggests that there are significant positive associations between purchasing loot boxes and 'problem gambling' (Spicer et al. 2021). This relationship has also been shown in older adolescents (Zendle et al. 2019), and when factors such as impulsivity and gambling participation are controlled (Wardle and Zendle 2021). However, as most of the existing research on loot boxes is cross-sectional in nature the direction of these relationships is unclear, and there may be shared factors which promote gaming behaviours, loot box purchases and gambling harms. One longitudinal multi-country study found that loot box expenditure predicted gambling involvement 12-months later in video game players who did not gamble at baseline (Brooks and Clark 2023). However, another longitudinal study from the UK has indicated that loot box purchasing did not increase PGSI scores in a sample of young people aged 16–26, but that for young people who engaged in 'skin betting' PGSI scores increased over time (skin betting involves using video game items, including those which can be earned through loot boxes, as a wager collateral) (Wardle and Tipping 2023). This indicates that relationships between loot boxes and gambling harms may be driven by engagement with the wider loot box environments, rather than engagement with loot boxes alone (Wardle and Tipping 2023). A large body of research has demonstrated the harms associated with gambling (Langham et al. 2015; Orford 2020). Harms to the individual range from lower-level harms such as lost time, through to serious harms including debt, homelessness, and suicide (Langham et al. 2015; Orford 2020; Wardle et al. 2020). Harms are not solely concentrated in those experiencing the most severe gambling harms, with the majority of the total burden of harm within those who gamble at low- and moderate-risk gambling levels (Browne et al. 2017; Browne 2020; Canale et al. 2016).

Most of the current literature regarding loot boxes has focussed on whether they are linked to gambling harms, with further debates around whether loot boxes should be considered a gambling activity (Drummond and Sauer 2018; Griffiths 2018). However, little research has investigated if there are relationships between the purchase of loot boxes and harmful outcomes, independent of gambling behaviours. Most of the current literature on loot boxes has relied on convenience samples, with gaming being one of the inclusion criteria. Little work has been undertaken with population level samples. One previous study which did utilise a population level sample of people across three countries who played video games found that greater past-month loot box spend was associated with negative moods, and psychological distress, albeit with relatively small effect sizes (Drummond et al. 2020). Importantly, this study did not control for gambling, but

another study of an online sample of people who play video games found that purchasing loot boxes was indirectly related to mental distress through harmful video gaming and gambling behaviours (Li et al. 2019). However, these findings were not replicated in an online self-selecting sample of adult video game players across fifty-one countries (Etchells et al. 2022).

Globally, some countries have started to consider regulation of loot boxes. For example, Belgium has taken a prohibitive approach, banning the sale of loot boxes which can be purchased with money, through inclusion in pre-existing legislation, although this has been difficult to enforce in practice (Xiao 2023). Difficulties in enforcement are largely due to a lack of capacity to effectively monitor the large volume of gaming content available through different platforms, and a lack of knowledge of regulations by gaming companies (Xiao 2023). In China, regulations require that the probabilities of obtaining certain rewards are clearly disclosed to those who purchase loot boxes (Xiao 2023; Xiao and Newall 2022). However, evidence indicates that this is unlikely to be effective in reducing consumers loot box spending (Xiao and Newall 2022). This is likely in part due to the difficulties for purchasers in making sense of the complexity of loot box probability disclosures, as probabilities can change depending on number of purchases made (Xiao and Newall 2022). In the UK, there are currently no plans to regulate the sale of loot boxes under the Gambling Act (2005), with industry self-regulation being the preferred approach (Department for Digital, Culture, Media & Sport 2022; Xiao 2023). In their response to a call for evidence on loot boxes the Department for Digital, Culture, Media & Sport stated that ‘while many loot boxes share some similarities with traditional gambling products, we view the ability to legitimately cash out rewards as an important distinction’, going on to further acknowledge the difficulties that implementing changes to the Gambling Act may have (Department for Digital, Culture, Media & Sport 2022).

Considering emerging developments in policy in response to potential harms arising from loot boxes, it is important to better understand whether these products may be associated with poorer health and wellbeing outcomes. Further, as research has suggested that loot boxes have structural characteristics which are similar to gambling, it is important to examine if any associations between purchasing loot boxes and harms exist independently of gambling behaviours (Ash et al. 2022; Drummond and Sauer 2018; Mills et al. 2023; Wardle 2021).

The current study aimed to estimate the prevalence of loot box purchasing in a general population of a British island, and examine the relationships between loot box purchasing and gambling behaviours, financial problems, and mental wellbeing. The current study aimed to examine whether there are associations between purchasing loot boxes and

experiencing financial problems and low mental wellbeing, independent of gambling behaviours.

## Methods

### A-priori power analysis

An *a-priori* power calculation (G\*Power 3.1) to detect a moderate effect size (OR: 1.30; power: 0.80) for effects of a binary logistic regression assuming covariates have a moderate relationship ( $R^2 = 0.25$ ) with the independent variable (experiencing financial problems), estimated a minimum sample size of 1196 was required.

### Study design and participants

The sample was drawn from residents of a self-governing British island. The island has a total population of 53,627 residents aged 16+ years (86.1% of all residents; 50.8% female, 49.2% male).

Between October and November 2019, a cross-sectional survey of residents aged 16+ was undertaken. Sampling was undertaken in two phases. Phase 1 was an invited household representative sample of the British island’s population, with 7,000 addresses randomly selected and invited to take part in the study. Sampling was stratified by locality (‘parishes’) and social or non-social housing status due to an expected low response rate amongst individuals in social housing. Phase 2 consisted of a convenience sample, promoted through media channels. Surveys were completed predominantly online ( $n = 1199$ ) with paper versions available on request ( $n = 35$ ).

The total sample size was  $n = 1,234$ , equating to 2.4% of the total population aged 16+ years.

## Measures

### Purchasing loot boxes

The current study was a secondary analysis of a larger population level gambling, health, and wellbeing study, and loot boxes were not the main focus of that study. Therefore, purchasing of loot boxes was only assessed using one researcher derived binary measure.

Purchasing loot boxes was defined as those who answered yes (scored = 1 or 0) to the question ‘In the last 12 months, have you purchased in-game loot boxes (e.g., weapons, armour, players for a virtual sports team)?’.

### Financial problems

Financial problems were defined as those who answered yes (scored = 1 or 0) to the question ‘In the past 12-months, have

you been behind (e.g., paid late, had to borrow money, or have gone without) with payments for expenses such as rent, utilities, mortgage repayments, taxes etc.?’.

### Gambling behaviours

Gambling harm was assessed using the Problem Gambling Severity Index (PGSI). The PGSI is a self-report, validated instrument for use in general populations (Ferris and Wynne 2001; Holtgraves 2008). The PGSI tool consists of nine questions, each measured on a four-point Likert scale (0 = never, 1 = sometimes, 2 = most of the time, 3 = almost always). Scores for each question are summed, giving a total overall score ranging from 0 to 27, higher scores indicate a greater severity of gambling risk. PGSI score can be divided into the following categories: 0 = ‘non-problem gambling’; 1–2 = ‘low-risk gambling’; 3–7 = ‘moderate risk gambling’; 8+ = ‘problem gambling’. Other gambling behaviours were assessed such as the frequency of gambling (0 = never, 1 = every day, 2 = 2+ days a week, 3 = once a week, 4 = at least once a month, 5 = less than once a month), and how individuals spent money on gambling activities (online; in person; both online and in person).

### Low mental wellbeing

Mental wellbeing was measured using the short version of the Warwick-Edinburgh Mental Wellbeing Scale (SWEM-WBS; Stewart-Brown et al. 2009). This is a validated scale including seven-items about an individual’s current mental wellbeing, scored on a 5-point scale (1 = none of the time; 2 = rarely; 3 = some of the time; 4 = often; 5 = all of the time). Total scores on the SWEMWBS range from 7 to 35, with higher scores indicating higher levels of mental wellbeing. Raw scores are then converted to metric scores using a standard conversion table (Stewart-Brown et al. 2009). Metric scores were dichotomised to indicate low mental wellbeing as more than one standard deviation (4.397) below the mean (24.378), thus low mental wellbeing was operationalised as scores of < 19.981.

### Sociodemographic factors

Included sociodemographic factors were: gender, age (16–17; 18–34; 35–54; 55+ years), and household income level (< £20,000; £20,000–£79,999; £80,000+).

### Analyses

Bivariate analyses using  $\chi^2$  tests were first used to examine associations between loot box purchasing, and sociodemographics, gambling behaviours, financial problems, and low mental wellbeing. Separate binary logistic regression (enter

method) models were then used to model the relationships between loot box purchasing (independent variable) and experiencing financial problems and low mental wellbeing (separate dependent variables), controlling for sociodemographics as independent variables. To understand the extent to which gambling behaviours affected these relationships, PGSI score was also controlled for as an independent variable in separate models. Finally, in a separate model, when examining the relationships between loot box purchasing (independent variable) and low mental wellbeing (dependent variable), sociodemographics, PGSI score, and financial problems were also controlled for as independent variables. Analyses were undertaken in SPSS v.28 (IBM Corp. 2021), and alpha was set at  $p < 0.05$ .

## Results

Just over one in twenty (5.9%;  $n = 73$ ) study participants reported that they had purchased loot boxes in the past 12-months. Table 1 shows the sociodemographic characteristics of loot box purchasers. In bivariate analyses there were significant associations between purchasing loot boxes and gender (male, 8.6%; female, 2.9%;  $p < 0.001$ ), and age (16–17, 42.9%; 18–34, 11.7%; 35–54, 3.6%; 55+, 1.0%;  $p < 0.001$ ). There was no significant association between purchasing loot boxes and income level.

Loot box purchasers’ gambling behaviours are shown in Table 1. 75.3% of those who purchased loot boxes had engaged in any gambling activity in the past 12-months. In bivariate analysis there was no significant association between purchasing loot boxes and PGSI score.

In bivariate analyses the prevalence of experiencing financial problems was significantly higher amongst those who purchased loot boxes in the past year (25.7%) compared to those who did not (7.0%;  $p < 0.001$ ; Table 1). In regression models, after controlling for gender, age, and income level, those who purchased loot boxes were 3.46 times (AOR = 3.46 (1.49–8.04);  $p < 0.01$ ) more likely to experience financial problems (Table 2, Model 1). After controlling for sociodemographics and PGSI score, those who purchased loot boxes were 3.39 times (AOR = 3.39 (1.42–8.11);  $p < 0.01$ ) more likely to experience financial problems (Table 2, Model 2).

In bivariate analysis, the prevalence of low mental wellbeing was significantly higher in those who purchased loot boxes in the past year (42.5%), compared to those who did not (15.9%;  $p < 0.001$ ; Table 1). In regression models, after controlling for gender, age, and income level, those who purchased loot boxes in the past year were 3.07 times (AOR = 3.07 (1.51–6.22);  $p < 0.01$ ) more likely to report low mental wellbeing than those who didn’t purchase loot boxes (Table 3, Model 1). After controlling for sociodemographics

**Table 1** Sociodemographics, gambling behaviours, experiences of financial problems, and low mental wellbeing of loot box purchasers

	All	Purchased loot boxes (past 12-months) % (n)	Not purchased loot boxes (past 12-months) % (n)	$\chi^2$	p value
Overall	-	5.9 (77)	94.1 (1156)	-	-
Gender					
Male	45.9 (561)	8.6 (48)	91.4 (510)		
Female	54.1 (661)	2.9 (19)	97.1 (640)	18.997	<0.001
Age					
16–17	6.9 (85)	42.9 (36)	57.1 (48)		
18–34	12.6 (155)	11.7 (18)	88.3 (136)		
35–54	29.9 (369)	3.6 (13)	96.4 (353)		
55+	50.6 (625)	1.0 (6)	99.0 (619)	245.495	<0.001
Income level					
<£20,000	9.1 (96)	6.3 (6)	93.8 (90)		
£20,000–£79,999	59.5 (630)	3.5 (22)	96.5 (605)		
£80,000+	31.4 (332)	5.7 (19)	94.3 (313)	3.299	0.192
Any past year gambling	78.6 (966)	75.3 (55)	78.8 (911)	0.490	0.484
Any online gambling	12.7 (145)	16.7 (11)	12.4 (134)	1.008	0.315
Gambling frequency					
Never	25.0 (263)	26.1 (18)	24.9 (245)		
Less than once a month – At least once a month	61.3 (646)	56.5 (39)	61.7 (607)		
At least once a week	13.7 (144)	17.4 (12)	13.4 (132)	1.063	0.588
Mean PGSI score	0.23; SD = 1.77 (1222)	1.00; SD = 4.14 (71)	0.18; SD = 1.50 (1148)	-	0.103
Experiences financial problems	8.1 (99)	25.7 (18)	7.0 (81)	31.028	<0.001
Has low mental wellbeing	17.5 (212)	42.5 (31)	15.9 (181)	33.334	<0.001

**Table 2** Relationships between financial problems and purchasing loot boxes in the past year

	Model 1		Model 2 *(including PGSI score)	
	AOR (95% CI)	p value	AOR (95% CI)	p value
Gender				
Male (ref)	-	-	-	-
Female	1.39 (0.83–2.32)	0.210	1.47 (0.87–2.50)	0.151
Age (years)				
55+ (ref)	-	-	-	-
16–17	7.47 (2.33–23.93)	<0.001	8.68 (2.66–28.27)	<0.001
18–34	7.00 (3.20–15.31)	<0.001	7.01 (3.14–15.65)	<0.001
35–54	8.42 (4.32–16.42)	<0.001	8.74 (4.39–17.40)	<0.001
Income level				
£80,000+ (ref)	-	-	-	-
<£20,000	7.88 (3.12–19.87)	<0.001	7.98 (3.10–20.54)	<0.001
£20,000–79,999	3.67 (1.94–6.97)	<0.001	3.79 (1.95–7.34)	<0.001
PGSI score	-	-	1.18 (1.08–1.29)	<0.001
Loot boxes				
Has not purchased loot boxes (ref)	-	-	-	-
Has purchased loot boxes	3.46 (1.49–8.04)	0.004	3.39 (1.42–8.11)	0.006

**Table 3** Relationships between low mental wellbeing and purchasing loot boxes in the past year

	Model 1		Model 2 *(including PGSI score)		Model 3 *(including financial problems and PGSI score)	
	AOR (95% CI)	<i>p</i> value	AOR (95% CI)	<i>p</i> value	AOR (95% CI)	<i>p</i> value
<b>Gender</b>						
Male (ref)	-	-	-	-	-	-
Female	1.21 (0.85–1.72)	0.287	1.26 (0.89–1.80)	0.198	1.20 (0.83–1.72)	0.334
<b>Age (years)</b>						
55+ (ref)	-	-	-	-	-	-
16–17	2.42 (1.04–5.64)	0.040	2.53 (1.09–5.90)	0.031	2.11 (0.88–5.06)	0.095
18–34	1.66 (0.97–2.81)	0.063	1.58 (0.93–2.71)	0.094	1.24 (0.71–2.19)	0.452
35–54	2.13 (1.44–3.14)	<0.001	2.11 (1.43–3.12)	<0.001	1.69 (1.12–2.54)	0.012
<b>Income level</b>						
£80,000+ (ref)	-	-	-	-	-	-
<£20,000	3.49 (1.90–6.43)	<0.001	3.30 (1.79–6.10)	<0.001	2.73 (1.46–5.12)	0.002
£20,000–79,999	1.76 (1.18–2.63)	0.006	1.70 (1.13–2.54)	0.010	1.45 (0.96–2.19)	0.078
<b>PGSI score</b>						
	-	-	1.13 (1.03–1.23)	0.007	1.09 (1.00–1.19)	0.041
<b>Financial problems</b>						
No financial problems (ref)	-	-	-	-	-	-
Experiences financial problems	-	-	-	-	3.83 (2.28–6.42)	<0.001
<b>Loot boxes</b>						
Has not purchased loot boxes (ref)	-	-	-	-	-	-
Has purchased loot boxes	3.07 (1.51–6.22)	0.002	2.99 (1.46–6.13)	0.003	2.30 (1.07–4.95)	0.034

and PGSI score, those who purchased loot boxes in the past year were 2.99 times (AOR = 2.99 (1.46–6.13);  $p < 0.01$ ) more likely to have low mental wellbeing than those who didn't purchase loot boxes (Table 3, Model 2). After controlling for sociodemographics, PGSI score, and financial problems, the relationship between purchasing loot boxes and low mental wellbeing remained significant (AOR = 2.30 (1.07–4.95);  $p < 0.05$ ; Table 3, Model 3).

## Discussion

This study examined the prevalence of loot box purchasers in a general population sample, and examined the relationship between purchasing loot boxes, financial problems, low mental wellbeing, and gambling behaviours. We found associations between loot box purchasing and harm, independent of gambling behaviours. After controlling for sociodemographic variables, both PGSI score and purchasing loot boxes were independently related to experiencing financial problems and lower mental wellbeing. After controlling for sociodemographic variables and PGSI score, those who purchased loot boxes were 3.39 times more likely to experience financial problems. After controlling for sociodemographic variables and experiences of financial problems, PGSI score and purchasing loot boxes were both independently related to low mental wellbeing. After

controlling for sociodemographic variables, PGSI score, and financial problems, those who purchased loot boxes were 2.30 times as likely as those who did not to experience low mental wellbeing.

Our findings suggest that purchasing loot boxes may be associated with experiencing financial problems independent of gambling behaviours. Although this has not been examined in other studies of loot boxes, it is in accordance with qualitative evidence showing that purchasing loot boxes directly contributes to experiences of financial problems (Ash et al. 2022; Mills et al. 2023). These qualitative studies (Ash et al. 2022; Mills et al. 2023) were conducted between 2019 to 2022 and explored the experiences of gaming and in-game spending in children aged 5–17 years and their families living in one English region. Financial problems are often one of the earliest indicators of traditional gambling harm (Langham et al. 2015). Similarly, financial problems may also be an early indication of harmful outcomes of loot boxing purchasing behaviour. Experiencing financial problems has significant implications for health and wellbeing, and is associated with stress, experiences of stigma and shame, and less expenditure on items which are beneficial for health (Kiely et al. 2015; Richardson et al. 2013). Gambling-related stigma and shame act as significant barriers to help-seeking behaviours, promoting secrecy and exacerbating difficulties (Hing et al. 2016).

Our findings also suggest that purchasing loot boxes may be associated with poorer mental wellbeing, independently of experiencing gambling harms or financial problems. Although our study design does not allow us to make claims about causation, this interpretation is supported by previous research showing that greater loot box spend is associated with negative moods and psychological stress (Drummond et al. 2020), and qualitative research showing that purchasing loot boxes has direct negative emotional impacts (Ash et al. 2022; Mills et al. 2023). However, Etchells et al. (2022) did not find any association between mental wellbeing (using the full version of the WEMWBS) and loot box spend. The differences in findings with the current study may be due to their use of a different indicator of loot box purchasing, and the use of a self-selecting sample of video game players across multiple countries. Gaming involvement could be an underlying factor that is associated with low mood and not loot boxes. By definition, loot boxes are encountered in video games, therefore participants endorsing purchases in our study were gamers. However, Etchells et al. (2022) controlled for disordered gaming scores (measured using an adapted version of the Internet Gaming Disorder Checklist) and did not find this difference. Future studies using general population samples should control for gaming behaviours.

That loot boxes may be associated with poorer wellbeing, independent of gambling behaviours or experiencing financial problems has implications for public health. Purchasing loot boxes may be a risk factor for lower mental wellbeing, and may bring about emotional harms such as frustration, and disappointment when those who purchase loot boxes do not receive desired items, and potential negative emotions from overspending (Ash et al. 2022; Mills et al. 2023). Alternatively, people with poorer mental wellbeing may be more likely to purchase loot boxes as a source of entertainment or mood improvement. Further research on loot boxes should focus on understanding the associations between purchasing loot boxes and experiencing poor mental wellbeing.

Loot boxes with different characteristics may have different relationships with harmful outcomes. As such, different types of loot boxes may require different levels of policy action to address harms (Ballou et al. 2022). For example, video games with only loot boxes that cannot be purchased with real world money would not have negative financial impacts. Similarly, loot boxes with higher probabilities of receiving a desired item are also unlikely to promote overspending and are less likely to encourage experiencing frustration or disappointment (Ash et al. 2022; Xiao et al. 2022; Xiao and Newall 2022). In contrast, loot boxes which can be purchased with real world money, and which contain items that give the gamer competitive advantages over others may be particularly attractive to gamers, and therefore may promote overspending behaviours, which may then make

experiencing financial problems more likely (Nicklin et al. 2021; Wardle 2021; Xiao et al. 2022; Zendle et al. 2019).

Loot boxes with a high number of structural characteristics that are similar to some gambling products (e.g. having prominent audiovisual displays, or the presence of ‘near misses’), or that meet the definitions of gambling, may be more likely to promote engagement with traditional gambling products (Ballou et al. 2022). As such, these types of loot boxes may require specific policy action, particularly as shown in the current study a larger proportion of those in younger age groups purchase them. Policy action would also need to take account of factors in the wider environment that may contribute to levels of harm associated with loot boxes, but that are external to the loot box purchase (Ballou et al. 2022; Wardle 2021). For example, third party websites through which items received through loot boxes can be cashed out into real world money, are external to the loot box purchase and reward mechanism, but may make loot boxes more congruent with the definitions of gambling, which may increase risk levels. Further, the ability to trade in-game items with other players may influence levels of risk, as in these games players can use items earned through loot boxes as a wager collateral in ‘skin betting’. Skin betting has been shown by previous longitudinal research to potentially increase PGSI scores, and therefore levels of gambling risk (Wardle and Tipping 2023).

In contrast to earlier studies (Drummond et al. 2020; Etchells et al. 2022; Li et al. 2019; Spicer et al. 2021), the current study did not find a significant relationship between purchasing loot boxes and PGSI score. This may be due to methodological differences; for example, the current study recruited a sample of a general household population aged over 16 years, whereas other studies have mostly included self-selecting convenience samples of adults recruited online, with playing video games being part of the inclusion criteria. In the current sample those who were 16–17 years old were the age group reporting the highest prevalence of loot box purchasing. However, 16–17 year olds in the sample geography cannot legally gamble until the age of 18 years. Therefore, there would be a smaller proportion of individuals in the total sample that have gambled compared to other studies with adults only. Furthermore, differences in findings could also be explained by differences in the indicators of loot box purchasing used. We used a binary indicator of loot box purchases within the past year, whereas other studies have used more detailed indicators such as loot box spend, frequency of purchasing loot boxes, problematic loot box behaviours (Spicer et al. 2021). PGSI score may therefore be more closely related to more frequent or intensive engagement in loot box activity.

The findings in the current study should also be considered in light of the following limitations. The measure of loot box purchasing in the past year did not account

for heterogeneity in loot boxes characteristics. Some loot boxes may have some more harmful characteristics than others, and these may be more likely to promote more harmful levels of overspending and have more negative impacts on wellbeing (e.g., loot boxes with short outcome times, and loot boxes with lower chances of receiving desired outcomes). As such, there may be differential impacts of different types of loot boxes which are not accounted for in the current study. Further, as discussed above, the current study did not assess frequency of loot box purchases or overall loot box spend, therefore it is unclear whether the relationships we identified are more likely in those with higher purchasing frequencies. Future research should therefore aim to assess whether the current findings are consistent across different types of loot boxes purchased, and across different purchasing intensities.

Similar to the measure for purchasing loot boxes, our measure for experiencing financial problems in the past year was a broad indicator, in that even paying expenses late, or borrowing to help pay for expenses once would have constituted experiencing financial problems. While this measure captures everyone who experienced any financial problems in the past year, it does not discern between those experiencing lower-level financial problems and those who may experience more serious levels of financial problems. Further research on loot boxes should assess whether purchasing loot boxes are associated with different levels of financial problems. Finally, the current study was cross sectional in design, and so causality cannot be assessed.

## Conclusion

Our findings suggest that purchasing loot boxes is associated with higher probability of both experiencing financial problems and low mental wellbeing, even after controlling for gambling harm. This suggests that loot boxes might contribute to the overall burden of gambling related harms. As such policy action on the most harmful forms of loot boxes should aim to reduce risks of overspending and financial problems, and negative outcomes for mental wellbeing.

**Authors' contributions** CW designed the data analysis for the study, analysed the data, and produced the manuscript. NB, ZQ, and HS contributed to data analysis design and supported the drafting of the manuscript.

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**Data availability** Study materials and data are available from the corresponding author upon reasonable request.

**Code availability** Not applicable.

## Declarations

**Ethics approval and consent to participate** Formal ethical approval was granted from Liverpool John Moores Research and Ethics Committee.

**Consent to participate** Informed consent was obtained from all study participants before taking part and the study was carried out in accordance with the Declaration of Helsinki.

**Consent for publication** Not applicable.

**Competing interests** The authors have no competing interests to declare.

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## References

- Armstrong T, Rockloff M, Browne M, Li E (2018) An exploration of how simulated gambling games may promote gambling with money. *J Gambl Stud* 34(4):1165–1184. <https://doi.org/10.1007/s10899-018-9742-6>
- Ash J, Gordon R, Mills S (2022) Between gaming and gambling Children, young people, and paid reward systems in digital games. Newcastle University. Available at: <http://www.gaminggamblingresearch.org.uk/wp-content/uploads/2022/10/ESRC-BGG-Final-Report-2022.pdf>
- Ballou N, Gbadamosi C, Zendle D (2022) The hidden intricacy of loot box design: A granular description of random reward mechanisms in games. (Preprint). <https://doi.org/10.31234/osf.io/xecbk>
- BBC (2019) Youtube stars under fire for 'loot box' videos. Available at: <https://www.bbc.co.uk/news/technology-46757669>
- Brooks G, Clark L (2023) The gamblers of the future? Migration from loot boxes to gambling in a longitudinal study of young adults. *Comput Human Behavior* 141. <https://doi.org/10.1016/j.chb.2022.107605>
- Browne M, Greer N, Rawat V, Rockloff M (2017) A population-level metric for gambling-related harm. *Int Gambl Stud* 17(2):163–175. <https://doi.org/10.1080/14459795.2017.1304973>
- Browne M (2020) Measuring harm from gambling and estimating its distribution in the population. In: H Bowden-Jones, C Dickson, C Dunand, and O Simon, Harm Reduction for Gambling a Public Health Approach, 1<sup>st</sup> edn. Routledge, pp 14–22
- Canale N, Vieno A, Griffiths M (2016) The extent and distribution of gambling-related harms and the prevention paradox in a British population survey. *J Behav Addict* 5(2):204–212. <https://doi.org/10.1556/2006.5.2016.023>
- Cruz E (2019) The psychological and virtual siege of loot boxes. *J Technol Law Policy* 23(2):215–228

- Department for Digital, Culture, Media & Sport (2022) Government response to the call for evidence on loot boxes in video games. Available at: <https://www.gov.uk/government/consultations/loot-boxes-in-video-games-call-for-evidence/outcome/government-response-to-the-call-for-evidence-on-loot-boxes-in-video-games#executive-summary>
- Drummond A, Sauer J (2018) Video game loot boxes are psychologically akin to gambling. *Nat Hum Behav* 2:530–532. <https://doi.org/10.1038/s41562-018-0360-1>
- Drummond A, Sauer J, Ferguson C, Hall L (2020) The relationship between problem gambling, excessive gaming, psychological distress and spending on loot boxes in Aotearoa New Zealand, Australia, and the United States – A cross-national survey. *PLoS ONE* 15(3):e0230378. <https://doi.org/10.1371/journal.pone.0230378>
- Etchells P, Morgan A, Quintana D (2022) Loot box spending is associated with problem gambling but not mental wellbeing. *Royal Soc Open Sci* 9:220111. <https://doi.org/10.1098/rsos.220111>
- Ferris J, Wynne H (2001) The Canadian problem gambling index: final report. Ottawa, Canada
- Gainsbury S, Russell A, King D, Delfabbro P, Hing N (2016) Migration from social casino games to gambling: motivations and characteristics of gamers who gamble. *Comput Hum Behav* 63:59–67. <https://doi.org/10.1016/j.chb.2016.05.021>
- Griffiths M (2018) Is the buying of loot boxes in video games a form of gambling or gaming? *Gaming Law Review* 22(1):52–54. <https://doi.org/10.1089/qlr.2018.2216>
- Hing N, Nuske E, Gainsbury S, Russell A (2016) Perceived stigma and self-stigma of problem gambling: perspectives of people with gambling problems. *Int Gambl Stud* 16(1):31–48. <https://doi.org/10.1080/14459795.2015.1092566>
- Holtgraves T (2008) Evaluating the problem gambling severity index. *J Gambl Stud* 25(1):105–120. <https://doi.org/10.1007/s10899-008-9107-7>
- IBM Corp (2021) IBM SPSS statistics for windows, version 28.0. IBM Corp. <https://www.ibm.com/uk-en/products/spss-statistics>
- Kiely K, Leach L, Olesen S, Butterworth P (2015) How financial hardship is associated with the onset of mental health problems over time. *Soc Psychiatry Psychiatr Epidemiol* 50:909–918. <https://doi.org/10.1007/s00127-015-1027-0>
- Langham E, Thorne H, Browne M, Donaldson P, Rose J, Rockloff M (2015) Understanding gambling related harm: a proposed definition, conceptual framework, and taxonomy of harms. *BMC Public Health* 16(1). <https://doi.org/10.1186/s12889-016-2747-0>
- Li W, Mills D, Nower L (2019) The relationship of loot box purchases to problem video gaming and problem gambling. *Addict Behaviors* 97:27–34. <https://doi.org/10.1016/j.addbeh.2019.05.016>
- Mills S, Ash J, Gordon R (2023) Children and young people’s experiences and understandings of gambling-style systems in digital games: loot boxes, popular culture, and changing childhoods. *Ann Am Assoc Geogr* 114(1):200–217. <https://doi.org/10.1080/24694452.2023.2248293>
- Nicklin L, Spicer S, Close J, Parke J, Smith O, Raymen T, Lloyd H, Lloyd J (2021) “It’s the attraction of winning that draws you in” – A qualitative investigation of reasons and facilitators for videogame loot box engagement in UK gamers. *J Clin Med* 10(10). <https://doi.org/10.3390/jcm10102103>
- Orford J (2020) The gambling establishment challenging the power of the modern gambling industry and its allies. 1<sup>st</sup> edn. Routledge
- Richardson T, Elliott P, Roberts R (2013) The relationship between personal unsecured debt and mental and physical health: a systematic review and meta-analysis. *Clin Psychol Rev* 33(8):1148–1162. <https://doi.org/10.1016/j.cpr.2013.08.009>
- Spicer S, Nicklin L, Uther M, Lloyd J, Lloyd H, Close J (2021) Loot boxes, problem gambling and problem video gaming: A systematic review and meta-synthesis. *New Media Soc* 24(4). <https://doi.org/10.1177/14614448211027175>
- Stewart-Brown S, Tennant A, Tennant R, Platt S, Parkinson J, Welch S (2009) Internal construct validity of the Warwick-Edinburgh mental well-being scale (WEMWBS): a rasch analysis using data from the Scottish health education population survey. *Health Qual Life Outcomes* 7:1–8
- The Gambling Commission (2022) Young people and gambling. Available at: <https://www.gamblingcommission.gov.uk/report/young-people-and-gambling-2022>
- Wardle H, Tipping S (2023) the relationship between problematic gambling severity and engagement with gambling products: longitudinal analysis of the emerging adults gambling survey. *Addiction* 118:1127–1139. <https://doi.org/10.1111/add.16125>
- Wardle H, John A, Dymond S, McManus S (2020) Problem gambling and suicidality in England: secondary analysis of a representative cross-sectional survey. *Public Health* 184:11–16. <https://doi.org/10.1016/j.puhe.2020.03.024>
- Wardle H, Zendle D (2021) Loot boxes, gambling, and problem gambling among young people: results from a cross-sectional online survey. *Cyberpsychol Behavior Social Network* 24(4). <https://doi.org/10.1089/cyber.2020.0299>
- Wardle H (2021) Games without frontiers? Socio-historical perspectives at the gaming/gambling intersection. 1<sup>st</sup> edn. Palgrave Macmillan
- Wilson C, Butler N, Quigg Z (2022) Associations between playing free-to-play sports gambling predictor games and online sports betting frequency for men in the United Kingdom. *J Public Health*. <https://doi.org/10.1007/s10389-022-01774-4>
- Xiao L (2022) Which implementations of loot boxes constitute gambling? A UK legal perspective on the potential harms of random reward mechanisms. *Int J Ment Heal Addict* 20:437–454. <https://doi.org/10.1007/s11469-020-00372-3>
- Xiao L, Henderson L, Nielsen R, Newall P (2022) Regulating gambling-like video game loot boxes: a public health framework comparing industry self-regulation, existing national legal approaches, and other potential approaches. *Curr Addict Rep* 9:163–178. <https://doi.org/10.1007/s40429-022-00424-9>
- Xiao L, Henderson L, Newall P (2023) What are the odds? Poor compliance with UK loot box probability disclosure industry self-regulation. *Plos One* 18(9). <https://doi.org/10.1371/journal.pone.0286681>
- Xiao L, Newall P (2022) Probability disclosures are not enough: Reducing loot box reward complexity as a part of ethical video game design. *J Gambling Issues*. <https://doi.org/10.31234/osf.io/nuksd>
- Xiao L (2023) Loot box state of play 2023: Law, regulation, policy, and enforcement around the world. (Preprint). <https://doi.org/10.31219/osf.io/q2yv6>
- Zendle D, Meyer R, Over H (2019) Adolescents and loot boxes: links with problem gambling and motivations for purchase. *Royal Soc Open Sci* 6. <https://doi.org/10.1098/rsos.190049>

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