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Loot boxes and problem gambling: Investigating the "gateway hypothesis"

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ABSTRACT

Loot boxes are purchasable items in video games with a chance-based outcome. They have attracted substantial attention from academics and legislators over recent years, partly because of associations between loot box engagement and problem gambling. Some researchers have suggested that loot boxes may act as a gateway into subsequent gambling and/or problem gambling. However, such "gateway effects" have not been formally investigated. Using a survey of 1102 individuals who both purchase loot boxes and gamble, we found that 19.87% of the sample self-reported either "gateway effects" (loot boxes causally influencing subsequent gambling) or "reverse gateway effects" (gambling causally influencing subsequent loot box engagement). Both subsets of participants had higher scores for problem gambling, problem video gaming, gambling-related cognitions, risky loot boxes engagement, and impulsivity. These individuals also had a tendency for higher loot box and gambling spend; suggesting that potential gateway effects are related to measurable risks and harms. Moreover, the majority of participants reporting gateway effects were under 18 when they first purchased loot boxes. Content analysis of free text responses revealed several reasons for self-reported gateway effects, the most frequent of which were sensation-seeking, normalisation of gambling-like behaviours, and the addictive nature of both activities. Whilst the cross-sectional nature of our findings cannot conclusively establish directions of causality, thus highlighting the need for longitudinal research, we conclude that there is a case for legislation on loot boxes for harm minimisation purposes.

1. Background

Loot boxes are purchasable items in video games with a chance-based outcome. They are available in the majority of games across various formats (Zendle, Meyer, Cairns, & Ballou, 2019), and 44–78% of gamers are thought to have purchased them (Brooks & Clark, 2019; Li, Mills, & Nower, 2019; Zendle & Cairns, 2018). They have come under increasing scrutiny from academics, policymakers and the media (Drummond, Sauer, Ferguson, & Hall, 2020), with a particular focus on their wide availability to children (Zendle et al., 2019). This controversy has often focused on the structural similarities with gambling (Drummond & Sauer, 2018), where evidence from surveys of gamers – including systematic review and meta-analysis evidence (Drummond et al., 2020; Garea, Drummond, Sauer, Hall, & Williams, 2020; Spicer et al., 2021; Yokomitsu, Irie, Shinkawa, & Tanaka, 2021; Zendle & Cairns, 2018) – has established that loot box engagement is robustly associated with problem gambling.

Due to the correlational nature of this evidence, the direction of relationships between loot boxes and gambling are unknown (Delfabbro & King, 2020; Garea et al., 2020; Zendle, Meyer, & Over, 2019). There are three possibilities: either (a) gamblers purchase more loot boxes; (b) loot box purchasers are more likely to start gambling – via 'gateway effects'; or (c) there is a complex, dynamic relationship between the two behaviours – where gambling is known to interact with other risky behaviours in bidirectional, self-reinforcing cycles of activity (Derevensky, Gupta, & Della, 1996; Forrest & McHale, 2018). Furthermore, emerging evidence suggests that loot box purchasing is driven by complex motivational factors (Nicklin et al., 2021). Whatever the direction of

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causality, such associations suggest that loot box purchasers are at a disproportionate risk of harm (Zendle & Cairns, 2018; Zendle et al., 2019), and a clearer understanding of how such harm manifests will help tailor appropriate legislative, educational and therapeutic interventions.

Gateway effects have been studied in other contexts, most notably within substance abuse literature including alcohol (Kirby & Barry, 2012), cannabis (Hall & Lynskey, 2005), and prescription opioids (Grau et al., 2007), for example where legally available substances are conceptualised as a gateway into the use of controlled substances. The existence of such "classic" gateway effects has been debated (Chapman, Bareham, & Maziak, 2019; Etter, 2018), where "common liability" theories have often been proposed as an alternative to classic gateway effects, i.e. where individuals engaging in one risky activity are more likely to engage in another, due to separate shared predictors (Chapman et al., 2019; Etter, 2018; Mayet, Legleye, Beck, Falissard, & Chau, 2016). More broadly, the evidence for gateway effects is often inconclusive – for example, a meta-analysis of vaping as a gateway to smoking (Chan et al., 2021) concluded that longitudinal evidence for associations is limited by publication bias and the potential effects of confounding variables.

There is further debate about the underlying mechanisms of gateway effects, with potential reasons including pre-existing (personality) traits, peer group associations, social attitudes, and impacts on brain function (Hall & Chan, 2021; Hall & Lynskey, 2005). For the purpose of this paper, we use the term "gateway effects" to refer specifically to video gaming (mainly loot boxes) and gambling, and whether one behaviour influences the other. Broader conceptualisations of gateway effects in other fields are beyond the scope of this research.

Despite several academic commentators suggesting that such gateway effects may exist with loot boxes (Delfabbro & King, 2020; Zendle et al., 2019), as yet, there has been a paucity of research into the phenomenon. There is evidence of three-way associations between loot boxes, problem gambling and problem video gaming (Garea et al., 2020; Spicer et al., 2021; Yokomitsu et al., 2021), but this is predominantly correlational and cross-sectional. One longitudinal study found evidence of a "reverse" gateway effect (Zendle, 2019) – of gambling into loot boxes. Another longitudinal study (Molde et al., 2019) found evidence of problem gaming leading to later problem gambling (but not the reverse), although this study did not directly investigate loot boxes. There is also longitudinal evidence suggesting that certain types of social casino game are linked with subsequent real-money gambling (Dussault et al., 2017; Kim, Wohl, Salmon, Gupta, & Derevensky, 2015), although this is less relevant because these social games do not involve real money. Finally, a recent review (Delfabbro & King, 2020) into gateway effects from video gaming (including loot boxes) into gambling noted the inconclusive nature of the existing evidence. No published primary research has directly investigated gateway effects of loot boxes into problem gambling, or associations between potential gateway effects and other harms.

Legislators in several jurisdictions are either considering evidence on loot boxes and gambling (e.g. UK and Brazil), or have already introduced regulations (e.g. Belgium and The Netherlands) – with issues around legislation currently under discussion in the literature (Xiao, 2021). In the UK, such policy debates have cited putative gateway effects (Department for Digital, 2020), and we therefore sought to investigate the existence of such effects, and any potential relationships with psychological profile (e.g. impulsivity and gambling cognitions) and risky behaviours such as problem gambling and problem video gaming.

1.1. The present study

To understand whether such gateway effects exist, to what extent, and whether they are linked to risks and harms, we conducted a short survey of loot box purchasers who also gamble. This survey had three broad aims. First, to establish whether loot box purchasing acts as a gateway into subsequent gambling ("gateway effects"). Second, to establish whether gambling leads to subsequent loot box purchasing ("reverse gateway effects"). Third, to understand whether individuals reporting gateway effects are a younger, at-risk group, who may be experiencing measurable harms. We included validated instruments of problem gambling, gambling-related cognitions (e.g. illusion of control and perceived inability to stop gambling (Raylu & Oei, 2004), problem video gaming, risky loot box behaviour, and impulsivity.

Our survey used a cross-sectional design, with questions that retrospectively asked participants whether their loot box purchasing influenced them to start gambling – or vice versa (i.e. about gateway effects). We identified several research questions, and made a number of predictions (Table 1). Due to the exploratory nature of this study, it was not pre-registered, although it is a specific, targeted sub-study from a wider project (e.g. (Close, Spicer, Nicklin, Lloyd, & Lloyd, 2022) that has been pre-registered (Close, Nicklin, & Fullwood, 2021). We wanted to understand whether gamers were influenced into subsequent gambling while they were under the legal gambling age (under 18) in the UK (P1). We anticipated that the proportion of under 18s would be higher for those reporting gateway effects, compared to those reporting no gateway effects. We also investigated any potential effects of (biological) sex (P2), as male sex has been suggested as a potential risk factor for loot box engagement (Kristiansen & Severin, 2020). Our remaining predictions (P3-P10) were motivated by an expectation that potential gateway effects would be associated with harmful/risky behaviour and spending patterns – particularly problem gambling. While gateway effects have not been formally studied, such relationships have been previously speculated (Drummond & Sauer, 2018; Zendle et al., 2019). Consistent with previous findings of no association between loot box spend and income (Close et al., 2021), we did not expect to see an association between gateway effects and income.

2. Methods

We collected data from 1102 UK adults (aged 18+) who disclosed that they both gamble and purchase loot boxes. Participants were recruited via Prolific (prolific.co. Prolific [Internet]., 2021), and

Table 1
Exploratory questions (Q) and predictions (P).

Q1.	What proportion of participants self-report gateway effects (loot boxes influencing subsequent gambling) or reverse gateway effects (gambling influencing subsequent loot box engagement)?
Q2.	Does the proportion of participants self-reporting such effects vary, depending on which activity came first?
Q3.	What processes underpin any potential gateway effects, and what are the reasons for participation in one activity influencing the other?
Q4.	Are there any differences in age or sex for processes/reasons uncovered?
P1.	A greater proportion of participants self-reporting gateway effects (loot boxes into gambling) were under 18 when they first purchased a loot box. *N.b. we did not investigate this for age first gambled (*i.e. *gambling into loot boxes) because the legal gambling age in the UK is 18 – producing a confound.*
P2.	A greater proportion of males versus females will report gateway effects.
Participants self-reporting gateway / reverse gateway effects will have…	
P3.	**higher problem gambling** scores than those reporting no such effects.
P4.	**higher gambling-related cognition** scores than those reporting no such effects.
P5.	**higher problem video gaming scores** than those reporting no such effects.
P6.	**higher risky loot box engagement** scores than those reporting no such effects.
P7.	**higher impulsivity** scores than those reporting no such effects.
P8.	**higher spend on loot boxes** than those reporting no such effects.
P9.	**higher spend on gambling** than those reporting no such effects.
P10.	**will not have a higher income** than those reporting no such effects.

completed a questionnaire on the Qualtrics platform (qualtrics.com. Qualtrics [Internet]., 2021). These questions were embedded within a larger survey intended for separate publication (Close et al., 2021), which included a wider range of questions about gaming, gambling and loot boxes, along with measures of motivation to purchase loot boxes, psychological distress, mental health and wellbeing (see Appendix 1 for further details). Participants provided informed consent prior to completing the survey. Ethical approval was granted by the University of Plymouth Faculty of Health Research Ethics and Integrity Committee.

Participants were asked what age they first gambled and first purchased loot boxes. If participants purchased loot boxes first, they were asked, "Did purchasing loot boxes, in your opinion, contribute to your decision to start gambling?" If participants gambled first, they were asked, "Has your previous experience with gambling, in your opinion, influenced your decision to purchase loot boxes?" Both questions had binary yes/no responses. If participants were the same age when they started both activities, they were asked, "Which came first – your first gambling experience or your first loot box, or did you decide to do both at the same time?" Depending on their answer to this question ("Gambling", "Loot Boxes" or "Both"), participants were directed to one, or neither, of the above questions. Participants answering "yes" to one of the above questions were asked "could you explain a bit more about your answer to the previous question?" and provided with a free text box to respond.

Additionally, we asked participants "thinking about the past year, how much money did you spend in a typical month on each of the following?" to obtain typical spend on both loot boxes and gambling. Additionally, we asked "if you are working, what is your income (per year, before tax)". We also asked participants to answer questions on a set of validated measurement scales: problem gambling severity index (PGSI (Ferris & Wynne, 2001); gambling-related cognitions (GRCS (Raylu & Oei, 2004); internet gaming disorder i.e. problem video gaming (IGD (Pontes & Griffiths, 2015); risky loot box index (RLI (Brooks & Clark, 2019); and Barratt impulsivity scale – brief (BIS-Brief (Patton, Stanford, & Barratt, 1995).

2.1. Quantitative analyses

We analysed differences in the proportion of participants answering yes versus no on the gateway/reverse gateway questions using both frequentist Chi-Squared tests, and equivalent Bayesian Contingency tests. Differences in mean scores on the spend data and measurement scales were analysed using both frequentist Wilcoxon tests, and Bayesian t-tests. Spend data is often highly skewed (Close et al., 2021), so we have reported results from both untransformed and Tukey transformed spend data on the Bayesian t-tests. We applied False Discovery Rate (FDR) corrections for multiple statistical tests, across the entire set of frequentist analyses. The alpha level was set to $p < .05$ for all frequentist analyses, while $BF > 3$ was set as substantial evidence of a difference for all Bayesian analyses (Jeffreys, 1998), with $BF < 0.33$ providing evidence of no difference (and values in between accepted as inconclusive).

2.2. Content analysis

We conducted a quantitative content analysis (Krippendorff, 2018) on the free-text responses to the gateway questions to explore and categorise the underlying processes relating to any self-reported gateway effects. This followed an exploratory approach, using an emergent coding scheme (see further methodological details (Hewson, Vogel, & Laurent, 2015; Stemler, 2015; Prasad, 2008; Fullwood, Sheehan, & Nicholls, 2009)). Each response box was coded independently and in its entirety (by researcher CF). A codebook was developed for the different reasons (see Appendix 2 for examples) participants believed loot boxes were a gateway to gambling (and vice versa). Before the final analysis, a second researcher (LN) coded 20 random responses in each data set to compare with the primary coder's codes. As agreement (k = 0.50) was below the desired level for both codebooks (k < 0.60) (Landis & Koch, 1977), each was revised following discussion, to reduce ambiguity and improve reliability. A second random sub-sample of 20 responses from each data set was then coded using the revised codebooks and agreement (Cohen's kappa) demonstrated good reliability for the gateway and reverse gateway data (0.93 and 0.88 respectively). Additional quantitative analyses were conducted on the gateway categories (from our content analysis) against the age participants first bought loot boxes and gambled – using both frequentist (FDR corrected) and Bayesian ANOVA's.

3. Results

3.1. Prevalence of gateway effects (Q1-Q2; P1-P2)

The data and analysis for this study are openly available at https://osf.io/hs2e7/. The proportion of participants reporting gateway effects and reverse gateway effects (Q1) was equivalent in both directions with 19.87% reporting either effect (19.63% of those who bought loot boxes first reported gateway effects, while 20.11% of those who gambled first reported reverse gateway effects – see Table 2). Our analyses provided evidence of no difference ($BF < 0.33$) in the proportion of participants in each group (gambled first versus bought loot boxes first) (Q2), $\chi^2(1) = 0.01$, $p = .912$, $BF = 0.06$.

Of those who perceived a (forward) gateway effect, 82.4% (n = 61) were under 18 (P1) when they first purchased a loot box, significantly more than 67.3% (n = 204) for those who did not perceive a gateway effect, $\chi^2(1) = 5.80$, $p = .021$, $BF = 4.24$. This finding suggests that loot boxes influenced gamers' subsequent gambling behaviour while they were below the legal UK gambling age. We note that more gamers gambled before buying loot boxes than the reverse – possibly reflecting the shorter time loot boxes have been widely available. The proportion of males reporting gateway effects was significantly higher than the proportion of females (P2), $\chi^2(1) = 6.14$, $p = .019$, $BF = 3.43$. However, there was evidence of no difference between the proportion of males and females reporting reverse gateway effects, $\chi^2(1) = 0.20$, $p = .693$, $BF = 0.09$.

3.2. Profile of participants reporting gateway effects (P3-P10)

See Table 3 for results of P3-P10. As predicted, participants who reported gateway/reverse gateway effects experienced greater gambling-related harm (P3), gambling-related cognitions (P4), and problem video gaming (P5). These participants were also more impulsive (P7), had greater risky engagement with loot boxes (P6), and spent more money on gambling (P9). Participants who bought loot boxes first also spent more money on loot boxes (P8), although this result was ambiguous for participants who gambled first (frequentist test suggested a significant difference, but the BF was inconclusive). As predicted, participants reporting gateway/reverse gateway effects did not have a higher income (P10), confirming no link with greater financial resources (Close et al., 2021). It is worth noting that significant differences on the

Table 2
The proportion of participants self-reporting gateway effects (LB first) or reverse gateway effects (Gambled first), split by sex, with n reporting effects in parentheses. N.b. 29 participants reported starting gambling and LB purchasing at same time.

Group	% who perceived a 'gateway effect' from one activity to the other		
	Total	Male	Female
Bought loot boxes first (n = 377)	**19.6%** (n = 74)	23.8% (n = 56)	12.8% (n = 18)
Gambled first (n = 696)	**20.1%** (n = 140)	21.0% (n = 67)	19.4% (n = 73)

Table 3
Difference in scores, spend and income, for participants reporting gateway effects versus no gateway effects. Mean values are reported in the 'Avg' column, except spend data for LB (row "LB Spend") and Gambling (row "Gamb Spend") where high skew resulted in non-representative means, so the median is reported instead. Significance tests with an assumption of normality were calculated using both transformed and non-transformed spend data (with the latter in parentheses; "UT"). All scales are scored positively, so higher numbers signify higher level of measured concept. Please note that scales were standardised to start from zero, with scale range (i.e. 0–27 for PGSI) detailed in parenthesis in the "Group" column. Green shading indicates a significant difference, red indicates no significant difference, and yellow indicates a mixed result.

Group	Gateway	Loot boxes first Avg	Sig	Gambled first Avg	Sig
PGSI (P3) (0-27)	Yes	6.46	$p < .001$ $BF = 1.10x10^9$ $d = .92$	5.19	$p < .001$ $BF = 2.19x10^{15}$ $d = .85$
	No	2.45		1.84	
GRCS (P4) (0-138)	Yes	43.8	$p < .001$ $BF = 1.65x10^6$ $d = .77$	42.0	$p < .001$ $BF = 1.57x10^{19}$ $d = .95$
	No	27.7		23.4	
IGD (P5) (0-36)	Yes	14.7	$P < .001$ $BF = 1.95x10^3$ $d = .59$	13.4	$p < .001$ $BF = 1.04x10^{11}$ $d = .73$
	No	10.6		8.51	
RLI (P6) (0-20)	Yes	13.4	$p < .001$ $BF = 5.21x10^2$ $d = .54$	12.9	$p < .001$ $BF = 1.79x10^{10}$ $d = .70$
	No	11.3		10.1	
BISB (P7) (0-24)	Yes	11.1	$p = .007$ $BF = 3.40$ $d = .34$	10.2	$p < .002$ $BF = 27.16$ $d = .32$
	No	9.77		8.83	
Loot Box Spend (P8) (£)	Yes	20	$p = .001$ $BF = 55.70$ (UT = .29) $d = .46$ (UT = .16)	10	$p = .022$ $BF = 1.49$ (UT = .83) $d = .22$ (UT = .20)
	No	10		10	
Gambling Spend (P9) (£)	Yes	20	$p < .001$ $BF = 3.66x10^2$ (UT = .14) $d = .53$ (UT = .02)	13.5	$p < .001$ $BF = 86.75$ (UT = .11) $d = .35$ (UT = .01)
	No	5		5	
Income (P10) (£)	Yes	1204	$p = .202$ $BF = .28$ $d = .16$	1882	$p = .055$ $BF = 1.24$ $d = .21$
	No	1388		2169	

Bayesian t-tests (for spend) were dependent on first transforming the spend data (which was highly skewed). There was also a correlation between loot box spend and problem gambling within our full dataset ($\tau = 0.15$, $p < .001$, $BF = 2.91 \times 10^{10}$), as well as between loot box spend and problem video gaming ($\tau = 0.13$, $p < .001$, $BF = 6.23 \times 10^7$), replicating previous findings (4,7–9). Impulsivity, previously suggested as a risk factor for loot boxes – albeit with mixed findings (8), did not correlate with loot box spend ($\tau = 0.01$, $p = .495$, $BF = 0.05$), but did correlate with risky loot box engagement ($\tau = 0.10$, $p < .001$, $BF = 1.07 \times 10^4$).

3.3. Content analysis (Q3 and Q4)

A codebook was developed for participants reporting gateway (n = 74) and reverse gateway (n = 139) effects to explore the reasons for such effects (Q3). The final categories for the gateway and reverse gateway codebooks are in Table 4.

Table 4
Codebooks emerging from content analysis.

Gateway		Reverse gateway	
1. Sensation-seeking	Replicating thrill, excitement, adrenaline rush of loot boxes in a different format	**1. Sensation-seeking**	Replicating thrill, excitement, adrenaline rush of gambling in a different format
2. Normalised	Transitioned to gambling because it has similar characteristics to loot boxes. It has become normalised/routine	**2. Normalised**	Transitioned to loot boxes because it has similar characteristics to gambling. It has become normalised/routine
3. Attitude change	Using loot boxes has altered attitudes/perceptions, e.g. no harm had come from loot boxes so assumed same would be the case in gambling	**3. False perceptions**	Gambling has created false perceptions, e.g. success in gambling is presumed to carry over to loot boxes.
4. Addiction	Loot boxes were considered addictive and gambling is another outlet to satisfy that addiction	**4. Addiction**	Gambling was considered addictive and loot boxes are another outlet to satisfy that addiction
5. Money	Moved on to gambling to make 'real' money	**5. Safer**	Transitioned to loot boxes as they are considered a 'safer' form of gambling, e.g. easier to control/limit spending
6. Unable to determine/other	None of the above	**6. Unable to determine/other**	None of the above

3.3.1. Content analysis: gateway data

The total frequencies for the gateway categories (i.e. from loot boxes into gambling) for male and female respondents (Q4) are displayed in Fig. 1. *Sensation-seeking* (n = 29; 39.2%) and *Normalised* (n = 21; 28.4%) were the two most frequent categories explaining the transition from loot boxes to gambling.

ANOVA (both frequentist and Bayesian) revealed a significant difference between the mean age participants first purchased loot boxes, between the five gateway categories (Q4), $F(4,69) = 4.49$, $p = .007$, $BF = 9.63$, $\eta^2 = 0.21$. While the mean age participants first purchased loot boxes appeared lowest in the *addiction* and *normalisation* categories (see Table 5), the sub-sample of participants was too small to conduct accurate post-hoc tests. There was no significant difference between the age participants first gambled (with an inconclusive *BF*), $F(4,69) = 2.59$, $p = .073$, $BF = 1.30$, $\eta^2 = 0.13$. Therefore, post-hoc tests were not conducted.

3.3.2. Content analysis: reverse gateway data

The total frequencies for the reverse gateway (i.e. from gambling into loot boxes) categories for male and female respondents are displayed in Fig. 1. *Sensation-seeking* (n = 49; 35.3%) and *Safer* (n = 37; 26.6%) were the two most frequent categories explaining the transition from gambling to loot boxes. In addition, men were proportionally (n = 19; 28.8%) more likely than women (n = 6; 8.6%) to indicate that they had transitioned to gambling from loot boxes because it had become *Normalised*. This effect was significant, $\chi 2(1) = 11.52$; $p = .003$, $BF = 304.07$.

There was no significant difference in the age participants first purchased loot boxes, between the five gateway categories (excluding 'unable to determine'), $F(4,132) = 2.01$, $p = .097$, $BF = 0.55$, $\eta^2 = 0.06$. There was also no significant difference between categories in terms of the age participants first gambled, $F(4,132) = 2.25$, $p = .084$, $BF = 0.87$, $\eta^2 = 0.06$. Both *BF*'s were inconclusive. Post-hoc tests were not conducted.

Table 5
Mean age (S.D) by forward and reverse Gateway Categories.

Gateway direction	Category	Age of first loot box purchase: Mean (S.D)	Age first gambled: Mean (S.D)
Forward Gateway	Sensation-seeking	15.79 (2.41)	18.79 (2.44)
	Normalised	14.86 (1.42)	17.57 (1.66)
	Attitude Change	16.43 (1.62)	18.71 (2.43)
	Addiction	14.00 (1.94)	17.67 (1.94)
	Money	18.63 (5.15)	20.63 (2.58)
Reverse Gateway	Sensation-seeking	26.73 (8.22)	17.90 (2.49)
	Normalised	24.48 (5.58)	16.96 (1.99)
	False Perceptions	26.08 (8.52)	17.58 (2.84)
	Addiction	30.43 (4.78)	18.14 (3.98)
	Safer	31.03 (15.99)	19.54 (5.28)

4. Discussion

Our results provide the first preliminary evidence of hypothesised gateway effects of loot boxes into gambling (Delfabbro & King, 2020; Drummond & Sauer, 2018; Zendle et al., 2019), as well as further evidence of the reverse effect (Zendle, 2019). A sizeable minority (19.87%) of loot box purchasers who gamble self-report such effects. Importantly, 80.13% of loot box purchasers who also gamble did not report gateway effects, suggesting the majority of gamers may not be at risk of these effects – and indicating that we must not ignore other factors, including potentially complex motivations driving engagement with loot boxes (Nicklin et al., 2021). Nevertheless, loot boxes may pose risks without progression to other forms of gambling; a point that has previously been highlighted (Spicer et al., 2021; Zendle et al., 2019). For example, 61 of 303 participants in our dataset, who reported no gateway effects (loot boxes into gambling), were in the highest quarter of the risky loot box engagement (RLI) scale.

All of our predictions (P3-P10) were supported for gateway effects. In particular, problem gambling (PGSI) scores were almost three times higher among participants reporting gateway effects than those reporting no gateway effects. Notably, scores of 3–7 are classed as "moderate risk gambler" on the PGSI, so a mean score of 6.46 in this group (see Table 3) is at the upper end – with 32.43% over the threshold for "problem gambler" (scores of 8 or above). Participants reporting gateway effects also had higher scores for gambling-related cognitions, problem video gaming and impulsivity, while also spending more on loot boxes and gambling. These findings suggest complex relationships between risky behaviours – with migration between them – and measurable harm in a young population. Participants reporting gateway effects did not have a higher income, consistent with concerns about unsustainable spending patterns (Close et al., 2021; Gach, 2017; Hannah & Andrews, 2020; Higuchi, 2017; Zendle et al., 2019). An equivalent pattern of results was seen for reverse gateway effects, where all but one of our predictions were supported; where P8 (loot box spend) had mixed results (depending on statistical paradigm). These findings support concerns that problem gamblers who engage with loot boxes are at risk of developing harmful patterns of loot box engagement and spend (Close et al., 2021; Drummond et al., 2020; Zendle et al., 2019). With 19.87%

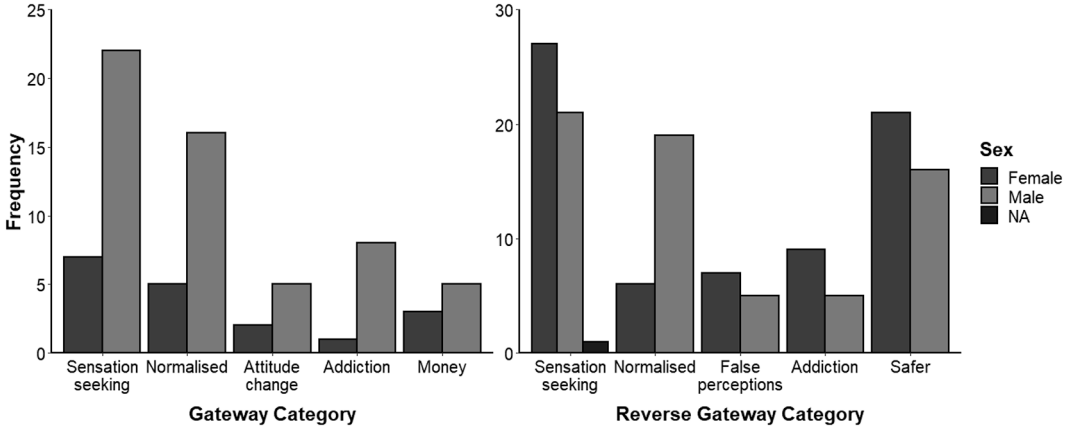

Fig. 1. Frequency of categories split by sex for gateway and reverse gateway data.

of our sample self-reporting gateway effects (in either direction), a substantial number of the UK gaming population may be impacted by such effects.

The majority of participants reporting gateway effects were under-18 when they first purchased loot boxes. Whilst this does not establish evidence that loot boxes are "training children to gamble later in life" (England, 2020; Zendle et al., 2019), it does highlight that any putative gateway effects are disproportionately liable to manifest during childhood. Furthermore, participants who stated *addiction* as the primary reason for loot boxes leading to other forms of gambling had a mean age of 14.00 when they first purchased loot boxes (see Table 5). Similarly, the mean age of participants in the *normalisation* category was 14.86, suggesting a subset of underage loot box purchasers are progressing to other forms of gambling due to shared characteristics between the activities. That males were significantly more likely to report that gambling had become normalised, to explain their transition into loot box purchasing, also warrants further investigation, as it suggests that loot boxes are an additional factor in the cultural normalisation of gambling for young males (McGee, 2020).

The content analysis highlights other processes underlying gateway and reverse gateway effects. *Sensation seeking* was the most frequent category, with both directions of gateway effect showing the importance of thrill seeking amongst these sub-populations of gamers; consistent with our finding that these cohorts are also more impulsive. Sensation-seeking and impulsivity may therefore be useful predictors of gamers most susceptible to gateway effects. Here, previous studies have found mixed results of a relationship between loot box spend and impulsivity (King, Russell, Delfabbro, & Polisena, 2020; Zendle et al., 2019). Our results revealed a relationship between impulsivity and risky loot box engagement – but not loot box spend. Furthermore, our study focuses on a subset of gamers, where impulsivity may be specifically linked with gateway effects in younger gamers. We also note sex differences between gateway and reverse gateway effects: the former is male dominated; the latter is even across sexes. The reasons are not clear, although male sex has been previously associated with loot box engagement (Kristiansen & Severin, 2020).

In contrast to impulsive and sensation seeking motivations, a subset of participants reporting reverse gateway effects started engaging with loot boxes because they perceived this to be a *safer* activity than other forms of gambling. It is possible that loot boxes may be beneficial to such gamers i.e. as a way of reducing harm – although the perception that loot boxes are 'safer' may be illusory, as such individuals may simply be transferring harms to a new activity. Research is required to establish the relative harms of these activities.

In summary, there appears to be a complex relationship between loot boxes and gambling, in which bidirectional effects result in gateway and reverse gateway effects – and absence of any perceived gateway effects amongst others. These effects are also related to a number of other behaviours, including problem gambling, problem video gaming and higher spend on gambling and loot boxes. Content analysis suggests that putative gateway effects often manifest via addiction, normalisation, and sensation seeking.

4.1. Limitations

The primary limitation of this study is the cross-sectional approach, where we asked participants about gateway effects retrospectively. Any subjective reporting of causality does not necessarily mean it exists, and individuals with gambling problems may actively seek explanations for their behaviour, providing alternative interpretations of our results. Future longitudinal research is required and may have importance in justifying the implementation – or removal – of specific types of legislation. However, broader legislation rests on more than evidence of gateway effects. Our cohort was limited to a UK population over the age of 18, and any future research should include children. A larger sample would enable pairwise comparisons of gateway categories and age first gambled/bought loot boxes. Future research should incorporate qualitative interviews, to gain a richer understanding of these processes, and could more clearly investigate the distinction between gateway effects into gambling – and gateway effects into *problem* gambling, gaming and loot box engagement.

5. Conclusions

Our findings have implications for future policy, where our preliminary evidence of self-reported gateway effects suggests that around one in five loot box purchasers who gamble are influenced by such effects – and that these individuals exhibit greater problem gambling behaviours. Even if such associations are underpinned by common liabilities (i.e. rather than directly causational gateway effects), the results demonstrate that gambling and loot boxes have shared psychological characteristics and risk profiles. Whilst we emphasise a need for some caution interpreting our preliminary findings, loot box legislation may be argued on both structural grounds (e.g. the shared characteristics to gambling) and also harm minimisation purposes.

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CRediT authorship contribution statement

Stuart Gordon Spicer: Methodology, Investigation, Formal analysis, Writing – original draft, Writing – review & editing. **Chris Fulwood:** Methodology, Investigation, Formal analysis, Writing – original draft, Writing – review & editing. **James Close:** Methodology, Investigation, Writing – review & editing, Supervision, Project administration. **Laura Louise Nicklin:** Methodology, Investigation, Formal analysis, Writing – review & editing. **Joanne Lloyd:** Methodology, Investigation, Writing – review & editing, Supervision, Project administration. **Helen Lloyd:** Methodology, Investigation, Writing – review & editing, Supervision, Project administration.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.addbeh.2022.107327.

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