Loot boxes and other gambling-like products inside video games

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Suggested running head (62 characters including spaces):
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Abstract (200 words):

Loot boxes and other similar products inside video games can be purchased by players with real-world money to obtain random rewards. These mechanics have been deemed as gambling-like because players are betting money on unknown outcomes. Concerns have been raised about players spending too much money and the normalization of gambling-like behaviors amongst children, who generally cannot legally access more traditional forms of gambling due to age restrictions on participation. Despite these products being relatively novel, many studies have already been conducted considering whether they might be similarly 'addictive.' Importantly, monetary spending on loot boxes is linked to problem gambling, suggesting that gambling consumers could also be at risk of loot box-related harms, or that loot box users could be particularly vulnerable to gambling harms. More research is required to better understand this association. Notwithstanding, some countries have already sought to proactively address potential harms through regulation. Multiple potential approaches, ranging from completely restricting access to merely requiring the disclosure of information related to the product, are available. The regulations' implementation should be regularly assessed to allow for countries to decide whether the rules should be changed based on scientific evidence and whether they should follow another country's example.

Key words (5-6):

Loot boxes; Gacha; Gambling-like products and activities; Computer games; Videogaming regulation; Novel behavioral addictions

Introduction

Video games companies are increasingly generating revenue not only through the sale of a copy of the software (*i.e.*, a 'product') but also by offering players opportunities to make so-called 'in-game purchases' to access additional content (*i.e.*, providing a 'service'). This shift from the game-as-a-product business model to that of the game-as-a-service paradigm is not inherently unethical (Neely, 2021), although it has given rise to some concerns.

Firstly, prior to the proliferation of in-game purchases, the amount players could spend on a single game was known and effectively capped because the software was purchased at a set price, after which there were very few further opportunities to spend more money. However, many recently released games are continuously maintained by companies to encourage players to make additional financial contributions in exchange for access to newer content. Under this model, spending has become potentially unlimited. A player cannot know how much they will spend in total on a specific game, but they can safely assume the opportunity to make 'microtransactions' will be regularly advertised.

Secondly, some in-game transactions involve randomization to determine what the player receives in return for spending money. The different potential outcomes vary greatly in desirability: most of the time, the player will obtain worthless or mediocre rewards, whilst rarely, the player will obtain valuable items. This encourages players to spend money on repeat purchases to attempt to get rarer items and effectively creates a gambling-like system (Drummond & Sauer, 2018). These in-game purchases involving random chance in contemporary video games have many forms (*e.g.*, 'loot boxes' (Zendle & Cairns, 2018); 'card packs' (Xiao et al., 2024); 'gacha' 'summoning' mechanics (Woods, 2022); and even social or simulated casino games (Gainsbury et al., 2014)), and many of these games are given age ratings stating that they are suitable for young children (Xiao et al., 2023; Zendle et al., 2020). This chapter first explores the many different kinds of gambling-like products that are presently available and identifies how the previous literature has oversimplified the situation. These new developments in the monetization of video games mean that players are now offered the opportunity to spend an unlimited amount of money on in-game purchases whose results are randomly determined (hereinafter, collectively referred to using 'loot boxes' as a shorthand). Many have argued that loot boxes are a close approximation to gambling because of the psychological and structural similarities (*e.g.*, similarities in their design) shared between these activities, or argued that loot boxes are actually gambling (Drummond & Sauer, 2018; Nielsen & Grabarczyk, 2019; Xiao, 2022b). Yet, traditional gambling is generally heavily regulated and, even where permitted, available only to adults. In contrast, loot boxes are widely available for purchase by children (Xiao et al., 2023;

Zendle et al., 2020), who might be less developmentally, psychologically, and informationally equipped to recognize the relevant risks involved (Mills et al., 2023, p. 206).

Irrespective of the age of the person who purchases a loot box, there is concern that they might experience harm. Research has found that loot box spending and engagement is linked to problematic gambling (Brooks & Clark, 2019; Kristiansen & Severin, 2019; Li et al., 2019; Zendle & Cairns, 2019), problematic video gaming (Garea et al., 2021; Spicer et al., 2022), and other traits (e.g., impulsivity) and socio-economic demographic features that are associated with engaging in more traditional addictive behaviors, such as substance misuse (Close et al., 2022; Spicer et al., 2022). This chapter therefore also comprehensively reviews the quantitative and qualitative literature on loot boxes from psychology and other fields to establish what is known and what more still needs to be learned.

Interestingly, despite loot box engagement being much more novel and significantly less studied than other behaviours known to pose the risk of addiction, many countries have sought to address potential concerns by regulating loot boxes without a robust evidence base . This chapter closes by summarizing various regulatory approaches that have been attempted globally, with an emphasis on empirical assessments as to whether they have worked in practice. The success and failures of these efforts at regulating this novel and potentially addictive behavior associated with digital technology can inform any public health policies that may be taken to address other emerging addictive behaviors.

Finally, it should also be emphasized that irrespective of whether or not an activity is 'addictive' *per se*, regulation might well be justified to address consumer protection concerns. In the case of loot boxes, even though engaging with the product itself has not yet been proven to be a separate form of addiction, heavy use of loot boxes might well be a symptom of gambling or video gaming addiction, both of which have been medically recognized and addressed in other chapters of this Handbook, although the latter's recognition has been controversial (Aarseth et al., 2016).

What is a Loot Box? Exploring the Different Types

This chapter focuses on in-game purchases involving some elements of randomization. This does not mean that other non-randomized in-game purchases (such as 'battle passes' that players buy to gain the opportunity to obtain predetermined items but only after subsequently spending significant amounts of gameplay time (Petrovskaya & Zendle, 2020)) and even non-monetized video game mechanics (such as daily login rewards that incentive the player to engage with the) are not potentially concerning (Petrovskaya et al., 2022; Petrovskaya & Zendle, 2021). They are, as these too can potentially cause players to spend substantial sums of money or to engage in videogame play (e.g., spending purely 'too much' time absent of additional monetary expenditures) in a problematic

and arguably addictive manner that is detrimental to other aspects of the player's life and their wellbeing. Indeed, there are loot boxes that can be obtained and opened entirely for free without the player having to spend any real-world money during the process (Xiao, 2022b, pp. 446–449). These non-paid or free loot boxes are similarly outside the ambit of the present chapter which deals exclusively with paid loot boxes that both involve the investment of at least some real-world money and randomization, given that stakeholders tend to be more concerned about these mechanics specifically as their potential harms are more directly obvious. The term 'loot boxes' means 'paid loot boxes' hereinafter unless otherwise specified.

The most 'traditional' loot boxes were found in games such as *Overwatch* (Blizzard Entertainment, 2016): players were given the opportunity to spend real-world money to directly purchase items that were literally called 'loot boxes' containing randomized rewards. The mechanic in other games may not be visually represented as a box, a crate, or a treasure chest being opened but operate on similar gambling-like principles and remain clearly recognizable as such. For example, in the game *Hearthstone* (Blizzard Entertainment, 2014), the 'loot box' mechanic was represented as a pack of random cards being opened, whilst in *灌篮高手 [Slam Dunk]* (DeNA, 2018), the loot box was portrayed as a prize wheel that randomly landed upon various spaces indicating different results (Xiao, 2022a, pp. 351–352). The 'loot boxes' of many so-called East Asian 'gacha' games (Blom, 2023), such as *Honkai Star Rail* (miHoYo, 2023), are not even depicted as an interactable object. Instead, the player 'summons' potential rewards, such as new playable characters, on so-called 'banners' that display (possibly exclusively) the most highly sought-after potential rewards. These mechanics are broadly referred to by players as 'gacha' mechanics. The literature has also debated whether social or simulated casino games, which allow the player to spend real-world money to participate in traditional gambling activities (typically highly randomized or chance-based) but, importantly, does not allow players to convert any potential winnings back into real-world money, would also constitute games with 'loot boxes' (Xiao, Henderson, & Newall, 2022; cf. Zendle et al., 2022).

In many games, loot boxes could not be purchased directly with real-world money and must be bought instead using a virtual in-game currency that was in turn bought with real-world money. Such additional layers of currency transactions likely obfuscate the real-world monetary costs of loot boxes: for example, a loot box priced at US$0.99 clearly costs exactly that, whilst in games like Genshin Impact (miHoYo, 2020), the actual cost of a loot box priced at 160 'primogems' (an invented, in-game currency) is a lot less clear when the player can only buy at least 300 'genesis crystals' (another in-game currency) for US$4.99 that must then be converted to primogems at a ratio of 1:1; the remaining 140 primogems cannot actually be spent to buy another loot box unless the player obtains more primogems, by spending more money buying more genesis crystals.

Other games implemented even more complex procedures for obtaining and opening loot boxes. In games like *Counter-Strike: Global Offensive* (Valve, 2012), the loot box itself can be obtained without spending money, but can only be opened to get random rewards if the player spends money on a key to unlock it. Some games have gone even further, in *Diablo Immortal* (Blizzard Entertainment & NetEase, 2022), players were able to buy keys that can unlock random rewards with real-world money but then must complete certain gameplay challenges before being presented with the opportunity to spend a key in exchange for random rewards. Other games like *MapleStory M* (Nexon, 2018) offered classic loot boxes containing random content but also implemented mechanics that allowed players to spend money for a random chance to upgrade their existing items.

Another specific aspect that is highly important is whether the random content obtained can be converted into real-world money, because the presence of which often results in the relevant loot box being found to have satisfied a necessary legal element of 'gambling.' Paid loot boxes whose random content is convertible into money (*e.g.*, because they can be transferred to another player in exchange for the other player providing cash) would constitute illegal gambling under the laws of many countries (Xiao, Henderson, Nielsen, et al., 2022).

Many other aspects of loot box design have also been implemented differently in various games (Ballou et al., 2020). Conceivably, the various types of loot boxes described above would also affect player psychology in different ways, such as how informed (or not) a decision to purchase loot boxes might be. However, much of the existing literature speaks of 'loot boxes' only as if they are a singular phenomenon, although some exceptional studies have focused on specific differences in implementation (cf Zendle et al., 2019). Players are often, for example, asked how much they have spent on loot boxes generally across many different games, and this is not particularly informative in helping us to better understand these nuanced variations of loot box mechanics. To illustrate, players who engage with 'gacha' mechanics may not even identify as someone who buys 'loot boxes' and thus under-report their spending. Future research should consider specific implementations of loot boxes, rather than generalizing and oversimplifying the whole issue.

Review of the Literature

Motivations for Loot Box Engagement

A number of studies have explored player motivations for loot box use through qualitative means. In a sample of 441 respondents, Zendle, Meyer, & Over (2019) noted that common motivations to purchase loot boxes included: for gameplay advantages (21.9% of participants), for specific items/collections (19.2%), for the thrill of it (16.0%), for cosmetic items (15.3%), to support the game (10.7%), the perception that loot boxes provide good value for money (9.8%), quicker in-game progression (6.2%), and for relatively few, to specifically 'cash out' by selling the received item

(0.9%). Similarly, Nicklin et al. (2021) completed in-depth interviews with 28 players and identified motivations using inductive thematic analysis, producing seven themes that generally aligned with Zendle et al. (2019). Their results included a broader range of social factors (e.g., status, supporting a charity, the influence of others), a fear of missing out, and being nudged through specific triggers (e.g., in-game promotions). Puiras et al. (2023) noted that gambling and loot box use converge on the motivations of the chance to win something of value and an enjoyment of the activity. A series of online focus groups with adolescents (aged 14-to-17), found that young gamers generally defined gambling as having the features of: a loss of money, reliance on chance outcomes, and the risk of addiction (Rolando & Wardle, 2023), and that these characteristics also apply to loot boxes and other video game elements. Notably, the ability to cash out was not seen as a necessary feature of gambling. This suggests that regulation which has only focused on loot boxes that allow cashing out could be overly restrictive and miss the other possible harms outlined above.

Associations Between Loot Boxes and Gambling

Early research on microtransactions within video games focused upon 'social casino games'. Players have the opportunity to purchase more points to continue play or to unlock features via microtransactions (Wohl, Salmon, Hollingshead, & Kim, 2017). Social casino games are associated with increased gambling urges among those with gambling problems (Gainsbury, Hing, Delfabbro, Dewar, & King, 2014; Hollingshead, Kim, Wohl, & Derevensky, 2016), and making microtransactions has predicted migration to online gambling (Kim, Wohl, Salmon, Gupta, & Derevensky, 2015). Gambling, social casino games, and loot boxes all share the characteristic of variable reward schedules, where behavioural reinforcement (i.e., actually winning money, points, or a desired virtual item) occurs unpredictably (Garea, Drummond, Sauer, Hall, & Williams, 2021; Macey & Hamari, 2022). Variable reward schedules produce high and steady response rates (Laskowski, Dorchak, Ward, Christensen, & Euston, 2019), and may also be effective at encouraging cognitive distortions such as an overconfidence in one's ability to predict outcomes and create a sense of illusory control (King, Delfabbro, & Griffiths, 2010). In gambling, high rates of these distortions are linked to problematic behaviour (Fortune & Goodie, 2012; Yakovenko et al., 2016). Thus, given what has been empirically observed between social casino games and gambling, it logically follows that the gambling-like loot box features of many video games will likely also link with actual gambling cognitions and behaviour.

A primary empirical finding that underscores the association between loot boxes and gambling is evidence of a positive correlation in cross-sectional surveys between measures of loot box engagement and gambling. These variables have typically centered upon loot box and gambling spending, and gambling symptoms assessed by self-report measures, such as the Problem Gambling Severity Index (PGSI; Ferris & Wynne, 2001). First shown by Zendle & Cairns (2018) in a large sample

(*n* = 7,422) of players recruited through Reddit, these findings have been replicated in adult (Brooks & Clark, 2019; Li, Mills, & Nower, 2019; von Meduna, Steinmetz, Ante, Reynolds, & Fiedler, 2020; Zendle & Cairns, 2019) and adolescent samples (Hing et al., 2022; Ide et al., 2021; Kristiansen & Severin, 2020; Zendle et al., 2019). Meta-analyses by Garea et al. (2021) and Spicer et al. (2022) reported average effect sizes of r = .26 and r = .27 (considered small-to-moderate effects), respectively, between loot box spending and problem gambling symptoms. In comparing loot box users to non-loot box users, Zendle & Cairns (2018) discovered that problem gamblers were more likely to purchase loot boxes than non-problem gamblers, but this did not extend to other microtransactions, suggesting a preference for loot boxes by gamblers. This finding was supported by Close et al. (2023) who found that the strength of association between problem gambling symptoms and video game spend was stronger with loot box users than non-users. Of note, almost all research on loot box engagement has come from Western countries (Xiao, Fraser, & Newall, 2023). Using a sample of gamers from the People's Republic of China (PRC), Xiao et al. (2023) initially did not replicate the otherwise repeatedly observed positive correlation between loot box spend and PGSI score (r_s = 0.07, not significant), and only weakly and non-meaningfully replicated the link between loot box spend and gambling engagement (r_s = 0.06, p = 0.04). However, that study was underpowered, and a more recent and robust PRC study did replicate the positive correlation between loot box spend and PGSI score (r_s = 0.22, p <.001) and also found a link between loot box spend and gambling engagement (r_s = 0.22, p <.001) (Xiao, Fraser, et al., 2024). Notwithstanding, a study of Pacific (mostly Samoan) New Zealand players failed to find an association between loot box purchasing and gambling participation (Gentles et al., 2022). Culturally unique factors, such as the limited availability of gambling, might influence the relationships between loot boxes and gambling. Significantly more research is needed of non-Western gamers to assess the generalizability of this otherwise robust link.

Research has also extended to variables beyond the relatively narrow scope of associating loot box spend with gambling spend or symptom comparisons. An attempt to broaden these analyses led to the development of the 'Risky Loot Box Index' (RLI; Brooks & Clark, 2019). This is a single factor measure of loot box-related behaviours that could be problematic. The RLI's five items align with compulsive use and preoccupation with loot boxes, as well as 'chasing' loot box items through repeated purchases, and initial tests found the RLI positively correlated with PGSI-measured gambling symptoms across two samples (r = .315 - .491), later replicated by Drummond, Sauer, Ferguson, & Hall (2020). Perhaps expectedly, risky loot box use has also associated with problematic video game use (Brooks & Clark, 2019; Drummond, Sauer, Ferguson, & Hall, 2020), and risky use does not need to link to gambling to be harmful (Spicer, Fullwood, et al., 2022; Xiao, Henderson, Nielsen, & Newall, 2022). Xiao, Fraser, Nielsen, & Newall (2024) reported that a translated Simplified Chinese version of

the RLI continued to correlate with problem gambling (r_s = 0.31), problem video gaming (r_s = 0.30), and loot box spending (r_s = 0.45) in a sample from the PRC. Using item response theory, Primi, Sanson, & Donati (2024) concluded this measure efficiently assesses the risks of loot box engagement among adolescents within an Italian sample, and that loot box engagement, expectedly, best explained risky use. Subsequent measures have also been developed such as the RAFFLE (Lloyd et al., 2021), which assesses the motivations to purchase loot boxes across seven factors (player enhancement, progression, social pressure, distraction/compulsion, altruism, fear of missing out, and item resale), and a modified 7-item Swedish version of the RLI expanded the measure to 2 factors: time spent and money spent to earn loot boxes (Forsström, Chahin, Savander, Mentzoni, & Gainsbury, 2022). The development and refinement of these, and future, measures will contribute to a more nuanced understanding of how loot box systems relate to player behaviours and traits.

Looking beyond measures of gambling spend or gambling symptomology, loot box engagement (measured by the RLI) has also been positively correlated with 'gambling-related cognitive distortions' (GRCDs; Brooks & Clark, 2019; Close et al., 2023). These are erroneous gambling beliefs that comprise a cognitive variable implicated in problematic gambling. For example, the *Gambler's Fallacy* is the belief that a win is 'due' after experiencing several losses in random-chance games. In a companion study to Close et al. (2023), Spicer et al. (2024) utilized a statistical method (zero-inflation Bayesian mixed-effects multiple regressions) to collapse their samples of loot box and non-loot box users into a single group. In doing so, problem gambling was no longer predictive of risky loot box engagement and less predictive of loot box spend, when problem video gaming and gambling-related cognitions were controlled for. However, gambling-related cognitions continued to predict loot box spend and engagement when controlling for problem gambling and video gaming. Spicer et al. (2024) interpreted their findings as supporting the idea that erroneous gambling beliefs could underpin both risky loot box and gambling behaviours, and therefore be responsible for overlap between these behaviours.

A primary finding of Close et al. (2023) was that greater loot box engagement positively associated with the experience of flow, where one feels fully immersed or absorbed in an activity. The authors postulate that flow could result from the broader game and subsequently influence loot box purchasing to maintain engaging gameplay, or that a motivation to escape negative affective states (e.g., low mood) through more passive distraction could incidentally lead to greater loot box use. This latter interpretation has been referred to as 'dark flow' (Dixon et al., 2018). In their second study, Spicer et al. (2024) described a particularly complex relationship between flow and loot boxes. Specifically, that flow is negatively associated with the onset of loot box expenditure, perhaps because loot box mechanics (e.g., entering menus to purchase/open a loot box) can be disruptive to the

broader game experience. However, among their participants who already initiated loot box use, flow became predictive of higher loot box spend and risky use. As outlined by Spicer et al. (2024), this could signal either a transition to game experience enhancement by loot box obtained items or a state of escape due to the mechanism itself (i.e., dark flow). The concept of flow has received significant attention in the gambling literature and has been identified as one reason for continued gambling (Dixon et al., 2018; Murch, Chu, & Clark, 2017; Murch, Ferrari, McDonald, & Clark, 2020; Murch & Clark, 2019). Their research highlights another cognitive mechanism shared by both loot boxes and gambling and emphasizes the need for further exploration of the link between flow and in-game microtransactions, especially across different implementations of loot box mechanics.

Rarer and more desirable loot box rewards elicited 'post reinforcement pauses' from participants (Larche, Chini, Lee, Dixon, & Fernandes, 2021). These pauses represent a delay in the response-contingent behaviour (i.e., buying/opening another loot box) after receiving a desired reward. These same authors also reported that loot box outcomes are associated with increased physiological arousal as measured by skin conductance. These are regularly reported behavioural and physiological reactions in gambling (Dixon, MacLaren, Jarick, Fugelsang, & Harrigan, 2013). In sum, the collective research on loot boxes and gambling have demonstrated that the activities positively correlate at the behavioural, psychological, and even physiological levels.

Research Investigating Causal Pathways

Researchers in this area have regularly noted that causal interpretations cannot be inferred via analyses using cross-sectional data. Of course, understanding the directionality would provide valuable insight for the development of sensible consumer protections. Two possible pathways have generally been proposed as possible interpretations (Brooks & Clark, 2019; House of Commons Digital, Culture, Media, and Sport Committee, 2019; Spicer, Fullwood, et al., 2022). First is the concern that loot boxes could both introduce and encourage involvement in conventional gambling among players (Macey & Hamari, 2022; Spicer, Fullwood, et al., 2022; Zendle & Cairns, 2018). This pathway, of loot boxes leading to subsequent gambling, has been referred to as the 'gateway hypothesis' (Spicer, Fullwood, et al., 2022) or 'migration' (Brooks & Clark, 2023), and is similar to the finding that social casino game microtransaction use predicted subsequent gambling onset (Kim et al., 2015). A mechanistic explanation of this pathway could involve engagement of the dopamine system and the process of incentive sensitization, engaged by the uncertain reward outcomes of loot boxes (Zack, St. George, & Clark, 2020). This could increase incentive values of cues that become associated with desired loot box outcomes (e.g., the audio-visual experience; 'near-miss' outcomes). Data also indicates that an earlier onset of gambling, such as during adolescence, is a risk factor for later

gambling problems (Kessler et al., 2008). This implies that youth could be sensitized to gambling-like behaviour through loot box features at an age where conventional gambling is otherwise prohibited.

The second commonly proposed causal direction is the 'reverse' pathway, which proposes that individuals who are already experiencing gambling problems could be disproportionately drawn to loot boxes because of their behavioural and psychological similarities to gambling (Brooks & Clark, 2019; Spicer, Fullwood, et al., 2022; Zendle, 2019; Zendle & Cairns, 2018). This suggests separate regulatory action that would target gamblers as a vulnerable group to reduce financial harms when gaming. Both causal directions can exist, and other explanations involving third variables or respondent perceptions have been commented upon. Sidloski et al. (2022) found some evidence that gamers could be reporting symptoms of loot box use when completing problem gambling measures. Although the size of this effect was modest and cannot explain the full relationship (Xiao, Newall, et al., 2024), it is a reminder that alternative explanations (in this case ambiguous survey question wording) need to be empirically tested.

An increasing number of studies have focused upon these causal pathways, including some initial longitudinal work. Zendle (2019) conducted a survey on players (*n* = 112) of the game *Heroes of the Storm*, both before and after the publisher removed loot boxes from the game (with other microtransactions retained). Only individuals identified as 'Problem Gamblers' via the PGSI (Ferris & Wynne, 2001) reduced spending following this change. Zendle (1019) interpreted this as support for the reverse pathway, where gamblers were drawn specifically to loot box features. Spicer et al. (2022) utilized a cross-sectional survey to explore respondents (*n* = 1,102) retrospective impressions the influence loot box and gambling behaviours had upon each other. Approximately one-in-five participants endorsed a migration effect, attributing prior loot box use to later gambling behaviour, and another one-in-five endorsed the reverse. Endorsement of either pathway was associated with significantly higher PGSI scores, more gambling cognitions, risky loot box use, and greater gambling spend. Yet, retrospective data has some key limitations, including necessitating participants' own awareness of causal influences and the accurate recall of past experiences and behaviours. Spicer et al. (2022) supports the viability of both pathways and suggests that at least some gamers view the migration and reverse pathways as a possible explanation for their behaviour. Contrary to the above, in an experiment by D'Amico et al. (2022), participants (*n* =153) played a video game for twenty minutes in one of three groups: loot boxes, non-randomized rewards, and no rewards. After this exposure, they completed a well-established behavioral risk-taking task (Balloon Analogue Risk-Taking task), and strong evidence for no effect between these two behaviours was found. However, due to the brief nature of D'Amico et al. (2022) task, their results do not rule out the possibility of a cumulative sensitization to gambling from regular loot box use over months or years.

The regulatory discussion around loot boxes and gambling generally assumes that randomized reward mechanics underlie the proposed causal link between the behaviours. Video games also offer non-randomized items for purchase, and Zendle & Cairns (2018) initial study on loot boxes showed that these were not linked to problem gambling, but later studies have not been as definitive about this lack of relationship (Close, Spicer, Nicklin, Lloyd, & Lloyd, 2022; Drummond et al., 2020; Zendle & Cairns, 2019). To attempt to clarify this, Brooks & Clark (2023) conducted a six-month longitudinal study using a sample of self-identified non-gamblers (baseline *n* = 415; follow-up *n* = 291). Between baseline and follow-up, 33 non-gamblers reported initiating gambling activity. Using logistic regressions, baseline loot box spending and the RLI predicted both migration to gambler status and subsequent gambling spend. A participant was 24.9% more likely to migrate per doubling of loot box expenditure, and 61.6% more likely per standard unit increase on the RLI. Notably, baseline loot box spending continued to significantly predict migration to gambling when these non-randomized purchases were controlled for, and non-randomized purchases stopped predicting migration to gambling when loot box purchases were controlled. This was interpreted as evidence of: (1) a temporal link extending from loot boxes to later gambling, and (2) that the randomized reward mechanisms of loot boxes drive this relationship (rather than a general tendency to make microtransactions). Looking at the reverse pathway, Brooks & Clark (2023) resorted their baseline participants into a loot box non-user group, and this produced mixed evidence. While baseline gambling-related cognitions were predictive of loot box onset by six-month follow-up, gambling expenditure and PGSI score were not. This is somewhat consistent with Spicer et al. (2024), who noted gambling-related cognitions may underpin the broader relationships between loot box engagement, gambling spend, and problem gambling.

A longitudinal study conducted by González-Cabrera et al. (2023) sought to explore the stability of loot box purchases among minors (baseline *n* = 2,817; follow-up *n* = 2,213; aged 11-17 years-old), and to assess for temporal associations between loot box purchasing at baseline and six-month follow-up gambling and gaming behaviour. The authors found that a majority of participants who purchased loot boxes at baseline continued to do so at follow-up (56.2%). Given the many variables that likely influence loot box purchasing such as having access to fiat currency as a minor, parental supervision, and school obligations, this result can be interpreted as relative stability of the behaviour. González-Cabrera et al. (2023) also found that loot box purchasing minors (compared to non-purchasers) were more likely to report gambling at follow-up, both gambling disorder symptoms and gaming disorder symptoms; but this depended heavily upon participant gender. Loot box purchasing girls were 3.59 times more likely to endorse gambling (1.96 times for boys), as well as 10.7 times and 8.91 times more likely to meet criteria for online gambling and gaming problems,

respectively, when compared to their non-loot box purchasing counterparts. Loot box purchasing boys did not score significantly higher on these symptom measures than non-purchasing. González-Cabrera et al. (2023) both reinforce the evidence of a migration pathway and expand its presence to include adolescence.

In the longitudinal work described above, causal pathways are inferred from the temporal ordering of variables. Yet, temporal precedence is not enough to establish causality; this also requires covariance between the variables and elimination of possible third variable explanations for the perceived relationship (Duckworth, Tsukayama, & May, 2010). As described throughout this section, there is abundant evidence for covariation between loot boxes and gambling, and early evidence the migration to gambling pathway. However, more work needs to be done to strengthen the evidence for temporal relationships and rule out possible alternative explanations.

A longitudinal study by Wardle & Tipping (2023) points to one potential third variable explanation. The authors assessed several gambling activities at baseline among adolescents aged 16-to-26. In their 'parsimonious model' loot boxes were removed as a non-significant predictor, whereas 'skin betting' (the use of virtual items as a currency to gamble with) remained predictive of increased PGSI scores. Notably, even if skin betting fully accounts for the relationship, loot boxes would presumably still need to be purchased in order to gamble with the received virtual items, meaning the potential for financial harm remains. Other possible third variables have been considered in cross-sectional studies. Hing et al. (2022) reported that loot box purchasing behaviour continued to increase the odds of at-risk and problem gambling, when controlling for other gambling behaviours. Coelho et al. (2023) found that loot box purchases and their risky use remained significant predictors of problem gambling, when controlling well-known risk factors in the gambling literature (depression, anxiety, adverse childhood experiences, emotional dysregulation, and negative). This could be explained by evidence that loot box use and gambling actually differ in their risk and protective factors (DeCamp, 2021), and therefore the traditional risk factors of gambling might not play a significant confounding role in the relationship between loot box spending and gambling.

With the continued developments in the research on loot boxes and gambling, we can expect a steady shift from acknowledging the association towards better understanding the specific mechanisms and directions that produce the relationship. The early longitudinal work has started to provide some evidence for the migration from loot boxes to gambling, and it has also highlighted the random reward mechanism as the specific contributor to this pathway. Yet, for directional causality to be clearly established, much more work needs to be done to explore the potential effects of other variables within longitudinal studies. For example, as Brooks & Clark (2023) highlight, the unmeasured variable of low parental supervision could explain both youth engagement with loot boxes, and then

subsequent onset of gambling behaviour. Gambling-related cognitive distortions are one of the cognitive variables that deserve significantly more attention in the now burgeoning literature on loot boxes. These have been shown to account for a significant portion of risky loot box use (Brooks & Clark, 2019), and perhaps generally underpin the detected relationships between gambling and loot box behaviours (Spicer et al., 2024). Should subsequent work demonstrate that gambling cognitions are a primary explanatory variable for the link, then, to borrow from Drummond & Sauer (2018), this would be evidence that loot boxes are 'psychologically akin' to gambling.

Regulation

Scientific evidence on the potential harms of loot boxes is still emerging, and the public's understanding of these mechanics is still developing. Nonetheless, a number of countries have already adopted regulations to deal with the issue as a precaution (Leahy, 2022). A wide range of different approaches have been put into practice, ranging from prohibiting access by banning the mechanic entirely to merely requiring certain information to be provided by companies to players to help them make more informed decisions (Xiao, Henderson, Nielsen, et al., 2022).

Belgium: Banning Loot Boxes

Belgium has taken the most restrictive approach: the country's gambling regulator published a report explaining that all paid loot boxes irrespective of whether their rewards can be converted into real-world money constitute illegal gambling under the pre-existing national gambling law (which differs from those of other countries, which would only prohibit paid loot boxes whose rewards can be converted into cash as discussed above), thus banning them for both children and adults because even people aged 18 and above are not permitted to participate in illegal gambling (Belgische Kansspelcommissie [Belgian Gaming Commission], 2018). A number of major companies reported complying with the law (e.g., 2K Games, 2018; Nintendo, 2019) by removing either the ability to purchase loot boxes or withdrawing the games entirely from the country's market. However, in 2022, 82 of the 100 highest-grossing iPhone games were found to have continued to sell loot boxes despite the supposed 'ban' (Xiao, 2023b). The law has not been enforced beyond the publication of the original report due to practical difficulties, including a lack of funding for the regulator.

This case demonstrates that attempting to regulate a specific aspect of video games (or digital technology more broadly) is extremely difficult: more than one million games are available for iPhones alone, and it simply is unrealistic to expect a traditional regulator to moderate all of that content. Instead, governments might consider funding regulators sufficiently to ensure that they can regulate the most popular products, such as the 500 highest-grossing games (rather than every available product, which would be impossible to do), and ensure their compliance. This would not eliminate the problem entirely but can provide substantial protection to players as spending on video

games is known to be highly concentrated in the most popular games: 85% of all spending was estimated to be on the 100 top-grossing games (Joseph et al., 2023, p. 7253). If adopting such an approach, governments ought to be transparent about what is achievable in order not to mislead the public into believing that they are better protected than they actually are, which might cause them to be less careful and thus more vulnerable to harm .

Germany & Australia: Minimum Age Ratings

Instead of preventing everyone, including adults, from purchasing loot boxes like Belgium tried, but failed, to do, Germany and Australia have adopted policies requiring that the presence of loot boxes must be considered when making video game age rating decisions. These decisions would produce an age rating, which would be the official guidance for players and parents on whether a game is suitable for children under a certain age. In Australia, from September 2024 onwards, games with loot boxes must be rated M or 'not recommended' for children under 15 at a minimum (Guidelines for the Classification of Computer Games 2023 (Cth) (Australia)). A similar policy has been in force in Germany from January 2023 onwards (§ 10b(3) JuSchG (Jugendschutzgesetz [Protection of Young Persons Act]). Although German law does not set out a minimum age rating per se, unlike in Australia, rating decisions since made by the age rating organization have shown that, as a matter of practice, games with loot boxes would be given at least USK 12 (Xiao, 2024c), although this may be departed from. This approach may effectively restrict young children's access to loot boxes thus reducing harm. However, it also encourages companies to abandon the young children's market and to focus instead only on older consumer groups; this would negatively affect the amount of gameplay content available to younger children, who may be less able to derive the many benefits of video game play, ranging from entertainment to opportunities to socialize and practice certain skills. Government could instead consider requiring companies to produce child-appropriate versions of the game that do not generate revenue using loot boxes instead.

China, South Korea, UK, EU and Others: Information Disclosure

Other regions have been less interventionist in their regulations. Instead of preventing or limiting access, companies are required to provide more information about their products so that consumers can make more informed purchasing decisions. Neither players' ability to purchase loot boxes nor companies' ability to sell loot boxes have been curtailed. Broadly speaking, two types of disclosures have been required.

Presence Disclosure

The UK (Committee of Advertising Practice & Broadcast Committee of Advertising Practice, 2021) and the EU (through the European Commission (2021)) have required that companies must disclose that a game contains loot boxes in any advertising. This is because this information is

important for some consumers when deciding whether to purchase or download the game. The UK advertising regulator has enforced this rule by upholding multiple complaints against video game companies for failing to disclose loot box presence on app store listing pages and in social media advertising (Advertising Standards Authority, 2023a, 2023b, 2024a, 2024b, 2024c). Age rating organizations in North America and Europe (the Entertainment Software Rating Board (ESRB) (2020), Pan European Game Information (PEGI) (2020), and the USK (Unterhaltungssoftware Selbstkontrolle) (2022)) have also adopted rules requiring companies to disclose loot box presence and now provide this information alongside the age rating, although this disclosure message has been criticized for failing to sufficiently inform consumers about loot boxes' potential harms (Garrett et al., 2022; Xiao, 2021). Unfortunately, many games' store listings and advertising materials remain non-compliant because the regulators of other countries have been less proactive with enforcement, and it is difficult to inform companies based in faraway regions (*e.g.*, in China, the US, and Israel) about their obligations and force them to comply (Xiao, 2023a, 2023c, 2024a).

Probability Disclosure

Mainland China, Taiwan, South Korea, and the EU require companies to inform players about the probabilities of getting different potential rewards from loot boxes (Xiao, 2024b). This is intended to help players better estimate how much money they might need to spend for a given item by providing transparency. The exact requirements differ across countries: for example, Taiwan requires the provision of a specific warning message stating that buying loot boxes is a chance-based activity and does not guarantee that the player obtains any specific rewards. App stores like those of Apple and Google have also required probability disclosures as a matter of self-regulation in other regions, such as the UK, despite there being no legal regulations requiring them in those areas. Research has found that a majority of games now do make probability disclosures for their main loot box mechanic (Xiao et al., 2021, 2023). However, these disclosures are often not easy to access: *e.g.*, requiring many manual steps to be taken by the player before the disclosures would be eventually shown or displaying the disclosures only in an image that is non-text searchable. This means that players may not always have easy access to probability disclosures. Governments should require companies to make probability disclosures using an industry standard manner that is easily accessible and visually prominent to reduce the burden on consumers to try to find disclosures made in different ways in various games. No research has yet been conducted on whether this measure reduces overspending.

Conclusion

Loot boxes and other purchases that players can make inside video games that involve randomization are controversial because they are gambling-like. A scientific literature has developed around why people buy loot boxes; how loot box and gambling behaviours link together (with an

emphasis on problematic use); and what this means in terms loot box use potentially encouraging subsequent gambling and vice versa. A more nuanced understanding requires future studies to better account for, *inter alia*, the perspectives of non-Western players and how loot boxes are implemented differently in individual games. A number of countries have already attempted to regulate these novel products due to concerns around overspending and the normalization of gambling, particularly amongst children. Irrespective of whether purchasing loot boxes itself is an 'addiction' *per se*, high spending might be a symptom of gambling or video gaming addiction. A degree of precautionary regulation is likely justified to protect consumers by, *e.g.*, providing more transparency. Many different regulatory approaches of varying degrees of restrictiveness could potentially be imposed. Whether companies are complying with regulations and whether players are benefiting from stricter regulations in practice should be continually monitored.

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