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Loot Boxes, Problem Gambling, and Problem Gaming: A Critical Review of the Emerging Literature

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Abstract:

The literature studying video game loot boxes is young but growing quickly. Given the rapid proliferation of loot box research and its developing influence in public policy, a stocktaking and critical reflection is in order. This paper reviews the emerging literature on loot boxes and problematic behaviors such as problem gambling and problem gaming and describes some challenges facing this research. The main problems involve (1) the availability of relevant and useful data, choice of research subjects, and difficulties of reliable and representative sampling; (2) the use of research tools and methods that fail to take account of the unique characteristics of loot boxes; and (3) neglect of the underlying economic significance of loot box engagement, a necessity for considering the true social impact and the policy implications of loot boxes. Together, these challenges show clearly that loot box research has a long way to go before it can be relied on for practical purposes. The paper concludes by outlining a positive research program with a view to informing policy.

Keywords: Video Games, Loot Boxes, Problem Gambling, Problem Gaming, Economics, Public Policy.

[Department statements, if appropriate, will be added by the editors. Teaching cases and panel reports will have a statement, which is also added by the editors.]

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1 Introduction

Since 2017, the global video game industry has been inundated with calls for the regulation of “loot boxes,” randomized in-game rewards that can often be paid for with real-world currency. In some cases, paid loot boxes affect competitive gameplay, and they have been frequently criticized by gamers on the grounds that they undermine fair competition by allowing players to “pay to win,” and for various other reasons (Macey and Bujic, 2022). However, paid loot boxes have also been associated with disordered behaviors such as problem gambling and problem gaming. In consequence, many public authorities are studying loot boxes with a view toward regulation. To take only a few examples, in the United States, at least four states have proposed legislation to restrict the marketing and sale of loot boxes (McCaffrey, 2019); at the national level, the Federal Trade Commission held a workshop in 2019 to discuss loot boxes and consumer rights (Federal Trade Commission, 2019); and a bill to regulate loot boxes has been floated in the Senate (Van Allen, 2019). In Europe, representatives from numerous countries’ gambling authorities have expressed concern over the blurring of lines between gaming and gambling (Gaming Regulators European Forum, 2018), and the UK has investigated loot boxes as potential forms of immersive and addictive technologies (Digital, Culture, Media and Sport Committee, 2019). Authorities in Belgium and the Netherlands have required developers to remove loot boxes from games sold in their territories, although the latter decision was eventually overturned (for summaries of some of these proposals or restrictions, see Schwidessen and Karius, 2018; McCaffrey, 2019).

Importantly, regulatory and policy interest in loot boxes is informed by a growing body of academic literature. As will be shown, although this literature was effectively non-existent in 2017 (DeCamp, 2021, p. 190), it has since then ballooned into several dozen peer-reviewed articles across several disciplines—including Information Systems—and is growing quickly enough that reviews and meta-analyses of its results are beginning to appear (Garea et al., 2021; Spicer et al., 2021; Yokomitsu et al., 2021). This attention is understandable, as legislators and regulators have repeatedly pointed out that the technology behind loot boxes, as well as their implications for business and consumer psychology, are complex and require a dedicated body of research. Public investigations have therefore cited the peer-reviewed literature and invited researchers to give evidence in public inquiries (Environment and Communications References Committee, 2018; Australian Government, 2019; Digital, Culture, Media and Sport Committee, 2019), and researchers have been open about their desire to inform policymaking (e.g., Drummond, Sauer, and Hall, 2019; Griffiths, 2019; Li, Mills, and Nower, 2019, p. 31; Spicer et al., 2021; Zendle and Cairns, 2018, pp. 8, 9, 10; Zendle, Meyer, and Over, 2019, p. 17; Zendle et al., 2019). It is thus reasonable to say that academic research is having an impact on legislators’ and regulators’ opinions about loot boxes, which in turn highlights the need for a frank assessment of this literature, as public officials must be able to rely on a large body of rigorous and policy-relevant work in order to make informed decisions.

The need for a critical review is further indicated by the lack of critical attention currently being paid to the literature. For example, a recent literature review (Yokomitsu et al., 2021) showed that according to the 14-point Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies (National Heart, Lung, and Blood Institute, n.d.), there are currently no studies of the highest quality in the literature, and around 75% of available research is merely of “fair” quality. Among the most frequently-reported concerns were sampling criteria, justifications for sampling size, lack of repeat assessment, and the clarity and consistency of outcome measures. Despite these findings, however, there has been little or no investigation of the fundamental methods, concepts, and interpretations used in loot box research. Crucially, existing studies also tend to neglect the practical economic significance of loot box engagement, which is necessary for considering the policy implications of the controversy (McCaffrey, 2020). As a result, despite the prominence of loot box research in ongoing government investigations and policy proposals, most of it has been accepted uncritically. It is therefore reasonable to argue that more research into the economic and social impact of loot boxes is urgently needed. It is especially important to investigate potentially unique aspects of loot boxes that might help to inform legislators and policymakers.

This paper thus has three purposes: first, to reconsider the main findings of the academic literature on loot boxes and problem behaviors; second, to give legislators and other authorities a clearer idea of the limitations of current work and how any such problems relate to public policy; and third, to chart a research agenda for future work that encourages more rigorous research and more policy-relevant findings. What follows is a survey of the literature on loot boxes and human behavior, especially with regard to problem gambling and problem gaming. We begin by providing some background information

about gambling and gaming addiction research, and about loot boxes themselves. We note especially the conceptual problems posed in this literature, which often stem from assuming that new products or game design elements fit easily into older definitions and models of gambling behavior. We then conduct a hybrid “critical-scoping” review of the loot box literature and outline a series of general and specific problems facing current research. After examining experimental research, we focus on the empirical literature, addressing in turn several methodological problems: sampling, debates about the prevalence of loot box purchasing, motivations for loot box purchasing, and the methods used to screen for problem gambling and problem gaming. Finally, we turn to economic-philosophical issues about the practical significance of loot box engagement in terms of overspending and other potential harms, and the relationship between loot box research and moral panic. We conclude by outlining a positive program for future work, with a view to informing public policy.

2 Conceptual Foundations

2.1 Video Games and Addictive Behaviors

The addictive potential of video games was first studied in the 1980s, although this early work focused largely on anecdotal evidence or the hasty application of traditional criteria for pathological gambling to video games (Griffiths, Kuss, and King, 2012, pp. 1-2). The literature has developed substantially since that time, however, and there now exist specialized literatures on video game addiction, traditional gambling in video games, and the convergence of gambling and gaming (see, e.g., Wood, 2008; Griffiths, Kuss, and King, 2012; Macey and Hamari, 2018; Gainsbury, 2019; Delfabbro and King, 2020). Research on the behavioural implications of loot boxes forms a new branch of this broader literature. It revolves around two types of problematic behavior in particular: problem gambling and problem gaming. As we will see, both have been linked to loot box engagement, so it is necessary to discuss the meaning of these terms and how they are applied in the literature, beginning with problem gambling. Problem gambling is defined as “gambling behavior that creates negative consequences for the gambler, others in his or her social network, or for the community” (Ferris and Wynne, 2001, p. 8). This definition is especially relevant because it is the basis of widely used tools such in loot box research such as the Problem Gambling Severity Index.

In addition to studying gambling within games, some more recent research has argued that problem gaming is a diagnosable disordered behavior in its own right. As a result, Internet Gaming Disorder (IGD) has been added to the latest revision of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5), where it is defined as “Persistent and recurrent use of the Internet to engage in games, often with other players, leading to clinically significant impairment or distress” (APA, 2013). Similarly, the World Health Organization included Gaming Disorder in the 11th revision of the *International Classification of Diseases* (ICD-11), describing it as:

a pattern of persistent or recurrent gaming behaviour... manifested by: 1. impaired control over gaming (e.g., onset, frequency, intensity, duration, termination, context); 2. increasing priority given to gaming to the extent that gaming takes precedence over other life interests and daily activities; and 3. continuation or escalation of gaming despite the occurrence of negative consequences... The pattern of gaming behaviour results in marked distress or significant impairment in personal, family, social, educational, occupational, or other important areas of functioning. (World Health Organization, 2021)

However, these classifications are controversial, and IGD is the subject of serious criticism (e.g., van Rooij et al., 2018). For example, some researchers observe that (1) the quality of IGD research is low, (2) its definition relies too heavily on traditional criteria for evaluating substance use and gambling, and (3) that there is no consensus on the symptoms and assessment of IGD (Aarseth et al., 2017). In fact, these critics warn that accepting the new classifications without sufficient evidence will lead to moral panic and the “*premature application of a clinical diagnosis and the treatment of abundant false-positive cases, especially among children and adolescents*” (Aarseth et al., 2017, p. 269; emphasis in original). It will also encourage confirmatory rather than exploratory research, and may even create a social stigma around gaming that increases tension between parents and children and results in impaired physical or mental health for the latter (Aarseth et al., 2017).

Although the present paper is not an evaluation of IGD or related conditions as such, as we will see, the criticisms listed above can often be applied to loot box research, which shares many of the controversial

characteristics and assumptions of work on IGD. Loot box research draws heavily on these newly-classified disorders, and often analyzes behavior using tools that have not been sufficiently validated in the context of video games generally, or loot boxes specifically. To give just one example, Macey and Hamari (2018) argue that the literature on problem gambling and problem gaming draws on superficial or inaccurate characterizations of these conditions. Furthermore, the two disorders have sometimes been conflated, even though some empirical evidence shows that “problematic gaming and problematic gambling are clearly distinct from one another” (Macey and Hamari, 2018, p. 349).¹ In any case, the historical context of research into games and gambling is important because it reminds us that innovative concepts often fail to fit predetermined definitions and categories: definitions of gambling preceded the Internet; definitions of online gambling preceded the invention of loot boxes, and so on.² Researchers thus encourage caution when choosing interpretive frameworks and empirical methods based on older concepts.

2.2 Loot Boxes: Meaning and Controversy

Since the late 2000s the video game industry has undergone a significant shift in revenue models. For most of its history the sale of individual physical games was the primary source of revenue for publishers and developers. However, technological progress has greatly increased the cost of producing “AAA” games, while at the same time the rise of online and mobile gaming has made possible new ways of monetizing gameplay beyond a game’s initial purchase price (Tomić, 2017). This occurs especially through the use of “microtransactions,” typically small payments for in-game content. Loot boxes are a particularly controversial type of microtransaction:

The term ‘loot box’, also known as ‘loot crate’ or ‘prize crate’ and other names, typically refers to a consumable virtual item which can be redeemed to receive a randomized selection of further virtual items, ranging from simple customization options for a player’s game character, to game-changing equipment such as weapons, armor, virtual currency, additional skills and even completely new or exclusive characters... Loot boxes can be differentiated in two categories: Those dropping cosmetic items (the latter... often referred to as ‘skins’) and those generating items relevant for gameplay progress. (Schwiddessen and Karius, 2018, p. 18)

Although loot boxes can often be won by completing in-game challenges, in certain games they can also be paid for using real-world currency (either directly using real currency, or indirectly by first exchanging real currency for nominal in-game currency). A crucial legal or regulatory characteristic of paid loot boxes is the element of chance in obtaining rewards, which introduces risk. When this risk is combined with a financial transaction, it makes loot boxes appear similar to traditional gambling. This is the main issue at stake in most regulatory investigations. Loot box content can vary drastically in terms of its rarity and value to players, and in some cases, rewards and/or the virtual currency needed to buy them can be “cashed out” through secondary markets. Such sales usually violate a game’s terms and conditions and ignore end-user license agreements, but they persist nevertheless. Whether or not loot can be sold though, the low odds of obtaining the best items mean that it is possible to spend large sums in the hope of winning rare loot, similar to a slot machine. Loot box mechanics are common in a wide variety of games, and one informal survey suggests that they appear in the majority of top-selling mobile games (Zendle et al., 2020b).

If loot boxes constitute gambling, they are subject to licensing and other regulations in the regions in which they are sold. However, there is no easy way to prove that they are, because loot boxes vary in terms of if and how they are purchased, how risk falls on players, and most important of all, whether their rewards are “things of value” and/or can be redeemed for real-world currency (Nielsen and Grabarczyk, 2018). If and how a loot box satisfies these criteria determines how it will be viewed by regional gambling laws, which also vary in terms of definitions, interpretation, and enforcement (Schwiddessen and Karius, 2018). The purpose of this article, however, is not to explore the legal details of different loot box systems, but to evaluate the literature on loot box engagement and discuss ways to carry it forward: gambling raises questions about addiction and various kinds of consumer exploitation, particularly with regard to children, and these deserve to be investigated.

¹ Griffiths (2019), for instance, seems to conflate these problem behaviors. Importantly, the study by Macey and Hamari (2018) faces the same problem of self-selection bias as Zendle and Cairns (2018) discussed below. To ensure consistency in our criticisms therefore, we do not assume that the former is more reliable than the latter.

² We are grateful to an anonymous reviewer for this point.

The alleged dangers of loot boxes have invited a wide range of legislative and regulatory proposals, although few have been enacted to date. These include mandated labelling of games with loot boxes, age restrictions prohibiting minors from purchasing them, and outright bans of loot boxes or of games containing them (McCaffrey, 2019). There have also been legal actions regarding peripheral issues, such as in the UK, where third-party companies have been investigated for selling virtual currency, or in Germany and Japan, where loot boxes can in some cases violate consumer protection regulations about marketing to children (Schwiddessen, 2018; Koeder and Tanaka, 2017).

2.3 Conceptual Research on Loot Boxes

Several papers have developed conceptual models or new psychological taxonomies for studying gambling in video games (e.g., Hart, 2017), but to date there has been little empirical application of these tools to microtransactions and loot boxes. An early and fairly comprehensive study of casino games in Australia hinted at how loot-box-style mechanics might be developed, and even mentioned prominent publishers like Electronic Arts (EA) and Activision as early adopters of potentially harmful technologies. Ultimately, however, its report only speculated about how payment systems like loot boxes might function (Gainsbury et al., 2015).

The first specific work on loot boxes, gambling, and addiction was published in 2018 (i.e., King and Delfabbro, 2018; Griffiths, 2018a; Griffiths, 2018b; Drummond and Sauer, 2018). These early papers use simple comparisons of technological and aesthetic traits to suggest similarities between the psychology of opening loot boxes and gambling. For example, according to Griffiths (2018a, pp. 1-2), an exchange constitutes gambling when:

- (1) the exchange is determined by a future event for which, at the time of staking money (or something of financial value), the outcome is unknown;
- (2) the result is determined (at least partly or wholly) by chance;
- (3) the re-allocation of wealth (i.e., the exchange of money [or something of financial value] usually without the introduction of productive work on either side); and
- (4) losses incurred can be avoided by simply not taking part in the activity in the first place.

Griffith states that these attributes apply to loot boxes, which are therefore similar or equivalent to gambling. His commentary, however, is not empirical and does not analyze any game or specific type of loot box in detail. A subsequent article extended his analysis by surveying loot boxes in 22 best-selling games (Drummond and Sauer, 2018). Each game was evaluated according to the four features mentioned above, plus two more: the requirement that winners gain at the sole expense of losers, and the potential to cash out in-game rewards for real money. Ten of the 22 games met the first five criteria, and four games met all six (none of these four was age-restricted). Here too though, the discussion was speculative and conceptual: no empirical evidence was provided to establish that behavioural reactions to loot boxes are the same as to gambling, or that loot boxes are being marketed to or regularly opened by children or other at-risk individuals.

Several government agencies have also contributed to the emerging literature. A 2018 study by the Netherlands Gaming Authority used a risk assessment model to evaluate loot box addiction potential in ten games. The model quantified ten separate dimensions of play in order to produce an aggregate threat assessment (Netherlands Gaming Authority, 2018). These factors included the general availability of a game to players and whether a game includes auditory or visual inputs that encourage continued play. Based on this model, the Authority concluded that loot boxes are quite similar to slot machines, and that each of the loot boxes it examined had addictive potential. Importantly, the report was quick to add that its results should be treated carefully, as the risk model used was originally designed to analyse traditional games of chance with real-money rewards (Netherlands Gaming Authority, 2018, pp. 4, 8). In practice, this means that applying the model was a form of begging the question: it assumed what it needed to prove, namely, that loot boxes should be evaluated as a conventional form of gambling with addictive potential. The results should not therefore be used to draw conclusions about behavior or public policy. In fact, the report strongly qualifies its own results by explaining that it was not a piece of empirical research and that it had (as of 2018) received no evidence that problem players and/or addicted players were opening loot boxes on a large scale (Netherlands Gaming Authority, 2018, pp. 2, 4, 5, 7).³ This does not

³ It is unclear from the report how scale is measured.

imply, of course, that loot boxes cannot be associated with problematic behaviors, but it does mean there are few inferences to be drawn from this study.

A similar investigation was conducted by the Belgium Gaming Commission in 2018. Its report provides a lengthy list of loot box characteristics that are similar to conventional gambling. These include the use of virtual currency to conceal the price of loot boxes in terms of real currency, as well as a lack of transparency about the odds of winning the most valuable prizes. Environmental and social factors also encourage emotional involvement and conceal or downplay the true money cost of microtransactions (Belgium Gaming Commission, 2018, pp. 5-8; cf. also Hart, 2017). This report is also non-empirical and limited to pointing out similarities; nevertheless, it served as the basis for the Commission's request that loot boxes be removed from games in Belgium.⁴

One of the most comprehensive public discussions of the loot box controversy is a report by the Environment and Communications References Committee of the Australian Senate. It contains a range of opinions and evidence gathered from industry experts, advocacy groups, and public and academic research. These include the conceptual models mentioned above as well as some early empirical evidence discussed further in the survey below. It mentions a wide range of potential harms from loot boxes, but also acknowledges the paucity of data about them (Environment and Communications References Committee, 2018). Despite its scope, the Australian report is mainly a summary, and does not introduce much new content to the debate or draw any strong conclusions. Instead, it recommends further investigation by a range of government departments. Likewise, the Australian government's official response to the report was to also acknowledge the limitations of existing research and seek further data as a basis for policy (Australian Government, 2019). To summarise then, although several early investigations pointed to cosmetic and functional similarities between loot boxes and traditional gambling (e.g., to slot machines), they contained little or no empirical evidence about whether they have similar effects on behavior, especially among children.

However, whether or not loot boxes are *legally* gambling, it is still possible that they are similar enough to encourage problem behaviors, including problem gambling and problem gaming. This is especially worrying given that many games containing loot boxes are marketed to or played by children. As a result, the public outcry against loot boxes is often accompanied by calls to protect minors and other potentially vulnerable persons. In fact, even regulatory bodies that are not actively taking action against loot boxes warn of their possible effects on young people. For instance, the UK Gambling Commission did not initially consider loot boxes to be gambling due to uncertainty about whether they could consistently be converted into cash or its equivalent (Gambling Commission, 2017; Digital, Culture, Media and Sport Committee, 2019). Nevertheless, the Commission surveyed children in the UK with regard to their gaming habits and found that 31% had opened a loot box (either paid-for or earned in-game), a fact that it viewed with concern (Gambling Commission, 2018, p. 6). It remains to be seen, however, what effects loot boxes have on behavior, regardless of their legal status, including behavior among at-risk and problem players.

3 Methods

3.1 Hybrid Literature Review

It is generally agreed that effective literature reviews should not stop at summarizing past work, but should add to it through novel interpretation or criticism (Rowe, 2014, pp. 242-243; Schryen, 2015). With that in mind, this paper is organized as a *critical review*. Such reviews "critically analyze the extant literature on a broad topic to reveal weaknesses, contradictions, controversies, or inconsistencies" (Paré et al., 2015, p. 189). Criticism in this context means "indicating what was not done in a rigorous or relevant way... [in order to] identify systematic theoretical and methodological biases in a field and suggest fundamental reorientation for understanding the problem or central construct" (Rowe, 2014, p. 243). More specifically, critical reviews address broad research questions by using content analysis to examine selective or representative samples of work, samples that potentially include theoretical and empirical sources (Paré et al., 2015, pp. 186, 189). Unfortunately, there are few guidelines in the IS literature for conducting critical reviews, especially because such reviews tend to be lumped together with traditional narrative reviews, which have been criticized for their subjectivity and selectivity (see, e.g., Houy, Fettke, and Loos, 2015). One way to avoid this pitfall is to conduct a "hybrid review" that shares characteristics of more than one

⁴ Some claims in the report are difficult to verify, as they draw on remarks about possible links between loot boxes and gambling taken from an unpublished paper circulated privately for the Commission's use.

review type (Paré et al., 2015, p. 190). This is a valid option for the loot box literature, which is still relatively small, and can be explored more thoroughly than is often possible for larger, established bodies of research.

In this case, a critical review is combined with a “scoping review.” One key purpose of scoping reviews is to summarize “the findings and range of research in particular areas of study, thereby providing a mechanism for summarizing and disseminating research findings to policy makers, practitioners and consumers who might otherwise lack time or resources to undertake such work themselves” (Arksey and O’Malley, 2005, p.21). Like critical reviews, scoping reviews are motivated by broad research questions, potentially cover theoretical and empirical research, and rely on content analysis (Paré et al., 2015). The main differences are that scoping reviews are comprehensive and do not engage in criticism (Arksey and O’Malley, 2005; Paré et al., 2015). Critical and scoping reviews thus start from similar assumptions, but also have complementary differences: scoping reviews allow for a more comprehensive and less subjective approach to identifying relevant literature, while critical reviews allow for serious criticism rather than summary alone.

The problem being investigated in this hybrid review is players’ loot box engagement, specifically, potential links between loot box purchasing and problematic gambling or gaming behaviors. As mentioned in the introduction, the main justification for this review is that loot box research is increasingly invoked in the news media and in policy discussions, and therefore has a large potential impact on firms in the video game industry as well as on players. Any research that informs public opinion and policy in this way should be rigorous and relevant, but whether it is can only be established through careful critical analysis.⁵ The research question for this review is: What is known from the existing literature about the relationship between loot box engagement and problematic behaviors, and what insights does this present knowledge provide to policymakers? This invokes both the critical and scoping elements: our assessment of present knowledge (scoping) is draw from a study of the literature and the challenges it faces (critical).

3.2 Literature Search

We searched all EBSCOhost and Web of Science databases for publications related to loot boxes. The key search terms were “loot box” OR “loot boxes” OR “loot crate” OR “loot crates” OR “surprise crate” OR “surprise crates” OR “loot llama” OR “loot llamas” OR “(microtransactions OR microtransaction)” AND “chance based” AND “games” AND “(video OR computer OR online OR mobile).” The variation in search terms was designed to capture any alternative or euphemistic names for loot boxes, such as the “loot llamas” found in the *Fortnite* franchise. Our search terms and snowballing methods draw heavily on those used in a recent meta-analysis of the loot box literature (e.g. Spicer et al., 2021). Importantly though, our search was broader and was intended to capture all research related to loot box engagement. For example, our survey includes several experimental studies of loot box engagement that are not included in previous reviews. We also wanted to allow for relevant “grey literature” (Adams, Smart, and Huff, 2017), although ultimately there were no relevant sources of that kind included in our final list. The results of the database searches were then supported and complemented by the use of snowballing, specifically, by examining the papers listed in previous literature reviews (Garea et al., 2021; Spicer et al., 2021; Yokomitsu et al., 2021) and citations to key papers in the literature (e.g., citations to the earliest and most commonly-cited articles on loot boxes).

The initial database search for the years 2017 to 2021 yielded 196 results from EBSCOhost and 106 from Web of Science for a total of 302 potential sources.⁶ Each of these results was examined further, and duplicates (within and between lists), non-English-language sources, news articles, and irrelevant publications were eliminated.⁷ This left a total of 50 potential sources from EBSCOhost and a further 45 non-overlapping sources from Web of Science. The lists were combined, and the 95 articles were sorted into three groups: full-length research articles (71), commentary and opinion pieces (22), and grey

⁵ A critical review is also valuable in light of the way IS reviews are conducted. For example, in a discussion of methods for article selection in IS reviews, Okoli argues that “the methodological quality of articles should be evaluated to examine the implications of errors, inconsistencies and methodological choices on the results reported in the literature” (Okoli, 2021, p. 25). Although Okoli’s arguments refer to how articles are initially selected for inclusion in literature reviews, they apply to the way articles are evaluated within reviews as well. Our approach also answers the call for critical reviews that clearly define criticism and express genuine critical judgment (Wright and Michailova, 2022).

⁶ The same search terms applied to the years 2000 to 2016 yielded no relevant results. Loot boxes have existed in video games in various forms since at least 2010, but widespread controversy over them began in 2017.

⁷ Some of the most common irrelevant results involved news stories about the company Loot Crate, which sells video game and other pop culture merchandise.

literature, especially market research reports (2). The full-length articles provide the basis of our critical review. A further breakdown of this group revealed that 29 articles focused mainly or exclusively on loot box engagement and problem behaviors. The remainder addressed broader issues such as theoretical pricing models for loot boxes, their technological features, or their legal status. They thus fall outside the scope of our research question; nevertheless, we reference these articles throughout where relevant. The final group of articles consisted of 22 empirical studies, 3 experimental studies, and 3 systematic reviews and/or meta-analyses.⁸ The majority of the discussion below focuses on the empirical work because it is the most common, but includes also the experimental papers, which have not been examined in systematic reviews so far because they do not measure the same relationships as most other studies. The 25 primary research articles are listed in Table 1.

Once selected, each article was read multiple times to ensure the accuracy of the information drawn from it. Most of the information summarized in Table 1 is objective and drawn directly from the papers themselves: information about issues such as methods and screening tools was also checked against other survey articles to further ensure consistency. The two research characteristics contained in Table 1 that require more interpretation—representativeness and economic significance—are explained in detail below.

Table 1. Problematic Factors in Primary, Behavioral Research on Loot Box Engagement.

Study	Self-Reported Questionnaires	Cross-Sectional Data	Studies Children/Adolescents	Representative Sampling Methods Used	Screening and Measurement Tool(s) for Gambling and/or Gaming Behavior*	Loot Spending and/or Economic Significance	Box
Empirical Studies of Loot Box Engagement							
<i>Brooks and Clark (2019)</i>	Yes	Yes	No	No	PGSI, IGD, RLI, GRCS	Small/no economic significance	
<i>Carey, Delfabbro, and King (2021)</i>	Yes	Yes	No	No	PGSI, IGD, BOG	Small/no economic significance	
<i>DeCamp (2021)</i>	Yes	Yes	Yes: aged 13-14 & 16-17	Yes	DSS	Spending not measured	
<i>Drummond et al. (2020)</i>	Yes	Yes	No	No	PGSI, IGD, RLI	Small/no economic significance	
<i>Evren et al. (2021)</i>	Yes	Yes	No	No	IGD-SF9	Spending not measured	
<i>Hall et al. (2021)</i>	Yes	Yes	No	No	PGSI, IGDC, RLI	Small/no economic significance	
<i>Ide et al. (2021)</i>	Yes	Yes	Yes	No	DSM-5 modified	Spending not measured	
<i>A. King et al. (2020)</i>	Yes	Yes	No	No	IGD, RLI modified, SOGS-RA	Small/no economic significance**	
<i>D.L. King et al. (2020)</i>	Yes	Yes	No	No	DSM-5	Spending not reported***	
<i>Kristiansen and Severin (2020)</i>	Yes	Yes	Yes: aged 12-16	Yes	SOGS-RA	Spending not measured [§]	
<i>Li, Mills, and Nower (2019)</i>	Yes	Yes	No	No	PGSI, IGD, BSI-18	Spending not measured	

⁸ One of these papers, Zendle et al. (2021), attempts to replicate empirical loot box research in the context of physical card games, in order to draw out similarities and differences between card collecting and loot box purchasing. We have therefore included it in our selection of articles even though it does not study loot boxes directly. A final paper, Close et al. (2021), pools secondary data drawn from a few of the primary empirical studies listed here. We thus do not include it in Table 1, although we do discuss its results below.

<i>Von Meduna et al. (2020)</i>	Yes	Yes	No	Yes	PGSI modified	Spending not measured
<i>Nicklin et al. (2021)</i>	No	Semi-structured interviews	Yes: aged 16+	No	PGSI, IGD-SF9	Spending not measured
<i>Rockloff (2021)</i>	Yes	No	Yes: aged 12-24	No	PGSI, SGHS for adults & DSM-IV-MR-J for adolescents	Spending not measured
<i>Wardle and Zendle (2020)</i>	Yes	Yes	Yes: aged 16-24	No [†]	PGSI, YGS modified	Spending not measured
<i>Zendle and Cairns (2018)</i>	Yes	Yes	No	No	PGSI	Small/no economic significance
<i>Zendle and Cairns (2019)</i>	Yes	Yes	No	No	PGSI	Small/no economic significance
<i>Zendle, Meyer, and Over (2019)</i>	Yes	Yes	Yes	No	CAGI	Small/no economic significance [‡]
<i>Zendle et al. (2020a)</i>	Yes	Yes	No	No	PGSI	Small/no economic significance [¶]
<i>Zendle (2019)</i>	Yes	Prospective cohort study	No	No	PGSI	Small/no economic significance
<i>Zendle (2020)</i>	Yes	Yes	No	Yes	PGSI, IGD	Spending not measured

Experimental Studies of Loot Box Engagement

<i>Brady and Prentice (2021)</i>	Yes ^{¶¶}	Experimental	No	No	Gaming Addiction Scale	Spending not reported
<i>Kao (2020)</i>	No	Experimental	No	No	None	Spending not measured
<i>Larche et al. (2021)</i>	Yes: experiment #1 No: experiment #2	Experimental	No	No	None	Spending not measured

Replication of Loot Box Research for Other Products

<i>Zendle et al. (2021)</i>	Yes	Yes	No	No	PGSI	Small/no economic significance
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Note: * Acronyms for additional screening tools: Gambling Related Cognitions Scale (GRCS); Benefits of Gambling (BOG); Delaware School Survey (DSS); Internet Gaming Disorder Scale–Short-Form (IGD-SF9); Brief Symptom Inventory (BSI-18); Youth Gambling survey (YGS); Canadian Adolescent Gambling Inventory (CAGI).

** Spending reported for microtransactions and/or loot boxes.

*** Spending data were gathered but not reported; spending measures provided are for respondents' estimates of their friends' spending.

§ Spending reported for simulated gambling.

† Although not generalizable, this sample is likely more representative of young adults than samples drawn from Reddit, Mechanical Turk, etc.

‡ Spending information drawn from raw data available online.

¶ Spending information drawn from raw data available online.

¶¶ Demographic information was directly gathered to support the main experiment.

4 Challenges of Experimental Research

Experimental work focuses on the act of opening loot boxes, the sensory aspects of doing so, and player reactions. This kind of research will likely prove crucial in the ongoing effort to learn more about the behavioral implications of loot boxes. So far though, published research tend to be limited by a lack of

realism created by the conditions of the experiments, the most important of which is the lack of real money being spent. The first study of this kind offered a unique experiment on the aesthetic aspects of loot boxes (Kao, 2020). Researchers created from scratch an open-source online platform called *Infinite Loot Box*, designed to test how visual and auditory effects influence the decision to open loot boxes. The platform essentially offers a stand-alone experience where participants are able to open loot boxes indefinitely in order to win prizes of varying rarity. The intent was to emulate the experience of opening loot boxes in actual games. Participants ($n=1235$) were invited via Amazon's Mechanical Turk marketplace and were randomly assigned to one of four versions of the platform, each with a different combination of high or low visual and auditory cues. The one standout finding was that high audio cues significantly influenced the number of loot boxes that participants opened. However, while the platform may prove valuable in stimulating loot box research, the initial results are limited, because several key factors were missing. For instance, loot boxes on the platform were not associated with any real game, could not be paid for, and conferred no obvious benefit on winners. The experiment was thus highly abstract and likely not a reflection of most loot box engagement.

There are also experiments that directly observe player behavior, and these seem more likely to become the standard approach. In one study, students took part in two experiments ($n=47$ and $n=46$) in which they viewed short videos of loot box openings in the game *Overwatch*. Both experiments concluded that players' valuations of loot box rewards (subjective value) were highly consistent with their rarity (objective value). Furthermore, rarer rewards were more arousing than common ones, and induced the urge to open additional boxes. Obtaining low-value rewards was found to be associated with more disappointment than higher-value rewards. These findings are intuitive, and fit with the behavioral patterns of traditional gamblers, yet they tell us little about the behavioral implications of loot boxes. They are also subject to potential survivorship bias: by studying loot box openings from *Overwatch*, a successful game that all participants had recently played, the study overlooked the many games that have failed to generate valuable loot (boxes) of any kind, regardless of rarity. More important is the finding about the urge to continue opening loot boxes, which is likely to be mitigated by the use of real money: in the experiment, participants did not pay for loot boxes, but merely watched videos of box openings. The choice to continue is likely to be influenced strongly by whether one has to pay to do so. Perhaps the greatest difficulty with this study, however, is that it does not identify any behavioral characteristics of loot box openings that are unique to gambling. Arousal and the choice to continue are characteristics of many positive experiences—especially those with uncertain outcomes—that are not classified as gambling. It is difficult to see how watching loot box openings is distinguishable as uniquely dangerous based on these kinds of criteria.

Other work has studied arousal from loot box openings among adult males ($n=25$) (Brady and Prentice, 2021). Mild but not statistically significant increases in arousal were found, and the most significant result was a negative one: participants with greater symptoms of gambling problems tended to react less to opening the box, consistent with the idea that problem gamblers become increasingly less aroused by the outcomes of their games. Participants opened only one box, however, and did not pay to do so. In summary then, although these experimental studies offer an important and even vital research opportunity, this research stream has yet to yield any substantial results.

5 Methodological Problems: Self-Reported Questionnaires, Cross-Sectional Data, and Representative Sampling

The majority of loot box research consists of empirical studies of player engagement, including the first serious attempts at gathering evidence to inform public policy, a goal that is mentioned often in the literature (e.g., Drummond, Sauer, and Hall, 2019; Griffiths, 2019; Li, Mills, and Nower, 2019, p. 31; Spicer et al., 2021; Zendle and Cairns, 2018, pp. 8, 9, 10; Zendle, Meyer, and Over, 2019, p. 17; Zendle et al., 2019). We examine this research in the following sections. Table 1 summarizes the main drawbacks of existing literature, each of which we discuss in turn. As we do so, we pay particular attention to papers where problems originated or where they are most pronounced.

Reliable sampling has proved to be a major problem in the loot box literature, and nearly all studies are explicit that their results should not be hastily generalized. The underlying reason is that most loot box studies make use of cross-sectional data from self-selected convenience samples gathered via online

surveys (Delfabbro and King, 2020).⁹ In fact, at this time, virtually all studies of loot box engagement are based on cross-sectional self-reported surveys (Table 1).

For example, the first peer-reviewed empirical study of loot box engagement gathered data through survey links posted on Reddit that described the research as a study of loot boxes and gambling (Zendle and Cairns, 2018).¹⁰ The same method has also been used by other studies (e.g., Zendle, Meyer, and Over, 2019) that have similarly been advertised as research on games and gambling (e.g., Hall et al., 2020). Given the emotionally-charged nature of the public debate over loot boxes, self-selection bias is highly likely. To avoid this bias, later replication studies have sometimes advertised their questionnaires through Amazon's Mechanical Turk as studies of gamers' spending habits, without reference to the overarching controversy (Zendle and Cairns, 2019). Yet while Mechanical Turk is a more reliable source than Reddit, it nevertheless has been criticized for generating non-representative samples that tend to over-represent relatively poor mental and physical health (Walters, Christakis, and Wright, 2018) and to over-represent gamblers (Mishra and Carleton, 2017). Despite acknowledging the limitations of these platforms, however, new studies continue to use them: for example, Zendle et al. (2021) use Reddit even after criticizing it in other work (e.g., in Zendle, 2020), and Brooks and Clark (2019) use Mechanical Turk (see also D.L. King et al., 2020).

In addition to potential self-selection bias, the demographics in the literature also have shortcoming in terms of representativeness and generalizability. For example, most articles gather data only from adult respondents. This is understandable to some extent because of the difficulties of conducting research involving children, but one unfortunate outcome is that the group with the greatest potential vulnerability to loot boxes is overlooked. D.L. King et al. (2020), for instance, surveyed adult players ($n=428$) of the game *Fortnite*, which has a large fan base of younger players and represents an important potential source of insight into their behavior.¹¹ This is especially important because if loot boxes do pose gambling-related threats, these are likely to be greater or even uniquely challenging for children. There has been some progress in this respect though. Zendle, Meyer, and Over (2019) study adolescents aged 16-18 ($n=1155$), and Kristiansen and Severin (2020) make a more successful attempt to gather a representative sample of younger gamers using data from 12-16-year-old Danish adolescents ($n=1137$). DeCamp (2021) studied two groups of adolescents, one aged 13-14 and the other aged 16-17 ($n=13042$). Rockloff et al. (2021) surveyed a sample of adolescents (aged 12-17) and one of adults (aged 18-24) in order to obtain a wider-ranging picture of their behavior ($n=1954$). There is thus a positive trend, with several newer studies covering adolescents aged 12-17, though still only about one-third of all studies include them, and there as yet are no studies of younger children (Table 1).

Other types of sampling issues occur as well. For instance, the sample in Zendle and Cairns (2018), which was gathered through survey links circulated on Reddit ($n=7422$), was strongly biased in terms of gender (89% male and 9% female respondents). Zendle, Meyer, and Over (2019) also received a 9% female response from Reddit. Gender bias is less pronounced in Zendle and Cairns (2019), with a 31% female response. This introduces an inconsistency though: in their 2018 study, the authors argued that a 9% female response was appropriate because it reflected underlying gamer demographics, but in the second study, a response more than three times larger was not considered troublesome ($n=1172$) (Zendle and Cairns, 2019, pp. 10-11).¹² Both proportions cannot be accurate. This is worrisome for three reasons: first, perhaps 46% of gamers are women (Entertainment Software Industry, 2019); second, women represent a major segment of the mobile gaming market, in which free-to-play games with microtransaction revenue models are increasingly the norm; third, as discussed below, other research findings about womens' engagement with loot boxes are ambiguous. Drummond et al. (2020) also failed to gather representative samples of participants from the US, Aotearoa New Zealand, and Australia

⁹ The dominance of quantitative tools such as questionnaires serves to highlight the lack of qualitative research on loot boxes.

¹⁰ Revealing the purpose of the study was especially problematic given that Reddit is a focal point of loot box criticism; in fact, it helped launch the public controversy when, in 2017, an employee of EA posted a comment defending the company's use of loot boxes on the site. The comment remains to this day the most downvoted comment in Reddit history, receiving more than 683,000 downvotes, roughly 7.7 times more than the second most downvoted comment (Reddit, 2021). Given this reaction, it is fair to say that bias is a serious issue in surveys distributed to the same community.

¹¹ Relatively few specific games are studied in the loot box literature, and as a result, the most commercially successful games such as *Fortnite* and the FIFA franchise are over-represented. This in turn means that if the publishers of these games (Epic Games and Electronic Arts, respectively) handle them particularly well or poorly, the larger literature is likely to be also skewed toward the merits or failings of these games. We are grateful to an anonymous reviewer for this point.

¹² One study cited as reflecting gamer demographics is actually a study of internet gamblers that does not mention video games (Gainsbury et al., 2012). Many responses with non-serious elements were included in the earlier sample. These include around 20 respondents who identified their gender as some version of "attack helicopter," and other bizarre answers (<https://osf.io/srykf/>)

($n=1,049$), but, as they explain, their sample struggled with bias in the opposite direction, by over-representing women as well as individuals exhibiting symptoms of problem gambling. Other studies purposely obtain more balanced gender responses (e.g., A. King et al., 2020), so there is some recognition of this problem.

Ethnicity is another issue that seems to interfere with representativeness. Brooks and Clark's (2019) study, for example, includes idiosyncrasies in the data that undermine confidence in their generalizability. Their first sample of university students was skewed toward Asian respondents (62.1%; $n=113$), who were only a small portion of their second sample, of adults (8.32%; $n=144$) (Brooks and Clark, 2019, p. 28). This might introduce a demographic bias (in particular), and could explain why higher levels of loot box engagement were reported among students than adults—39.7% of students reported having sold a loot box, compared to 27.8% of adults (Brooks and Clark, 2019, p. 32). This also appears to fit the claim that “eastern cultures” are more accepting of loot box mechanics deemed unfair by Western players (quoted in Environment and Communications References Committee, 2018, pp. 6-7; cf. also Liboriussen, 2017). In any case, these demographic factors warrant further attention.

Even though most loot box research explicitly acknowledges problems of representativeness and generalizability, only a few studies have attempted to gather more reliable data: in addition to Kristiansen and Severin's (2020) representative sample of Danish adolescents, Zendle (2020) uses a quota-sampled approach to obtain survey results that were representative of the UK in terms of ethnic, sex, and age subgroups; Von Meduna et al. (2020) gathered a representative sample of German Internet users as the basis for its study; and DeCamp (2021) used large random samples to collect data about groups of adolescents. Currently then, around one-fifth of the empirical literature relies on representative samples with a good chance of generalizability (Table 1).

5.1 Prevalence of Loot Box Engagement

A crucial underlying question is how prevalent loot box engagement is for children and/or adults. However, answers vary, likely due to differences in sampling methods. Shinkawa et al. (2021) surveyed Japanese adolescents aged 12-15 ($n=335$) and found that around 1.8% had opened loot boxes. In the total sample, 47 (14%) had made unplanned purchases, of which 6 listed opening loot boxes as one motivation for doing so. Ide et al. (2021) conducted a similar survey of Japanese adolescents (aged 14 years) and their primary caregivers ($n=1615$), finding that only 3.5% of adolescents and 1.9% of caregivers spent money on loot boxes. They also found no link between adolescents' spending on loot boxes and their caregivers' spending, indicating that spending habits are not adopted by the young generation from the old. Wardle and Zendle's (2020) survey of 16-24-year-olds in the UK ($n=3549$) found that 12% of respondents had purchased a loot box in the previous year, and 19.8% of Danish adolescents had done so, with 10.6% having sold loot box contents (Kristiansen and Severin, 2020). Among this sample, “The vast majority of adolescent gamers belonged to the ‘non-problem gambler’ group irrespective of their loot box engagement.” A large-scale survey of 8th and 11th grade students in Delaware found that 24.9% of 8th grade participants reported buying loot boxes in the past year (2066), with 17% of 11th graders reporting the same (2216) (DeCamp, 2021). The more representative samples among these articles are notable because they suggest significant engagement in absolute terms, even when proportional engagement is relatively low.

Engagement among adults seems less common. Zendle's (2020) survey ($n=1081$) found that 7.8% of respondents had spent money on loot boxes, and only 6.7% (72) had both bought loot boxes and engaged in traditional gambling in the previous year. Carey, Delfabbro, and King (2021) surveyed gamers ($n=471$) who play regularly (at least three times a week), in order to target more committed players. Even among this group, however, only 10.8% reported spending on loot boxes. Von Meduna et al.'s (2020) representative sample of German Internet users similarly found that 9.8% were loot box purchasers.¹³ The largest estimates for engagement come from Brooks and Clark (2019): 45.1% of their adult sample reported spending money on loot boxes, and 60.3% of their student sample (Brooks and Clark, 2019, p. 28).¹⁴ It is worth noting though that survey results from respondents who were unfamiliar with loot boxes

¹³ A. King et al. (2020) report that in their adult sample ($n=300$), just over half (157) had played a game with microtransactions. In turn, just over half of this group reported spending on “microtransaction and/or loot boxes.” These two types of transaction were grouped together though, so loot box purchases as such were not identified.

¹⁴ They further explain that respondents were given a clear definition of loot boxes to avoid confusion, but this definition is not provided in their paper.

were excluded (Brooks and Clark, 2019, p. 27). In practice then, people who are already familiar with loot boxes are more likely to have interacted with them, an unsurprising finding.

In terms of gender, most studies find that men are more engaged with loot boxes than women (Kristiansen and Severin, 2020; Ide et al., 2021). However, women and adolescent girls who do purchase loot boxes are sometimes more likely to exhibit symptoms of problem gambling (Kristiansen and Severin, 2020; Rockloff et al., 2021), hinting at the importance of proper representation. Ultimately, the divergence in reported prevalence of loot box engagement is likely due to the use of different samples and sampling methods. Another important possibility is that loot box engagement is under-reported among those who view loot boxes as objectionable, or who are worried about social sanctions from other people who believe this.¹⁵ In any case, more reliable estimates of loot box engagement are needed to understand its full welfare implications, and important part of showing its economic significance, discussed below.

5.2 Motivations for Purchasing Loot Boxes

No matter which measure of loot box engagement turns out to be most accurate, it is clear that engagement is significant enough to warrant careful study. A next natural step is to investigate why players might choose to open loot boxes, and how they perceive this behavior (e.g., whether loot boxes are seen as useful or useless, as offering high or low value for money, as provoking uncontrolled impulse purchases, and so on). Of course, *players' personal beliefs do not determine whether loot boxes are legally gambling or if they possess addictive properties*, but it is still crucial to know what their beliefs are. If anything, this information is more valuable if loot boxes turn out to be associated with serious harm.

Among a general survey of gamers who were familiar with loot boxes, 48.3% ($n=131$) claimed that they enhanced their gaming experience, compared to 17.6% who claimed the opposite ($n=48$) (Li, Mills, and Nower, 2019). Why this is the case, however, remains to be seen. The first investigations into the habits of loot box buyers were done by assessing participation rates and demographic characteristics of eSports spectators (Macey and Hamari, 2019a). Loot boxes and eSports spectating appear to be part of the same "ecosystem" of gaming and/or gambling; however, both average weekly hours spent opening loot boxes and average monthly spending on them are found to have significant, negative relationships of moderate strength with eSports engagement (Macey and Hamari, 2019a, p. 33). A representative sample has shown that loot box buyers tended to live in households of average income, and that only 3.1% were unemployed, with 83.8% employed and the remaining 13.1% outside the labor force (retired, students, stay-at-home parents, etc.) (Von Meduna et al., 2020). In fact, there is a strong negative relationship between unemployment and loot box purchasing (Von Meduna et al., 2020). This is intuitive, as fully-employed people will tend to be more interested in taking shortcuts to winning in order to economize their time. It also hints at the more practical motivations behind loot box engagement, as opposed to behavioral motivations related to lack of control.

It is increasingly recognized that players' own views about their behavior are important, especially for understanding complex motivations. In one survey that allowed for open-ended answers, only 16% of purchasers reported opening loot boxes for "the fun, excitement and thrills of opening the box itself" (Zendle, Meyer, and Over, 2019, p. 13). In context, fun, excitement, and thrills included any responses connected to gambling or addiction, such as one player's statement that opening loot boxes "scratches my gambling itch." Together, this category provided the third most common types of motivation in this sample, although it is unclear from the published results how many responses actually invoked motivations related to problematic behaviors like the one just suggested. Out of the other seven motivation categories reported, most involved personal or practical reasons like wanting to gain competitive advantages from loot (21.9%) or wanting to create a content collection (19.2%). Ranked fourth were "cosmetic reasons," at 15.3%. These results make sense, as the items needed to achieve each of these goals are typically only available through loot boxes. Less than 1% reported buying in order to cash out and turn a profit. Moreover, 10.7% of respondents reported paying for loot boxes as a way to support the developers of free-to-play games (see also Macey and Bujic, 2022, pp. 205-207), while 9.8% believed loot box rewards provided good value for money (Zendle, Meyer, and Over, 2019, pp. 13-14). These results seem to cut against the idea that gambling-like features of loot boxes are consciously the main reason for their popularity. In fact, similar studies have found that spending on non-randomized virtual rewards was also

¹⁵ An anonymous reviewer observes that the samples used in the literature are unlikely to capture the extreme engagement of "whales," the tiny proportion of players who have a disproportionately large impact on spending.

significantly positively correlated with problem gambling, hinting that problem gamblers are bigger spenders on a variety of content, not necessarily on loot boxes specifically (Drummond et al., 2020).

Another potentially valuable finding in this more open-ended survey was that out of those respondents who had opened a loot box within the previous month, 80.6% stated they had waited over a month after initially playing a game to buy a loot box (Zendle, Meyer, and Over, 2019). This also hints that the exciting mechanics of loot box openings have less effect on player behavior than suggested in the conceptual literature. It also fits the practical needs of players, as many free-to-play games can be played for long periods of time before the pace of the game becomes so slow or the in-game resource requirements so high that buying loot boxes for their contents becomes a viable method of progressing. Other results are counter-intuitive or possibly contradictory. For example, a link was found between loot box spending and the availability of limited-time-only loot boxes, which seems plausible, as players may rush to win fleeting rewards. Yet counter to that result, no relationship was found between respondents' impulsiveness and loot box spending (Zendle, Meyer, and Over, 2019, pp. 15-16).

There has been limited qualitative research into loot box purchase motivations. Semi-structured interviews with UK respondents suggest a more nuanced list of seven motivations: opening-related factors; value of items; game-related factors; social factors; fear of missing out; compulsive/emotive factors; and facilitators (Nicklin et al., 2021). These are then broken down into more than twenty specific triggers or motivators. The results indicate that loot boxes are purchased for a variety of different and often intermingled reasons. The most commonly reported were the positive experience of opening boxes and the functional or cosmetic value of loot box rewards. Importantly, most participants (19 out of 28) did report buying loot boxes due to emotive or impulsive influences such as problems with urges, temptations, or control—this was the 6th most common motivation, broadly consistent with other findings (Zendle, Meyer, and Over, 2019). These results did not, however, map consistently onto measures of problematic behavior, thus “challenging the idea that “compulsive” loot box purchasers would typically be those reporting problematic gaming” (Nicklin et al., 2021, p. 16). What work has been done on motivations for engaging with loot boxes has, so far, failed to show that their uniquely gambling-like characteristics are responsible for their popularity. In fact, there seems to be a negative attitude in the literature toward potentially beneficial aspects of loot box engagement, to the point that when loot boxes are associated with positive mood, great effort is taken to explain away the result (see Drummond et al., 2020, pp. 11-12, for an example). Once more, a fuller investigation of these issues would go a long way toward informing our understanding of the human costs and benefits of loot boxes, whether they are legally gambling or not.¹⁶

6 Methodological Problems: Screening and Measurement Tools for Gambling and/or Gaming Behavior

As explained in the methods section, this critical review focuses on the relationship between loot box engagement and problematic behaviors such as problem gambling and problem gaming. It is therefore necessary to discuss how these behaviors or conditions are assessed, and whether there are potential problems with existing methods. We suggest that there are: specifically, we find several reasons why the indexes used to measure problem gambling and problem gaming do not adapt well to the specific case of loot boxes. At the very least, they need further refinement and modification to ensure that the relationship between loot box engagement and problem behavior is genuine, and not simply an artefact of an inappropriate method. This is important because the studies listed in Table 1 have mostly, though not entirely, shown that loot box engagement is correlated with problem gambling and problem gaming, and have called for regulatory oversight in response.

The main finding of the literature so far is a correlation between the severity of players' problem gambling and the amount they spent on loot boxes. This relationship was found in the first systematic research on loot boxes as well as in replication studies (Zendle and Cairns, 2018, 2019). However, studies of this type tend to suffer from methodological and interpretive problems that call their key result into question. These specific problems appear in most loot box research to date, so they are worth exploring in detail. A first problem is that the survey questions used in these studies may give an inaccurate picture of respondents' gambling habits. One research challenge is to isolate spending on the uniquely “gambling-like” features of

¹⁶ Some efforts in this direction are undertaken by Macey and Bujic (2022), who analyze Reddit and other message board comments in order to explore players' opinions of loot boxes.

loot boxes, so as to avoid conflating these purchases with heavy spending in general.¹⁷ To do this, Zendle and Cairns (2018) asked players about their other in-game spending habits and compared this information to their loot box spending. However, this comparison does not capture the difference between loot boxes and general spending, as players could be high or low spenders while still spending large or small amounts on loot boxes. Consider an example: if loot box rewards cannot be obtained through other purchases, then loot box spending may not be due to gambling-like elements specifically. In fact, we should expect this kind of motivation for loot box spending over other spending, as the value to players of skins or competitive perks from loot boxes can be quite different from the value of game maps, play modes, or storylines obtained through non-randomized purchases. Moreover, the two types of spending might not be equally available within or between games, making the comparison even less relevant. This suggestion is supported by the research on loot box motivation discussed in the previous section. It is not clear then that surveys have isolated the appropriate characteristics of loot boxes. The same is true for replications (e.g., Zendle and Cairns, 2019), and surveys that ask about “microtransactions and/or loot box” use, without separating the latter (A. King et al., 2020). The larger point though is that the complexities of loot boxes and microtransactions require adopting a nuanced approach to studying player behavior and choice.¹⁸

6.1 The Problem Gambling Severity Index (PGSI)

Next, in the existing literature problem gambling is operationalized in ways that could be misleading *in the context of loot boxes*. Specifically, loot box research relies heavily on the Problem Gambling Severity Index (PGSI) to measure symptoms of gambling disorder. The PGSI classifies participants as non-problem gamblers, low-risk gamblers, moderate-risk gamblers, or problem gamblers (see, e.g., Zendle and Cairns, 2018, p. 3). Scores can range from 0 to 27, with values of 8 or over being classified as problem gambling. This index is a standard measure in gambling research, but it may be inappropriate for studying loot boxes. In fact, Macey and Hamari (2019a, p. 36) urge caution when applying the PGSI to their sample of eSports spectators precisely because it may not be an appropriate tool. One reason is that it is relatively easy for correct information to result in a misleading classification.¹⁹ For instance, a respondent who is quite frequently criticised for gambling, or feels regularly guilty about gambling, is automatically categorized as a moderate-risk gambler, regardless of whether she gambles, or of any practical effects gambling has on her. Moreover, the question being investigated in the literature is whether loot boxes are behaviorally similar to gambling. The PGSI thus poses a problem, because some players already believe strongly that loot boxes *are* gambling (e.g., 58% according to the Royal Society for Public Health, 2019, p. 21).²⁰ This opinion by itself can bias survey results. For example, if a concerned friend believes loot boxes are gambling and criticizes a colleague’s spending habits, or if this colleague simply feels guilty knowing that others consider loot boxes to be gambling, these are sufficient to classify him as a moderate-risk gambler. In such cases, studies using the PGSI simply correlate loot box spending with gambling, with gambling being defined as loot box spending. They would thus assume what they need to prove. Importantly, scenarios in which people are wrongly classified as problem gamblers are plausible given similar problems identified in studies of video game addiction. For example, some research has shown that it can be easy to confuse addiction with other issues, such as poor time management or playing to cope with personal problems. Inaccurate labelling by family or friends can even convince players themselves that they are addicts without substantiating evidence (Wood, 2008).

Finally, there is the question of correlation versus causation. Fortunately, this issue is widely acknowledged in the literature. Unfortunately, current interpretations of causation tend to arbitrarily adopt negative opinions of loot boxes and of the video game industry, and many studies recommend regulation of loot boxes based on correlations alone. Yet there are alternate ways to interpret these relationships that are not so pessimistic. These should be considered because (a) they can add nuance and a wider range of perspectives to our understanding of loot box engagement, and (b) they are necessary for any discussion of policy design. For example, the possibility that problem gamblers might self-select games

¹⁷ In addition, some survey questions do not specify a date range (Zendle and Cairns, 2018, p. 4), risking confusion about behavioral changes over time, such as sudden increases or decreases in loot box engagement.

¹⁸ Zendle (2019) attempts to resolve some of these issues using a before-and-after study of a game that removed loot boxes. This paper is discussed below, in the section on economic significance.

¹⁹ Currie, Hodgins, and Casey (2013), who are cited throughout the loot box literature, point out that there are more general problems with the index as well, such as the difficulty of distinguishing between low- and moderate-risk gamblers.

²⁰ Brooks and Clark (2019, p. 28) report this value as 86.2% for one of their samples, which is significant because their participants included only people who were previously familiar with loot boxes.

with loot boxes is mentioned often, but typically is not explored in detail. But it could be the case that problem gamblers choose games with loot boxes based on superficial rather than substantive similarities. Loot boxes may also be viewed by problem gamblers as a less harmful spending alternative, a relatively harmless way of satisfying the urge to gamble, and/or as a way to transition out of conventional gambling. In fact, Delfabbro and King (2020) find little evidence that loot boxes serve as a “gateway” into gambling, and there is likewise no indication of a migration from loot boxes to gambling. Based on correlations alone it is impossible to say which explanations are best. Only an underlying qualitative analysis can provide a basis for understanding the results. Despite the lack of such work, however, there is a trend in the literature toward pessimistic interpretations.²¹

Referring to the pattern of correlation between loot box engagement and problem behaviors, it has been claimed that,

Although these effects are correlational, meaningful relationships would be problematic irrespective of causal direction. Whether loot box spending causes problem gambling, problem gambling causes loot box spending, or both are caused by third variables (e.g. preference for high-risk activities), all possibilities represent problematic relationships. (Garea et al., 2021)

Yet this simply assumes away the possibility of non-problematic relationships such as those suggested above. To take another example, Carey, Delfabbro, and King (2021) suggest that “gamers who have higher levels of gaming involvement or commitment are more likely to use loot boxes.” In their view, involvement may be an antecedent of both loot box engagement and harm. But their reasoning also allows for explanations that do not involve harm. These possibilities are understudied in the literature.

Li, Mills, and Nower (2019) conduct a study that examines both problem gambling and problem gaming. Self-reported survey results ($n=618$) revealed strong correlations between loot box purchases and both problem gaming and problem gambling, and also higher levels of mental distress. Nevertheless, although carefully designed, the research faces the same problems seen elsewhere in the literature, including assumptions about the applicability of the PGSI to the case of loot boxes, lack of evidence about the causal meaning of the correlations discovered, and limited generalizability. Von Meduna et al. (2020) found mixed results when examining the relations between loot box engagement, problem gambling, and problem gaming. Gambling problems were measured using the PGSI and gaming problems were measured using an experimental, unvalidated modification of the PGSI in which questions about gambling were adjusted to refer to gaming and to the length of time spent gaming. Perhaps ironically, this currently-unvalidated tool may elicit more accurate responses, as it avoided question-begging assumptions about whether loot boxes are gambling.

Given that loot boxes are likened to gambling based on aesthetic and mechanical similarities, it makes sense to investigate whether loot box research can be replicated for other activities with similar traits. So far there is only one study of this type (Zendle et al., 2021), which examines spending and symptoms of problem gambling in physical card collecting (because collecting also involves monetary expenditure for randomized rewards). The study found no evidence that such collecting was associated with problem gambling in the same way as loot box spending. It suggests this may be because there are important differences between physical cards and loot boxes, which is intuitively plausible. Yet there is an additional point to raise: both the studies of loot boxes and card collecting used the PGSI as a measurement tool. However, collectible cards are not the center of a public controversy and do not seem to possess the same question-begging gambling stigma as loot boxes. So it may be that respondents simply did not associate card collecting with problematic behavior.

In any case, it is vital to take a careful and critical approach to screening and measurement tools to ensure they are fit for purpose in the study of loot boxes, especially given that nearly 80% of empirical research on loot boxes relies on the PGSI (Table 1). This emphasis has a knock-on effect as well, because literature reviews and meta-analyses must also take these tools as a starting point.

6.2 The Risky Loot-box Index (RLI)

There are also some positive efforts underway to construct new tools specifically intended for the study of loot box engagement, specifically, a tentative Risky Loot-box Index (RLI) (Brooks and Clark, 2019). This tool uses 12 items assessed through Likert scales to evaluate potentially problematic behavior. It is

²¹ We could also develop even more pessimistic interpretations in addition to more optimistic views. This seems unnecessary though, as the pessimistic views are already disproportionately represented in discussion.

already being adopted in other studies (e.g., Drummond et al., 2020; A. King et al., 2020; Hall et al., 2021). The creators of this tool find correlations between various aspects of loot box interaction and problem gambling, as well as other risky behavior. Despite taking care to develop this new tool, and complementing it with other measure of problem behavior, the individual items in the Risky Loot-box Index are also sometimes confusing or ambiguous. For example, the statement “My Loot Box use has caused me problems” can be interpreted in various ways that are irrelevant to problem gambling or related issues. A further complication is that the survey questions do not always make it obvious whether they are asking about *opening* loot boxes or *paying to open* them (loot boxes can often be obtained through gameplay, without paying). This ambiguity seriously influences how we interpret answers to prompts such as “Opening Loot Boxes is exciting,” or “Opening Loot Boxes sometimes feels like making a bet.”

6.3 Other Screening Tools

Several other measures have also been used to screen for problem gambling. Kristiansen and Severin (2020) find that greater engagement with loot boxes was positively associated with higher estimate of problem gambling severity, measured using the South Oaks Gambling Screen-Revised for Adolescents (Winters, Stinchfield, and Fulkerson, 1993). The SOGS-RA is similar to the PGSI in that it scores the answers to 12 questions in order to produce an overall measure of the severity of problem gambling. However, it also shares the same drawbacks, in particular the use of the terms “gambling” and “betting” in ways that allow them to include loot boxes. It does not appear that any modifications were made to the questions to adjust them to this special case. Other measures, such as the Gaming Addiction Scale (Brady and Prentice, 2021), or the Short Gambling Harms Screen (Rockloff et al., 2021), involve similarly vague questions.²² Ide et al. (2021) adapt the DSM-5 criteria for gambling disorder by replacing the word “gambling” with “online gaming” in order to focus on the latter. Unfortunately, they give no indication that this change was likely to produce valid results, in other words, that the new version fit well with online gaming in general or loot boxes in particular.²³

In summary, the most commonly used measurement tools for assessing problem gambling and problem gaming have yet to be validated in the context of loot boxes, which presents some special problems for how screening questions are interpreted by researchers and respondents. In fact, some tools, such as the IDG scale, have yet to be fully accepted in general, while others like the PGSI potentially suffer from question-begging assumptions or ambiguities. These issues are likely to bias survey results against loot boxes and in favor of the idea that loot boxes are behaviorally akin to gambling.

7 Economic-Philosophical Problems: Loot Box Spending and Practical Significance

Loot boxes are used by game developers because they offer at least two main economic advantages. First, they provide a revenue stream to complement or to replace traditional sales revenue. Second, they provide a relatively low-cost way to add new content to games that keeps players engaged over time, increasing life cycles and encouraging brand loyalty. Little publicly available data exists about the revenue generated by loot boxes, but estimates suggest that total sales exceeded \$15 billion in 2020 (Clement, 2021). SEC filings from Electronic Arts, one of the most successful vendors, indicate that its *Ultimate Team* modes for its sports franchises—based mainly on loot box sales—generated nearly \$4.5 billion in net revenue from 2019-2021 (Electronic Arts, 2021).

Loot box research so far has focused little on developers themselves, however; instead, the emphasis is on player engagement. As explained above, there is no consensus about how many people buy loot boxes on a regular basis, though what evidence there is suggests that proportionally the value is small. Nevertheless, it could still be the case that loot boxes cause major harm among a relatively small number of people, so it is vital to explore what current data have to say about the practical harms associated with loot boxes. Two obvious examples are psychological harm (e.g., stress, depression, damaged relationships) and economic harm (e.g., overspending). What does the literature tell us about the prevalence and seriousness of such harms? The answer is, surprisingly little, especially given persistent attempts to use the findings of loot box research to inform policy.

²² Furthermore, these tools are quite easy to “game,” in the sense that they require a small number of positive responses in order to pass the threshold for problem behavior.

²³ Although their adapted questions are ultimately similar to those on the Internet Gaming Disorder Scale–Short-Form (IGDS9-SF).

7.1 Overspending and Harm

Any attempt to understand the real impact of loot boxes on human behavior and well-being, and any such research that hopes to influence policymaking, should take into account the difference between statistical significance and economic significance. That is, how does loot box engagement influence player welfare? Do players overspend on loot boxes, and does their spending put them in precarious financial positions? Practically all empirical loot box research claims to have real-world relevance; however, half of all studies do not even collect data on loot box spending or other relevant financial information, and those that do tend to show that spending and/or spending relative to income are of minor importance. Despite claiming practical, clinical significance then, most studies do not explain why this is so, and instead limit themselves to quoting a general guide to interpreting effect sizes (e.g., Zendle and Cairns, 2018, pp. 7, 8). The most frequently cited source is Ferguson (2009). Yet this guide explicitly states—correctly—that there is no guarantee that any particular effect size is also practically significant. The minimum size adopted by Ferguson is $r=.2$, but even this is provided only as a suggestion. Yet this citation has been almost universally used in the loot box literature to claim that effect sizes that meet this threshold are likely to carry practical significance.²⁴ Given this limitation, it is crucial to look at the underlying evidence to see if it provides cause for alarm.

Only half of empirical loot box studies report information about spending, income, or similar data that could help researchers determine the economic significance of loot box engagement (this information is self-reported). These studies consistently report that average monthly spending is low. For example, in one adult sample, median monthly spend was \$10, with 6.2% reporting spending more than \$40, while in a parallel student sample, median spend was \$17.50, with 10.3% spending more than \$50 (Brooks and Clark, 2019, p. 28). The earliest empirical studies suggest that there is an average difference of roughly \$10-\$15 per month in loot box spending between problem and non-problem gamblers (Zendle, quoted in Environment and Communications References Committee, 2018, p. 42). These results are consistent with more recent findings that correlate loot box spending and relatively high scores on measures of problem gambling and gaming, as well as impulse control issues. For example, alleged problem gamblers spend on average \$12.92 more per month than non-problem gamblers (or about \$21 when including outliers), with these amounts being driven by a small number of relatively extreme cases (Drummond et al., 2020). Even during the early days of the COVID-19 pandemic, mean spending by those who purchased loot boxes was \$6.08, a small figure consistent with other findings (Hall et al., 2021). In a similar timeframe, other players reported engaging with loot boxes 2.1 times in the preceding three months, with an average spend of \$16.49 on each occasion (Carey, Delfabbro, and King, 2021). When extrapolated, this translated to \$25.97 spent on loot boxes over the period. The authors agree that this is a relatively small amount, and suggest that loot box engagement and harm are likely to have a common antecedent, namely, greater involvement with or commitment to games. In fact, it is estimated that a cumulative average spend of €1000 across all forms of gambling “increases the likelihood of purchasing a loot box by 4% and increases the frequency of purchases by 12-16 times in a given year” (von Meduna et al., 2020, pp. 7-8). These are small results compared to the size of the initial spend required.²⁵

The largest estimate of average monthly spending on loot boxes in the literature is reported by players of *Heroes of the Storm* in a study examining the game one month before and one month after its loot boxes were removed (Zendle, 2019). Within this sample, non-problem gamblers, low-risk gamblers, and moderate-risk gamblers spent on average \$8.47, \$11.37, and \$21.11 per month, respectively, while problem gamblers spent \$86.87.²⁶ The last value is noticeably larger than the others, yet as the author acknowledges, it is still a relatively small amount in practice (Zendle, 2019, p. 11). The results could still indicate problems though, because “individual problem gamblers themselves experienced a large drop in spending [*sic*] For example, if one consults the raw data associated with this study, one will observe individual problem gamblers whose spending decreased by hundreds of dollars when loot boxes were removed” (Zendle, 2019, p. 11). However, inspection of this data reveals that although spending by problem gamblers did generally decrease when loot boxes were removed, only one player reported spending “hundreds” less, the amount in question being exactly \$200. In fact, 4 out of 22 problem

²⁴ This trend includes some research co-authored by Ferguson himself (see, e.g., Drummond et al., 2020).

²⁵ In A. King et al. (2020) spending on microtransactions and/or loot boxes was reported as an ordinal choice, with a mean range of \$20.00-29.99.

²⁶ The author's interpretations of this data are unclear, because in the portion of the paper in which spending among problem gamblers is supposed to be reported and examined, the monetary values are missing, and the discussion cuts off mid-sentence in an unfinished paragraph (Zendle, 2019, p. 10).

gamblers reported spending marginally more money *after* loot boxes were removed, including the largest reported spender in the data set (<https://osf.io/ts7ue/>).²⁷

It is not clear why the spending figures reported above constitute problematic behavior. If anything, the underlying data lead to nearly the opposite conclusion: they suggest that the practical impact of loot box spending is small. Of course, it could be argued that average spending figures can hide cases of extreme spending. Yet averages also conceal extremes at the lower bound, which in this case is represented by players who spent nothing.²⁸ For instance, according to some raw data (for Zendle and Cairns, 2018), 64.2% of those who reported spending on loot boxes spent \$10 per month or less (<https://osf.io/srykf/>). Furthermore, the significance of spending is often related to the spender's income. Spending is very different for adults with steady and relatively high incomes, who could spend perhaps a few hundred dollars per month on loot boxes, than it is for children or people with limited financial means.²⁹ The data often reveal that cases of high spending and low income are rare. For instance, respondents in one case chose from sixteen different income brackets ranging from less than \$10,000 to greater than \$100,000 per year, and spending was divided into thirteen brackets ranging from less than \$1 to greater than \$300 per month (Zendle and Cairns, 2018). 82 people (from a sample of 7,422) reported spending \$200 or more per month on loot boxes. The pattern was the same within income brackets: for each level of income, between 1 and 4 respondents reported spending at the highest level of more than \$300 per month. Only 2 people with reported incomes less than \$10,000 spent at this level. The only exception was for the bracket for income greater than \$100,000, in which 18 people reported the highest level of spending. In general, the vast majority of respondents reported loot box spending that constituted 1% or less of their total income. A replication study also failed to show that loot box spending among problem gamblers was economically significant, even while also claiming that the results provided good reason to regulate loot boxes (Zendle and Cairns, 2019, p. 1).³⁰

Close et al. (2021) conducted a secondary analysis that pooled survey responses to early loot box studies ($n=7771$) to further investigate their economic significance. Their two novel findings are, first, that the majority of revenue generated from loot boxes tends to come from a small number of large spenders, or “whales”; and second, no association was found between higher spending on loot boxes and higher self-reported salaries. The authors take the second finding to be evidence for the exploitative nature of loot boxes. There are several problems with this interpretation, however. First, because this study pools the results of other works (discussed above), it inevitably takes on their potential flaws as well. Second, even if we take the quantitative results for granted, this study, like the ones on which it is based, shows that loot box spending is low for most players, and even the highest spenders in all reported categories (the maximum reported spend was \$500 per month) reported average annual incomes of at least \$40,000. Those who spent \$300-\$400 per month reported average annual income of \$70,000. The extremes among these examples, where players spend around 15% of their income on loot boxes, could well be cases of excessive spending, particularly for large households. Yet no further evidence is provided to establish that this is the case. Third, even taking these results for granted, a lack of correlation between higher spending and higher salaries is not evidence that developers are “unscrupulous” (Close et al., 2021, p. 4) or that problematic behavior is occurring. What constitutes overspending, for example, is not an objective fact, but can only be understood in light of the subjective preferences of the spender. No absolute amount of spending or salary by itself is sufficient to establish this: it requires deeper investigation into “the particular circumstances of time and place” (this is one reason why the importance of qualitative work is stressed in the conclusions below). Fourth, although annual income is likely to be an important factor in determining individuals' subjective notions of what counts as “overspending” or troubled behavior, it is far from the only

²⁷ Interestingly, in one version of the model, moderate-risk gamblers generally spent more money after loot boxes were removed.

²⁸ Most studies do not offer respondents an opportunity to state whether they earned a net revenue from loot boxes, i.e., from selling boxes or their rewards. Although there is little hard data on their activities, players who act as loot box vendors in this way could prove to be an interesting minority group to study in future work.

²⁹ Additionally, what constitutes limited means or overspending is context-dependent. Dreier, et al. (2017) argue that many children can be classified as “whales” (the big spenders who drive microtransaction revenue models), but only when defining a whale as someone who spends more than €16 per month on a game, a low threshold in practice (cf. also Hart, 2017).

³⁰ Correlations between loot box spending and problem gambling are replicated again in Zendle et al. (2020a). This preregistered study also attempts to isolate the effects of specific aspects of loot boxes to determine what effects they have on the spending-gambling relationship. These factors include whether rewards can be cashed out, whether they influence competitive gameplay, and whether they contain exclusive items not available elsewhere in the game. Most of the findings, however, demonstrated only weak relationships, often with small effect sizes. The authors also discovered that gamers are often unaware of different features available in the games they played, such that they inaccurately reported key information about issues such as whether it was possible to sell loot box rewards on secondary markets. And once more, there is no discussion of the practical meaning of the statistical results, or demonstration of serious harm.

one. Finally, notwithstanding these issues, the design of these studies also raises the question of how to identify and capture the behavior of whales. Whales are rare and may not be included even in large samples, and may even self-select out of research studies (out of shame, for instance). And although we are critical of the lack of generalizability in the literature, it is possible that in the case of whales, sampling is not purposive enough to capture them. Furthermore, if spending is not reported, or is reported but capped, or is reported with only a minimum boundary (where spending is reported as, say, “more than \$300 per month”), whales’ true contributions will be further obscured. This hints at a broader problem as well, namely, that real-world behavior does not usually occur according to a neat and consistent schedule: as a result, evenly distributed brackets for income and spending likely do not map well to actual player behavior.³¹

7.2 Other Estimates of Harm

Despite the correlation between loot box engagement and problem gambling, the data often reveal that very few respondents actually experienced problems with gambling or had spent seemingly excessive amounts on loot boxes (e.g., Brooks and Clark, 2019, pp. 29-30). Nevertheless, some studies find a notably high proportion of loot box engagement, especially the selling of loot boxes. In one sample, 39.7% of university students and 27.8% of adults reported having sold a loot box (Brooks and Clark, 2019, p. 32). A reasonable inference is that university students are simply more willing to go to the effort of selling loot on secondary markets because they have limited financial means, while adults are willing to take some time and effort (compared to adolescents, say) to recoup some of their spending. This is tentatively supported by evidence that the more money players make by selling loot box rewards, the weaker the relationship between loot box spending and problem gambling (Zendle et al., 2020a).³²

Evidence of other psychological harms is also varied and ambiguous. The global lockdowns that began in April 2020 in response to the COVID-19 pandemic offered the opportunity for a natural experiment comparing loot box engagement among isolated and non-isolated gamers (Hall et al., 2021). Research on this topic has produced mixed results, however, despite using multiple screening tools such as the PGSI, RLI, and IGD Checklist. No evidence was found of differences between loot box spending by those in quarantine and those not, and there was no difference between risky loot box use between the isolated and non-isolated. Weak associations were found between fear of germ contamination and loot box spending, and between spending and psychological distress. Higher PGSI scores were also associated with higher loot box spending, but the practical effects were small. Average spending on loot boxes in the previous month was \$2.98. The authors hasten to add that this low average was influenced by the fact that 989 out of 1144 respondents (87%) reported not spending on loot boxes in the previous month. The fact that so few respondents paid for loot boxes indicates that they are not as widespread in practice as the correlations alone might suggest. Other research has similarly had to confront the unique challenges of the pandemic. For example, one self-administered survey ($n=471$) used a variety of measures of benefits and harms associated with gaming (Carey, Delfabbro, and King, 2021). IGD was found to be predicted by loot box spending. Furthermore, the relationship between spending on loot boxes and financial harm was significantly positive for two out of three measures used. The authors acknowledge though that the pandemic itself may have been responsible for some of the harms reported (for example, poor mental health during lockdowns).

Qualitative research using semi-structured interviews found that only 1 out of 28 gamers scored above the threshold for disordered gaming, and identified no consistent relationship between high IDG scores and reported problems controlling loot box spending (Nicklin et al., 2021). This runs counter to the notion that ““compulsive” loot box purchasers would typically be those reporting problematic gaming,” though the sample is not representative and should not be taken for granted (Nicklin et al., 2021, p. 16). Participants’ scores on the PGSI were also low, with 17 out of 28 interviewees scoring 0, and 3 scoring in the problem gambling range. Out of these three, the highest scorer (18), was fully employed, earned above £40000 per year, and spent £25 per month on loot boxes. The second highest scorer (10), was normally fully employed but was furloughed at the time of interview, earned £20001-25000 per year, and spent £2000 per year on loot boxes (monthly spend was not reported). The third highest scorer, at the minimum PGSI threshold of 8, was unemployed and earning no income, and reported monthly spending of £100 (though inconsistently reported spending £300 per year).

³¹ We are grateful to an anonymous reviewer for these points about whales.

³² The ability to sell loot boxes or loot brings them closer to traditional legal definitions of gambling, whatever their behavioral significance.

Whatever its statistical significance might be, the practical significance of loot box engagement provides the most important evidence of potential harm. And at least some researchers have argued that demonstrating practical, observable harm is a crucial part of justifying regulatory intervention in loot boxes (McCaffrey, 2020). Such evidence is so far lacking in the literature though. For a simple comparison, reported average monthly spending in most loot box studies is less than the price of a Netflix subscription, and a good deal less expensive than an evening at the pub, to say nothing of how it compares to average total monthly spend on all media and entertainment services in developed nations. Likewise, we do not yet have evidence that those who spend money on loot boxes are systematically unemployed or likely to be in a state of financial hardship. And we have no evidence at all about how any of these conditions change over time. The empirical evidence thus does not give us reason to believe that loot box engagement encourages excessive spending or that it is closely related to serious harms.

7.3 Contrary Evidence

Despite the prevalence of studies showing association between loot box engagement and problem gambling and/or problem gaming, some evidence runs counter to these findings. In addition to individual points discussed above, some of these results are worth discussing further. A survey of *Fortnite* players (a game that is especially popular among relatively young gamers, although this particular study surveyed adults) found no association between loot box purchases and symptoms of gaming disorder ($n=428$) (D.L. King et al. (2020). Instead, it found that loot box purchases were linked to peer behavior factors such as whether close friends had recently purchased loot boxes (importantly, most other loot box studies neglect this social element). Other predictors included the number of payment methods available, higher age, and the number of hours spent playing the game each week.

Another large-scale survey of 8th and 11th grade students in Delaware provided a more direct comparison between loot boxes and gambling by studying the relationship between loot box purchasing and risk and protective factors (DeCamp, 2021). These factors include “parental bond, depression/ anxiety, victimization, bullying, substance use, school grades, gender, and race/ethnicity” (DeCamp, 2021, p. 193). The results indicate that both loot box purchases and other forms of microtransaction are poorly predicted by standard risk factors. This hints that in this respect at least, loot boxes and traditional gambling are dissimilar.³³

There has also been a small effort to study loot box engagement over time. Rockloff et al. (2021) used cross-sectional surveys, but respondents were also asked retrospective questions about how many years it had been since they first opened a loot box, and also since they first purchased one. These questions are small steps toward the kind of analysis that can support causal research. However, for adults, after controlling for age, there was no relationship between the length of time since first exposure to loot boxes and any key outcome that was reported. For adolescent girls there was some association between recent first openings of loot boxes and potential problem gambling. Yet longer past engagement with loot boxes did not predict gambling outcomes in adults or adolescents.

7.4 Rhetoric and Moral Panic

The importance of effect sizes rather than statistical significance as such is a common theme in the loot box literature (e.g., Zendle, Meyer, and Over, 2019, pp. 5, 14). However, no effort is made in current studies to explain the practical meaning of reported effect sizes or to justify the claim that loot boxes constitute a serious public harm or influence players’ economic decisions in an important way. If anything, the strength of effect sizes should be a cause for doubt: one paper, for example, finds that the link between loot box spending and problem gambling is “an order of magnitude larger” than the link between problem gambling and risk factors such as alcohol dependence (Zendle, Meyer, and Over, 2019, pp. 3, 14). This is surprising given that there is as yet no evidence that loot boxes are related to anything like the same kinds of destructive behaviors known to be associated with traditional gambling or alcohol dependence. It would be more reasonable to suspect that there are underlying problems with the methods and tools being used that produce exaggerated results when applied to loot boxes. Similarly non-intuitive results are found by von Meduna et al. (2020), who report that “Nearly every second loot box user (48.3%) is a gambler and nearly all of them (95.0%) meet the criteria for problem gambling according to their PGSI score. A bit more than two-thirds of loot box users (68.9%) can be classified as problem gamers.” There is no practical evidence as yet that links such extreme statistical results to practical welfare concerns.

³³ The study is cross-sectional, yet as the author points out, when there are no correlations there is also no causality to establish.

These and the other results discussed above cast doubt on the claim that loot box spending is economically significant. Importantly, even if taken in their worst light, the data discussed in this review do not fit the extreme picture of problem gambling presented in the literature:

[Problem gambling is] a pattern of gambling activity which is so extreme that it causes an individual to have problems in their personal, family, and vocational life... These issues range from domestic abuse... and intimate partner violence... to involvement in illegal activities... increased medical costs... and suicidality. (Zendle and Cairns, 2018, p. 2)³⁴

None of these behaviors has been reported in the loot box literature, and almost none of them have even been the subject of survey questions. In other places, microtransactions are described as a “virtual epidemic” (Brady and Prentice, 2021), while loot boxes are a matter of “life or death” for problem gamblers, and are said to have the potential to generate an “epidemic of problem gambling the scale of which the world has never seen” (Zendle, quoted in Sinclair, 2019). No evidence of these behaviors with respect to loot boxes is offered, however, and framing the controversy using such extreme rhetoric creates a risk of moral panic at the expense of dispassionate analysis (Bowman, 2015). When moral panic sets in, “moral beliefs can substantially influence scientific research, and its results are readily used as confirmation for what has been suspected” (Elson and Ferguson, 2013, p. 322). Furthermore, “research projects launched in the midst of a moral panic bear the risk of introducing bias and distracting from more important issues” (Elson and Ferguson, 2013, p. 322), such as more fundamental causes of gambling or gaming problems. Confusion and potential for moral panic are exacerbated by inaccurate claims about the financial value of loot boxes, which is consistently overstated. Many papers cite a report by Juniper Research (2018) suggesting that the market value of loot boxes in 2018 was around \$30 billion and was predicted to reach \$50 billion by 2022 (e.g., Garea et al., 2021). However, this figure is a combined estimate for loot boxes and skins gambling, and the portion represented by loot boxes is undefined. Zendle, Meyer, and Over (2019, p. 17) compound this error by referring to the \$30b figure as the “annual profit” from loot boxes. It is no such thing: it is a market value based on *total spending*, not an annual profit estimate.³⁵

8 Summary and Directions for Future Research

The previous sections have argued that many conclusions in the literature are unsatisfactory or at least premature. What then would be a more plausible interpretation of the data, and can we say anything with certainty about loot box engagement? It is clear that loot boxes are a novel and potentially exciting way to engage with games, and that in some cases it is possible to spend large amounts of real-world money purchasing them. There are also sometimes aesthetic similarities between loot box openings and traditional gambling activities such as slot machines, although exciting sounds and images are staples of most video games (this highlights some underlying conceptual problems that should be further explored). However, loot boxes are also extremely inconsistent in terms of their form, availability, subjective value to players, ability to exchange and monetary value (if any), prevalence of engagement, and conscious motivations for engagement (this highlights some methodological problems in current work). Further, existing evidence does not yet show that loot boxes are responsible for a widespread, consistent, or significant practical harm to players (highlighting some deeper economic and philosophical problems). Instead, they seem to follow the pattern of many innovations: because they are novel, loot boxes do not fall easily into established legal or research categories. This ambiguity perhaps understandably results in confusion and moral panic, especially because, as we have argued above, studying innovations using traditional methods can result in overstating risks or harms. Nevertheless, despite any potential problems in previous works, the results we have surveyed could still add up to a significant pattern of behavior, especially concerning the correlation between loot box engagement and symptoms of problem gambling or problem gaming. This is certainly possible. However, if we accept this core finding on these grounds, then by the same reasoning we should also accept the other main conclusion of the literature, that existing research shows little or no evidence of overspending or other serious harms being inflicted on players. If the first conclusion is accepted “warts and all,” then the second should be as well. However, in our opinion, at this stage, neither finding is definitive.

In terms of the amount of public, legislative, regulatory, and academic controversy they have generated, loot boxes are one of the most commonly studied problems in the history of the video game industry. For

³⁴ Cf. also Zendle, Meyer, and Over (2019, p. 2).

³⁵ Close et al. (2021) likewise confuse profit and revenue.

policymakers, the larger issues at stake include the protection of children, the individual and social problems of addictive behaviors, and the regulation of gambling activities. The bulk of the controversy so far though has focused on potential behavioural similarities between loot box engagement and traditional gambling, and whether those who purchase loot boxes are more likely to be problem gamblers or problem gamers. Positive correlations have been repeatedly found between loot box opening or purchasing and various indicators of disordered or problem behavior.³⁶ Yet reviews of the literature have suggested that the methodological quality of most studies is relatively low, and no studies are graded as being of the highest quality (Yokomitsu et al., 2021).

We have also seen that while interest in loot boxes has grown rapidly, there are still fundamental problems in most research that have not been explored by reviews and meta-analyses (Garea et al., 2021; Spicer et al., 2021; Yokomitsu et al., 2021). The main problems we identified in this critical review are listed in Table 1. Table 2 summarizes these issues and suggests research practices that will produce more reliable and useful results.

Table 2. Agenda for Research On Loot Boxes And Problem Behaviour.

Research Gaps	Research Pathways
Lack of conceptual foundations for loot box research	<ul style="list-style-type: none"> Reduce focus on quantitative research until stronger foundations are available Reduce focus on basic comparisons of the aesthetic qualities of loot boxes and other products Reduce focus on mechanical, deterministic views of player behavior Increase focus on qualitative research to develop stronger foundations Increase focus on theorizing and mapping complex player motivations Disaggregate loot box purchase motivations Increase focus on theorizing and mapping player decision processes Develop better accounts of causation
Lack of clear definitions/implementation of loot boxes in current research	<ul style="list-style-type: none"> Clearer statements about whether specific loot boxes/their contents can be bought for money Clearer questions to respondents about whether they open or actively purchase loot boxes/their contents Avoid question-begging definitions of loot boxes Disaggregate loot boxes in “AAA” games (e.g., on major platforms) vs. free-to-play or indie games (e.g., on mobile platforms) Disaggregate loot boxes across game genres Disaggregate loot box availability Clearer statements about End-User License Agreements and the ownership and sale of loot boxes/their contents
Lack of representative samples and generalizable results	<ul style="list-style-type: none"> Reduce focus on self-reported data Reduce focus on cross-sectional data alone Reduce focus on potentially biased samples and data sources (e.g., Reddit, Mechanical Turk) Increase focus on observational data Increase focus on longitudinal studies of loot box engagement Increase focus on more representative gender samples Increase focus on studying the behavior of children and adolescents When more targeted samples are used, gather higher-quality data on or about players (e.g., “whales”)
Lack of clear and validated screening and assessment tools for problem behaviors in the	<ul style="list-style-type: none"> Reduce focus on applying conventional gambling screening tools to loot boxes

³⁶ In addition to the discussions in this paper, these results are summarized in a review of studies investigating links between (a) loot box engagement and problem gambling and (b) loot box engagement and problem video gaming (Spicer et al., 2021), and in other literature surveys (Yokomitsu et al., 2021).

context of loot boxes	Increase focus on clear, unambiguous, and neutral definitions of loot boxes Increase focus on developing and validating research tools that take into account the unique characteristics of loot boxes
Lack of evidence of serious, widespread, and economically meaningful harm caused by loot boxes	Define major types of harm in a clear, measurable, and generalizable way Define specific forms of harm, e.g., “overspending” Gather verifiable data, preferably through observation
Lack of research relevance to public policy	Increase focus on studying the costs and benefits of loot box engagement Increase focus on the costs and unintended consequences of loot box legislation

These problems mainly stem from a lack of underlying qualitative or conceptual research, which in turns makes it difficult for current work to grapple with the question of how to study unique aspects of video game mechanics, and how to account for the unique choices loot box users face. Most studies rely on self-administered surveys from convenience samples, and offer only cross-sectional data that is seldom representative. To date, there is not a single observed case of problem gambling or problem gaming with respect to loot boxes: all empirical evidence is self-reported. Furthermore, survey questions do not always disaggregate spending on loot boxes due to the thrill of opening them from more practical goals such as acquiring content unavailable by other means. In fact, extant studies assume that methods for studying traditional gambling can be used to study loot boxes without any special modifications. This is something that must be proved, however: it cannot be assumed, and there is still a dearth of evidence that the conventional tools of gambling research adapt easily and appropriately to loot boxes. In fact, measures of problem gambling such as the PGSI can easily classify loot box users as moderate-risk gamblers even if they do not gamble at all. They are also subject to question-begging definitions of loot boxes. Finally, despite repeated calls for regulatory oversight, none of the studies reviewed here has demonstrated that loot boxes are associated with a serious practical harm. Instead, they rely exclusively on statistical significance and non-contextualized interpretations of effect sizes, and say little about the individual or social effects of loot box engagement. Those studies that do measure loot box spending directly show that average spending is relatively low and is fully comparable to average spending for standard forms of entertainment and media consumption.

Public investigations and academic research have stressed repeatedly that the literature on loot boxes, gambling, and addiction is in its infancy (e.g., Environment and Communications References Committee, 2018; Australian Government, 2019). For this reason, it is vital to outline a positive research program to develop our understanding and to guide public opinion and public policy. With this in mind, we conclude by suggesting some directions for future research that will help to overcome the problems identified in this paper and foster a more rigorous and relevant literature.

First, loot box studies can be more frank and direct about what they do and do not study, and about potential limitations in terms of their ability to add to our general knowledge of loot box engagement and their relevance for public policy. This means working toward more accurate representation of key demographics. It also means tackling the difficult problem of studying the behavior of children, whose safety is a key concern in the loot box debate, but whose habits and preferences are seldom reported. It is also essential to explore longitudinal data on loot box use, especially to determine how loot box spending and related behaviors evolve over time. This is necessary for building meaningful accounts of causation, which are still lacking and have so far focused entirely on a small group of correlations. It is also relevant because existing studies are not usually generalizable, and in fact, tend to sample from different segments of the same type of respondents: highly engaged Internet users with serious interests in online gaming and/or online gambling, and with pre-existing interests and even strong opinions about the loot box controversy. In addition to more radically different samples and sampling techniques, different types of games should also be represented. Existing research rarely makes a distinction between, say, loot boxes in major “AAA” games designed for PCs or consoles that come with large base prices, and loot boxes in free-to-play apps for mobile devices. These kinds of differences in the scale, genre, and availability of games deserve further attention, as they cannot be assumed to elicit the same player behavior.³⁷ While

³⁷ An unpublished conference paper by Macey and Hamari (2019b) takes steps in this direction by studying correlations between loot box consumption and different game genres and sales models. However, their survey generated few significant results, indicating

individually, the problems mentioned above are common and may not have an enormous impact on any particular study, together they cause greater problems, and especially they reduce the value of loot box research for public policy. It is also important to point out though that high-quality data are not easy to come by. In many cases they require detailed financial information from development and publishing firms with little or no incentive to make such information available.³⁸ Given this limitation, it is understandable that current researchers are studying what they can, when they can. Nevertheless, the difficulty of conducting the highest-quality research does not mitigate the problems found in the current literature, which should not be assumed away simply because this is a new field of study: on the contrary, it is precisely *because* this is a new field of study that it is so important to build it on as strong a foundation as possible. With that in mind, the lack of excellent quantitative data is not necessarily a barrier to more qualitative research; in fact, qualitative methods are especially promising at this stage because they can help us understand the unique behavior and decision processes of consumers (players) and businesses (developers and publishers) alike, and thereby provide a framework for a robust body of work in and around microtransactions and loot boxes. One specific example of this relates to the behavior of “whales,” whose behavior patterns deserve study in their own right given the impact they are thought to have on loot box spending.

Second, research methods should be updated to reflect the unique qualities of video games, microtransactions, and loot boxes. They must also account for the unique choices players face when opening loot boxes, and the complex motivations that encourage them to do so. This also means acknowledging that conventional tools for studying gambling, even online gambling or online gaming, may not be appropriate in this space, and new measures may need to be developed. It is particularly important not to assume that loot boxes can be easily studied using simple variations of methods that have proved successful in the past in studying other behaviors. In practice, this means looking more closely at tools such as the PGSI to determine whether they adequately capture unique features of loot boxes, including the extent to which controversial definitions influence survey results.

Third, if this research is to be relevant for public policy, it should devote more attention to studying the underlying economic significance of loot box spending and gamer behavior, not merely their statistical significance. The literature still has far to go in terms of showing that the general trend of correlation between loot box engagement and problem gambling is important enough to represent a serious, widespread social problem. This is an especially crucial point because many if not most commenters in the loot box controversy are enthusiastic about using their results as a basis for informing policy, and often recommend investigation or action by public authorities (e.g. Drummond, Sauer, and Hall, 2019; Griffiths, 2019; Li, Mills, and Nower, 2019, p. 31; Spicer et al., 2021; Zendle and Cairns, 2018, pp. 8, 9, 10; Zendle, Meyer, and Over, 2019, p. 17; Zendle et al., 2019). However, none of the studies we reviewed seriously considers the costs, benefits, and unintended consequences of regulation, even for problem gamblers and other vulnerable people. In fact, their policy recommendations are largely based on the *non sequitur* that if a social ill exists, public regulation to remove it is necessary and desirable, no matter the cost.³⁹

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only that loot box engagement tends to be closely connected with retail and free-to-play games, and that it is tied to the shooter genre.

³⁸ In some cases, this problem can be overcome when companies are legally obligated to disclose information, as in the case of Chinese developers.

³⁹ King and Delfabbro (2019a) are practically the only commenters to suggest the possibility of unintended consequences from regulation. Elsewhere they suggest a series of policies that businesses and public regulators could introduce to limit the potential harm of loot boxes (King and Delfabbro, 2019b). McCaffrey (2019) studies self-regulatory efforts in the video game industry, and explains that numerous developers are removing or modifying loot boxes in response to criticism (most of these actions predated King and Delfabbro's list of reforms). In addition to abandoning loot boxes altogether, industry actions include publishing loot box odds, guaranteeing high-value items, raising the odds of receiving valuable items, and changing the structure of loot boxes to remove or mitigate risk. Although it is uncertain what will ultimately become of loot boxes as a revenue model in gaming, it is clear at least that the problem is being treated seriously by developers and publishers. The more this trend continues, the weaker becomes the rationale for regulating loot boxes.

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