# Loot box gambling addiction risk versus responsible computing: a systematic review

**Luiz Felipe Carvalho Duarte** [ **Universidade de Brasília** | *luiz.duarte11@yahoo.com.br* ]
**Edison Ishikawa** [ **Universidade de Brasília** | *ishikawa@unb.br* ]

**Abstract**

There are many ways to monetize video games: from the simple direct purchase to the system of "games as a service". There are, however, forms of monetization that show strong indications of being detrimental to consumers, such as the so-called "loot boxes" that are offered during gameplay. No study so far has categorically proven whether or not loot boxes cause a dependency or lead to gambling addiction, therefore this study seeks to perform a systematic literature review to determine which studies and experiments were performed, in order to: 1) determine the harmful effects of loot box consumption; 2) compare the results found in these studies; 3) identify gaps in the methodology applied to suggest further research that might lead to stronger conclusions and 4) check if there are studies in the field of responsible computing of articles that aim to minimize the harmful effects of loot box in humans. These studies could be useful in, for example, supporting the drafting of regulatory legislation for the use of microtransactions in video games, and consumer protection and the need to research computational algorithms to try to reduce potential addictive effects generated by loot boxes, which is part of responsible computing. In this study, although this systematic review shows that these studies still do not prove that loot boxes lead to gambling addiction, they do show that there is a correlation between them and there is still a need for more studies in the field of computing area dedicated to the research of algorithms that seek to minimize the potentially harmful effects of loot box in humans.

**Keywords:** *loot boxes, microtransactions, systematic review, video games, gambling*

## 1 Introduction

In 2019, the video games industry generated $152.1 billion in revenue (Newzoo, 2020), while other comparable industries made significantly less over the same period, such as the film industry, which for the first time accumulated more than $42 billion in 2020 (Ripley, 2020). This discrepancy is attributed, mainly, to how access to these products is charged. When watching a film at a cinema, a consumer would only pay once for admission and, maybe, acquire a copy for personal future use. A consumer of a video game with comparable production value can be charged, in total, multiple times the asking price of the product, due to "microtransactions", which are relatively small offerings made in such a way as to be purchased multiple times over the usage of a certain game.

Among the different methods of microtransactions, the loot box has stood out in recent times. It is characterized by offering some manner of benefit, be it aesthetic or not, as a possible reward inside of a bundle, such that the specific reward given is selected randomly and presented only after purchase. This system of offering something seen as valuable according to some random selection method is similar to those seen in gambling, since the loot box consumer pays to acquire something, without knowing what they will actually receive. However, due to the recentness of this practice, gathering relevant data and parameters is difficult. Consequently, many studies investigated whether loot boxes might have an addicting effect, and if their use should be regulated in a similar fashion to gambling. These analyses, in general, were performed over experiments utilizing instruments for diagnosis of gambling addiction on individuals that claimed to be loot box consumers, with the goal of determining if similar symptoms are present in them (Griffiths, 2018).

The objectives of this systematic literature review were to determine which studies and experiments were performed, in order to verify if it is possible to scientifically prove the harmful effects of loot boxes, compare these studies, and determine what types of research are still needed to prove whether loot boxes do or do not lead to gambling addiction. More precisely, the contributions of this systematic review are:

- Compilation of the currently available knowledge regarding the similarities between the resulting effects of loot box consumption and those resulting from gambling addiction.
- Identification of aspects not-yet explored in this research field, and which future experiments could approach them.
- Show the need for more research in the field of responsible computing that seeks to minimize the potential harmful effects of services and computer products, in this case the use of loot boxes in electronic games, before they become commercialized.

The article is structured as follows. Section 2 discusses the concepts that support this work. Section 3 presents the methodology. Section 4 presents the data synthesis. In Section 5 we conclude the work. Finally, in Section 6 we present some limitations and suggestions for further research are presented.

## 2 Background

Video games are a form of entertainment different from others for various reasons (Grodal et al., 2000), one being how
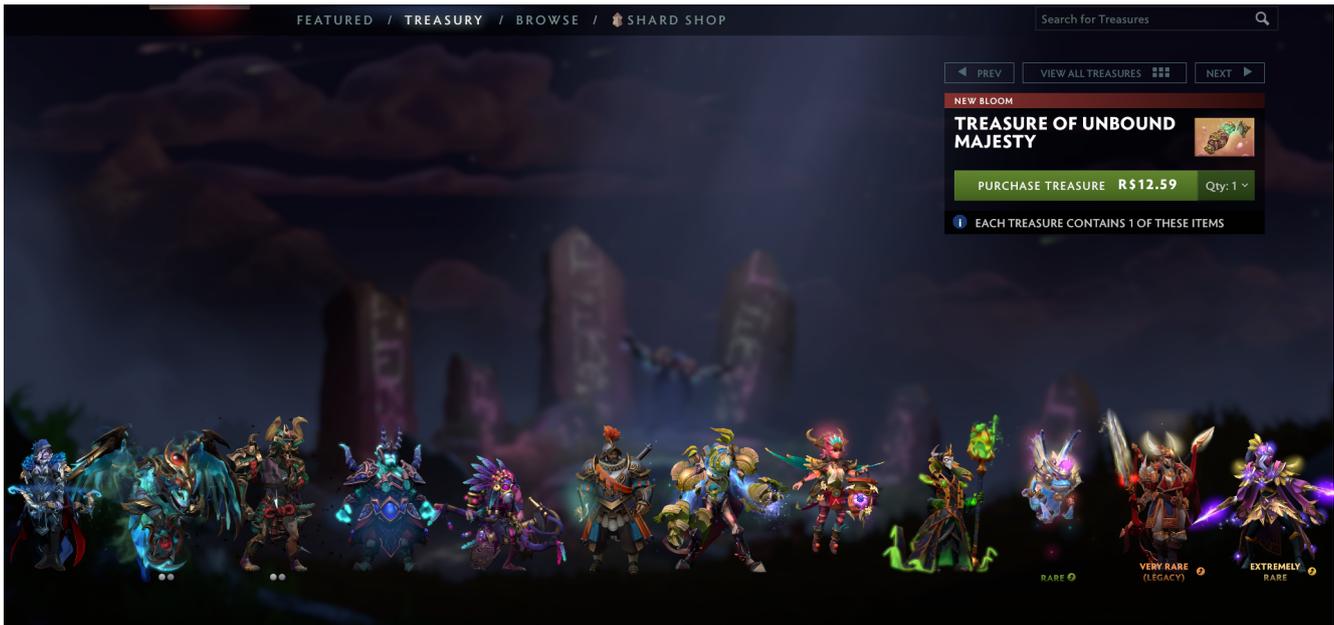
**Figure 1.** Example of a loot box. Here the player is offered one of several sets of cosmetic items as a reward, but is not informed which one they will receive. Source: *Dota 2*, Valve

parts of the product are restricted until the consumer surpasses some obstacle, which is presented as a challenge to be overcome (Sweetser and Wyeth, 2005; Liu et al., 2009). For example, one section of the game might be inaccessible until the player defeats a certain amount of enemies. These can also be tasks such as performing a certain action within a time limit, or in a specific way, or a specific number of times, etc. Once the challenge is overcome, the player is given access to the restricted areas as a reward.

However, certain video games allow the player to use real money payments as a substitute for these required actions, via a system known as *microtransactions* (Oh and Ryu, 2007). This practice caused controversy among both players and psychology experts, due to the notion that, since there is the potential to generate additional revenue from players being frustrated with a given obstacle, or lacking the time required to overcome it, video game developers would be encouraged to plan their future products in such a way as to incentivize players to make as many microtransactions as possible (Švelch, 2017; Mistry, 2018; Cruz, 2018).

Eventually, certain video game developers started developing games with a different form of microtransaction, known as the loot box. In these microtransactions, the player is offered a metaphorical black box, inside of which is one of a series of possible prizes. These items are available only via this package, but are awarded randomly to the costumer. The player is informed of which are the possible prizes, but receives only a vague notion of the probability of receiving any one item (Ballou et al., 2020), as shown in Figure 1.

The inspiration for this practice comes from the system that was present in packs of cigarettes and sweets, where one collectible image of a baseball or soccer player was randomly picked from a set and added with the product, incentivizing consumers to complete the set by purchasing more packs . It also took inspiration from popular collectable card games, such as *Magic: The Gathering* (Wright, 2017). What changed drastically in recent times is how the random selection process is being glorified: there is an exaltation of this process, via language and audiovisual effects similar to those present in casino games (Spicer et al., 2022a,c).

The prizes with a lower chance to be awarded are, in general, considered more prestigious, either due to their aesthetic design or simply for the fact that they are rare (Larche et al., 2021). This results in the player, who is already invested in the product and used to chasing rewards, desiring access to the rare item. They believe that it is worthwhile to try purchasing one more loot box and, most times, they do not receive the item they wish, which leads them to try again. This cycle of trial and error by the consumer is the effect in question, due to its similarity to the vicious cycle present in many gambling games (Montiel et al., 2022).

Shortly after the emergence of the loot box in video games, various sectors of society raised concerns agaitns loot boxes (Cerulli-Harms et al., 2020) like Consumer protection authorities. Psychologists were concerned with the high prevalence rates of severe psychological distress among loot box buyers (Drummond et al., 2022). Justice authorities have noticed undue economical exploitation of young people due complaints with local gambling, youth protection regulators, the mass media and politicians to take action against loot boxes (Schwiddessen and Karius, 2018). This led economists to study the loot box model of business and predict a sharp decline of the pay-to-play to sales and more aggressive reliance on loot boxes (Tomić, 2018).

On the other hand, restricting loot boxes will favor big companies or restrictions can make the problem worse as loot box will be illegal and will be more difficult to enforce safety standards (McCaffrey, 2019). One way to try to resolve this conflict is through research that provides stronger evidence that loot boxes cause addiction to games or are addictive, in order to support other necessary measures to reduce the damage caused by loot boxes or that provides guidelines to better regulate lott boxes. For example, Belgium has banned loot boxes (Xiao, 2023b). Other countries

preferred self-regulation of loot box usage by game companies themselves (King and Delfabbro, 2019; Xiao, 2021; Harvey, 2021). Other countries regulated its use and there is some studies trying to to help in this effort (Derrington et al., 2021; Drummond et al., 2020). Other countries have been concerned about the issue, but are still unsure of the most effective actions to control possible damage caused by loot boxes, or so they are researching the issue (Greer et al., 2022). Finally, there are countries that think that loot boxes are not the cause of gambling and therefore have not taken any action (Dorries, 2022).

On the opposite side, there are studies to maximize the profits obtained with loot boxes or increasing their attractiveness to co-opt users, without any ethical concerns about what the indiscriminate use of loot boxes could bring to their users, their families or society. For instance, Kaneko et al. (2018) models loot box consumption habits with the purpose of establishing marketing strategies to better sell lootboxes, Kao (2020) researches how to increase the attractiveness of loot boxes with the aim of increasing their consumption and finds that highly auditory effects greatly increase profits and in (Chen et al., 2021), a study is carried out to obtain the ideal price of loot boxes and how to design them in order to maximize the final profit, however, he warns that unscrupulous companies can advertise probabilities of obtaining fake loot boxes, which would increase even more profits.

# 3 Methodology

A systematic literature review was a procedure initially developed for medical research. It was adapted for other fields due to the methodological rigor in the process of verifying previous works. Its objective is to perform a reproducible, procedural, and comprehensive analysis of all available scientific works to answer a research question. This is done by following a series of steps, as outlined by the work of Keele et al. (2007), which was chosen as it is a methodology derived from medical systematic reviews, but made to be used in the field of software engineering to produce empirical data in a rigorous manner. Its steps are as follows: :

1. **Specify the research question(s)**. The product of this step will guide the rest of the process, since it will be used to determine how studies will be looked for, and which ones will be considered relevant, therefore it is crucial that it is well defined.
2. **Develop the review protocol**. Specification of the methods that will be used to perform the actual review, such as the search method and filtering rules. This step exists to reduce the chance for bias by the researcher.
3. **Selection of primary studies**. According to the method established in the previous step, all studies supposedly related to the research question(s) are procured, with all results considered irrelevant discarded.
4. **Evaluation of study quality**. Further refinement of the found studies is performed to remove those studies not directly related to the research question(s).
5. **Data extraction and monitoring**. The remaining studies are thoroughly analyzed and categorized according to their methodology and conclusions.
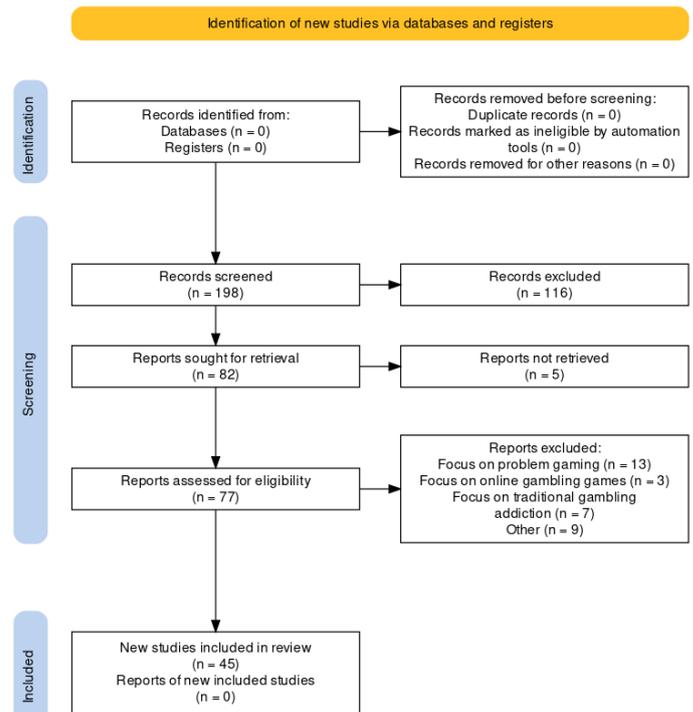


**Figure 2.** Illustration of the review process, with the number of articles that passed filtering in each step. Created with PRISMA tool by Haddaway et al. (2022).

6. **Data synthesis**. Using the gathered information, conclusions are drawn.
7. **Draft the report**. All conclusions are organized in a comprehensive report of the whole process.

A summary of this procedure, and the number of articles filtered out in each of these steps in this work can be found in Figure 2.

## 3.1 Research Question

In accordance to the procedure of systematic literature reviews, we register here the research questions utilized:

1. What is the degree and type of relationship that exists between the effects of loot box usage and gambling addiction symptoms?
2. Which experiments were performed to analyze this relationship, and what were their conclusions?
3. What is still left to be done for a general conclusion of this problem to be reached?
4. Are there studies in the field of responsible computing that are concerned with minimizing the possible harmful effects of loot boxes on humans?

## 3.2 Review Protocol

The search for articles was carried out in two parts by Duarte on the *Google Scholar* (GS) platform, first in July, 2021, then in March 2023. This is an online search tool specialized in scientific articles, which was chosen due to its wide variety of available works, including peer-reviewed articles with indexed bases, and other kinds of academic papers, such as theses. In it, keywords are used to perform the search, so the

results must contain them in their body and/or title. The keywords used in this study were "gambling" "addiction" "loot box" "systematic review". This search string is intended to find other systematic reviews, which would serve as a good indicator of the general state of the field. In order to better indicate which results were found in which search, the following sections will indicate the total number of studies that reached that step, then indicate how many came from each search, respectively.

## 3.3 Study Selection

This search gave us 198 (77 on the first part + 121 on the second) results, which would be too many to analyze each in detail. Furthermore, many of the articles obtained, due to the imprecision of the search platform used, were not truly relevant to the research questions. Therefore, by only verifying the titles of the results, we were able to eliminate several results. In this study, of the 198 results, 116 (39 + 77) were eliminated due to their titles not referencing loot boxes directly or indirectly[1].

## 3.4 Quality Evaluation

After initial filtration, 82 (38 + 44) results were left and their contents were analyzed. As such, in this step the summaries of the remaining studies were examined, so as to gain further understanding of their subject matter. A categorization system was also utilized in this step, in order to sort the works based on which kinds of experiments and/or analyses were performed en mass. Figure 3 shows the category summarization.

### 3.4.1 Removed Studies

We removed 39 (29 + 10) studies in this step due to not being directly related to the research questions. These articles contain certain traits in common, and were classified accordingly, as follows:

1. **Focus on problem gaming**: 13 (8+5) articles reference loot boxes as a possible cause or catalyst for problem gaming, i.e. gaming addiction. This is a condition where a consumer of video games makes use of these products in such excess that they begin to ignore other daily needs, such as biological necessities. Problem gaming is a phenomenon studied alongside loot boxes, but with many possible causes. As the focus of this review is on effects caused only by loot boxes, these studies were discarded. Between them there are 7 studies:

   - an interview of problematic and normal video game users about the difficulties they face (Stevens et al., 2021);
   - an interview on the usage of substances and symptoms representative of problem gaming and gambling (Mills et al., 2020);

   - an investigation, seeking to identify the optimal diagnostic tool for problem gambling, which solicits future studies on loot boxes (King et al., 2020b);
   - an interview, investigating whether smartphone video games are likely to cause problem gaming symptoms (Tham and Perreault, 2021);
   - an online survey, looking to determine the kinds of harm experienced by regular gamers that were believed to be suffering from problem gaming were attributable to playing video games, instead of other factors (Carey et al., 2022);
   - a survey, examining the effects of personal relative deprivation, and the search for upward societal mobility, as motivations for excessive gaming (King and Wong-Padoongpatt, 2022);
   - a survey done on Japanese high school students in order to determine if these students planned their in-game purchases, and how that related to symptoms connected to problem gaming (Irie et al., 2022);

   There is also a series of systematic reviews (King et al., 2019; Evren, 2020; Raneri et al., 2022), including a meta-analysis focused on the relationship between loot boxes and gaming and/or gambling addiction (Garea et al., 2021). Finally, there is a piece on online gaming and the characteristics of gaming disorder, its similarities to other addictions, and current treatment options (Columb et al., 2022), and an editorial on the *Irish Journal of Psychological Medicine* examining problem gambling, which mentions loot boxes as a possible gray area between video games and gambling.

2. **Focus on online gambling games**: 3 (3+0) of the articles were on online gambling games, which are simulators of traditional gambling games such as poker, blackjack, slots, etc.. These are based on real cash prizes instead of items with subjective and/or volatile value which are found in loot boxes. In two of them, loot boxes are cited as possible entryways for online gambling games (Sirola et al., 2021; Floros, 2018), while the third is a study made on the efficacy of warning labels for online gambling games used in the United Kingdom (Newall et al., 2020).

3. **Focus on traditional gambling addiction**: 7 of the articles focused on addiction to gambling games, citing loot boxes in part. Here there are systematic reviews about:

   - categorization of gambling addiction, where loot boxes are briefly mentioned (Beynon et al., 2020);
   - the relationship between gaming and gambling, specifically on how the former can lead to the later (Ginley et al., 2019; Delfabbro and King, 2020);
   - the effects of exposing youths to gambling propaganda (Labrador et al., 2021);

   There are also two chapters of medical books, one on cognition and addictions that explores how cognitive judgement and decision processes are part of the basis from which cognitive distortions related to gambling surge, using loot boxes as a modern example (Brooks et al., 2020), while the other is on on issues related to excessive gambling and gaming in high-level athletes

---

[1]Some articles used other terms to refer to loot boxes, such as "Mystery Boxes", "Gacha", and "Random Reward Mechanisms". These works were considered to be relevant for this step.

(Derevensky, 2022). Finally, there are two studies on Australian adolescent gambling, one which cites loot boxes directly (King et al., 2020c), while the other mentions "simulated gambling games" (Hing et al., 2022a), and a study on young adults in the United States, examining whether problem gaming leads to gambling addiction (King et al., 2020a). These also don't enter into details on the consequences of the usage of loot boxes, and were thus discarded.

4. **Inaccessible**: 5 (2+3) of the articles (Kelling and Tham, 2021; Rehbein et al., 2021; Woods, 2022; Annala, 2022; Yin and Xiao, 2022) were inaccessible, asides from their summaries, via the avenues available for this work, and were thus discarded.

5. **Other**: 9 (9+0) of the articles were on specific topics. Here we have:

   • A systematic review on mental and physical health problems in e-Sports players, e-Sports being video games with large-scale professional tournaments. One of the referenced studies cites loot boxes (Palanichamy et al., 2020).

   • A systematic review on modern gambling games (Buchanan and Shen, 2021).

   • An experiment investigating whether e-Sports gamblers have higher addiction severity indices in general when compared to regular sports gamblers. Does not mention loot boxes.

   • A systematic review on a kind of loot boxes, referred to as 'skill-based', where the consumer must show a certain level of skill in one or more aspects of the game in order to be able to use one of its loot boxes (Pickering et al., 2020).

   • A study analyzing the consequences and antecedents of gambling addiction in 20 to 24 year old's. A rise in loot box purchases is indicated as one of the motivations for the study (Emond et al., 2020).

   • An interview of players of the video game *Fortnite*, investigating playing and purchasing habits and motivations (King et al., 2020d). Among the acquired items reported, there were others besides loot boxes, so this study was discarded.

   • A short discussion on the phenomenons surrounding loot boxes, with no conclusions or data to be used for our purposes (Zendle and Bowden-Jones, 2019).

   • A study on the convergence of gambling and video games, done on a population of citizens of Ontario, Canada (Stark et al., 2020) mentions loot boxes.

   • An analysis of American legislation on the relation between loot boxes and gambling games, due to the large presence of video game developers in the country (Evans, 2020).

## 3.5 Data Extraction

After filtering, we were left with 45 (11+34) articles to be analyzed in depth. These were summarized and categorized according to the three main types of study identified being
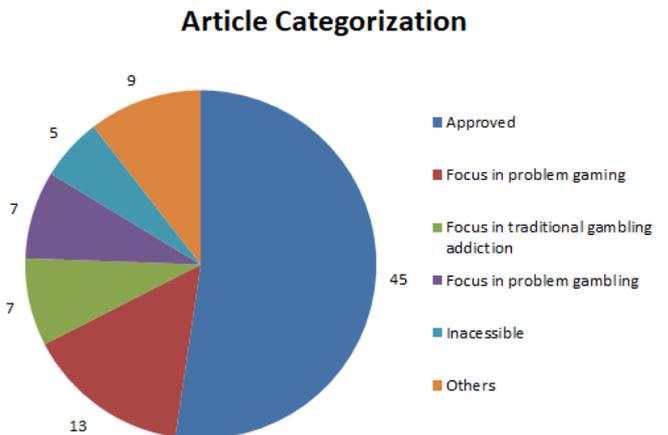


**Figure 3.** Summary of the categorization process of the selected studies.

done in them (Table 1), for better data synthesis on the following step:

### 3.5.1 Studies consisting of cross-sectional online surveys

The majority (7+11) of the studies found were online cross-sectional surveys, i.e., questionnaires put forward to participants recruited in some way, usually via an online volunteer recruitment platformed (e.g. *Amazon Mechanical Turk*), or the online discussion forum *Reddit*, seeking a punctual view of the relevant data from different members of an affected population. These questionnaires all had the hypothesis that the consumption of loot boxes is psychologically similar to that of gambling games, as well as the goal of testing this supposition using a survey that aimed to obtain data to be utilized in some kind of statistical analysis, via some diagnostic tool used in the field of psychology for the diagnosis of problem gambling (e.g. *Problem Gambling Severity Index*). The main difference between each of these works is which statistical methods were used.

Among the methods used, we have:

   • Spearman's Rank Correlations, mann-Whitney U and Kruskal Wallis tests, moderation analysis, Cohen's Kappa, and analysis of qualitative data, done on data obtained from a sample made up of adolescents, aged 16 to 18 (n=1155) (Zendle et al., 2019).

   • Spearman's Rank Correlations done on data corrected with a bias correction test named 'Harman's Single Factor Test' (n=1201) (Zendle, 2020).

   • Regression analysis on part of an international database (n=1508), established via a series of international surveys dubbed the e-GAMES initiative (*Electronic Gambling Multinational Empirical Surveys*) (von Meduna et al., 2020).

   • Bi-variate and multi-varied path analysis done on data from individuals recruited in a non-preferential form (n = 809) (Li et al., 2019).

   • Logistical regression analyses and regular regression analysis on results obtained from a representative sample of the estimated population of video game players

| Paper Type | Citations |
|---|---|
| Cross-sectional online surveys | Zendle et al. (2019); Zendle (2020); von Meduna et al. (2020); Li et al. (2019); Evren et al. (2021); Zendle et al. (2020); Rockloff et al. (2021); Xiao et al. (2023); Forsström et al. (2022); Xiao et al. (2022a); Lemmens (2022); Drummond et al. (2022); Newall et al. (2023); Garrett et al. (2023); Spicer et al. (2022b); Close et al. (2022); González-Cabrera et al. (2023); Hing et al. (2022b) |
| Literature analysis/Discussion | European Parliament. Directorate General for Internal Policies of the Union. et al. (2020); McCaffrey (2022); Greer et al. (2022); Xiao and Declerck (2023); Xiao and Newall (2022); Xiao et al. (2022b); Derevensky et al. (2021); Xiao and Declerck (2022); Xiao (2023b); Amadieu (2022); Ghosh (2023); Macey et al. (2022); Montiel et al. (2022); Spicer et al. (2022d) |
| Specific Experiment | Brady and Prentice (2021); Primi et al. (2022); D'Amico et al. (2022); Aagaard et al. (2022); Amano and Simonov (2023); Xiao (2023a); Sanmartín et al. (2022); Kamamura et al. (2022); Coelho et al. (2022) |

**Table 1.** Classification of articles according to the type of study performed.

in Turkey (n = 752) (Evren et al., 2021).

- Spearman's Rank Correlation, Mann-Whitney U tests, and moderation analysis conducted on data obtained from a population of volunteers (n = 1607) (Zendle et al., 2020).
- Partial correlational analysis on a sample of individuals aged between 12 and 24 from the region of New South Wales, Australia (n = 1954) (Rockloff et al., 2021).
- Correlation matrix and linear regression of data consisting of demographics, income, loot box spending, risky loot box index (RLI), and various psychological tests, such as the PGSI, on a population of +18 year old residents of Mainland People's Republic of China (n=2601) (Xiao et al., 2023).
- Exploratory factor analysis, Pearson correlation analyses, and confirmatory factor analysis on data obtained from a survey (n=364) of non-specific internet users, in order to assess the accuracy of the Risky Loot Box Index (Forsström et al., 2022).
- Spearman's Rank Correlation tests, a Point Biserial Correlation test, Pearson's Correlation tests, and a two-sample z-test applied over demographic, PGSI, BIS-Briefdata, and loot box usage data obtained from a survey of Chinese users of internet video gaming forums and social media (n=879) (Xiao et al., 2022a).
- Bivariate correlations between weekly time spent playing and its potential predictors on data obtained from an online questionnaire distributed among regional and international Facebook groups, Discord servers, and other online forums dedicated to Fifa Ultimate Team, aged 16 or older (n=1144), seeking to find which characteristics are shared by these players (Lemmens, 2022).
- Binomial logistic regression analysis, Risk Curves, and Relative Risk analysis of two online surveys (total n=2432) of American, Australian, and New Zealander residents, in order to investigate whether use of loot boxes can lead to severe psychological stress (Drummond et al., 2022).
- Spearman's Rank correlation test, binary logistic regression, and a Tobit regression on data obtained from 18+ year old gamers residing in the UK (n=2027), seeking to check if PGSI scores are positively related with loot box expenditure (Newall et al., 2023).

- Bayesian correlation on data obtained from two surveys (total n=1484), in order to check if measures of impulsivity and reward sensitivity, as measured by the UPPS Impulsive Behaviour scale, and the BIS/BAS-Drive, respectively, could be used to predict loot box spending (Garrett et al., 2023).
- Comparison of loot box purchasing behaviour across demographic variables and gambling engagement, establishing significance using false discovery rate, on data obtained from 18+ UK respondents, aiming to measure the correlation between loot box engagement and socioeconomic correlates (Close et al., 2022).
- Cronbach's alpha, McDonald's Omega, central tendency and dispersion, frequency analysis, point and over time prevalences, sign test, Pearson's Rho bivariate correlation, and variance analysis with post hoc Games-Howell comparisons. These tools were used on data obtained from Spanish adolescents (n=2213), with the goal of ascertaining the stability of loot box purchasing in minors, and determining the presence and degree of association between loot box purchasing and online gambling and gambling disorder within six months (González-Cabrera et al., 2023).
- Biserial correlation, correlation matrices, and multinomial regressions performed on DSM-IV-MR-J results and questions regarding loot box usage and monetary gambling from 12-17 year old Australians (n=1669) (Hing et al., 2022b).
- Frequentist Chi-Squared tests, equivalent Bayesian Contigency tests, Wilcoxon tests, Bayesian t-tests, False Discovery Rate, and a quantitative content analysis done by a study seeking to establish if there are signs of a "gateway" or "reverse gateway" effect between loot box purchasing and gambling, performed on data from UK adults (n=1102) (Spicer et al., 2022b).

The results of these analyses will be used to verify the conclusions obtained, which will be helpful in indicating the aspects of this problem that still need to be investigated.

### 3.5.2 Literature Analysis

14 (1+13) of the articles are literature analyses. The only one that appeared in the original search was requested by the In-

ternal Market and Consumer Protection committee of the European Union parliament, and done by the IPOL (Policy Department for Economic, Scientific and Quality of Life Policies) (European Parliament. Directorate General for Internal Policies of the Union. et al., 2020). This paper's goal was to measure the effects of loot box use in their consumers, particularly youths, and suggest courses of action, such as restrictions or prohibitions, to be taken, if deemed necessary. This goal is achieved by presenting a general definition of loot boxes and their related mechanisms, exploring articles done by other researchers on the psychological effects of their use, consulting relevant legislation of member countries of the European Union and other international regulatory bodies, such as the PEGI (Pan European Game Information) system.

The other reviews were gatherings of relevant works done by academic groups, also seeking to summarize the conclusions reached by these papers.

### 3.5.3 Specific Experiment

The final (1+8) articles were specific experiments, including in-person surveys or non-survey trials. The only one found in the original search(Brady and Prentice, 2021) is on an experiment performed on a group of 25 male participants aged 18 to 30, with the hypotheses that loot box consumers would show an increase in heart rate and GSR (galvanic skin response) on the moment of purchase, and that this rise is more significant in individuals with higher indices of problem gaming, as measured by the Gaming Addiction Scale (Lemmens et al., 2009). The experiment was performed by gathering the metrics in question for each participant 3 seconds before, during and 3 seconds after each participant launched the video game FIFA, and all three measurements again relating to the usage of a loot box present in the game.

Among the others, we have:

- Two studies, both done on 1078 adolescents from urban centers in Northeaster Italy. The first study was an in-person survey, where the participants were asked about their loot box usage, as well as gambling and video gaming behaviours, if any. The second was done during the COVID-19 lockdown, as there was an increase in video game consumption during this period. These studies sought to determine the mechanisms of the relationships between these 3 factors (Primi et al., 2022).
- Recruitment of participants (n=153) to play a bespoke videogame that featured a reward mechanism modelled after loot boxes, and were acquired via currency gained by simply playing (D'Amico et al., 2022).
- Report on interviews and workshops conducted with mobile game players, designers, developers, and business developers regarding the prevalence of attention-grabbing designs (Aagaard et al., 2022).
- Development and testing of an economic framework in order to measure the relative importance of loot boxes in a game's environment (Amano and Simonov, 2023).
- Investigation on whether the ESRB and PEGI boards were consistently applying the "In-Game Purchases (Includes Random Items)" label to relevant games (Xiao, 2023a).

- Study comparing cognitive biases among problematic gamblers, loot box purchasers and free loot box openers, performed on individuals identified by Spanish institutions dedicated to the treatment of gambling addiction, and Spanish competitive e-sports team members (total n=279) (Sanmartín et al., 2022).
- Study on the effects of risk preference and, loss aversion, and temporal preference on the behaviour of gacha-purchasing Japanese teens and young adults (n=1210) (Kamamura et al., 2022).
- Survey done on gamers from 5 Canadian universities as well as the online forum *Reddit*, regarding loot box and gambling engagement, as well as psychological characteristics of both (Coelho et al., 2022).

## 4   Data Synthesis

As to the conclusions presented by the utilized articles, we can identify a series of points in common.

### 4.1   There is a relationship between usage of loot box and gambling addiction

All of the reviewed works here concluded that there is a significant link between frequency and quantity of loot box consumption, and factors indicative of gambling addiction, such as how Zendle et al. (2019) observe that those who spent money purchasing loot boxes in a given month were shown to possess problem gambling severity ratings that were twice as high as the used baseline.

Even more noteworthy are the conclusions that youths were affected more intensely, as indicated by the results of the study of Rockloff et al. (2021), where more than half of the youths interviewed, aged 12 to 17 and consumers of loot boxes, showed problems related to consumption of gambling games. It should be noted that this does not suggest that usage of loot boxes is linked to participating in gambling, but to symptoms similar to those identified as consequences of such, which, when combined with the hypothesis postulated by von Meduna et al. (2020), where they observed that people with less available income would spend more of that capital on loot boxes, just as seen in studies on gambling, indicates a need for regulation of their use.

However, it is important to highlight the conclusions of the IPOL report, specifically on the link between loot box consumption and gambling addiction, and the consequences of regulatory measures taken by the offices of certain member countries of the European Union. Firstly, it is cited that, in the revised articles, it was not established what is the direction of the link between loot box usage and gambling addiction habits, or in other words, whether purchasing loot boxes leads to symptoms of problem gambling, or if those that already show these symptoms are attracted to loot boxes. They conclude:

"Researchers are unable to establish whether loot box spending leads to problem gambling, or whether online game players with pre-existing problems are especially attracted to spending money on loot boxes." (European Parliament. Directorate General for Internal Policies of the Union. et al.,

2020).

This indicates that, while regulation is necessary, the motives and manner necessary have not yet been established, which can lead to excessive or insufficient restrictions on the practice, among other problems.

Secondly, we should note the efficacy and results of the regulatory methods utilized. Belgium (Gerken, 2018) and the Netherlands completely illegalized the sale and usage of loot boxes in games distributed in their territories. This resulted in adaptations by the various video game developers that operate in these countries (European Parliament. Directorate General for Internal Policies of the Union. et al., 2020), such as changing to a traditional system, where the player may directly acquire the desired item for a shown price, or clearly announcing the probabilities behind what will be awarded by a given loot box, as we can see in Figure 4. Other actions include, however, changing characteristics of their loot box system implementation such that these would avoid the specific legal definition, such as presenting the contents of the loot box before purchase or, problematically, removing the content granted by the loot boxes from those instances of the game sold in these countries. In summary, the regulations implemented resulted in a multitude of actions by these companies, but as some were undesired, it remains difficult to determine if they were, in all, more beneficial than not.

### 4.2 There is a lack of longitudinal studies

All, except for one Brady and Prentice (2021), of the experiments analyzed from the articles obtained were cross-sectional, which serve to provide a temporally punctual sample of the subgroups present in a population. However, individually, these don't show long-term effects that may affect the population. This fact is brought up by the authors of these studies in their 'future works' sections. Zendle, for instance, notes, regarding the question of the direction of the link found, that their greatest limitation was that it was yet another cross-sectional study, which are not sufficient to establish precedence (Zendle, 2020).

### 4.3 Most experiments were performed online

Another aspect shared by the cross-sectional experiments is the source of the volunteers used and the method of application of the questionnaires. Most of the former were recruited via some online platform for the recruitment of volunteers to answer surveys in exchange for some reward, usually cash. Although this method is low-cost, both monetarily and temporally speaking, it has significant flaws. Firstly, the user population in these platforms is not assuredly representative of any other population asides from itself. This is due to how there is no guarantee that the interviewee is really answering the survey in good faith, which is a concern in traditional survey applications but is exacerbated here due to its international availability. Even when tools are used to verify a user's place of origin, for example, this can be faked using a Virtual Private Network to mask the public IP address of the user's device. Methods such as these are known to the researchers, which can take measures to further guarantee the

authenticity of a user's answers, such as eliminating submissions from users that answered too quickly, or always select the first available answer, etc.

## 5 Conclusion

The study of the effects resulting from consumption of loot boxes is still in its primordial stage, but is constantly advancing. According to what was seen here, we have the following as the answers to our research questions:

1. What is the degree and type of relationship that exists between the effects of loot box usage and gambling addiction symptoms?

   - There is a low- to medium-level link between usage of loot boxes and symptoms of gambling addiction.

2. Which experiments were performed to analyze this relationship, and what were their conclusions?

   - Cross-sectional studies were the ones primarily performed, which indicates there is a certain amount of predictability between consumption of loot boxes and appearance of symptoms related to gambling addiction. This link is even more prevalent in teenagers.

3. What is still left to be done for a general conclusion of this problem to be reached?

   - There is a lack of longitudinal studies to explore effects resulting from long-term loot box consumption, as well as a lack of studies that establish the direction of the link.

4. Are there studies in the field of responsible computing that are concerned with minimizing the possible harmful effects of loot boxes on humans?

   - There is still a need for more studies in the computing area aimed at researching algorithms that seek to minimize potentially harmful effects of computer products and services before they are launched on the market.

Regarding the lack of long-term studies, we hypothesise that due to how recent this particular field of study is, there are not yet resources, financial or otherwise, available such that this kind of study could be performed. We suggest, then, that a future study could perform some kind of algorithmic simulation that could, in mass, illustrate the possible actions that a group of consumers could take. This would allow a preliminary analysis, that could serve as justification for future studies.

Proving that a product or service is the cause of harm to the user or society is not trivial, as the systematic review carried out in this work shows. It took more than fifty years to prove that cigarettes cause cancer and the companies that sell them were held accountable (Pearl and Mackenzie, 2018). It was recently reported by the press that companies behind social networks designed algorithms that increase the probability that their users will be logged in for longer (Seymour,

**Figure 4.** Example of the adaptation taken on loot boxes present in the video game FIFA. Now the exact probabilities of each type of result are shown. Source: https://www.tweaktown.com/news/66350/ea-promises-more-transparency-around-lootbox-odds/index.html

2019; Maccluskey, 2022). Although proving that this leads to addictive habits is not trivial, considering all the evidence found, there is a moral obligation for these practices to be, at the very least, subject to some kind of oversight by an organization. In other words, if advertisements are considered to need to be subject to self-regulatory agencies, as well as new drugs and pesticides, then so should loot boxes.

# 6  Limitations

This study was limited by several factors, namely that most research involving experiments did not make their data available for general access, so the analysis performed here was somewhat restricted. Additionally, the amount of resources available for this project did not allow exploring other aspects of this problem, such as the effectiveness of each technique used to increase the attraction of loot boxes. It would also be interesting to explore these topics from a psychological and UX point of view to examine how the mechanisms that electronic games use are employed to attract, retain, encourage, and provoke players to perform microtransactions. These spaces are left as topics for future work.

# Acknowledgements

# References

Aagaard, J., Knudsen, M. E. C., Bækgaard, P., and Doherty, K. (2022). A Game of Dark Patterns: Designing Healthy, Highly-Engaging Mobile Games. In *Extended Abstracts of the 2022 CHI Conference on Human Factors in Computing Systems*, CHI EA '22, pages 1–8, New York, NY, USA. Association for Computing Machinery.

Amadieu, T. (2022). Addictive Technologies? The Moral and Normative Dynamics Shaping the Chinese Gaming Culture. In Chrétien-Ichikawa, S. and Pawlik, K., editors, *Creative Industries and Digital Transformation in China*, pages 59–82. Springer Nature, Singapore.

Amano, T. and Simonov, A. (2023). A Welfare Analysis of Gambling in Video Games.

Annala, W. (2022). *The Effects of Relational Training on Loot Box Selection - ProQuest*. PhD thesis.

Ballou, N., Gbadamosi, C., and Zendle, D. (2020). The hidden intricacy of loot box design: A granular description of random monetized reward features.

Beynon, C., Pearce-Smith, N., and Clark, R. (2020). Harms associated with gambling: abbreviated systematic review protocol. *Systematic Reviews*, 9(1):148.

Brady, A. and Prentice, G. (2021). Are Loot Boxes Addictive? Analyzing Participant's Physiological Arousal While Opening a Loot Box. *Games and Culture*, 16(4):419–433.

Brooks, G., Ferrari, M., and Clark, L. (2020). Cognitive factors in gambling disorder, a behavioral addiction. In *Cognition and Addiction*, pages 209–219. Elsevier.

Buchanan, J. and Shen, Y. (2021). Gambling and marketing:

a systematic literature review using HistCite. *Accounting & Finance*, 61(2):2837–2851.

Carey, P. A. K., Delfabbro, P., and King, D. (2022). An Evaluation of Gaming-Related Harms in Relation to Gaming Disorder and Loot Box Involvement. *International Journal of Mental Health and Addiction*, 20(5):2906–2921.

Cerulli-Harms, A., Münsch, M., Thorun, C., Michaelsen, F., and Hausemer, P. (2020). Loot boxes in online games and their effect on consumers, in particular young consumers. *Publication for the Committee on the Internal Market and Consumer Protection (IMCO), Policy Department for Economic, Scientific and Quality of Life Policies, European Parliament, Luxembourg*, 202.

Chen, N., Elmachtoub, A. N., Hamilton, M. L., and Lei, X. (2021). Loot Box Pricing and Design. *Management Science*, 67(8):4809–4825.

Close, J., Spicer, S. G., Nicklin, L. L., Lloyd, J., and Lloyd, H. (2022). Loot box engagement: relationships with educational attainment, employment status and earnings in a cohort of 16 000 United Kingdom gamers. *Addiction*, 117(8):2338–2345. _eprint: https://onlinelibrary.wiley.com/doi/pdf/10.1111/add.15837.

Coelho, S. G., Keough, M. T., Hodgins, D. C., Shead, N. W., Parmar, P. K., and Kim, H. S. (2022). Loot box purchasing is associated with gambling and problem gambling when controlling for known psychological risk factors of gambling. *Addiction Research & Theory*, 0(0):1–10. Publisher: Taylor & Francis _eprint: https://doi.org/10.1080/16066359.2022.2141717.

Columb, D., Griffiths, M. D., and O'Gara, C. (2022). Online gaming and gaming disorder: more than just a trivial pursuit. *Irish Journal of Psychological Medicine*, 39(1):1–7. Publisher: Cambridge University Press.

Cruz, E. K. (2018). The psychological and virtual siege of loot boxes. *J. Tech. L. & Pol'y*, 23:215.

Delfabbro, P. and King, D. L. (2020). Gaming-gambling convergence: evaluating evidence for the 'gateway' hypothesis. *International Gambling Studies*, 20(3):380–392.

Derevensky, J. (2022). Behavioral Addictions: Excessive Gambling and Gaming. In Reardon, C. L., editor, *Mental Health Care for Elite Athletes*, pages 145–152. Springer International Publishing, Cham.

Derevensky, J. L., Marchica, L., and Richard, J. (2021). The Migration Between Gaming and Gambling: Our Current Knowledge. 5.

Derrington, S., Star, S., and Kelly, S. (2021). The case for uniform loot box regulation: A new classification typology and reform agenda. *Journal of Gambling Issues*, 46:302–332.

Dorries, H. N. (2022). Government response to the call for evidence on loot boxes in video games. Technical report, United Kingdom Government - Secretary of State for Digital, Culture, Media and Sport.

Drummond, A., Hall, L. C., and Sauer, J. D. (2022). Surprisingly high prevalence rates of severe psychological distress among consumers who purchase loot boxes in video games. *Scientific Reports*, 12(1):16128. Number: 1 Publisher: Nature Publishing Group.

Drummond, A., Sauer, J. D., Hall, L. C., Zendle, D., and

Loudon, M. R. (2020). Why loot boxes could be regulated as gambling. *Nature Human Behaviour*, 4(10):986–988.

Duarte, L. and Ishikawa, E. (2022). Lootboxes em jogos eletrônicos estão viciando nossos jovens em jogos de azar? o que a comunidade de computação pode fazer a respeito? In *Anais do III Workshop sobre as Implicações da Computação na Sociedade*, pages 55–66, Porto Alegre, RS, Brasil. SBC.

D'Amico, N. J., Drummond, A., de Salas, K., Lewis, I., Waugh, C., Bannister, B., and Sauer, J. D. (2022). No effect of short term exposure to gambling like reward systems on post game risk taking. *Scientific Reports*, 12(1):16751. Number: 1 Publisher: Nature Publishing Group.

Emond, A., Griffiths, M. D., and Hollén, L. (2020). Problem Gambling in Early Adulthood: a Population-Based Study. *International Journal of Mental Health and Addiction*.

European Parliament. Directorate General for Internal Policies of the Union., ConPolicy., and VVA. (2020). *Loot boxes in online games and their effect on consumers, in particular young consumers.* Publications Office, LU.

Evans, S. (2020). Pandora's Loot Box. *SSRN Electronic Journal*.

Evren, C. (2020). A short update of disordered gaming. *Dusunen Adam:The Journal of Psychiatry and Neurological Sciences*.

Evren, C., Evren, B., Dalbudak, E., Topcu, M., and Kutlu, N. (2021). The Relationship of Loot Box Engagement to Gender, Severity of Disordered Gaming, Using MMORPGs, and Motives for Online Gaming. *Psychiatry and Behavioral Sciences*, 11(1):25.

Floros, G. (2018). Gambling disorder in adolescents: prevalence, new developments, and treatment challenges. *Adolescent Health, Medicine and Therapeutics*, Volume 9:43–51.

Forsström, D., Chahin, G., Savander, S., Mentzoni, R. A., and Gainsbury, S. (2022). Measuring loot box consumption and negative consequences: Psychometric investigation of a Swedish version of the Risky Loot Box Index. *Addictive Behaviors Reports*, 16:100453.

Garea, S. S., Drummond, A., Sauer, J. D., Hall, L. C., and Williams, M. N. (2021). Meta-analysis of the relationship between problem gambling, excessive gaming and loot box spending. *International Gambling Studies*, pages 1–20.

Garrett, E. P., Drummond, A., Lowe-Calverley, E., de Salas, K., Lewis, I., and Sauer, J. D. (2023). Impulsivity and loot box engagement. *Telematics and Informatics*, 78:101952.

Gerken, T. (2018). Video game gambling banned in Belgium. *BBC News*.

Ghosh, A. (2023). Game Over: An Analysis of How Video Game Loot Boxes and Advertisements Target Children with Potential Solutions.

Ginley, M., Pfund, R., and Collie, C. (2019). Gambling and video games: What do we know? Should we worry?

González-Cabrera, J., Basterra-González, A., Ortega-Barón, J., Caba-Machado, V., Díaz-López, A., Pontes, H. M., and Machimbarrena, J. M. (2023). Loot box purchases and their relationship with internet gaming disorder and on-

line gambling disorder in adolescents: A prospective study. *Computers in Human Behavior*, 143:107685.

Greer, N., Boyle, C. M., and Jenkinson, R. (2022). Harms associated with loot boxes, simulated gambling and other in-game purchases in video games: a review of the evidence. Technical report, Australian Institute of Family Studies.

Griffiths, M. D. (2018). Is the Buying of Loot Boxes in Video Games a Form of Gambling or Gaming? *Gaming Law Review*, 22(1):52–54.

Grodal, T. et al. (2000). Video games and the pleasures of control. *Media entertainment: The psychology of its appeal*, pages 197–213.

Haddaway, N. R., Page, M. J., Pritchard, C. C., and McGuinness, L. A. (2022). *PRISMA2020* : An R package and Shiny app for producing PRISMA 2020□compliant flow diagrams, with interactivity for optimised digital transparency and Open Synthesis. *Campbell Systematic Reviews*, 18(2).

Harvey, D. J. (2021). Should loot boxes be considered gambling or can self-regulation and corporate social responsibility solve the loot box issue? a review of current uk law and international legislation. *Interactive Entertainment Law Review*, 4(1):48–62.

Hing, N., Dittman, C. K., Russell, A. M. T., King, D. L., Rockloff, M., Browne, M., Newall, P., and Greer, N. (2022a). Adolescents Who Play and Spend Money in Simulated Gambling Games Are at Heightened Risk of Gambling Problems. *International Journal of Environmental Research and Public Health*, 19(17):10652. Number: 17 Publisher: Multidisciplinary Digital Publishing Institute.

Hing, N., Rockloff, M., Russell, A. M. T., Browne, M., Newall, P., Greer, N., King, D. L., and Thorne, H. (2022b). Loot box purchasing is linked to problem gambling in adolescents when controlling for monetary gambling participation. *Journal of Behavioral Addictions*.

Irie, T., Shinkawa, H., Tanaka, M., and Yokomitsu, K. (2022). Online-gaming and mental health: Loot boxes and in-game purchases are related to problematic online gaming and depression in adolescents. *Current Psychology*.

Kamamura, T., Koyama, Y., Mori, T., Motonishi, T., and Ogawa, K. (2022). Loot box gambling and economic preferences: a survey analysis of Japanese adolescents and young adults. *Applied Economics*, 0(0):1–17. Publisher: Routledge _eprint: https://doi.org/10.1080/00036846.2022.2138817.

Kaneko, Y., Yada, K., Ihara, W., and Odagiri, R. (2018). How Game Users Consume Virtual Currency: The Relationship Between Consumed Quantity, Inventory, and Elapsed Time Since Last Consumption in the Mobile Game World. In *2018 IEEE International Conference on Data Mining Workshops (ICDMW)*, pages 848–855, Singapore, Singapore. IEEE.

Kao, D. (2020). Infinite Loot Box: A Platform for Simulating Video Game Loot Boxes. *IEEE Transactions on Games*, 12(2):219–224.

Keele, S. et al. (2007). Guidelines for performing systematic literature reviews in software engineering. Technical report, Citeseer.

Kelling, K. and Tham, S. (2021). "Role" of the Dice: An Exploratory Analysis of Gamer Perceptions and Interpretations of Loot Box Advertising. *Journal of Interactive Advertising*, 21(1):68–74.

King, A. and Wong-Padoongpatt, G. (2022). Do Gamers Play for Money? A Moderated Mediation of Gaming Motives, Relative Deprivation, and Upward Mobility. *International Journal of Environmental Research and Public Health*, 19(22):15384. Number: 22 Publisher: Multidisciplinary Digital Publishing Institute.

King, A., Wong-Padoongpatt, G., Barrita, A., Phung, D. T., and Tong, T. (2020a). Risk Factors of Problem Gaming and Gambling in US Emerging Adult Non-Students: The Role of Loot Boxes, Microtransactions, and Risk-Taking. *Issues in Mental Health Nursing*, 41(12):1063–1075.

King, D. L., Chamberlain, S. R., Carragher, N., Billieux, J., Stein, D., Mueller, K., Potenza, M. N., Rumpf, H. J., Saunders, J., Starcevic, V., Demetrovics, Z., Brand, M., Lee, H. K., Spada, M., Lindenberg, K., Wu, A. M., Lemenager, T., Pallesen, S., Achab, S., Kyrios, M., Higuchi, S., Fineberg, N. A., and Delfabbro, P. H. (2020b). Screening and assessment tools for gaming disorder: A comprehensive systematic review. *Clinical Psychology Review*, 77:101831.

King, D. L. and Delfabbro, P. H. (2019). Video game monetization (eg,'loot boxes'): A blueprint for practical social responsibility measures. *International Journal of Mental Health and Addiction*, 17(1):166–179.

King, D. L., Delfabbro, P. H., Perales, J. C., Deleuze, J., Király, O., Krossbakken, E., and Billieux, J. (2019). Maladaptive player-game relationships in problematic gaming and gaming disorder: A systematic review. *Clinical Psychology Review*, 73:101777.

King, D. L., Russell, A., and Hing, N. (2020c). Adolescent Land-Based and Internet Gambling: Australian and International Prevalence Rates and Measurement Issues. *Current Addiction Reports*, 7(2):137–148.

King, D. L., Russell, A. M., Delfabbro, P. H., and Polisena, D. (2020d). Fortnite microtransaction spending was associated with peers' purchasing behaviors but not gaming disorder symptoms. *Addictive Behaviors*, 104:106311.

Labrador, F. J., Estupiñá, F. J., Vallejo-Achón, M., Sánchez-Iglesias, I., González-Álvarez, M., Fernández-Arias, I., Labrador, M., and Bernaldo-de Quir´ós, M. (2021). Exposición de jóvenes y adolescentes a la publicidad de los juegos de azar: una revisión sistemática. *Anales de Psicología*, 37(1):149–160.

Larche, C. J., Chini, K., Lee, C., Dixon, M. J., and Fernandes, M. (2021). Rare loot box rewards trigger larger arousal and reward responses, and greater urge to open more loot boxes. *Journal of gambling studies*, 37:141–163.

Lemmens, J. S. (2022). Play or pay to win: Loot boxes and gaming disorder in FIFA ultimate team. *Telematics and Informatics Reports*, 8:100023.

Lemmens, J. S., Valkenburg, P. M., and Peter, J. (2009). Development and validation of a game addiction scale for adolescents. *Media psychology*, 12(1):77–95.

Li, W., Mills, D., and Nower, L. (2019). The relationship of loot box purchases to problem video gaming and problem gambling. *Addictive Behaviors*, 97:27–34.

Liu, C., Agrawal, P., Sarkar, N., and Chen, S. (2009). Dynamic difficulty adjustment in computer games through real-time anxiety-based affective feedback. *International Journal of Human-Computer Interaction*, 25(6):506–529.

Maccluskey, M. (2022). How addictive social media algorithms could finally face a reckoning in 2022. Time Magazine. January 4, 2022. https://time.com/6127981/addictive-algorithms-2022-facebook-instagram/.

Macey, J., Cantell, M., Tossavainen, T., Karjala, A., and Castrén, S. (2022). How can the potential harms of loot boxes be minimised?: Proposals for understanding and addressing issues at a national level. *Journal of Behavioral Addictions*, 11(2):256–266. Publisher: Akadémiai Kiadó Section: Journal of Behavioral Addictions.

McCaffrey, M. (2019). A cautious approach to public policy and loot box regulation. *Addictive Behaviors, Forthcoming*.

McCaffrey, M. (2022). Loot Boxes, Problem Gambling, and Problem Gaming: A Critical Review of the Emerging Literature.

Mills, D. J., Marchica, L., Keough, M. T., and Derevensky, J. L. (2020). Exploring differences in substance use among emerging adults at-risk for problem gambling, and/or problem video gaming. *International Gambling Studies*, 20(3):539–555.

Mistry, K. (2018). P (l) aying to win: Loot boxes, microtransaction monetization, and a proposal for self-regulation in the video game industry. *Rutgers UL Rev.*, 71:537.

Montiel, I., Basterra-González, A., Machimbarrena, J. M., Ortega-Barón, J., and González-Cabrera, J. (2022). Loot box engagement: A scoping review of primary studies on prevalence and association with problematic gaming and gambling. *PLOS ONE*, 17(1):e0263177.

Newall, P., James, R., and Xiao, L. Y. (2023). To screen, or not to screen: Re-examining the relationship between video game loot box expenditure and problem gambling severity. Publisher: Open Science Framework.

Newall, P. W. S., Walasek, L., Ludvig, E. A., and Rockloff, M. (2020). Nudge versus sludge in gambling warning labels. preprint, PsyArXiv.

Newzoo, B. (2020). Global Games Market Report 2019. Technical report, Newzoo.

Oh, G. and Ryu, T. (2007). Game design on item-selling based payment model in korean online games. In *DiGRA Conference*, pages 650–657.

Palanichamy, T., Sharma, M., Sahu, M., and Kanchana, D. (2020). Influence of Esports on stress: A systematic review. *Industrial Psychiatry Journal*, 29(2):191.

Pearl, J. and Mackenzie, D. (2018). *The book of why: The New Science of Cause and Effect*. Penguin Books.

Pickering, D., Philander, K. S., and Gainsbury, S. M. (2020). Skill-Based Electronic Gaming Machines: a Review of Product Structures, Risks of Harm, and Policy Issues. *Current Addiction Reports*, 7(2):229–236.

Primi, C., Sanson, F., Vecchiato, M., Serra, E., and Donati, M. A. (2022). Loot boxes use, video gaming, and gambling in adolescents: Results from a path analysis before and during COVID-19-pandemic-related lockdown in Italy. *Frontiers in Psychology*, 13.

Raneri, P. C., Montag, C., Rozgonjuk, D., Satel, J., and Pontes, H. M. (2022). The role of microtransactions in Internet Gaming Disorder and Gambling Disorder: A preregistered systematic review. *Addictive Behaviors Reports*, 15:100415.

Rehbein, F., King, D. L., Staudt, A., Hayer, T., and Rumpf, H.-J. (2021). Contribution of Game Genre and Structural Game Characteristics to the Risk of Problem Gaming and Gaming Disorder: a Systematic Review. *Current Addiction Reports*, 8(2):263–281.

Ripley, N. (2020). Comscore Reports Highest Ever Worldwide Box Office. Library Catalog: www.comscore.com.

Rockloff, M., Russell, A. M., Greer, N., Lole, L., Hing, N., and Browne, M. (2021). Young people who purchase loot boxes are more likely to have gambling problems: An online survey of adolescents and young adults living in NSW Australia. *Journal of Behavioral Addictions*, 10(1):35–41.

Sanmartín, F. J., Velasco, J., Gálvez-Lara, M., Cuadrado, F., and Moriana, J. A. (2022). Do gamblers and loot boxers share similar fallacies of thought? A comparative analysis of Cognitive Biases. preprint, In Review.

Schwiddessen, S. and Karius, P. (2018). Watch your loot boxes!–recent developments and legal assessment in selected key jurisdictions from a gambling law perspective. *Interactive Entertainment Law Review*, 1(1):17–43.

Seymour, R. (2019). The machine always wins: what drives our addiction to social media. The Guardian. August 3, 2019. https://www.theguardian.com/technology/2019/aug/23/social-media-addiction-gambling.

Sirola, A., Savela, N., Savolainen, I., Kaakinen, M., and Oksanen, A. (2021). The Role of Virtual Communities in Gambling and Gaming Behaviors: A Systematic Review. *Journal of Gambling Studies*, 37(1):165–187.

Spicer, S. G., Fullwood, C., Close, J., Nicklin, L. L., Lloyd, J., and Lloyd, H. (2022a). Loot boxes and problem gambling: Investigating the "gateway hypothesis". *Addictive Behaviors*, 131:107327.

Spicer, S. G., Fullwood, C., Close, J., Nicklin, L. L., Lloyd, J., and Lloyd, H. (2022b). Loot boxes and problem gambling: Investigating the "gateway hypothesis". *Addictive Behaviors*, 131:107327.

Spicer, S. G., Nicklin, L. L., Uther, M., Lloyd, J., Lloyd, H., and Close, J. (2022c). Loot boxes, problem gambling and problem video gaming: A systematic review and meta-synthesis. *New Media & Society*, 24(4):1001–1022.

Spicer, S. G., Nicklin, L. L., Uther, M., Lloyd, J., Lloyd, H., and Close, J. (2022d). Loot boxes, problem gambling and problem video gaming: A systematic review and meta-synthesis. *New Media & Society*, 24(4):1001–1022.

Stark, S., Reynolds, J., and Wiebe, J. (2020). Gambling and Gaming in an Ontario Sample of Youth and Parents. *Journal of Gambling Issues*, 46.

Stevens, M. W., Delfabbro, P. H., and King, D. L. (2021). Prevention approaches to problem gaming: A large-scale qualitative investigation. *Computers in Human Behavior*, 115:106611.

Švelch, J. (2017). The discourses of microtransactions' acceptance and rejection in mainstream video games. *The*

*evolution and social impact of video game economics*, 101.

Sweetser, P. and Wyeth, P. (2005). Gameflow: a model for evaluating player enjoyment in games. *Computers in Entertainment (CIE)*, 3(3):3–3.

Tham, S. M. and Perreault, G. P. (2021). A Whale of a Tale: Gaming Disorder and Spending and Their Associations With Ad Watching in Role-Playing and Loot-Box Gaming. *Journal of Gambling Issues*, 46.

Tomić, N. Z. (2018). Economic model of microtransactions in video games. *J. Econ. Sci. Res. Vol*, 1(01).

von Meduna, M., Steinmetz, F., Ante, L., Reynolds, J., and Fiedler, I. (2020). Loot boxes are gambling-like elements in video games with harmful potential: Results from a large-scale population survey. *Technology in Society*, 63:101395.

Woods, O. (2022). The affective embeddings of gacha games: Aesthetic assemblages and the mediated expression of the self. *New Media & Society*, page 14614448211067756. Publisher: SAGE Publications.

Wright, S. T. (2017). The evolution of loot boxes. *PC Gamer*.

Xiao, L. Y. (2021). Regulating loot boxes as gambling? towards a combined legal and self-regulatory consumer protection approach. *Interactive Entertainment Law Review*, 4(1):27–47.

Xiao, L. Y. (2023a). Beneath the label: unsatisfactory compliance with ESRB, PEGI and IARC industry self-regulation requiring loot box presence warning labels by video game companies. *Royal Society Open Science*, 10(3):230270. Publisher: Royal Society.

Xiao, L. Y. (2023b). Breaking Ban: Belgium's Ineffective Gambling Law Regulation of Video Game Loot Boxes. *Collabra: Psychology*, 9(1):57641.

Xiao, L. Y. and Declerck, P. (2022). Video game loot boxes are NOT gambling under Dutch gambling regulation? Shifting the goalpost in Electronic Arts v Kansspelautoriteit. *OSFPreprints*.

Xiao, L. Y. and Declerck, P. (2023). Paid Video Game Loot Boxes are Not Gambling Under Dutch Gambling Regulation? Shifting the Goalpost in Electronic Arts V Kansspelautoriteit.

Xiao, L. Y., Fraser, T. C., Newall, P., and Nielsen, R. (2023). Loot Box Risk Factors in China. Publisher: Open Science Framework.

Xiao, L. Y., Fraser, T. C., and Newall, P. W. S. (2022a). Opening Pandora's Loot Box: Weak Links Between Gambling and Loot Box Expenditure in China, and Player Opinions on Probability Disclosures and Pity-Timers. *Journal of Gambling Studies*.

Xiao, L. Y., Henderson, L. L., Nielsen, R. K. L., and Newall, P. W. S. (2022b). Regulating Gambling-Like Video Game Loot Boxes: a Public Health Framework Comparing Industry Self-Regulation, Existing National Legal Approaches, and Other Potential Approaches. *Current Addiction Reports*, 9(3):163–178.

Xiao, L. Y. and Newall, P. (2022). Probability disclosures are not enough: Reducing loot box reward complexity as a part of ethical video game design. *Journal of Gambling Issues*.

Yin, M. and Xiao, R. (2022). The Reward for Luck: Understanding the Effect of Random Reward Mechanisms in Video Games on Player Experience. In *Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems*, CHI '22, pages 1–14, New York, NY, USA. Association for Computing Machinery.

Zendle, D. (2020). Beyond loot boxes: a variety of gambling-like practices in video games are linked to both problem gambling and disordered gaming. *PeerJ*, 8:e9466.

Zendle, D. and Bowden-Jones, H. (2019). Loot boxes and the convergence of video games and gambling. *The Lancet Psychiatry*, 6(9):724–725.

Zendle, D., Cairns, P., Barnett, H., and McCall, C. (2020). Paying for loot boxes is linked to problem gambling, regardless of specific features like cash-out and pay-to-win. *Computers in Human Behavior*, 102:181–191.

Zendle, D., Meyer, R., and Over, H. (2019). Adolescents and loot boxes: links with problem gambling and motivations for purchase. *Royal Society Open Science*, 6(6):190049.