



## Loot boxes in Spanish adolescents and young adults: Relationship with internet gaming disorder and online gambling disorder

Joaquín González-Cabrera<sup>a</sup>, Aránzazu Basterra-González<sup>a</sup>, Irene Montiel<sup>a</sup>, Esther Calvete<sup>b</sup>, Halley M. Pontes<sup>c</sup>, Juan M. Machimbarrena<sup>d,\*</sup>

<sup>a</sup> Faculty of Education, Universidad Internacional de La Rioja (UNIR), Logroño, La Rioja, Spain

<sup>b</sup> Faculty of Psychology, Universidad de Deusto, Bilbao, Basque Country, Spain

<sup>c</sup> Department of Organizational Psychology, Birkbeck, University of London, London, United Kingdom

<sup>d</sup> Faculty of Psychology, Universidad del País Vasco (UPV/EHU), Donostia, Basque Country, Spain

### ARTICLE INFO

**Keywords:**  
Loot boxes  
Gaming  
IGD  
Gambling  
Prevalence

### ABSTRACT

In recent years, the video game industry has introduced the possibility of buying virtual random goods (e.g., loot boxes) in electronic games using money through microtransactions, which are becoming more widespread and potentially akin to gambling. Although previous research has linked loot boxes with problematic gaming and gambling behaviors, there are very few studies that relate them to the clinical indicators of these problems. The overall goal of this study is to ascertain the prevalence of loot box purchasing behavior and its association with Internet Gaming Disorder (IGD) and Online Gambling Disorder (OGD). A secondary objective is to develop and analyze the psychometric properties of the Problematic Use of Loot Boxes Questionnaire (PU-LB). A cross-sectional study was conducted among 6633 participants (4236 males, 63.9%, and 4123 minors, 62.2%) with an average age of  $16.73 \pm 3.40$  in a range of 11–30 years. The Spanish versions of the Internet Gaming Disorder Scale-Short Form (IGDS9-SF) and the Online Gambling Disorder Questionnaire (OGD-Q) were used. A total of 2013 (30.4%) participants reported purchasing a loot box in the last 12 months (28.9% among minors). A person who had purchased a loot box in the last 12 months had a prevalence rate (PR) of 3.66 [95% CI 2.66, 5.05] of presenting an IGD, and a PR = 4.85 [IC 95% 2.58, 9.12] of presenting an OGD. The PU-LB exhibited adequate reliability and validity indicators and was positively and significantly related to loot box expenditure, IGDS9-SF, and OGD-Q scores. The results are further discussed, and practical implications and future lines of research proposed.

### 1. Introduction

According to recent figures, almost 40% of the world's population plays video games while, the number of gamers has increased about 6% annually over the past five years, reaching about 2.7 billion gamers in 2020 (Wijman, 2020). In the European context, it is estimated that 51% of the population between the ages of 6–64 plays video games, and the age group with the highest percentage of gamers is 1–14 years old. Electronic gaming is therefore a cultural, social, and leisure phenomenon that has special relevance to adolescents and young people (ISFE Europe's Video Games Industry, 2020).

In the context of video games, the so-called microtransactions (such as Pay2Win) have increased significantly in recent years, and they represent a business model whereby gamers can buy virtual items by

means of micro-payments so that video game developers have a means to generate additional revenue. The purchase of specific in-game virtual goods using real money is made in relation to specific in-game virtual goods and/or objects that are known to the buyer (e.g., weapons, capes, pets, cards, characters, etc.) (King & Delfabbro, 2018). However, other types of microtransactions have also emerged. One such example are loot boxes (also referred to as crates, cases, or chests, among other possible names) in which gamers use real-world currency to purchase an in-game random virtual item (Drummond, Sauer, Ferguson, & Hall, 2020; Zendle & Cairns, 2019).

Although there is no consensus about whether or not loot boxes should be considered a type of gambling, some authors highlighted their virtual and random nature, pointing to a relationship with the reward systems present in gambling (von Meduna et al., 2020; Xiao, 2020). In

\* Corresponding author. Department of Clinical and Health Psychology and Research Methods, Universidad del País Vasco, Avenida de Tolosa 70, 20018, Spain.  
E-mail address: [juanmanuel.machimbarrena@ehu.eus](mailto:juanmanuel.machimbarrena@ehu.eus) (J.M. Machimbarrena).

<https://doi.org/10.1016/j.chb.2021.107012>

Received 28 May 2021; Received in revised form 8 July 2021; Accepted 6 September 2021

Available online 7 September 2021

0747-5632/© 2021 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

the same vein, Evans (2020) suggested that loot boxes have similarities with gambling (Wong, 2019) and collectible card packs, although new evidence has questioned the latter relationship (Zendle et al., 2021). Other authors such as Nielsen and Grabarczyk (2019) argued that only loot boxes that are integrated into the general economy (i.e., those that offer random rewards that can be sold and purchased) can be considered structurally similar to gambling, whereas other authors (Drummond, Sauer, Hall, Zendle, & Loudon, 2020) indicated that virtual objects have real-world monetary value to users, regardless of whether they can be collected, and could therefore be regulated under the existing gambling legislation.

Research on the prevalence of loot box purchases is in its early stages and few studies have been conducted with representative samples. Among adolescents, the studies by Kristiansen and Severin (2020) in Denmark, Ide et al. (2021) in Tokyo (Japan) and DeCamp (2021) in Delaware (USA) stand out. In these studies, the prevalence of annual purchase among gamers varied between 20% and 33.9%. Among adolescent population in general, the annual purchase prevalence varied between 12% among 16–24 year old individuals in Great Britain (Wardle & Zendle, 2021) and 24.9% among 13–14 year old individuals in Delaware (DeCamp, 2021). Regarding the adult population, the prevalence of annual purchase among gamers and no-gamers has been found to vary between 7.8% in the United Kingdom (Zendle, 2020) to 9.8% in Germany (von Meduna et al., 2020). However, among Pay2Win users, the prevalence has been found to be about 38.9% (von Meduna et al., 2020).

In a similar vein, to the best of our knowledge, there is only one standardized assessment tool evaluating risky behaviors that can become problematic in the use of loot box and which offers a risky usage index: the Risky Loot-Box Index (RLI; Brooks & Clark, 2019). The RLI consists of 5 items associated with the following three dimensions pertaining to risky loot box purchasing behavior: cognitive preoccupation about loot box use, impulsive use, and chasing of losses. Although the RLI has shown promising psychometric evidence, it presents with key limitations related to its internal validity and problematic conceptualization of the construct due to the low number of indicators.

Currently, some authors have claimed that loot boxes are introducing gambling elements within electronic games, and it has been considered whether they may be acting as a gateway to other problems (Drummond & Sauer, 2018). Scholars have also recently debated whether excessive use of loot boxes may be better conceptualized within the theoretical framework of problem gambling or problem/excessive gaming (Garea et al., 2021; King & Delfabbro, 2019). To this end, a recent meta-analysis found a small but potentially clinically relevant association between gambling symptomatology and loot box spending, and this association was at least as large as that found with symptoms of excessive gaming behavior in electronic gaming, suggesting the need to continue researching this intersection (Garea et al., 2021).

Moreover, Close et al. (2021) provided further evidence about the relationship between loot box spending and gambling problems. However, there is currently very little evidence about the relationship between loot boxes and problems with video games and gambling from a clinical perspective. More recently, Zendle (2020) reported a positive relationship between loot box purchase frequency and disordered gaming, measured with the Internet Gaming Disorder Scale (IGDS), while Li, Mills, and Nower (2019) found a positive association between the purchase of loot boxes and the severity of gaming problems measured by the clinical criteria of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; APA, 2013). In the same vein, between 39.3% (Li et al., 2019) to 68.9% of loot box users may be classified as disordered gamers (von Meduna et al., 2020). A positive association between the RLI and IGDS scores has also been observed (Brooks & Clark, 2019; Drummond, Sauer, Ferguson, & Hall, 2020). It is important to note that these studies report on findings from adult samples, so it is paramount to investigate these relationships among other developmental stages such as adolescence.

Regarding problematic gambling both in adult and adolescent samples, a positive relationship was found between problem gambling (as measured with the Problem Gambling Severity Index (PGSI)) and the money invested in buying loot boxes (Drummond, Sauer, Ferguson, & Hall, 2020), with actual frequency of loot boxes purchases (Macey & Hamari, 2019), and risky loot box purchase (as measured with the RLI) (Brooks & Clark, 2019; Drummond, Sauer, Ferguson, & Hall, 2020). Nevertheless, these studies did not include a clinical diagnosis of online gambling disorder (OGD). Therefore, additional studies that take into account a clinical perspective and that follow the guidelines of the APA (APA, 2013) within the DSM-5 and the guidelines of the World Health Organization (2020) within the International Classification of Diseases (ICD-11) are required.

In the case of the OGD, a conceptualization has been used that adapts the DSM-5 criteria for gambling disorder [312.31] to the online context, also following the indications of the ICD-11 (under the heading 6C50 and 6C50.1) and the components model of addictions by Griffiths (2005). Recent data on this conceptualization reported that almost 1% of adolescents presented with a clinical problem related to online gambling, with over 6% being found to be at risk (González-Cabrera et al., 2020).

Further, the DSM-5 (APA, 2013) included IGD within its Section III as a tentative disorder. According to the DSM-5, IGD can be diagnosed using nine criteria, of which, at least five must be endorsed over a 12-month period (APA, 2013). In Spain, the prevalence of this problem, as measured by the Internet Gaming Disorder Test (IGD-20; Pontes, Király, Demetrovics, & Griffiths, 2014) and the Internet Gaming Disorder Scale-Short Form (IGDS9-SF) (Pontes & Griffiths, 2015) has been reported to range from 1% to 3% (Beranuy et al., 2020; Fuster et al., 2016).

The extant literature suggests the existence of a problem that has not yet been studied in depth due to its novelty despite its social and clinical relevance. Thus, the main objective of the present study is twofold: (i) to ascertain the prevalence of loot box purchases (both for minors [under 18 years of age] and adults [at least 18 years of age]) in a large Spanish sample and (ii) to examine the association between buying loot boxes with IGD and OGD. In addition, as a secondary objective, the Problematic Use of Loot Boxes Questionnaire (PU-LB) was developed to evaluate the use of loot boxes from a clinical perspective.

Based on current evidence, we hypothesize that the prevalence of annual loot box purchases among video game players will be less than 33.9% for minors (De Camp, 2021) and for those over 18 years of age less than 38.9% (von Meduna et al., 2020). Additionally, we expect to find statistically significant and positive relationships between loot boxes purchasing behavior with both IGD and OGD scores (Close et al., 2021; Garea et al., 2021).

## 2. Method

### 2.1. Design and participants

The present study adopted a cross-sectional design, with a psychometric investigation being carried out to examine the secondary objective. Sampling was incidental in order to obtain the largest possible sample, and the recruitment of participants was conducted between February and March 2021 and the initial sample comprised 6633 participants. The average age of the overall sample was  $16.73 \pm 3.40$  years (range: 11–30 years). Table 1 shows the response frequencies based on sex, grade/educational stage, and whether participants were minors or adults.

The sample was obtained from 24 educational centers of eight Autonomous Communities within the Spanish jurisdiction (i.e., Asturias, Basque Country, Cantabria, Castilla la Mancha, Castilla y León, Community of Madrid, Navarre and Valencian Community).

**Table 1**

Distribution of the general sample and the sample that has purchased loot boxes in the last 12 months for the variable sex, grade/educational stage, problems of IGD and OGD.

Overall sample (N = 6633)	Purchased loot boxes in the last 12 months (n = 2013)	
	Minors (n = 4123) <sup>1</sup>	Adults (n = 2510) <sup>1</sup>
Males (n = 4236–63.9%)	2370 (57.5)	1886 (74.3)
Females (n = 2397–36.1%)	1753 (42.5)	644 (25.7)
6th Grade- Primary (n = 112)	111 (2.6)	0 (0.0)
First Secondary Cycle (n = 1275)	1274 (30.9)	0 (0.0)
Second Secondary Cycle (n = 1196)	1193 (28.9)	0 (0.0)
High school (n = 516)	481 (11.6)	35 (1.5)
Professional Vocation (n = 3475)	1036 (25.1)	2439 (97.5)
IGD problems (n = 163)	91 (2.2)	72 (2.9)
OGD problems (n = 75)	25 (0.6)	50 (1.9)

Note: <sup>1</sup> = N of which the percentage is indicated in the column. IGD = Internet Gaming Disorder; OGD = Online Gambling Disorder. Minor = < 18 years old; Adults = 18 years old or over.

**2.2. Assessment instruments**

Additional sociodemographic data were collected to characterise the sample recruited. Before asking whether participants had purchased a loot box in the last 12 months, we defined loot boxes as follows “A loot box is a virtual object such as a chest, envelope, key and/surprise box within a video game that offers random contents such as equipment, accessories, weapons, or any other advantage within the game in exchange for some money”. After the definition was presented, we asked participants the following questions: “Have you purchased a loot box from a video game in the last 12 months?”, “How many times have you purchased a loot box in the last week?”, and “How much money have you invested/spent on loot boxes in the last month?”

Additionally, we used two psychometric instruments that have been previously validated and adapted to the Spanish context. The Spanish version of the Internet Gaming Disorder Scale-Short Form (IGDS9-SF; Pontes & Griffiths, 2015; Spanish version: Beranuy et al., 2020) includes nine items that evaluate IGD symptoms in adolescents according to the DSM-5 criteria (e.g., “Do you consistently fail to control or quit your gaming activity?”). The IGDS9-SF has been shown to exhibit sound psychometric properties when assessing IGD within the Spanish context (see Maldonado-Murciano et al., 2020; Sánchez-Iglesias et al., 2020). The responses given to all nine items can range from 0 (never) to 4 (very often), and a participant is considered to meet a clinical criterion when their responses are often or very often for at least five items (Pontes & Griffiths, 2015). The total score can range from 0 to 45, with greater scores suggesting higher symptom-severity of disordered gaming. In terms of internal reliability, the Cronbach’s alpha coefficient and Omega coefficient in the present sample were .85 and .86, respectively.

The Gambling Disorder Questionnaire (OGD-Q) (González-Cabrera et al., 2020) consists of 11 items that assess online gambling in adolescence (e.g., “Do you feel nervous, irritated, or angry when trying to reduce or stop gambling online?”). The scale’s response options range from 0 (never) to 4 (every day). A participant is likely to be a problematic online gambler when their response answers are frequently, almost every day, or every day to four or more items (González-Cabrera et al., 2020). The total score can range between 0 and 45. In relation to its internal reliability, the Cronbach’s alpha coefficient and Omega coefficient in the present sample were .92 and .92, respectively.

To fulfil the secondary objective of this study, the PU-LB was devised following current national and international guidelines and standards for the design of psychometric tests (American Educational Research Association [AERA], the American Psychological Association [APA] and the National Council on Measurement in Education [NCME]) (Muñiz & Fonseca-Pedrero, 2019). The PU-LB includes items evaluating the contents reflected in the RLI (Brooks & Clark, 2019): cognitive preoccupation about the use of loot boxes, impulsive use, and chasing of losses. It also includes items related to the negative consequences as defined within Caplan’s (2002, 2010) Problematic Use Model.

Overall, the PU-LB consists of 18 items assessing the potentially problematic nature of engaging in loot box purchasing behavior. For this purpose, it was hypothesized that the PU-LB would comprise three theoretically unique dimensions pertaining to: 1) problematic use of loot boxes (e.g., “I usually buy loot boxes to feel better or happier”); 2) gaming-related problems concerning loot boxes (e.g., “I feel guilty about the amount of time I’ve spent obtaining loot boxes”); and 3) gambling-related problems (e.g., “I feel guilty about the amount of money I’ve invested in loot boxes”). All items of the PU-LB were analyzed by four experts in order to ascertain the content validity of the items, with an inter-rater reliability greater than 0.8 being achieved throughout this process. The Likert-type response scale presented five response alternatives (0 = strongly disagree, 5 = strongly agree), with total scores ranging from 0 to 90.

**2.3. Procedure**

The battery of questionnaires was applied in online format using the Survey Monkey © platform. Participants completed the online survey in their classrooms using either a mobile device or computer with guidance and supervision of a classroom tutor. The time needed to fill out the online survey ranged between 5 to 15 minutes according to students’ age and reading abilities.

**2.4. Ethical considerations**

The study was conducted with the consent of all participants and the schools’ principals. In order to obtain an informed consent from each participant, school principals sent a consent form to all parents and/or legal guardians of participants aged below 18 years. The purpose of the study, its voluntary, anonymous, and confidential nature was explained to all participants. All parents and/or legal guardians who did not wish to allow participation returned the consent form unsigned. This occurred in less than 1% of the sample. All participants over 18 years old were informed about the nature of the study and asked to provide their informed consent when completing the online survey.

This study was approved by the Research Ethics Committee of Universidad Internacional de la Rioja (UNIR) (PI007-2020 and PI001/2021). There were no formal exclusion criteria, except for the refusal to allow participation from parents and/or legal guardians.

**2.5. Data analysis**

The statistical analyses were performed using the Statistical Package for Social Sciences (SPSS) version 25 (IBM Corp Statistical Package for the Social Sciences for Windows, 2020), EPIDAT 3.1 (Xunta de Galicia, 2006), and the FACTOR 11.0 program (Ferrando & Lorenzo-Seva, 2017).

To meet the main objectives, the following analyses were carried out:

(1) frequency analyses, central trend measures, and measurement dispersion; (2) chi-squared ( $\chi^2$ ) to contrast proportions and adjusted residuals (ASR); 3) *t*-tests for independent samples; 4) analysis of variance with Games-Howell post-hoc comparisons; 5) in cases where statistically significant differences were found, Cohen's *d* or eta squared ( $\eta^2$ ) coefficients were calculated to provide a measure of effect size; 6) prevalence rates (PR); and 7) Pearson correlations for a 95% confidence interval (CI).

An initial analysis of the psychometric properties of each item of the PU-LB was performed to assess the arithmetic mean, standard deviation, item-total correlation, percentage of positive responses to each item, and the factorial loadings of each item (see Table 3). The criteria adopted for the retention of items without technical deficiencies (Carretero-Dios & Pérez, 2005) was that they had to present with at least one of the following three statistical parameters: a) a mean between 2 and 3; b) standard deviation equal to or greater than 1; and c) item-total correlation equal to or greater than 0.35.

The factor structure of the PU-LB was examined through subjecting all 18 items to an Exploratory Factor Analysis (EFA) using Robust Maximum Likelihood (MLR) with Oblique Rotation (Promin) as the extraction method. For the choice of the optimal factorial solution, both the theoretical adequacy and the number of factors were informed by Parallel Analysis based on Minimum Rank Factor Analysis (PA-MRFA) (Timmerman & Lorenzo-Seva, 2011).

Subsequently, the model fit was assessed using the Comparative Fit Index (CFI), the Tucker-Lewis Index (TLI), and the Root Mean Square Error of Approximation (RMSEA). In general, CFI and TLI values of 0.95 or higher reflect an adequate fit. RMSEA values of less than 0.06 indicate an excellent fit, whereas values between 0.06 and 0.08 indicate an acceptable fit (Byrne, 2006; Hu & Bentler, 1999). In order to determine the internal consistency of the instruments used in the present study, Cronbach's alpha and Omega coefficients were estimated.

To obtain the prevalence of IGD and OGD, firstly, we dichotomized the responses of the items for each instrument (i.e., endorsing or not endorsing the criterion) so that a polythetic diagnostic approach established in the clinical manuals could be followed. Thus, for IGD, a participant is considered to present with this disorder when they endorse five or more criteria in the last 12 months (Beranuy et al., 2020). In the case of OGD, a participant is considered to present with online gambling disorder if they endorse to at least four items during the last 12 months (González-Cabrera et al., 2020).

### 3. Results

#### 3.1. Prevalence of loot box purchasing and associated sociodemographic variables

For the total sample, a total of 2013 participants (30.4%) reported buying loot boxes in the past year. The average age and standard deviation was  $16.90 \pm 3.12$  years, with a range of 11–30 years. Table 1 shows the distribution for sex and grade/educational stage both for the overall sample and for loot box buyers only. In terms of minors and adults, a total of 1190 (28.9%) minors who participated in the study reported purchasing loot boxes in the past year. Of these, 91% ( $n = 1083$ ) were boys, 66.3% ( $n = 789$ ) were enrolled between the 6th grade of primary school and the 2nd grade of high school, and the mean age was  $14.90 \pm 1.79$  years (range: 11–17 years).

Table 2 shows how many times participants purchased a loot box in the last week and how much money they spent in the last month, broken down for the overall sample and the minor and adult subsamples. Among those who reported purchasing loot boxes, statistically significant differences were only observed between minors and adults who reported purchasing between 6 and 10 loot boxes a week (with more minors buying,  $p = .014$ ). In the case of money spent, there were statistically significant differences between those who spent between €11 to €25 ( $p < .001$ ) and between €26 to €50 ( $p < .001$ ).

**Table 2**

Differences between minors and adults over 18 in the number of loot boxes purchased in the last week and the money invested/spent in the last month.

Sociodemographic question	Response category	Overall sample	Minors	Adults	$\chi^2$ ( <i>p</i> )
How many times have you purchased a loot box in the last week? ( $n = 1879$ )	Never	1533 (81.6)	862 (81.5)	671 (81.7)	14.18 (.005)
	1-5 times	230 (12.2)	116 (11) <sup>a</sup>	114 (13.9) <sup>b</sup>	
	6-10 times	59 (3.1)	45 (4.3) <sup>b</sup>	14 (1.7) <sup>a</sup>	
	11-30 times	27 (1.4)	15 (1.3)	12 (1.5)	
	31-50 times	7 (0.4)	5 (0.5)	2 (0.2)	
	+50 times	23 (1.2)	15 (1.3)	8 (1)	
How much money have you invested/spent on loot boxes in the last month? ( $n = 1889$ )	Nothing	1071 (56.6)	592 (54.8)	479 (58.8)	26.38 (0.001)
	1-10€	310 (16.4)	156 (14.4) <sup>b</sup>	154 (18.9) <sup>a</sup>	
	11-25€	231 (12.2)	152 (14.1) <sup>a</sup>	79 (9.7) <sup>b</sup>	
	26-50€	115 (6.1)	84 (7.8) <sup>a</sup>	31 (3.8) <sup>b</sup>	
	51-100€	57 (3)	32 (3)	25 (3.1)	
	+100€	112 (5.9)	65 (6)	47 (5.8)	

Not:  $\chi^2$  = Chi-Square, *p* = significance.

Significant differences are shown in bold. Minors = < 18 years old; Adults = 18 years old or over.

<sup>a</sup> Adjusted standardized residuals < -1.96

<sup>b</sup> Adjusted standardized residuals > 1.96

#### 3.2. Relationship between loot box purchasing, IGD and OGD

In relation to the overall sample ( $n = 6633$ ), 1190 (17.9%) reported gambling online in the last 12 months. Among minors, 550 (13.3%) reported gambling online. In the overall sample, 75 participants (1.1%) could be potentially classified with an online gambling disorder (among minors, this figure was 0.6% [ $n = 25$ ]). Regarding the diagnosis of IGD in the overall sample, 163 participants met the criteria (2.5%) for disordered gaming while 91 minors met this diagnosis (2.2%) (see Table 1).

When examining those who had reported purchasing loot boxes in the last 12 months, 597 (29.7%) also reported engaging in online gambling. Among those reporting purchasing loot boxes, 61 participants (3%) met the criteria for OGD. Moreover, 81.3% of the participants potentially presenting with OGD had purchased loot boxes. Similarly, 107 (5.3%) participants met the diagnostic criteria for IGD, and about 65.6% ( $n = 70$ ) of these participants reported purchasing loot boxes (see Table 1).

A participant reporting purchasing a loot box in the last 12 months had a PR of 4.85 [CI 95% 2.58, 9.12] of presenting a clinical online gambling problem. Thus, in those who have purchased loot boxes, having a problem of OGD is 4.85 times more prevalent than in those who have not bought a loot box (for minors, PR = 4.43 [CI 95% 1.54, 12.78]). Regarding IGD, in these participants the PR was 3.66 [CI 95% 2.66–5.05], so presenting with disordered gaming was 3.66 times more prevalent among those who purchase loot boxes than those who did not (for minors, PR = 4.01 [CI 95% 2.61, 6.16]). In the overall sample, only 9 participants presented with both IGD and OGD simultaneously (0.15%). Of these, 4 were minors (0.1%).

When comparing the total scores obtained by the adult subsample for the Spanish version of the IGDS9-SF, between those who reported



**Table 3**

Means, standard deviations, item-total correlation, factor loading, and the negative and positive response percentage of the PU-LB Questionnaire items (n = 1965).

	<i>M</i>	<i>SD</i>	<i>IT</i>	<i>FL</i>	<i>%+</i>	<i>%-</i>
<b>Problematic Use of Loot Boxes Questionnaire</b>						
1. The main reason I play video games is to get things from the loot boxes.	0.69	1.23	0.51	0.56	4.9	81.8
2. Loot boxes have caused problems in my life (either social, economic, family, school, or work. etc.).	0.23	0.76	0.55	0.62	1.4	93.9
3. I usually buy loot boxes when I'm sad or bored.	0.30	0.85	0.59	0.67	1.6	91.7
4. I usually buy loot boxes when I'm happy or I'm on a high.	0.87	1.40	0.58	0.59	6.6	74.5
5. I usually buy loot boxes to feel better or happier.	0.49	1.09	0.65	0.69	3.1	86.3
6. I experience a great thrill when I open loot boxes and that motivates me to buy more boxes.	1.10	1.52	0.59	0.58	9.3	68.8
7. When I haven't opened loot boxes for a while, I feel the urge to buy one.	0.37	0.96	0.64	0.70	2.3	89.7
8. I prefer to open a lot of loot boxes at once than do it several times in a timely manner.	1.25	1.73	0.44	0.43	14.7	66.8
9. I often play longer than I intended to be able to obtain loot boxes.	0.93	1.43	0.64	0.63	7.8	74.1
10. I think about playing for long periods of time to get loot boxes.	0.97	1.45	0.63	0.61	7.9	72.8
11. I feel guilty about the amount of time I've spent obtaining loot boxes.	0.72	1.28	0.55	0.55	5.3	80.4
12. I postpone other activities, work, or tasks to be able to play longer and thus get more loot boxes.	0.62	1.20	0.62	0.65	4.5	83.0
13. I feel nervous or irritated when I can't play enough to get loot boxes.	0.43	1.00	0.67	0.71	3.0	89.1
14. I often invest more money than I intended to get loot boxes.	0.36	0.92	0.63	0.68	2.0	90.2
15. I feel guilty about the amount of money I've invested in loot boxes.	0.76	1.41	0.46	0.49	7.7	80.4
16. I postpone other activities, work, or tasks to be able to buy more loot boxes.	0.36	0.95	0.67	0.73	2.6	90.4
17. After purchasing a loot box and not getting a valuable item, I keep buying more boxes.	0.50	1.07	0.65	0.70	3.2	86.4
18. When I can't buy loot boxes, I feel nervous or irritated.	0.23	0.74	0.67	0.75	1.2	93.6

Note: *M* = arithmetic mean; *SD* = standard deviation; *IT* = corrected item-total correlation; *FL*-Factor loading; *%+* = frequency and percentage that has responded *strongly* or *fairly agree*; *%-* = frequency and percentage that has answered *strongly* or *fairly disagree*.

having purchased loot boxes and those who did not, the values were significantly higher for the former (YES = 7.99 ± 7.04; NO = 3.56 ± 5.09; *t* = 16.80, *p* < .001, *d* = 0.72). Loot box buyers also exhibited significantly higher scores on the OGD-Q compared to those who did not report purchasing loot boxes (YES = 3.88 ± 6.79; NO = 1.81 ± 4.01; *t* = 4.37, *p* < .001, *d* = 0.37). Among minors, the results were consistent with the findings reported above for both the IGDS9-SF (YES = 7.46 ± 6.56; NO = 4.11 ± 4.76; *t* = 17.451, *p* < .001, *d* = 0.58) and the OGD-Q (YES = 2.91 ± 5.73; NO = 1.36 ± 3.61; *t* = 3.615, *p* < .001, *d* = 0.32).

### 3.3. Psychometric properties of the PU-LB

Table 3 presents the psychometric indicators for each of the PU-LB items (i.e., means, standard deviations, item-total correlations, and the percentage of positive responses to each item). At the psychometric level, the scores obtained in the items revealed conjoint problems in the means and standard deviations of all the items, despite the fact that item-total correlations were satisfactory across all items. Further, between 1.2% and 14.7% of the items had at least one positive value (i.e., a response value of 4 or 5 [*fairly agree* and *strongly agree*]).

With regard to the EFA results, the PA-MRFA suggested the choice of a one-dimensional model ( $\chi^2 [135, n = 1971] = 3021.212, p < .001$ ; RMSEA = 0.078; CFI = 0.963; TLI = 0.967) explaining up to 43.3% of the total variance based on eigenvalues. The factor loadings ranged from 0.43 to 0.75 (see Table 3), and the standardized alpha coefficient was 0.92, and the Omega coefficient was 0.87.

### 3.4. Evidence of the validity of the scores

Correlation coefficients of *r* = 0.461 (CI 95% 0.43, 0.50) and 0.373 (CI 95% 0.30, 0.44), respectively, were obtained between the total PU-LB scores and the total IGDS9-SF and OGD-Q scores. Furthermore, IGD and OGD scores were positively correlated (*r* = 0.229; [CI 95% 0.17, 0.29]). PU-LB total scores also showed statistically significant and positive correlations with the amount of money spent in loot boxes the last month (*r* = 0.266; [CI 95% 0.24, 0.31]) and the number of loot boxes purchased in the last week (*r* = 0.257; [CI 95% 0.21, 0.30]).

## 4. Discussion

The purchase of loot boxes has been conceptualized as an emerging risky behavior, especially for adolescents and young individuals due to their increased psychosocial risks and vulnerabilities. This study contributes to the understanding of this emerging phenomenon by examining its association with clinical problems of gaming and gambling in a large sample.

Regarding the first aim (i.e., to ascertain the prevalence of loot box purchases in a large sample of Spanish adolescents and young adults), about 30.4% of participants aged between 11 and 30 years bought loot boxes in the last year (28.9% among those under 18 years old). Comparing these results with other studies is rather difficult as there are few studies with population-based samples and there are notable methodological differences between studies hindering comparisons (e.g. age range, type of definition of loot boxes, type of sample, time span, etc.).

As hypothesized, the prevalence for older adults was below the 38.9% reported by von Meduna et al. (2020) and within the range reported in other studies with a convenience sample of gamers: between 22.7% by Evren et al., 2021 and 44.2% by Li et al. (2019). However, these figures are well above that reported by Zendle (2020) for a representative sample of the British adult population (i.e., 7.8%). When only minors were considered, the rate was also aligned with the hypothesis as it fell below the 33.9% obtained by De Camp (2021), and above the 20% found in Denmark in children aged 12–16 years (Kristiansen & Severin, 2020). Notably, our data are very similar to those found by DeCamp (2020) in a sample of American students aged 16–17 who play video games (28.3%) and those found by Kristiansen and Severin (2020) with 23.5% for the same time frame and age group in Denmark. However, the prevalence rate found in our study is well above the results reported by Ide et al. (2021) in a representative sample of 14-years-old children where a prevalence of 3.5% was found. Although our findings lend support to the hypothesis regarding the prevalence of loot box purchase, the results obtained should be interpreted with caution as this study did not have a representative sample of Spanish adolescents and young people.

Regarding the relationship between loot box purchasing and IGD, the

results indicated a higher prevalence of IGD problems among those who bought loot boxes. These results are in line with previous studies reporting an association between loot box purchase and problems with video games (Evren et al., 2021; Garea et al., 2021; Li et al., 2019; von Meduna et al., 2020; Zendle, 2020).

Further, Drummond, Sauer, Ferguson, and Hall (2020) and Garea et al. (2021) found a positive association between loot box spending and IGD symptoms, while Brooks and Clark (2019) found an association between the RLI and IGD, which is also evident in this study. Thus, our data point in the direction of the hypothesis, finding a positive relationship between loot boxes and IGD symptoms. However, in our study, the selected assessment tools were clinical in nature as we used the IGDS9-SF, which is widely adopted in the international context and has been adapted to more than 10 languages (Bernaldo-de-Quirós et al., 2019). Thus, we can partially compare our results with the studies conducted by Zendle (2020), Evren et al. (2021) and Li et al. (2019) as these studies found a positive relationship between loot box purchasing and disordered gaming as measured with the IGDS9-SF and the diagnostic criteria of the DSM-5, respectively.

In terms of the relationship between the purchase of loot boxes and OGD, the results obtained in our study supported this relationship. Our findings mirror the findings of previous research reporting a positive association between loot boxes and problematic gambling (Brooks & Clark, 2019; Close et al., 2021; Drummond, Sauer, Ferguson, & Hall, 2020; Garea et al., 2021; Kristiansen & Severin, 2020; Macey & Hamari, 2019; von Meduna et al., 2020; Wardle & Zendle, 2021; Zendle, 2020; Zendle, Meyer, & Over, 2019, 2020; Zendle & Cairns, 2018, 2019). However, contrary to the present study, most of these studies did not use clinical measures, a shortcoming that further highlights the relevance of the present study. The most frequently used instrument in these studies was the PGSI, which was designed to reflect more social rather than clinical aspects of problematic gambling (Petry, 2016). In any case, the clinical indicators adopted in the present study were particularly stricter and as such, our results provide a novel contribution to the field.

Previously, the RLI (Brooks & Clark, 2019) was the only psychometric test available that provided an index of risky loot box purchasing behavior. Notwithstanding this, the RLI presents with important shortcomings in its psychometric validation process, as well as drawbacks for not covering other key aspects related to problems that may arise due to engaging in loot box purchasing behaviors (e.g., impulsivity to purchase more loot boxes, personal consequences, salience of playing time or guilt, among others). Thus, the psychometric development of the PU-LB also represents an important contribution to the field as it helps moving forward the research agenda examining the links between problem gambling and disordered gaming through loot-boxes.

When devising the PU-LB, we adopted relevant guidelines for the development of psychometric tests (Muñiz & Fonseca-Pedrero, 2019) and we conducted an expert assessment of the scale's content validity through an assessment of inter-rater reliability. The results indicated that the new psychometric test showed adequate psychometric indicators. We had hypothesized that the PU-LB would present with three latent dimensions related to loot boxes (one general, one focused on gaming-related aspects, and one focused on gambling-related aspects). The PA-MRFA suggested a one-dimensional model. Hence, although there may be conceptual differences between the three suggested dimensions, they all delve into the same reality and are interpreted as a general factor of problematic use of loot boxes.

This single dimension showed excellent internal consistency and was significantly and positively associated with IGDS9-SF and OGD-Q scores. The total scores were also positively and significantly related to loot box expenditure in the last month and the number of loot boxes purchased in the last week, further supporting the scale's validity. These results obtained align with those reported in other studies using the RLI (Brooks & Clark, 2019; Drummond, Sauer, Ferguson, & Hall, 2020).

Despite its many contributions, the present study has some limitations. First, the results were based on self-reports, which may be prone to

different biases such as response bias. Second, there may also be a retrospective memory recall bias as participants were asked to recall actions over the past 12 months. Third, despite the efforts to obtain a large sample of participants from several regions and 24 centers, our sampling was non-random, as such, it is not representative of the Spanish context. This also implies that the results reported represent an approximation of its cultural context and is by no means sufficient to provide definitive answers regarding the prevalence of loot box purchasing behaviors. Moreover, the data were collected cross-sectionally, which renders causality invariable. Consequently, the use of loot boxes can be both seen as an antecedent and/or as an outcome of IGD and OGD.

Given these potential limitations, future research should include longitudinal designs that take into account the variables used in the present study and other variables related to personality, cognitive distortions, impulsivity, or escapism, among other possible ones as they may help explaining specific risk factors associated with loot box purchasing behaviors.

The present study presents with potential practical implications, particularly to political institutions in Spain where loot boxes are currently under legislative debate. Based on our findings, we support the adoption of better regulations to protect minors from the potential harms stemming from loot box purchasing. Furthermore, the gaming industry should improve communication of information regarding the inclusion of loot box and gambling-like mechanics in their products as this is of utmost interest to the general public, particularly to parents and/or legal guardians. Additionally, it is paramount that the industry design self-regulatory systems (e.g., the European Game Information [PEGI]) providing better guidance for families on the appropriate age for consumption of video games that include the purchase of loot boxes with real money.

There is currently a "gambling" category when a video game contains elements that encourage gambling behaviors. However, this label does not require the industry to categorize the video game as being appropriate for adults only (i.e., PEGI 18). Instead, these games can be classified as adequate for pre-adolescents (i.e. PEGI 12). Regarding self-regulation, it should be noted that prevalence studies like ours attempt to approximate the figures of purchasing that the video game industry holds and does not make publicly available. Therefore, greater transparency from the industry is essential in order to benefit users through the development of evidence-based player protection policies that are developed through independent partnership with scientists (Griffiths & Pontes, 2020; Shi, Potenza, & Turner, 2020).

Regarding further research, similarly to what has been done to other risky behaviors (e.g., European Monitoring Centre for Drugs and Drug Addiction), a permanent observatory on loot boxes in electronic gaming could be established, especially in the Spanish context, in order to help buyers (and their families when they are minors) to obtain credible and official information on the type of loot box, its implications for the game, and other additional features. Also, policy makers should introduce questions on national gambling surveys enabling national estimates on the prevalence of loot box purchasing behaviors as this will help stakeholders to fully comprehend the potential extent of problems caused by risky behaviors.

## 5. Conclusion

In conclusion, the present study suggests the existence of a relatively high prevalence of loot box purchasing behavior in a large sample of Spanish adolescents and young people. In addition, a positive and significant relationship was established between the purchase of loot boxes with IGD and OGD.

## Credit author statement

Joaquín González-Cabrera: Conceptualization, Methodology, Data

curation, Formal analysis Writing - Original Draft, Writing – review & editing, Supervision, Funding acquisition. Aranzazu Basterra-González: Investigation, Data curation, Writing – review & editing. Irene Montiel: Conceptualization, Writing – original draft, Writing- Reviewing and Editing. Esther Calvete: Writing – review & editing. Halley Pontes: Writing – review & editing. Juan M. Machimbarrena: Conceptualization, Methodology, Data curation, Formal analysis, Writing – original draft, Writing- Reviewing and Editing.

### Ethical approval

Participation was voluntary and participants were informed that their responses were confidential and would only be read by the research team. The procedure always followed the standards of the Declaration of Helsinki. The Ethics Committee of Universidad Internacional de la Rioja approved this study (PI007-2020 and PI001/2021).

### Funding

This study has been funded by the Ministry of Science and Innovation [RTI2018-094212-B-I00: (CIBER-AACC)] and by the International University of La Rioja in its Own Research Plan [Grupo Ciberpsicología triennium 2017-2020 and biennium 2020-2022]. Open Access funding provided by University of Basque Country UPV/EHU.

### Declaration of competing interest

The authors declare that they have no competing interests.

### References

- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). <https://doi.org/10.1176/appi.books.9780890425596>
- Beranuy, M., Machimbarrena, J. M., Vega-Osés, M. A., Carbonell, X., Griffiths, M. D., Pontes, H. M., et al. (2020). Spanish validation of the internet gaming disorder scale–short form (IGDS9-SF): Prevalence and relationship with online gambling and quality of life. *International Journal of Environmental Research and Public Health*, 17(5), 1562. <https://doi.org/10.3390/ijerph17051562>
- Bernaldo-de-Quirós, M., Labrador-Méndez, M., Sánchez-Iglesias, I., & Labrador, F. J. (2019). Instrumentos de medida del trastorno de juego en internet en adolescentes y jóvenes según criterios DSM-5: Una revisión sistemática. *Adicciones*, 32(4), 291–302. <https://doi.org/10.20882/adicciones.1277>
- Brooks, G. A., & Clark, L. (2019). Associations between loot box use, problematic gaming and gambling, and gambling-related cognitions. *Addictive Behaviors*, 96, 26–34. <https://doi.org/10.1016/j.addbeh.2019.04.009>
- Byrne, B. M. (2006). *Structural equation modeling with EQS: Basic concepts, applications and programming* (2nd ed.). Erlbaum.
- Caplan, S. E. (2002). Problematic Internet use and psychosocial well-being: Development of a theory-based cognitive-behavioral measurement instrument. *Computers in Human Behavior*, 18(5), 553–575. [https://doi.org/10.1016/S0747-5632\(02\)00004-3](https://doi.org/10.1016/S0747-5632(02)00004-3)
- Caplan, S. E. (2010). Theory and measurement of generalized problematic internet use: A two-step approach. *Computers in Human Behavior*, 26(5), 1089–1097. <https://doi.org/10.1016/j.chb.2010.03.012>
- Carretero-Dios, H., & Pérez, C. (2005). Normas para el desarrollo y revisión de estudios instrumentales. *International Journal of Clinical and Health Psychology*, 5(3), 521–551. <https://www.redalyc.org/pdf/337/33705307.pdf>
- Close, J., Spicer, S. G., Nicklin, L. L., Uther, M., Lloyd, J., & Lloyd, H. (2021). Secondary analysis of loot box data: Are high-spending “whales” wealthy gamers or problem gamblers? *Addictive Behaviors*, 117, 106851. <https://doi.org/10.1016/j.addbeh.2021.106851>
- DeCamp, W. (2021). Loot boxes and gambling: Similarities and dissimilarities in risk and protective factors. *Journal of Gambling Studies*, 37, 189–201. <https://doi.org/10.1007/s10899-020-09957-y>
- Drummond, A., & Sauer, J. D. (2018). Video game loot boxes are psychologically akin to gambling. *Nature Human Behaviour*, 2(8), 530–532. <https://doi.org/10.1038/s41562-018-0360-1>
- Drummond, A., Sauer, J. D., Ferguson, C., & Hall, L. C. (2020). The relationship between problem gambling, excessive gaming, psychological distress and spending on loot boxes in Aotearoa New Zealand, Australia, and the United States-A cross-national survey. *Plos One*, 15(3), Article e0230378. <https://doi.org/10.1371/journal.pone.0230378>
- Drummond, A., Sauer, J. D., Hall, L. C., Zendle, D., & Loudon, M. R. (2020). Why loot boxes could be regulated as gambling. *Nature Human Behaviour*, 4(10), 986–988. <https://doi.org/10.1038/s41562-020-0900-3>
- Evans, S. (2020). *Pandora's loot box. St. John's legal studies research paper* (Vol. 20). <https://doi.org/10.2139/ssrn.3733910>, 0015.
- Evren, C., Evren, B., Dalbudak, E., Topcu, M., & 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. <https://doi.org/10.5455/PBS.20200915101516>
- Ferrando, P. J., & Lorenzo-Seva, U. (2017). Program FACTOR at 10: Origins, development and future directions. *Psicothema*, 29, 236–240. <https://doi.org/10.7334/psicothema2016.304>
- Fuster, H., Carbonell, X., Pontes, H. M., & Griffiths, M. D. (2016). Spanish validation of the internet gaming disorder-20 (IGD-20) test. *Computers in Human Behavior*, 56, 215–224. <https://doi.org/10.1016/j.chb.2015.11.050>
- Xunta de Galicia. (2006). *EPIDAT 3.1*. <https://www.sergas.es/Saude-publica/Epidat-3-1-descargar-Epidat-3-1-espanol>
- Garea, S., Drummond, A., Sauer, J. D., Hall, L. C., & Williams, M. (2021). Meta-analysis of the relationship between problem gambling, excessive gaming and loot box purchasing. *International Gambling Studies*, 1–20. <https://doi.org/10.1080/14459795.2021.1914705>, 0(0).
- González-Cabrera, J. M., Machimbarrena, J. M., Beranuy, M., Pérez-Rodríguez, P., Fernández-González, L., & Calvete, E. (2020). Design and measurement properties of the online gambling disorder questionnaire (OGD-Q) in Spanish adolescents. *Journal of Clinical Medicine*, 9(1), 120. <https://doi.org/10.3390/jcm9010120>
- Griffiths, M. D. (2005). A ‘components’ model of addiction within a biopsychosocial framework. *Journal of Substance Use*, 10(4), 191–197. <https://doi.org/10.1080/14659890500114359>
- Griffiths, M. D., & Pontes, H. M. (2020). The future of gaming disorder research and player protection: What role should the video gaming industry and researchers play? *International Journal of Mental Health and Addiction*, 18(3), 784–790. <https://doi.org/10.1007/s11469-019-00110-4>
- Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, 6(1), 1–55. <https://doi.org/10.1080/10705519909540118>
- IBM Corp statistical package for the social sciences for Windows.(2020). SPSS 25.
- Ide, S., Nakanishi, M., Yamasaki, S., Ikeda, K., Ando, S., Hiraiwa-Hasegawa, M., et al. (2021). Adolescent problem gaming and loot box purchasing in video games: Cross-sectional observational study using population-based cohort data. *JMIR Serious Games*, 9, Article e23886. <https://doi.org/10.2196/23886>
- ISFE Europe's Video Games Industry. (2020). *Key facts 2020*. <https://www.isfe.eu/publication/isfe-key-facts-2020/>
- King, D. L., & Delfabbro, P. H. (2018). Predatory monetization schemes in video games (e.g. “loot boxes”) and internet gaming disorder. *Addiction*, 113(11), 1967–1969. <https://doi.org/10.1111/add.14286>
- King, D. L., & Delfabbro, P. H. (2019). Loot box limit-setting is not sufficient on its own to prevent players from overspending: A reply to Drummond. *Sauer & Hall. Addiction*, 114(7), 1324–1325. <https://doi.org/10.1111/add.14628>
- Kristiansen, S., & Severin, M. C. (2020). Loot box engagement and problem gambling among adolescent gamers: Findings from a national survey. *Addictive Behaviors*, 103, 106254. <https://doi.org/10.1016/j.addbeh.2019.106254>
- Li, W., Mills, D., & Nower, L. (2019). The relationship of loot box purchases to problem video gaming and problem gambling. *Addictive Behaviors*, 97, 27–34. <https://doi.org/10.1016/j.addbeh.2019.05.016>
- Macey, J., & Hamari, J. (2019). eSports, skins and loot boxes: Participants, practices and problematic behaviour associated with emergent forms of gambling. *New Media & Society*, 21(1), 20–41. <https://doi.org/10.1177/1461444818786216>
- Maldonado-Murciano, L., Pontes, H. M., Griffiths, M. D., Barrios, M., Gómez-Benito, J., & Guilera, G. (2020). The Spanish version of the internet gaming disorder scale-short form (IGDS9-SF): Further examination using item response theory. *International Journal of Environmental Research and Public Health*, 17(19). <https://doi.org/10.3390/ijerph17191111>
- von Meduna, M., Steinmetz, F., Ante, L., Reynolds, J., & 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. <https://doi.org/10.1016/j.techsoc.2020.101395>
- Muniz, J., & Fonseca-Pedrero, E. (2019). Diez pasos para la construcción de un test. *Psicothema*, 31(1), 7–16. <https://doi.org/10.7334/psicothema2018.291>
- Nielsen, R. K. L., & Grabarczyk, P. (2019). Are loot boxes gambling? Random reward mechanisms in video games. *Transactions of the Digital Games Research Association*, 4(3), 171–207. <https://doi.org/10.26503/todigra.v4i3.104>
- Petry, N. M. (2016). *Gambling disorder: The first officially recognized behavioral addiction. En behavioral addictions: DSM-5® and beyond* (pp. 7–42). Oxford University Press.
- Pontes, H. M., & Griffiths, M. D. (2015). Measuring DSM-5 internet gaming disorder: Development and validation of a short psychometric scale. *Computers in Human Behavior*, 45, 137–143. <https://doi.org/10.1016/j.chb.2014.12.006>
- Pontes, H. M., Király, O., Demetrovics, Z., & Griffiths, M. D. (2014). The conceptualisation and measurement of DSM-5 internet gaming disorder: The development of the IGD-20 test. *Plos One*, 9(10), e110137. <https://doi.org/10.1371/journal.pone.0110137>
- Sánchez-Iglesias, I., Bernaldo-de-Quirós, M., Labrador, F. J., Estupiñá Puig, F. J., Labrador, M., & Fernández-Arias, I. (2020). Spanish validation and scoring of the internet gaming disorder scale - short-form (IGDS9-SF). *Spanish Journal of Psychology*, 23, e22. <https://doi.org/10.1017/SJP.2020.26>. Article e22.
- Shi, J., Potenza, M. N., & Turner, N. E. (2020). Commentary on: “The future of gaming disorder research and player protection: What role should the video gaming industry and researchers play?”. *International Journal of Mental Health and Addiction*, 18(3), 791–799. <https://doi.org/10.1007/s11469-019-00153-7>
- Timmerman, M. E., & Lorenzo-Seva, U. (2011). Dimensionality assessment of ordered polytomous items with parallel analysis. *Psychological Methods*, 16(2), 209–220.

- Wardle, H., & Zendle, D. (2021). Loot boxes, gambling, and problem gambling among young people: Results from a cross-sectional online survey. *Cyberpsychology, Behavior, and Social Networking*, 24(4), 267–274. <https://doi.org/10.1089/cyber.2020.0299>
- Wijman, T. (2020). *Free global games market report*. Newzoo; PDF.
- Wong, A. W.-T. (2019). Analysis of global regulatory schemes on chance-based microtransactions. *Asper Rev. Int'l Bus. & Trade L.*, 19, 111.
- World Health Organization. (2020). *International statistical classification of diseases and related health problems* (11th ed.) <https://icd.who.int/>.
- Xiao, L. Y. (2020). Conceptualising the loot box transaction as a gamble between the purchasing player and the video game company. *International Journal of Mental Health and Addiction*, 1–3. <https://doi.org/10.1007/s11469-020-00328-7>
- 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, Article e9466.
- Zendle, D., & Cairns, P. (2018). Video game loot boxes are linked to problem gambling: Results of a large-scale survey. *Plos One*, 13(11), Article e0206767. <https://doi.org/10.1371/journal.pone.0206767>
- Zendle, D., & Cairns, P. (2019). Loot boxes are again linked to problem gambling: Results of a replication study. *Plos One*, 14(3), Article e0213194. <https://doi.org/10.1371/journal.pone.0213194>
- Zendle, D., Cairns, P., Barnett, H., & 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. <https://doi.org/10.1016/j.chb.2019.07.003>
- Zendle, D., Meyer, R., & Over, H. (2019). Adolescents and loot boxes: Links with problem gambling and motivations for purchase. *Royal Society Open Science*, 6(6), 190049. <https://doi.org/10.1098/rsos.190049>
- Zendle, D., Walasek, L., Cairns, P., Meyer, R., & Drummond, A. (2021). Links between problem gambling and spending on booster packs in collectible card games: A conceptual replication of research on loot boxes. *PLoS ONE*, 16(4), Article e0247855. <https://doi.org/10.1371/journal.pone.0247855>