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The potential relationship between loot box spending, problem gambling, and obsessive-compulsive gamers

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ABSTRACT

Background and Aims: Loot boxes are digital containers of randomised rewards available in many video games. Individuals with problem gambling symptomatology spend more on loot boxes than individuals without such symptoms. This study investigated whether other psychopathological symptomatology, specifically symptoms of obsessive-compulsive behaviour and hoarding may also be associated with increased loot box spending. **Methods:** In a large cross-sectional, cross-national survey ($N = 1,049$ after exclusions), participants recruited from Prolific, living in Aotearoa New Zealand, Australia, and the United States, provided self-reported loot box spending, obsessive-compulsive and hoarding symptomatology, problem gambling symptomatology, and consumer regret levels. **Results:** There was a moderate positive relationship between loot box spending and obsessive-compulsive symptoms and hoarding. Additionally, greater purchasing of loot boxes was associated with increased consumer regret. **Discussion and Conclusion:** Results identified that those with OCD and hoarding symptomatology may spend more on loot boxes than individuals without OCD and hoarding symptomatology. This information helps identify disproportionate spending to more groups of vulnerable players and may assist in helping consumers make informed choices and also aid policy discussions around the potentialities of harm.

KEYWORDS

loot box/es, problem gambling, obsessive-compulsive disorder, OCD, hoarding, regret, video games

INTRODUCTION

Loot boxes are digital containers found in video games and purchased with real-world money that grant randomised in-game rewards (Drummond & Sauer, 2018; Griffiths, 2018; Lemmens, 2022). Due to the randomised nature of the rewards, concerns have been raised about the psychological and legal similarities between loot boxes and conventional forms of gambling (Brooks & Clark, 2019; Derevensky & Griffiths, 2019; Drummond & Sauer, 2018; Drummond, Sauer, Hall, Zendle, & Loudon, 2020; Garea, Drummond, Sauer, Hall, & Williams, 2021; Kristiansen & Severin, 2020; Zendle, Walasek, Cairns, Meyer, & Drummond, 2021). Further, there is a consistent association between loot box spending and problem gambling symptomatology, confirmed by meta-analysis (Garea et al., 2021; see also Brooks & Clark, 2019; Drummond, Sauer, Ferguson, & Hall, 2020; Lemmens, 2022; Zendle & Cairns, 2018, 2019; Zendle, Cairns, Barnett, & McCall, 2020).

Although research in this area has largely focused upon problem gambling populations, other personality or mental health traits may also have an association with increased spending on loot boxes. Despite compelling theoretical rationale to believe that certain groups, such as individuals

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who feel compelled to complete collections and item sets, may overspend on loot boxes, to date other potential populations and have largely gone unexplored (Garea et al., 2021). One area ripe for investigation is obsessive-compulsive symptomatology and related disorders. Loot boxes provide items that are often collected, that complete sets, that are available for limited times and/or exclusively through purchasing (Zendle, Meyer, & Over, 2019). Thus, people with predispositions for collectionism, compulsive buying, excessive organisation, and other potentially maladaptive behaviours for buying habits may be likely to spend more on loot boxes and other collectable in-game items. Research has identified a variety of motivations for engaging with loot box purchasing among adolescents (Zendle et al., 2019). One such motivation which may be relevant in the context of individuals with predispositions toward collectionism is that completing collections is demonstrable motivation for at least some adolescent loot box buyers; driving purchasing habits (Zendle et al., 2019). Here, we examined how spending on loot boxes relates to compulsions to buy, collect, keep, and organise items; symptoms often found at clinically disordered levels for individuals with obsessive-compulsive disorder (OCD) and/or hoarding.

Why might loot box purchasing be associated with obsessive compulsive and/or compulsive spectrum symptomatology? Although OCD is a clinical diagnosis, like many clinical diagnoses it exists on a continuum. For individuals displaying sub-clinical levels of OCD symptomatology, like hoarding, there is a spectrum of symptom severity, with individuals experiencing symptoms which range from mild to extremely severe. As many loot boxes provide exclusive and/or limited access to in-game items (Zendle et al., 2019), players predisposed towards collecting items may feel pressured to engage with loot boxes in order to complete their in-game virtual item sets. In turn, this may prompt individuals with more severe compulsive symptoms to spend more money on loot boxes to complete these sets. Collecting can become maladaptive when it negatively impacts one's personal, social, and psychical environments. Players with obsessive-compulsive/compulsive spectrum symptomatology may feel compelled to spend more (disproportionately) than other players.

OCD as designated by the DSM-5 is where the presence of obsessions and/or compulsions, that are both recurrent and persistent, result in marked distress (American Psychiatric Association, 2013). Hoarding, traditionally considered part of OCD symptomatology, has been moved to a related subcategorised disorder in the DSM-5 (now within the "Obsessive Compulsive and Related Disorders" section). Thus, although hoarding constitutes a related but distinct clinical phenomenon, many of the psychometrically validated instruments, such as the Revised Obsessive-Compulsive Inventory (OCI-R) and Dimensional Obsessive-Compulsive Scale (DOCS), retain hoarding and other key dimensions within their measurement of OCD. As such, these measures remain appropriate as screening and diagnostic tools to identify these symptom clusters and their clinical symptom severity (Abramowitz, Abramowitz, Reimann, & McKay, 2020; Wootton et al., 2015).

Although many of the dimensions of OCD symptomatology may be relevant to the psychological risk factors for disproportionate spending on loot boxes, hoarding - traditionally linked to OCD but now listed in a distinct 'compulsive spectrum disorder' category in the DSM-5 (Kalogeraki & Michopoulos, 2017) - might place individuals at particular likelihood of increased spending. Clinically significant hoarding or compulsive-hoarding occurs in the general population at up to four times the prevalence rate of rarer disorders such as bipolar or schizophrenia (Pertusa et al., 2010), and is often a condition that is concealed from others by the sufferer. It consists of both a desire to acquire, and a refusal to discard items (Nordsletten & Mataix-Cols, 2012). This refusal to discard is often associated with a strong personal-emotional connection to items of little or no economic (or objectively emotional) value, and these items are then acquired and retained in such large numbers that they impacts one's physical living environment and impair the individual's ability to engage in normal living activities. Additionally, whilst strong emotional attachment to items is often present, there is also often substantial emotional and personal distressed caused to the individual because of the accumulation of the items (Frost & Hartl, 1996).

Whilst traditional hoarding has physical markers that can be identified (as above), digital hoarding presents differently. Digital hoarding does not result in the cluttering of one's physical environment, but excess digital accumulation can still negatively affect the accumulator (Neave, Briggs, McKellar, & Sillence, 2019). For example, obsessively collecting and organising thousands of digital images can impair an individual's ability to complete other (necessary) daily tasks, including those related to personal hygiene, due to the impact on their time/attention as opposed to their physical space (van Bennekom, Blom, Vulink, & Denys, 2015). Digital hoarding can be a relatively invisible condition: It is much more difficult for an observer to identify non-physical hoarding (cf. physical hoarding) and/or connect this behaviour to current distress/disorganisation, especially when the sufferer shows little-to-no insight into the issue (Sweeten, Sillence, & Neave, 2018). The nascent research into digital hoarding demonstrates the negative effects posed to individuals who hoard digitally, such as the inability to find relevant items due to excess clutter, the inability to resist taking or buying 'everything' (obligated collectionism), paralysis of choice, and neglect of work/social/personal hygiene (Neave et al., 2019; Pertusa et al., 2010; van Bennekom et al., 2015). However, digital hoarding in relation to video games specifically is an area in need of further study.

The current study

As the relationships between loot box spending and obsessive-compulsive/hoarding symptoms are largely unknown, we aimed to determine if any associations between OCD/related symptomatology and loot box spending could be identified. Our focus was largely upon loot box spending (because the randomised rewards from loot boxes reduce the



volition that gamers with compulsive symptoms may have to complete sets in a targeted manner). However, collections of non-randomised rewards/digital items may plausibly be associated with this symptomatology. Thus, these variables were included for investigation.

Finally, although previous work has identified a small association between problem gambling symptoms and loot box spending, debate remains about whether loot boxes are harmful *per se* (e.g., McCaffrey, 2020). In response to such concerns, loot boxes themselves have been described to legislative bodies by game industry spokespeople as providing ‘surprise and delight’ to players, and as being entirely unrelated to gambling practices (Lum, 2018; Taylor, 2021). To test such claims, one potentially useful measure would be whether individuals experience regret at their previous purchasing decisions regarding loot boxes.

In relation to regret, existing research has identified in-game sales-mechanisms that ‘hide’ or obscure their potential financial impact (until players are psychologically ‘hooked’) as ‘predatory monetization’ (King & Delfabbro, 2018). These mechanisms often take the form of loot boxes and/or non-randomised rewards. Additionally, gamers have been found to report feelings of exploitation through exposure to such practices in their games (Petrovskaya & Zendle, 2022). Thus, we have included a scale of post-purchase regret to determine the extent to which people who spend more on loot boxes regret their purchases, and to help explore these concepts and their effects further. We do this using items included in the Post Purchase Regret scale (Lee & Cotte, 2009).

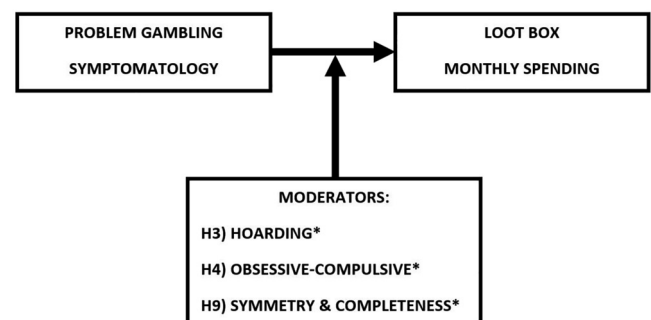
The present study looks for relationships between loot box spending and OCD and compulsive symptomatology, loot box spending and non-randomised reward spending, loot box spending and post purchase regret, and also whether hoarding (specifically) moderates the relationship between loot box spending and problem gambling.

Hypotheses

Based upon the reviewed literature, we pre-registered a number of hypotheses across three key categories: OCD and Hoarding, post purchase consumer regret, and replication hypotheses containing replications of previous problem gambling symptomatology and loot box spending associations.

OCD and hoarding hypotheses. With regard to OCD and Hoarding symptomatology, we made several specific predictions. Specifically, we predicted:

- 1) That there will be a significant positive correlation between the amount of money participants report spending on purchasing loot boxes and scores of obsessive-compulsive symptomatology on the Obsessive-Compulsive Inventory Revised (OCI-R) scale.
- 2) That there will be a significant positive correlation between the amount of money participants report spending on purchasing loot boxes and the hoarding subscale scores of the OCI-R scale.
- 3) That hoarding, according to scores on the OCI-R subscale, will moderate the relationship between problem gambling symptomatology as measured by the Problem Gambling Severity Index (PGSI) and loot box spending (See Fig. 1 below for diagram of all moderation hypotheses).
- 4) That the relationship between problem gaming symptomatology (PGSI) and loot box spending will be more strongly positive for participants with higher OCI-R scores.
- 5) That there will be a significant positive relationship between the amount participants report spending on non-randomized rewards in video games and scores on the hoarding subscale of the OCI-R.
- 6) That there will be a significant relationship between the amount participants report spending on non-randomized rewards in video games and higher scores on the obsessing subscale of the OCI-R.
- 7) That there will be a significant relationship between the amount participants report spending on non-randomized rewards in video games and higher scores on the checking subscale of the OCI-R.
- 8) That there will be a significant relationship between the amount participants report spending on non-randomized rewards in video games and higher scores on the Symmetry and Completeness subscale of the Dimensional Obsessive-Compulsive Scale.
- 9) That symmetry and completeness, according to scores on the Dimensional Obsessive-Compulsive Scale subscale, will moderate the relationship between problem gambling symptomatology; the relationship between problem gaming symptomatology (PGSI) and loot box spending will be more strongly positive for participants with higher Dimensional Obsessive-Compulsive Scale scores.



*Symptomatology

Fig. 1. Hypothesized moderation effects by hypothesis (Hx) of hoarding (using the hoarding subscale of the OCI-R), obsessive-compulsive symptomatology (using the full OCI-R scale), and symmetry and completeness (using the symmetry and completeness on the DOCS scale) on loot box monthly spending and problem gambling symptomatology (as measured by the PGSI)



Note: Hypotheses 3 and 4 were listed as-one in the pre-registration however they were intended to be separate and as such have been presented correctly here. Also, in our preregistration, the moderation hypotheses focusing on OCD, hoarding and Regret were listed as measuring both loot box spending & Risky Loot Box Index scores. This was an error and was intended to examine only loot box spending. Thus, analyses presented for these mentioned hypotheses report results using loot box spending as a variable only. The full dataset is openly available for reanalysis here:

https://osf.io/mwyvq/?view_only=70e70c1bb1f24f1ea66218136174356e.

Regret hypotheses. For post-purchasing consumer regret, we predicted that:

- 10) There will be a significant positive correlation between the amount of money participants report spending on purchasing loot boxes in the past month¹ and their scores of regret on the post-purchase consumer regret scale.
- 11) That there will be a significant positive correlation between risky loot box use scores and scores of regret on the post-purchase consumer regret scale.

Replication hypotheses. Based upon the past literature, we predicted that:

- 12) There will be a significant positive correlation between the amount of money participants report spending on purchasing loot boxes in the past month and their problem gambling symptoms as measured by the Problem Gambling Severity Index (PGSI).
- 13) There will be a significant positive correlation between the amount of money participants report spending on purchasing loot boxes (scored from individual spending items) in the past month and their Risky Loot Box Index scores (Brooks & Clark, 2019).
- 14) There will be a significant relationship between problem gambling symptoms (scored on the PGSI) and the amount participants report spending on non-randomized rewards in video games, but this will be smaller than the association for loot boxes.

METHOD

This study was a survey investigation sampling populations across Aotearoa New Zealand, Australia, and the United States.

Pre-Registration

The complete pre-registration document (which includes exclusions, analyses plans and full questionnaires) can be accessed at the Open Science Framework website here: https://osf.io/g3d64/?view_only=312e46b91d93464cb29635650ad25cf8.

A-priori power analysis

We used the software program G*Power to conduct a power analysis. A sample size of 1,200 allows us to reliably detect correlations of $r = 0.1$ (the smallest correlation of interest) in the total sample with a target power of 0.8 at an alpha level of 0.05.

Design

We used a cross-sectional between-subjects correlational design featuring 68 questions hosted on Qualtrics' survey software. Primary measures were problem gambling symptoms on the Problem Gambling Severity Index (PGSI) which is a continuous scale, loot box spending in the past month (continuous), the Risky Loot Box Index which categorically measures loot box use on a 1–7 scale (between strongly agree and strongly disagree), the Post-Purchase Consumer Regret scale which measures consumer regret on a Likert of 1–5 (strongly disagree-strongly agree) which can be collapsed into two main categories (regret of outcome, regret of process), the Obsessive-Compulsive Inventory Revised (OCI-R) which measures obsessive-compulsive behaviours/cognitions across six subscales (washing, obsessing, hoarding, ordering, checking, and neutralizing), and the Dimensional Obsessive-Compulsive Scale's subscale of 'symmetry and completeness' featuring 5 items on a Likert of 0–4 (with differing response options item-to-item). The present survey was modelled upon Drummond and Sauer's (2020) prior research. Thus, the internet gaming disorder symptomology (continuous) scale was also included for potential future exploratory analyses. However, no analyses utilising this scale were included in our pre-registration.

Participants

We recruited 1,201 participants across Aotearoa New Zealand, Australia, and the United States using Prolific. Participants (before exclusions were applied) had a mean age of 31.3 years ($SD = 9.64$) ranging from 18 to 74. Gender data revealed that 569 participants were male, 605 were female, 20 were non-binary, 2 preferred not to say, 4 reporting as 'other', and one participant not answering the question. Note that we had pre-registered the collection of 1,200 participants but received 1,201 responses due to software error. Analyses excluding the last recruited participant did not qualitatively alter the results.

Exclusions

Our pre-registered protocol included a number of exclusion criteria. We planned to exclude any mischievous response on the gender question, such as "Apache Attack Helicopter". We inspected the gender data for non-serious answers and found no evidence for mischievous responding. Thus, no specific exclusions were made on this basis. We excluded data from 29 participants who failed to correctly answer our attention checks – specifically if they answered either a) anything other than 4 for the question "What is $2 + 2$?"; b) anything other than 3 for the question "Please respond 3



to this question.”; or c) any participant who answered “true” to the question “I once owned a three-headed dog”. Ninety-one participants were excluded for indicating that they had not played video games within the last month (i.e., they answered “0, never”). Thirteen participants were excluded for indicating that they had spent more than \$1,000 on loot boxes in the past month (which we pre-registered would be deemed either a non-serious and/or an extreme response). Following the above exclusions we excluded, based on Tabachnick, Fidell, and Ullman (2007), any participant who indicated that they had spent ± 3.29 Standard Deviations from the mean (\$21.5USD, SD = \$64.2USD) on loot boxes in the past month as outliers. Eighteen participants were excluded for exceeding this \$232.718USD cut-off (set after examining the data). One participant was excluded for failing to respond to at least 75% of the PGSI questions, or 75% of the post purchased consumer regret questions, or 75% of the OCI-R questions. These exclusions resulted in a final sample size of $n = 1,049$ (total exclusions equalling 152 from a 1,201 sample).

We made one minor deviation from our pre-registered exclusion criteria. We had initially pre-registered that we planned to exclude any participant who did not spend any money on loot boxes. However, this was a mistake in our pre-registration documentation and was inappropriate for two reasons. First, applying the ‘never spent money on loot boxes’ exclusion took our sample from $n = 1,049$ to $n = 454$, drastically reducing our statistical power to detect differences. Second, part of the aim of our study was to investigate the associations between OCD symptomatology and loot box spending in the population, which includes people who do not purchase loot boxes. Thus, we did not apply this exclusion criteria to the analyses reported herein. Using the alternative exclusion criteria did not substantively alter the results. However, for transparency we provide the full dataset for reanalysis, and analyses employing this exclusion criteria in supplementary analyses. We also note any differences between those analyses in the main text below which exceeded a small difference in effect size magnitude, defined here and in the literature as being any difference between analyses of greater than $r = 0.10$ (Cohen, 1992), or if they altered the significance of the effect. To foreshadow, analyses were for the most part consistent across exclusion criteria, and there were relatively few instances where inconsistency occurred.

Measures

Problem Gambling Symptoms. Problem Gambling Symptoms were measured using the Problem Gambling Severity Index (PGSI). The PGSI is a 9 item scale which asks participants how frequently in the past 12 months they have engaged in potentially problematic gambling behaviours on a scale from 0 (never) to 3 (almost always). Higher scores indicating stronger problem gambling symptoms (Holtgraves, 2009). Scores totals tallied accounting for any reverse coding. Example items were “thinking about the last 12

months, have you bet more than you could really afford to lose?”; and “still thinking about the last 12 months, have you needed to gamble with larger amounts of money to get the same feel of excitement?”. Cronbach’s α for the PGSI scale was 0.947.

Risky loot box engagement. Risky loot box engagement was measured by the Risky Loot Box Index. The Risky Loot Box Index consists of 5 items outlining risky loot box engagement with higher scores relating to higher risk engagement (Brooks & Clark, 2019) on a scale from 1 (strongly disagree) to 7 (strongly agree). Higher scores indicating stronger risky loot box engagement. Example items: “I frequently play games longer than I intend to, so I can earn loot boxes.” And “I have put off other activities, work, or chores to be able to earn or buy more loot boxes.” Cronbach’s α for the Risky Loot Box Index scale was 0.915. Note that the Risky Loot Box Index has been amended from a 1–5 in its original form to a 1–7 scale here. This is due to the 1–7 scale being used in previous studies which were extended and replicated within the present study (e.g., Drummond et al., 2020). These changes were initially made in line with recommendations from Cox (1980), and Chyung, Roberts, Swanson, and Hankinson (2017), that employing a greater number of response options on Likert-type scales (ideally 7–9 items) can improve discrimination between participant responses.

Consumer regret. Consumer regret was measured by the Post Purchase Consumer Regret Scale. The Post Purchase Consumer Regret measures regret after spending across two key domains; regret of outcome, and regret of process, and is a 16 item instrument featuring a Likert scale of 1 (strongly disagree) to 5 (strongly agree). An additional response option was added to this measure for this study to screen for never having purchased loot boxes and which was coded as ‘0’. Higher scores indicate higher post-purchase consumer regret (Lee & Cotte, 2009). Example of (amended to include loot box) items include “I feel that I did not put enough consideration into buying Loot Boxes”, and “I regret purchasing as many Loot Boxes as I did in the past month.” Cronbach’s α for the Post Purchase Consumer Regret scale was 0.987.

Obsessive-compulsive symptoms. Obsessive-compulsive symptoms were measured using the Obsessive-Compulsive Inventory (Revised). The OCI-R scores across several subscales focusing on distinct aspects of obsessive-compulsive behaviours; washing, obsessing, hoarding, ordering, checking, and neutralizing (Foa et al., 2002). This scale features 18 items on a Likert-type scale of 0 (not at all) to 4 (extremely). Scores on this scale are tallied for a total score. Examples of some items are “I have saved up so many things that they get in the way.”, and “I check things more often than necessary.” Cronbach’s α for the OCI-R scale was 0.929.

Additional obsessive-compulsive symptoms. Additional obsessive-compulsive symptoms as identified by the ‘symmetry and completeness’ subscale from Dimensional Obsessive-Compulsive Scale (DOCS) were also included.



The DOCS subscale features 5 items using a 5 point Likert-type scale from 0 to 4 with differing response options item to item (Abramowitz et al., 2010). Scores from this measure were tallied (as subgroup only). Example items include “About how much time have you spent each day with unwanted thoughts about symmetry, order, or balance and with behaviours intended to achieve symmetry, order or balance?” and “To what extent have you been avoiding situations, places or objects associated with feelings that something is not symmetrical or “just right?”. Cronbach’s α for this DOCS (Symmetry subscale) was 0.878.

Loot box spending in the past month. Loot box spending in the past month was recorded by using a continuous measure asking how much money participants had spent on loot boxes in the last month (in their native currency).

Non-randomised reward spending in the past month. Spending was recorded by using a continuous measure asking how much money participants had spent on loot boxes in the last month (in their native currency).

NOTE: All currencies not reported in US dollars (USD; assessed by linking with the survey country item) were converted to US dollars using the exchange rates from XE.com and PountsterlingLive.com using the mid-day average (the difference between these two resources was minimal; for New Zealand currency, 1NZD = either 0.7093 or 0.7109 USD’s, and for Australian currency 1AUD = 0.7390 or 0.7400 USD’s). Rates were taken and applied for the date and afternoon that participants completed the survey (2 September 2021).

Ethics

Approval for survey data collection for this study was granted by Massey University’s Human Ethics Committee, Approval number: SOB 21/08. All subjects were informed about the study and provided informed consent.

RESULTS

The data for this study is open for public access and analysis here: <https://osf.io/mwyvq/>

Our pre-registration document outlined that we would exclude participants who had not spent real money on loot boxes (See point 22.1.5 of pre-registration document). However, as noted earlier, this criterion was a mistake in our pre-registration document and we did not apply this exclusion criterion for several reasons. When this filter was used, despite reducing the overall sample size, most effects were found to be qualitatively similar or slightly stronger. Where results across analyses are substantially different – identified by a difference of an r larger than 0.1 or a change in statistical significance – then both sets of results will be presented herein.

As loot box spending data showed strong skewness/kurtosis, all hypotheses are reported in the main text body using Spearman’s rho correlations as specified in our

preregistration document (Spearman’s were used over Pearson’s when spending data showed a high degree of skewness or kurtosis >2). Analyses employing Pearson’s correlations can be found in the [supplementary materials](#) available online.

OCD & hoarding hypotheses

Correlation hypotheses. Table 1 shows the associations between loot box spending, OCD symptomatology scores, and hoarding. Associations were small-to-moderate in size for loot box spending and OCI-R scores ($r = 0.324$, $p < 0.001$ (H1)) and loot box spending and the hoarding subscale of the OCI-R ($r = 0.227$, $p \leq 0.001$ (H2)).

Table 2 shows the associations between non-randomised reward spending and the compulsive symptomatology scores of hoarding, obsessing and checking, and symmetry and completeness. There were consistent, significant small-to-moderate associations between our individual difference variables and non-randomised reward spending. Additionally, a medium relationship was found with problem gambling symptoms which interestingly was slightly larger than what was observed between loot box spending and problem gambling (See Section 3.3).

We also found small-to-moderate associations between non-randomized reward spending and a) the hoarding subscale of the OCI-R, $r = 0.288$, $p \leq 0.001$ (H5); b) the obsessing subscale of the OCI-R, $r = 0.180$, $p \leq 0.001$ (H6); c) the checking subscale of the OCI-R, $r = 0.319$, $p \leq 0.001$ (H7); and d) the completeness subscale of the Dimensional Obsessive-Compulsive scale, $r = 0.243$, $p \leq 0.001$ (H8).

Table 1. Associations (Spearman’s Rho) between loot box spending, OCD symptomatology scores, hoarding, and consumer regret

Measure	Loot Box Monthly Spending	
		p
OCI-R	0.324	<0.001
Hoarding*	0.227	<0.001
Post Purchase Consumer Regret	0.437	<0.001

* The hoarding subscale of the OCI-R

Table 2. The association (Spearman’s Rho) between Non-randomised reward spending, OCD symptomatology scores, and hoarding

Measure	Non-Randomised Reward Monthly Spending	
		p
Hoarding ¹	0.288	<0.001
Obsessing ²	0.180	<0.001
Checking ³	0.319	<0.001
Symmetry & Completeness	0.243	<0.001

¹ The hoarding subscale of the OCI-R.

² The obsessing subscale of the OCI-R.

³ The checking subscale of the OCI-R



Moderation hypotheses. All three hypothesised moderating relationships were supported by the data with the hoarding subscale of the OCI-R moderating the relationship between PGSI and loot box spending (H3); full OCI-R scores moderating the relationship between PGSI and loot box spending (H4); and the symmetry and completeness subscale of the Dimensional Obsessive-Compulsive scale moderating the relationship between PGSI and loot box spending (H9). Table 3 shows the inferential statistics for each analysis.

Figure 2 shows that for OCI-R hoarding (H3/Panel A), total OCI-R (H4/Panel B) and DOCS scores (Panel C), the relationship between PGSI symptomatology and loot box spending was stronger for participants above the median score on the moderator variable. However, in all cases, when participants who never purchased loot boxes were excluded from analyses, these moderating effects became non-significant, $b < 0.208$, $p > 0.152$.

Regret hypotheses. As previously reported in Table 1, there was a significant, moderate association between loot box spending and consumer regret, $r_s = 0.437$, $p < 0.001$ (H10). When participants who had never purchased loot boxes were excluded from the analyses, the association between consumer regret and loot box spending remained significant but was reduced in magnitude, $r_s = 0.250$, $p < 0.001$. This may be due to participants who did not purchase loot boxes being unable to regret said loot box purchases (i.e., exaggerating the association between lack of regret and low levels of spending).

Additionally, results for risky loot box use scores and consumer regret showed a significant and strong positive correlation with a Spearman's rho of $r_s = 0.610$, $p < 0.001$ (H11). Thus, participants who engaged with loot boxes with greater risk tended to also more strongly regret their purchases. Like the association between consumer regret and spending above, this effect was markedly reduced (though remained significant) when participants who had not

purchased loot boxes were excluded from the analysis, $r_s = 0.340$, $p < 0.001$. Again, this difference may be explained in part due to a lack of regret for loot box purchases among those who did not purchase them.

Replication hypotheses. We also undertook analyses to replicate previously found associations between problem gambling symptomatology, risky loot box engagement and monthly loot box spending. Replicating prior work, we found a significant moderate-to-strong association between monthly loot box spending and PGSI, $r_s = 0.418$, $p < 0.001$ (H12). We also replicated the previously found moderate-strong association between Risky Loot Box Index scores and monthly loot box spending, $r_s = 0.529$, $p < 0.001$ (H13). Monthly spending on non-randomised rewards were also significantly associated with problem gambling symptoms, with a moderate-to-strong effect size, $r_s = 0.465$, $p < 0.001$ (H14).

Additional analyses

Controlling for age and gender produced negligible differences in core correlations. Thus, the associations did not appear to be due to age or gender. This adds confidence that our core associations of interest are not spuriously produced by demographic characteristics (Wysocki, Lawson, & Rhemtulla, 2022).

Exploratory analyses

As identified, non-randomised reward monthly spending matched or exceeded some effect sizes in relation to loot box spending and other measures. However this was not listed as an investigation avenue in our pre-registration. Accordingly, to present a clearer picture, a full correlation table is presented here for all non-randomised reward spending results (See Table 4). Additionally, please see the supplementary materials (Supp. Tables S1 and S2 for complete correlation matrix' across all measures).

Table 3. Moderation results by hypothesis in relation to loot box monthly spending including main and interaction effects plus median-split results

Variables	b	<i>p</i>	Above Median		Below Median	
			<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>
<i>Hypothesis H3:</i>						
PGSI Total	2.303	<0.001				
OCIR Hoarding Subscale	1.583	<0.001				
PGSI * OCI-R Hoarding	0.444	<0.001	0.475	<0.001	0.227	<0.001
<i>Hypothesis H4:</i>						
PGSI Total	1.731	<0.001				
OCI-R Total	0.420	<0.001				
PGSI * OCI-R Total	0.089	<0.001	0.5	<0.001	0.166	<0.001
<i>Hypothesis H9:</i>						
PGSI Total	3.291	<0.001				
DOCS Total	−0.117	0.652				
PGSI * Symmetry & Completeness	0.114	0.009	0.482	<0.001	0.266	<0.001

Note. Median split controlling for age and gender. * = Interaction.



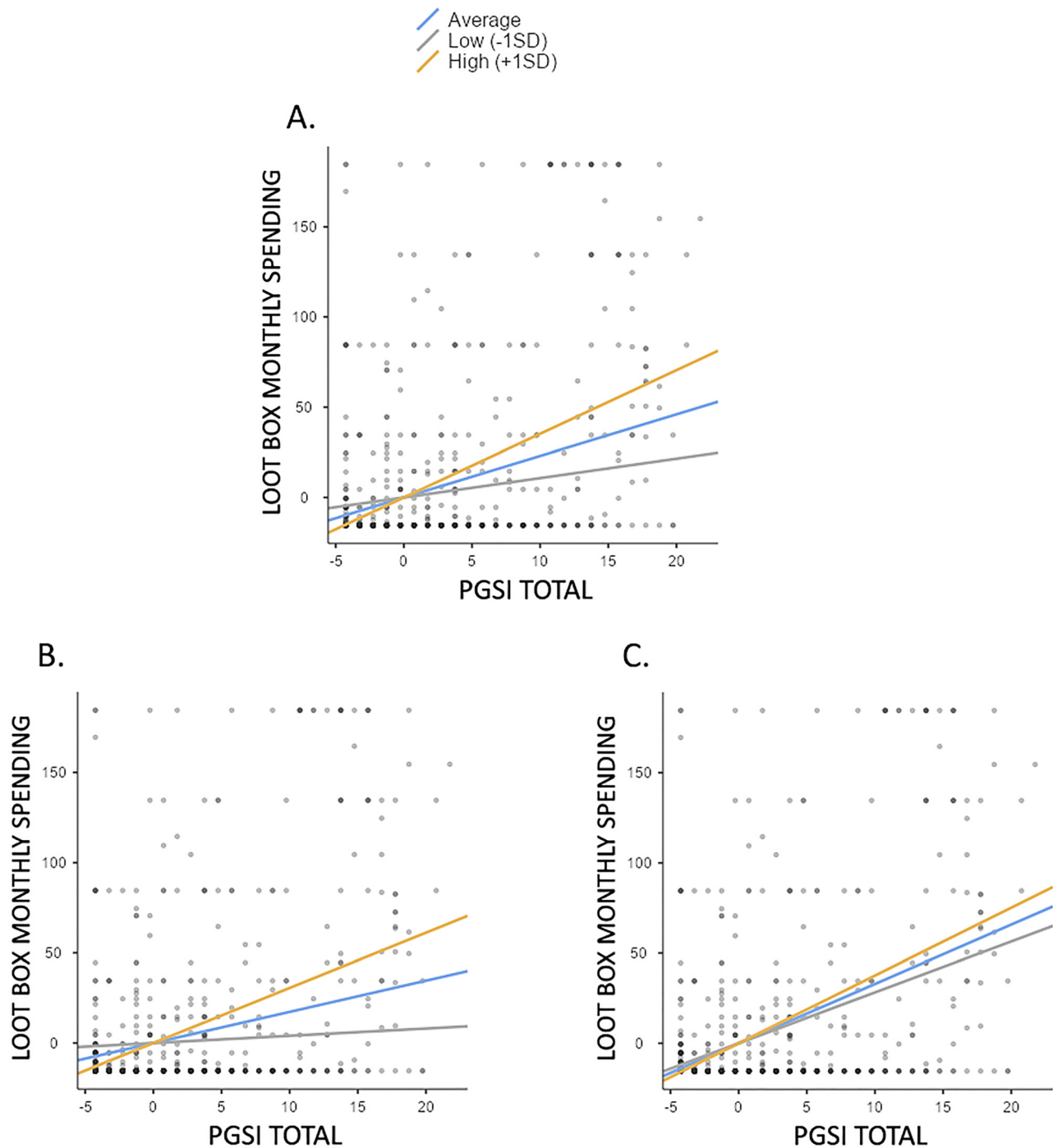


Fig. 2. Three simple slope plots outlining: Panel A) Moderation effects between loot box spending, problem gambling symptoms (PGSI) and hoarding subscale scores from the OCI-R. Panel B) Moderation effects between loot box spending, problem gambling symptoms (PGSI) and total scores from the OCI-R. Panel C) Moderation effects between loot box spending, problem gambling symptoms (PGSI) and DOCS symmetry and completeness scores

DISCUSSION

This study investigated the relationships between loot box spending, problem gambling symptoms, consumer regret, non-randomised reward spending, and OCD and hoarding symptomatology in samples from Aotearoa New Zealand, Australia, and the United States. In addition to replicating

the relationship between Problem Gambling Symptomatology and loot box spending found in other studies, our study found novel associations between OCD symptomatology, Hoarding symptomatology, and loot box spending. Participants with higher OCD/compulsive symptomatology appear to also disproportionately engage in higher loot box and non-randomised reward spending. We also identified a



Table 4. The association (Spearman's Rho) between Non-randomised reward spending and all other measures for exploratory analyses

Measure	Non-randomised Reward Monthly Spending	<i>p</i>
LB Monthly Spending	0.594	<0.001
PGSI Scores	0.465	<0.001
RLBI Scores	0.497	<0.001
OCIR Scores	0.358	<0.001
Hoarding Scores ¹	0.288	<0.001
Obsessing Scores ²	0.180	<0.001
Checking Scores ³	0.319	<0.001
Symmetry and Completeness	0.243	<0.001

¹ The hoarding subscale of the OCI-R. ² The obsessing subscale of the OCI-R. ³ The checking subscale of the OCI-R

novel association between loot box spending and consumer regret, showing that people who spend more on loot boxes also regret their spending more than those who spend less on loot boxes. Notably, the relationship between risky loot box engagement and regret was stronger still. The effect sizes for these associations all exceeded guidelines for the minimum effect sizes of interest (Ferguson, 2009). Being the first demonstration of this association, however, this finding obviously warrants further replication.

Hoarding (measured by the OCI-R scale) and obsessive-compulsive symptomatology (measured by both the OCI-R and Symmetry and Completeness scales) moderated the associations between problem gambling symptoms and loot box spending. The relationship between problem gambling symptoms and loot box spending was stronger for those high in hoarding/OCD scores compared to those low in hoarding scores. This indicates that individuals with comorbidities of problem gambling and OCD/compulsive symptomatology may be particularly likely to spend more on loot boxes.

It is important to acknowledge that a major limitation of the current research is that it is correlational, and we therefore cannot determine the directionality of the effect/s. Perhaps those with OCD are actually more likely to purchase loot boxes (perhaps to hoard items or due to a desire for completeness or symmetry in their collections). Alternatively, exposure to loot boxes and item 'collection' in video games may perhaps increases/creates OCD symptoms and/or symptom intensity. Given the typically small effects of media on psychological outcomes, we suspect that the latter direction of the relationship may be less likely. However, it is also possible that a third variable may be affecting both OCD symptoms and loot box spending habits.

Another important, novel finding of the present research is that participants who spend more money purchasing loot boxes tended to regret their purchases more than those who spend less purchasing loot boxes: Loot box spending is associated with regret. This finding suggests that due to loot boxes awarding players with mostly low

value, common items (Zendle et al., 2020), players who are spending in order to attain high rarity items will be often regretting their purchases. The finding that increased regret was associated with increased loot box spending highlights that consumers are not always happy with their loot box purchases. This may be due to the inability to know precisely what it is that they are getting prior to purchase, and this in part may be driven by many of the mechanisms of sale being engineered to encourage reflexive and emotive (conditioned) spending over considered and reasoned decision making (Derevensky & Griffiths, 2019). The associations between spending and regret, and risky loot box engagement and regret, strongly contrasts with gaming-industry descriptions of loot boxes as "surprise and delight" mechanisms, since the emotion of delight is seemingly antithetical to the affective response of regret (Lum, 2018; Taylor, 2021). After opening a loot box, and perhaps due to the rarity of highly desirable items (and the corresponding increased probability of receiving non-desired items), consumers are perhaps likely to find items they did not desire, and this results in immediate disappointment, and thus regret. Further research investigating whether consumer regret is similar or divergent across different spending domains or applications of randomised and non-randomised items is also a worthy goal. However, in order to accurately compare across domains and cultures, a wider understanding of the psychometric properties of, and norms for, the PPCR would likely be required.

Non-randomised reward purchasing was not a primary focus of the current study. However, it is worth noting that somewhat unexpectedly, exploratory analyses comparing post purchase consumer regret findings with non-randomised reward spending we found an almost identical result to regret/loot box spending. This suggests that non-randomised in game purchases may also be associated with regret for consumers. There are several reasons why this might occur. First, there appears to be some collinearity in the data – with those with higher non-randomised reward spending also scoring higher on problem gambling symptomatology as well as on loot box spending. Such overlap in symptomatology requires further research to fully understand. Second, it is possible that participants with OCD symptomatology may overspend on in-game purchases to collect items irrespective of whether such items are randomised or not. Further research is required to replicate and further examine this finding of regret and non-randomised reward spending.

Whilst existing studies have found clear positive small relationships between problem gambling symptomatology and loot box use, this study broadens our understanding of this phenomenon as it relates to OCD symptoms. People who score higher on obsessive compulsive scales spend more money on loot boxes, and those who spend more money on loot boxes, and those that spend more money on non-randomised reward purchases tend to regret those purchases more. In turn, this spending appears to be associated with increased consumer regret. Further research to examine this phenomenon using greater control



variables and clinical diagnoses would be helpful, as would longitudinal designs.

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Conflicts of interest: The authors declare no conflicts of interest.

Data availability: The data from this research is freely available for viewing and re-analyses here: <https://osf.io/mwyvq/>.

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SUPPLEMENTARY DATA

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