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Close, James

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Secondary analysis of loot box data: are high-spending “whales” wealthy gamers or problem gamblers?

Abstract

Introduction

Loot boxes are purchasable randomised reward mechanisms in video games. Due to structural and psychological similarities with gambling, there are fears that loot box purchasing may be associated with problematic gambling. Whilst monthly expenditure is typically modest (i.e. < \$20), the distribution is highly skewed, with a small number of high-level spenders, sometimes referred to as “whales”. It is not known what proportion of industry profits are derived from such players, and whether they are typically wealthy individuals and/or problem gamblers.

Methods

We used structured literature searches to identify surveys of gamers with open-access loot box data. The resulting datasets were aggregated, and correlations between loot box expenditure, problem gambling and earnings investigated using Spearman’s rho correlations.

Results

The combined open-access data comprised 7,771 loot box purchasers (5,933 with self-report earnings). Secondary analysis of this self-report data confirmed that disproportionate revenue appears to be generated from high-level spenders: the top 5 % of spenders (> \$100/month) represent over half of loot box revenue. Previously reported correlations between problem gambling and loot box expenditure were confirmed, with an aggregate correlation of $\rho = .33$, $p < .001$. In contrast, there was no significant correlation between loot box spend and earnings $\rho = .02$, $p = .10$.

Conclusion

Our secondary analysis suggests that games developers (unwittingly or not) are disproportionately profiting from moderate and high-risk gamblers, rather than high earning customers. Such patterns of spending mirror those observed with gambling revenues, and have implications for harm minimisation and ongoing policy debates around loot boxes.

Keywords: video games; problem gambling; loot boxes; microtransactions.

Introduction

Loot boxes are purchasable randomised reward mechanisms in video games, which have attracted recent controversy due to structural and psychological similarities with gambling¹. They are now prevalent across all gaming platforms and distribution channels, including both “free-to-play” and paid-for games²⁻⁴. Recently, online marketplace data was used to establish that these in-game items have real world value, and could therefore be regulated under existing gambling regulations in some jurisdictions⁵.

Legal debates have often juxtaposed the potential benefits of harm-minimisation (i.e. to protect at-risk individuals, such as problem gamers/gamblers) against the unintended consequences of legislation (i.e. reduced free-market choice; decreased developer revenue; burdens of enforcement)⁶. Here, a key question is affordability. Can players afford their recreational outgoings? Or can expenditure escalate dangerously, compounding comorbid behavioural addictions (i.e. problem gaming/gambling) and leading to financial/psychological harm? With several jurisdictions (including the UK, Australia, Sweden and the USA) currently investigating legislation for loot boxes⁷, answers to these questions have implications for these policy debates.

Anecdotal evidence gives cause for concern. There are media stories of young people making outsized expenditure on loot boxes – sometimes tens of thousands of dollars – compounding problems with video gaming or gambling^{8,9}. Similarly, individuals seeking treatment for internet gaming disorder have reported large debts due to microtransactions¹⁰. Such observations highlight a complex interaction between behavioural addictions, financial health and personal wellbeing. But are such cases isolated examples? Or are developers accruing significant revenue from malign spending behaviours? While loot box spend is typically modest (< \$20/month¹¹⁻¹⁵), and unlikely to place a burden on most gamers, spend distribution is highly skewed. A small number of high-level spenders (referred to as ‘whales’ by the industry) are purported to be high-earning individuals; able to afford the recreational outgoings¹⁶. Others, however, disagree, suggesting that high-spenders may be comprised primarily of problem gamblers, problem gamers, and other at-risk individuals¹³.

A recent large-scale international study indicates that gambling revenue is disproportionately derived from high-level spending of problematic gamblers¹⁷. Such patterns are liable to be observed with loot boxes. With loot boxes sharing many structural and psychological features with gambling¹, and triggering similar arousal responses¹⁸, commentators have argued they are liable to ‘entrapment’ (via obfuscated pricing and ‘sunk cost’ effects, similar to gambling), thus leading to dangerous cycles of over-spending, with subsequent potential for psychological and financial harms¹⁹.

Survey data supports the idea that loot boxes and gambling are related behaviours. A recent meta-analysis established reproducible associations (in 13 of 15 studies) of small to moderate size between loot box purchasing and problem gambling²⁰. Such associations have been repeated across various cohorts, nationalities and age groups^{13,21}, and remain stable after controlling for age and gender²¹⁻²³.

Whilst such findings suggest that high-level purchasing might be linked with problematic behaviour, they do not challenge industry suggestions that ‘whales’ are simply wealthy individuals. No previous publication has contextualised these (now well established) links with problem gambling against self-report earnings and patterns of spending. We therefore aimed to investigate the following questions

using existing, open-access data sources: *Are high-spending “whales” represented by high-earning individuals, as argued by the gaming industry? Or are they more likely to be at-risk individuals, such as problem gamblers? And if so, are substantial industry profits derived from such players?*

Material and methods

We searched databases (PubMed, Science Direct, Scopus, Web of Science, and Google Scholar) for literature related to loot boxes, with searches conducted prior to 28th March 2020. Search terms were: (1) “loot box” OR “loot boxes”; (2) (microtransactions OR microtransaction) AND “chance based” AND (games OR gaming) AND (video OR computer OR online OR mobile); (3) gaming AND gambling AND “reward schedule” AND variable AND online (video OR computer OR mobile). Further papers were included via expert knowledge or a snowballing approach (i.e. via the references of primary articles). Duplicates were removed, and papers excluded if not written in English, not relevant to loot boxes, only discussed loot boxes as a peripheral subject or were publications of a non-empirical nature (e.g. reviews, commentaries and book chapters).

Where available, we performed secondary analysis of publications that provided open-access data. Datasets analysed during the current study are available from the following sources:

<https://osf.io/srykf/>; <https://osf.io/b87pm/>; <https://osf.io/2jgph/>; <https://osf.io/vfw46/>;
<https://osf.io/ts7ue/>; <https://osf.io/f4nav/>

Whilst complete independence of each sample cannot be guaranteed, the surveys used substantively different pooling strategies: an 18+ cohort from online forums¹²; a 16-18 year old cohort from online forums¹³; a cohort of *Heroes of the Storm* players¹⁴; a nationally representative sample for New Zealand, Australia and the USA²³; with only 2 surveys drawing from the same pool of participants (Amazon Mechanical Turk; “AMT”)^{15,24}. However, these two surveys sampled over a year apart, used complementary targeting strategies (one even obfuscating any links with loot boxes¹⁵), and they drew from an extensive base sample (around 250,000 individuals on AMT²⁵) known to have a high attrition rate²⁶.

Datasets were combined and analysed in R²⁷, with the combined dataset comprising Problem Gambling Severity Index (PGSI) scores²⁸, self-report loot box expenditure and self-report earning (where available). Age and sex were also included (where available), and used for additional controlled correlations (see below). All datasets consistently used US dollars; no conversion was necessary.

Whilst the majority of surveys used numeric responses for loot box expenditure and earnings (i.e. free-form response boxes), when surveys used categorical responses (i.e. binned “pull-down” response scales, such as “\$1-2”; “\$2-3”; “\$3-4”, etc.), the responses were converted into numeric/scale data by using the mid-point of each bin.

We removed outliers with greater than \$1000 USD monthly loot box spend and annual earnings greater than \$250,000 USD (tests also reported on full dataset). A cumulative percent graph of loot box expenditure was utilised to understand relationships between loot box spending and industry profit (i.e. how revenues are distributed between low, mid and high-spending players). Correlations between problem gambling, loot box expenditure and earnings were investigated using Spearman’s Rho and Kruskal-Wallis rank sum test. These approaches, suitable for non-linear relationships,

follow previous publications on loot boxes which similarly report bivariate correlations^{13,23,24,29}. Partial correlations are also calculated to control for age and gender.

Results

Literature searches

From the literature searches, we identified 255 publications related to loot boxes, 22 of which were primary research. Of the 22 empirical publications, the majority (17) were surveys of gamers, including some measure of loot box behaviour, with 13 reporting associations between some combination of loot boxes, problem gambling and/or problem video gaming. A total of 6 provided open access data for both self-report monthly loot box spend and PGSI scores^{12-15,23,24}, with a subset of three papers also containing data on self-report earnings^{12,15,23}.

Secondary data analysis

Datasets were combined into a single dataset containing PGSI scores, loot box spend and self-report earning (where available). We removed outliers with self-report data greater than \$1000 USD monthly loot box spend (24 participants) or greater than \$250,000 USD annual earnings (3 further participants). The combined data, comprising 7,771 loot box purchasers, establishes a significant aggregate (Spearman's rho) correlation between problem gambling score and loot box expenditure, $\rho = .33, p < .001$. (Results are not substantively altered when controlling for age/gender or retaining outliers: $\rho = .32, p < .001$ when age/gender controlled, albeit on reduced dataset of 6950 participants; $\rho = .34, p < .001$ when retaining outliers).

Moreover, our secondary analysis confirms that a disproportionate amount of revenue is derived from high-level spenders. In Figure 1, the cumulative percent graph of loot box expenditure elucidates relationships between loot box spending and industry revenue – i.e. how revenue is distributed between low, mid and high-spending players. For example, Figure 1 reveals that in our dataset, around 5% of loot box purchasers (those spending over \$100 per month) generate over half of industry revenue from loot boxes. Similarly, nearly a third of revenue (in our dataset) is derived from the top 2% of purchasers.

Additionally, high-spending players have considerably higher PGSI scores (Figure 1) than those spending under \$100 per month, with almost one third falling into the 'problem gambler' category. A Kruskal-Wallis test revealed a significant effect of loot box spend category (as defined by the spend bins on Figure 1) on PGSI score, $H(4) = 273.24, p < .001$. Conversely, there is no evidence in our dataset ($n = 5,933$ with self-report earnings) that higher loot box spend is correlated with higher earnings, $\rho = .02, p = .10$ ($\rho = .01, p = .46$ when age/gender controlled, with 5200 participants; $\rho = .02, p = .09$ when retaining outliers).

Discussion

Our secondary analysis establishes three related observations. Extending previously published work²⁰, our secondary analysis first establishes an aggregate correlation between problem gambling score and loot box expenditure ($\rho = .33, p < .001$). This degree of correlation bears practical

significance³⁰, and is stronger than relationships between problem gambling and well-established co-morbidities, including depression and drug misuse^{12,31}.

Second, our work also establishes a more novel observation: the lack of any relationship between loot box expenditure and annual earnings. High-spending ‘whales’ do not have higher earnings. Instead, around a third of high-spenders (>\$100/month) are classified as problem gamblers. Given evidence from previous literature (where associations between loot box purchasing and problem video gaming are of a similar magnitude)²⁰, it is possible that a similar proportion of high spenders might also be classified as problem video gamers.

Finally, our work also establishes that disproportionate revenue appears to be generated from these high-level spenders: in our dataset, the top 5 % of spenders (> \$100/month) represent half of loot box revenue. Other recent research appears to support the finding that outsized profits are generated from a minority of individuals. Transaction data, derived from Chinese players of *Counter Strike: Global Offensive*, reveals that over half of loot box spending is attributable to around 10% of spenders³². Games developers, unwittingly or not, appear to be generating outsized loot-box profits from at-risk individuals, likely to include both problem gamblers and problem video gamers – but not from wealthy gamers.

It remains unknown, however, the degree to which such spending translates into financial or psychological harm. Nonetheless, survey evidence suggests that loot box purchasing may lead to psychological harm, albeit findings that are indirect²² or cautiously interpreted by the authors²³.

More research is required to further unpack these complex relationships between gaming, gambling, spending behaviour and financial/psychological wellbeing. Our work highlights the utility of open-access datasets, and future research would be enhanced by standards of open science and pre-registration, including capture of wider (but standardised) demographic variables.

Our work also has implications for policy and practice. Despite many outstanding research questions, available data has led academic researchers¹³, public organisations³³ and charities³⁴ to call for industry and government action on loot boxes. Responses have included legislation in Belgium, The Netherlands and Denmark, with several other jurisdictions (including the UK) now also proposing legislation^{6,7}.

Insights from our secondary analysis emphasises the potential utility of interventions such as government legislation and spending limits, and highlights how therapeutic packages should take heed of complex (and likely comorbid) links between problem gaming, problem gambling, over-spending, and potential impacts on financial and psychological harm³⁵.

Loot boxes represent the most obvious face of an increasing convergence of gambling and gaming behaviours in contemporary digital culture^{36,37}. Risks of loot boxes – such as potential over-exploitation of at-risk groups – may also apply in related areas. For instance, eSports and “skin betting” (wagering of loot box prizes in secondary gambling markets) have been further linked with harmful gaming/gambling behaviours⁴.

With this constantly evolving technological ecosystem³⁸ – and with large financial incentives for unscrupulous game designers – any legislation against loot boxes is in danger of quickly being rendered an anachronism. Longer term mitigation of risk will require provisions for ongoing

research, development of child-focused data protection and educational approaches that are designed to curb exploitation of psychological nudges and biases^{19,34,39}.

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