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Supplementary information

Why loot boxes could be regulated as gambling

In the format provided by the authors and unedited

Supplementary Material for

"Why Loot Boxes Could be Regulated as Gambling"

Steam Marketplace Data

To obtain information about sales from the Steam Marketplace, we interrogated the Steam Marketplace Application Programming Interface (API). We selected three popular games with Steam Marketplaces: Counter Strike Global Offensive (CS:GO), DOTA 2, and Player Unknown's Battleground (PUBG). These games were selected for having player bases and active marketplaces (all three are listed among the top 10 most active marketplaces on the Steam Marketplace).

To obtain data from these marketplaces, we undertook a 2-step process. First, using the computer programming language Python, we interrogated the Steam API, requesting a list of the 1,001 most popular (most traded) items in two popular video games (CS:GO and DOTA 2), and the entire 317 item list from a third, more recent game with fewer items available to obtain (PUBG). We had actually intended to collect data on 1,000 items from CS:GO and DOTA 2, but due to minor coding error collected data on 1,001 items.

We then used Python to download each item's web page. Each page contained a graph summarising every sale of the relevant item that had been made on the Steam Marketplace which was dynamically rendered by embedded JavaScript. Using the "Beautiful Soup" Python web scraping library, we extracted all of the embedded scripts from each item's webpage. We then used scrapeGraphScript() to extract the data from the sales graph JavaScript in the website's code. This provided us with summary data on the volume and median price of all sales from the time each item was first listed until data collection began. Importantly, this was not a sample of sales, but was summary data on *every sale* of every item up until the moment of data collection.

Data were collected on September 11, 2018 for CS:GO, September 20, 2018 for DOTA 2, and May 7, 2019 for PUBG. As items are added to the games at various times, this generated a list of 2,319 items which were purchasable for an average of 947 days (SD = 609 days; Range: 1-1,946 days). These data revealed approximately 1.45 billion sales worth $1,004,955,106.92 USD in real currency.

To determine what proportion of purchases resulted in a loss, we first inspected the data. A number of the purchases were for loot boxes and keys. These items are bought for the purpose of obtaining virtual items but are not, in themselves, rewards from loot boxes. They are therefore irrelevant to the issue of whether players lose from opening loot boxes, and we removed these items from the dataset. When these were removed from the data we were left with 2,265 items, producing a total of 751,402,339 sales for a total of $727,003,483.82 USD. We then calculated the number of sales which had occurred for less than $2.49 (i.e., the cost of purchasing a loot box), and therefore represented a financial loss, by counting every sale below this threshold in the data. This gave us 699,418,473 sales. We divided this number by the total number of sales (751,402,339) and multiplied by 100 to result in a ~93% loss rate. The full dataset is available for reanalysis here: https://osf.io/8xmrt/

Survey Data

The survey data we reanalyze in the present manuscript was drawn from a large scale survey undertaken by Zendle & Cairns (*S1, 2 in the main text*). This study was a cross sectional survey that employed Amazon Mechanical Turk to recruit 1,545 participants to a study investigating video games, loot boxes and gambling. Our final sample differs from the original for two reasons. First, some participants failed to answer some of the questions about virtual item spending and were therefore excluded from the analyses reported in the current manuscript. Second, we imposed some different exclusion criteria to the original study. Specifically, we restricted our sample to participants who had spent less than $1,000 USD in

the past month on loot boxes or on virtual items, deeming spending values in excessive of $1,000 USD per month implausibly high. This limited our sample to 1,516 participants. Including participants who spent more than $1,000 did not qualitatively alter the results (the direction and significance of the results remained). However, including these participants reduced the effect sizes of regression analysis (showing a positive relationship between spending on virtual items and total game-related spending), but increased the effect sizes of the t-test differences we observed (showing that gamers who purchase virtual items spend more on video games than gamers who do not). In the original study, the authors excluded a number of participants for giving inconsistent answers or for expressing suspicion that the study was interested in loot boxes and gambling specifically. Imposing these exclusions did not appreciably alter the results, effect sizes, significance, or interpretations of any of our analyses. The full dataset is available for reanalysis here: https://osf.io/2jgph/.

In the main text, we report regression analyses for the relationship between spending on loot boxes and spending on video games limiting our analyses to participants who did not regularly play games with a legitimate marketplace to monetize items. Specifically, this analysis excluded people who regularly played CS:GO, DOTA 2, League of Legends, and PUBG.

Literature showing hazards associated with loot boxes

The following is a list of papers showing a variety of potential hazards associated with loot box use and a brief summary of their main findings:

D. Zendle, P. Cairns, Video game loot boxes are linked to problem gambling: Results of a large-scale survey. *PloS one* **13**, e0206767 (2018). (*S2*).

Summary: Problem gamblers spend more on loot boxes than those without problem gambling symptoms.

D. Zendle, P. Cairns, Loot boxes are again linked to problem gambling: Results of a replication study. *PloS one* **14**, e0213194 (2019). (*S1*).

Summary: Replicates the effect in the previous study. Problem gamblers spend more on loot boxes than those without problem gambling symptoms.

G. A. Brooks, L. Clark, Associations between loot box use, problematic gaming and gambling, and gambling-related cognitions. *Addictive behaviors*, **96**, 26-34. (2019). (*S3*).

Summary: Risky loot box use is associated with increased problem gambling symptoms and gambling related cognitions.

A. Drummond, J. D. Sauer, L. C. Hall, Loot box limit-setting: A potential policy to protect video game users with gambling problems? *Addiction*, **114**, 935-936 (2019). (*S4*).

Summary: Finds a high proportion of higher spenders on loot boxes are classified as either moderate-risk or problem gamblers.

D. Zendle, R. Meyer, H. Over, Adolescents and loot boxes: Links with problem gambling and motivations for purchase. *Royal Society Open Science*, **6**, 190049 (2019). (*S5*).

Summary: Finds the association between problem gambling symptoms and loot box spending is twice as large in adolescents than the general population.

W Li, D. Mills, L. Nower, The relationship of loot box purchases to problem video gaming and problem gambling. Addictive behaviors, 97, 27-34, (2019). (*S6*).

Summary: Finds an association between problem gambling symptoms and loot box spending, problem gaming symptoms and loot box purchasing, and loot box purhcasing and psychological distress.

References

S1. D. Zendle, P. Cairns, Loot boxes are again linked to problem gambling: Results of a replication study. *PloS one* **14**, e0213194 (2019).
S2. D. Zendle, P. Cairns, Video game loot boxes are linked to problem gambling: Results of a large-scale survey. *PloS one* **13**, e0206767 (2018).
S3. G. A. Brooks, L. Clark, Associations between loot box use, problematic gaming and gambling, and gambling-related cognitions. *Addictive behaviors*, (2019).
S4. A. Drummond, J. D. Sauer, L. C. Hall, Loot box limit-setting: A potential policy to protect video game users with gambling problems? *Addiction*, **114**, 935-6 (2019).
S5. D. Zendle, R. Meyer, H. Over, Adolescents and loot boxes: Links with problem gambling and motivations for purchase. *Royal Society Open Science*, **6**, 190049 (2019).
S6. W Li, D. Mills, L. Nower, The relationship of loot box purchases to problem video gaming and problem gambling. Addictive behaviors, 97, 27-34, (2019).