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Physical Card Pack and Especially Video Game Loot Box Spending Are Both Positively Correlated With Problem Gambling but Not Linked to Negative Mental Health: An International Survey

Leon Y. Xiao[1, 2], David Zendle[3], Elena Petrovskaya[4], Rune K. L. Nielsen[5], and Philip Newall[6]

[1] School of Creative Media, City University of Hong Kong

[2] beClaws.org, London, United Kingdom

[3] Department of Computer Science, University of York

[4] College of Health and Science, University of Lincoln

[5] Center for Digital Play, IT University of Copenhagen

[6] School of Psychological Science, University of Bristol

Objective: Card packs are physical products providing random content that companies rely on to monetize trading or collectible card games. Loot boxes are equivalent digital products inside video games that can similarly be bought to obtain randomized rewards. Both products are psychologically similar to gambling because the player can "win" by obtaining rare and valuable rewards or alternatively "lose" by obtaining nonvaluable rewards. Loot box spending has been repeatedly and reliably linked to problem gambling. However, the link between card pack spending and gambling has been little studied. ***Method:*** We recruited card game players living in English-speaking Western countries ($N = 1{,}961$) to assess the links between card pack and loot box spending on one hand and problem gambling and mental health outcomes on the other. ***Results:*** Spending money on physical card packs ($r = 0.15$), loot boxes ($r = 0.31$), and virtual card packs (a specific type of loot boxes found in a specific genre of card-based video games; $r = 0.22$) were all linked to problem gambling but at markedly different strengths. Spending money on all these gambling-like products were not associated with negative mental health. Spending money on certain subcategories of loot boxes differs from overall spending. ***Conclusions:*** The current legal definitions of "gambling" in many countries should be modernized using scientific evidence: Presently, the law (if properly enforced) would regulate products that are less strongly correlated with problem gambling and therefore arguably less potentially harmful (e.g., physical card packs), but fails to regulate arguably more harmful products that are more strongly correlated with problem gambling (e.g., loot boxes).

Public Health Significance Statement

This study highlighted that monetary spending on physical gambling-like products, for example, card packs, is also linked to problem gambling, although video game loot box spending is more strongly correlated to problem gambling. Engagement with all of these products is not linked to negative mental health. The legal definition used to regulate "gambling" should be reassessed in light of scientific evidence to ensure more harmful products are included.

Keywords: trading and collectible card games; tabletop, nondigital, analog games; loot boxes and gacha; problem gambling; video game law and regulation

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Leon Y. Xiao https://orcid.org/0000-0003-0709-0777

David Zendle https://orcid.org/0000-0003-0279-6439

Elena Petrovskaya https://orcid.org/0000-0003-4276-6154

Rune K. L. Nielsen https://orcid.org/0000-0002-7209-9041

Philip Newall https://orcid.org/0000-0002-1660-9254

Our positionality statements follows: Leon Y. Xiao: Card Packs: Since 2012, Leon Y. Xiao has infrequently played *Magic: The Gathering*, that is, attending prerelease events and drafts. Between 2016 and 2017, he played more intensively and attended events almost weekly. As a result, he owns products and cards, valued at approximately £500. Loot Boxes: Leon Y. Xiao plays and enjoys video games and broadly views the activity very positively, except for certain aspects (e.g., monetization) that he believes should be subject to more scrutiny. In terms of Leon Y. Xiao's personal engagement with loot boxes, he has played and continues to play video games containing loot boxes, such as *Hearthstone* (Blizzard Entertainment, 2014) until 2018 and *Genshin Impact* (miHoYo, 2020) and *Zenless Zone Zero* (miHoYo, 2024) since their initial release. He therefore engaged and continues to engage with nonpaid loot boxes on a regular basis. However, he has never purchased any loot boxes with real-world money aside from negligible spending for research purposes to, for example, confirm the presence of paid loot boxes. David Zendle possesses a Magic: The Gathering collection whose worth may plausibly be estimated at between £500 and £1,500. Elena Petrovskaya has previously played games intensively, between the ages of 16–18, including *Hearthstone,* which includes loot boxes, and spent a small amount of money on loot boxes in this game. She quickly realized she found this unrewarding, and never spent money on a game again. She no longer plays any video games (outside what is required for research). Rune K. L. Nielsen: Games: Rune K. L. Nielsen is old enough to have grown up playing

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Collectible or trading card games (CCGs or TCGs) are a popular form of physical tabletop gaming: Players engage each other in strategic gameplay using cards (Švelch, 2020). Well-known examples, including *Magic: The Gathering* (Wizards of the Coast, 1993–present) and *Pokémon Trading Card Game* (The Pokémon Company, 1996–present), have been established for multiple decades and gained even more popularity during and after the COVID-19 pandemic (Ang, 2025). The cards required to play these games are usually obtained through booster packs (hereinafter, "card packs"), which are physical game products containing a randomized assortment of cards. The player does not know exactly which cards they will receive until they spend money and open the pack, similar to baseball card and Panini sticker packs. These cards are designed to be traded between players, thereby giving rise to a secondary market where these cards have a monetary value depending on their relative rarity and gameplay power (Mudd, 2003). The vast majority of packs contain cards whose combined market value is worth far less than the manufacturer's suggested retail price of the sealed card pack itself, while a few packs will contain cards that are worth significantly more.

To illustrate with an example: *Magic: The Gathering* is one of the most popular trading card games. As of April 11, 2023, a card pack from a recently released product line (specifically, "Phyrexia: All Will Be One") that remained in production at that time (and whose content's prices are thus not affected by artificial scarcity due to low product availability) can be bought for between US$3.49–US $4.49 (MTGGoldfish, 2023c). Most cards in the pack have very little monetary value on the secondary market. However, at least one of the cards in the pack occupies a "rare/mythic rare" slot that has the potential to be highly valuable (MTG Wiki, 2022). From the aforementioned pack worth about US$4.00: The player has a very small chance of finding a "mythic rare" "Elesh Norn, Mother of Machines" card with a resale value of US$33.28 on the secondary market (MTGGoldfish, 2023a) or a much higher chance of obtaining

games on coin operated arcade machines. Video gaming and more recently physical esports has been—and continues to be—a great source of joy in his life. Card packs: Rune K. L. Nielsen has only ever played physical card games once in a university class on board games and has never purchased any cards himself. Loot Boxes: Rune K. L. Nielsen has spent money on loot boxes for research and as a private individual.

The raw data, survey materials, analysis scripts and results, and complete peer review history are publicly available on the Open Science Framework at https://doi.org/10.17605/OSF.IO/MHEUS.

Leon Y. Xiao has provided paid consultancy for Public Group International Ltd (t/a PUBLIC; Companies House Number: 10608507), commissioned by the UK Department for Culture, Media and Sport (DCMS) to conduct independent research on understanding player experiences of loot box protections, since October 2024. Leon Y. Xiao has provided paid consultancy for the Council of Europe International Cooperation Group on Drugs and Addiction (the Pompidou Group) on a project concerning the risks of online gambling and gaming to young people co-funded by the European Union via the Technical Support Instrument and implemented by the Council of Europe, in cooperation with the European Commission, since December 2024. Leon Y. Xiao was supported by a Fellowship funded by the IT University of Copenhagen [IT-Universitetet i København], which was publicly funded by the Kingdom of Denmark [Kongeriget Danmark] (December 2021–November 2024). Leon Y. Xiao was employed by LiveMe, then a subsidiary of Cheetah Mobile (NYSE: CMCM), as an in-house counsel intern from July to August 2019 in Beijing, China. Leon Y. Xiao was not involved with the monetization of video games by Cheetah Mobile or its subsidiaries. Leon Y. Xiao undertook a brief period of voluntary work experience at Wiggin LLP (Solicitors Regulation Authority Number: 420659) in London, United Kingdom, in August 2022. Leon Y. Xiao has contributed to research projects enabled by data access provided by the video game industry, specifically Unity Technologies (NYSE: U; October 2022–August 2023). Leon Y. Xiao has been invited to provide advice to the UK Department for Digital, Culture, Media and Sport and its successor (the Department for Culture, Media and Sport; DCMS) on the technical working group for loot boxes and the Video Games Research Framework. Leon Y. Xiao was the (co)recipient of three Academic Forum for the Study of Gambling (AFSG) postgraduate research support grants (March 2022, January 2023, and July 2024) and a minor exploratory research grant (May 2024) derived from "regulatory settlements applied for socially responsible purposes" received by the U.K. Gambling Commission and administered by Gambling Research Exchange Ontario (GREO) and its successor (Greo Evidence Insights; Greo). Leon Y. Xiao accepted funding to publish open-access academic papers from GREO and the AFSG that was received by the U.K. Gambling Commission as above (October, November, and December 2022, November 2023, and May 2024). Leon Y. Xiao was the recipient of an Elite Research Travel Grant 2024 [EliteForsk-rejsestipendium 2024] awarded by the Agency for Higher Education and Science of the Danish Ministry of Higher Education and Science [Uddannelses-og Forskningsstyrelsen under Uddannelses-og Forskningsministeriet] (February 2024). Leon Y. Xiao has accepted conference travel and attendance grants from the Socio-Legal Studies Association (February 2022 and February 2023); the Current Advances in Gambling Research Conference Organizing Committee with support from GREO (February 2022); the International Relations Office of The Jagiellonian University (Uniwersytet Jagielloński), the Polish National Agency for Academic Exchange (NAWA; Narodowa Agencja Wymiany Akademickiej), and the Republic of Poland (Rzeczpospolita Polska) with cofinancing from the European Social Fund of the European Commission of the European Union under the Knowledge Education Development Operational Programme (May 2022); the Society for the Study of Addiction (November 2022, March 2023, and November 2024); the organizers of the 13th Nordic SNSUS (Stiftelsen Nordiska Sällskapet för Upplysning om Spelberoende; the Nordic Society Foundation for Information about Problem Gambling) Conference, which received gambling industry sponsorship (January 2023); the MiSK Foundation (Prince Mohammed bin Salman bin Abdulaziz Foundation; November 2023); and the U.K. Gambling Commission (March 2024). Leon Y. Xiao has received honoraria from the Center for Ludomani for contributing parent guides about mobile games at https://Tjekspillet.dk, which was funded by the Danish Ministry of Health's gambling addiction pool (Sundhedsministeriets Ludomanipulje; March and December 2023), the Fundació Pública Tecnocampus Mataró-Maresme (TecnoCampus Mataró-Maresme Foundation) for a guest lecture (November 2023), the Young Men's Christian Association of Greater Toronto Youth Gambling Awareness Program for a presentation, which was funded by the Government of Ontario, Canada (March 2024), Lunds universitet (Lund University) for the right to translate parent guides about mobile games into Swedish at https://Kollaspelet.se, which was funded by Mediamyndigheten (the Swedish Agency for the Media) and Barnahus Stockholm (December 2024); Shenkar College of Engineering, Design and Art for a guest lecture (December 2024); and DiGRA Korea and the Game-n-Science Institute [게임과학연구원] under the Game Culture Foundation [게임문화재단] under the Ministry of Culture, Sports and Tourism of South Korea [문화체육관광부] for participating in an academic research survey (January 2025). Leon Y. Xiao received royalties by virtue of the copyright subsisting in some of his publications from the Authors' Licensing and Collecting Society (Companies House Number: 01310636; March 2023, 2024, and 2025). A full gifts and hospitality register-equivalent for Leon Y. Xiao is available at https://www.leonxiao.com/about/gifts-and-hospitality-register. The up-to-date version of Leon Y. Xiao's conflict-of-interest

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a so-called "rare" "Malcator, Purity Overseer" card worth merely US$0.25 (MTGGoldfish, 2023b) in that same slot. Although they are seldom regulated as such, purchasing card packs can therefore be argued to fit not just the psychological but also the legal definition of "gambling" (Xiao, 2022), since they involve the risking of money for a chance to either "win" cards worth a substantial sum of money well above the purchase price of the card pack or, in contrast, "lose" by obtaining cards worth far less than the purchase price of the card pack (Neal et al., 2005, p. 4; Williams et al., 2017, pp. 10–12).

There is no reliable data on the total amount of money being spent on card packs globally. This information cannot be easily collated as it is partially held by many individual companies, commercially sensitive, and not publicly shared. However, contextual information can be used to propose some rough estimates. The parent company behind *Magic: The Gathering* reported that this intellectual property's net revenue was over US$1 billion for the 2022 fiscal year (Hasbro, 2023). Not all of that revenue would have been generated through the sale of physical card packs because some products are sold through nonrandomized fashions and the intellectual property is also otherwise utilized, for example, to make video games; however, a substantial portion of that US$1 billion would have been generated through card packs because they are the game's core monetization method (Švelch, 2020). *Magic: The Gathering* is but one of many trading card games; therefore, total spending on card packs across all games internationally is undoubtedly substantial. Indeed, the Pokémon Company reported that more than 9 billion *Pokémon Trading Card Game* cards were printed in the year between March 2021 and March 2022 (Carpenter, 2022). This equate to 900 million card packs, assuming 10 cards are contained in each pack as per usual practice (Pokémon Support, 2023) and disregarding how a portion of those 9 billion cards would instead have been distributed through other, nonpack-based means. With

statement is available at https://www.leonxiao.com/about/conflict-of-interest. David Zendle is a member of the Advisory Board for Safer Gambling—an advisory group of the Gambling Commission in Great Britain. David Zendle has never received any form of funding from the games or gambling industries. David Zendle has worked as a paid consultant for governments and charities seeking to understand the effects of video gaming. David Zendle has worked as an expert witness in cases relating to the video game industry, but has never represented the games industry legally or been formally affiliated with any games industry body in any way. David Zendle has been involved in brokering data sharing agreements with industry stakeholders in the past. David Zendle acknowledges that such data sharing agreements constitute a conflict of interest as important as financial awards, and wishes to highlight that he has used such data brokerage in ways that are likely to give him indirect financial advantage: He has used them as evidence for excellence in promotion and grant applications. David Zendle has no further conflicts to declare. Elena Petrovskaya is the recipient of an AFSG (Academic Forum for the Study of Gambling) Postgraduate Research Support Grants that were derived from "regulatory settlements applied for socially responsible purposes" received by the U.K. Gambling Commission and administered by Gambling Research Exchange Ontario (GREO; March 2022). Elena Petrovskaya is currently employed on a project funded by GREO and has had an honorary contract with the National Health Service United Kingdom. Since September 2024, Elena Petrovskaya has provided paid consultancy for Public Group International Ltd (t/a PUBLIC; Companies House Number: 10608507), commissioned by the UK Department for Culture, Media and Sport (DCMS) to conduct independent research on understanding player experiences of loot box protections. Rune K. L. Nielsen has received honoraria from Center for Ludomani for contributing parent guides about different games and their monetization for https://Tjekspillet.dk, which is funded by the Danish Ministry of Health's gambling disorder pool (Sundhedsministeriets Ludomanipulje). Rune K. L. Nielsen has served as an expert witness in a legal case about loot boxes, Rune K. L. Nielsen did not receive an honorarium or any other type of payment for this work; the honorarium was instead donated to an unknown charity. The content of the expert witness statement is identical to arguments made in Rune K. L. Nielsen's published research. Rune K. L. Nielsen has worked as a paid consultant for organizations funded by the Danish government seeking to understand the effects of video gaming. Rune K. L. Nielsen has accepted a minor honorarium as well as travel, food, and accommodation from Pan-European Game Information to deliver a research presentation. Rune K. L. Nielsen is employed by a university that teaches game design and game studies. Philip Newall is a member of the Advisory Board for Safer Gambling—an advisory group of the Gambling Commission in Great Britain, and in 2020 was a special advisor to the House of Lords Select Committee Enquiry on the Social and Economic Impact of the Gambling Industry. In the last 3 years, Philip Newall has contributed to research projects funded by the Academic Forum for the Study of Gambling, Clean Up Gambling, Gambling Research Australia, NSW Responsible Gambling Fund, and the Victorian Responsible Gambling Foundation. Philip Newall has received honoraria for reviewing from the Academic Forum for the Study of Gambling and the Belgium Ministry of Justice, travel and accommodation funding from the Alberta Gambling Research Institute and the Economic and Social Research Institute and open access fee funding from Gambling Research Exchange Ontario.

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Leon Y. Xiao played a lead role in conceptualization, data curation, funding acquisition, investigation, methodology, project administration, resources, writing–original draft, and writing–review and editing and a supporting role in formal analysis and software. David Zendle played a lead role in data curation, formal analysis, methodology, and software and an equal role in writing–review and editing. Elena Petrovskaya played a supporting role in formal analysis and an equal role in validation and writing–review and editing. Rune K. L. Nielsen played a supporting role in conceptualization, funding acquisition, and writing–review and editing. Philip Newall played a supporting role in conceptualization, funding acquisition, resources, and writing–review and editing.

Correspondence concerning this article should be addressed to Leon Y. Xiao, School of Creative Media, City University of Hong Kong, Run Run Shaw Creative Media Centre, Level 7, 18 Tat Hong Avenue, Kowloon Tong, Hong Kong, China. Email: leon.xiao@cityu.edu.hk

each Pokémon pack costing approximately US$4.00, 900 million packs would generate up to US$3.6 billion in revenue.

Loot boxes are conceptually similar virtual products in video games that players purchase to obtain randomized rewards. A wide definition of "loot boxes" as meaning any in-game purchases involving randomization is adopted by the present study (Xiao, Henderson, & Newall, 2022; cf. Zendle et al., 2022): This includes so-called "gacha" systems that are widely implemented in mobile games produced by East Asian companies, such as *Genshin Impact* (miHoYo, 2020), through which random characters can be summoned in exchange for real-world money (Blom, 2023; Woods, 2022). Paid loot boxes are therefore also conceptually similar to gambling, both structurally and psychologically: This is because the player voluntarily spends real-world money to engage in a randomized process whose results could cause them to either "win" by obtaining a useful and valuable in-game reward or "lose" by failing to obtain a desirable reward (Drummond & Sauer, 2018). Because some loot box rewards can be bought and sold between players on secondary markets (e.g., through Valve Corporation's Steam video game distribution platform, Thorhauge & Nielsen, 2021; Xiao & Henderson, 2024), the player could also "win" or "lose" real-world money as a result of buying loot boxes and obtaining either valuable or (far more likely) worthless rewards. For example, in relation to loot boxes that cost US$2.50, the value of their content on the secondary market ranged from $0.03 to $743.80 (Drummond, Sauer, Hall, et al., 2020, p. 987).

Card packs are arguably the physical equivalent of digital video game loot boxes. Both involve (a) the player spending real-world money to purchase the product and (b) the randomization of potential rewards, which means both are conceptually similar to traditional gambling (Drummond & Sauer, 2018; Zendle et al., 2021) when widely accepted criteria are applied (Griffiths, 1995, pp. 1–2). However, the legal definition of gambling is different from a psychological (or common sense) definition (Williams et al., 2017, pp. 10–12) and also differs across jurisdictions (Xiao, 2021; Xiao, Henderson, Nielsen, et al., 2022). Regulators (e.g., Spillemyndigheden [Danish Gambling Authority], 2017; U.K. Gambling Commission, 2017) and policymakers (e.g., House of Representatives Standing Committee on Social Policy and Legal Affairs [Australia], 2023) around the world have considered or are considering whether to regulate paid loot boxes as gambling by expanding the legal definition of gambling. During the UK Government's consultation on loot boxes, industry responses argued that "loot boxes were a modern manifestation of purchases with a random element, such as trading cards and some children's toys" (Department for Digital, Culture, Media and Sport, 2022, p. 151) when attempting to dissuade the imposition of stricter legislation on loot boxes.

The similarities between the two products and the fact that card packs are not regulated as a form of gambling formed the industry's argument against the regulation of loot boxes as gambling (Schreier, 2017). Some video game players have contrastingly voiced their opinion that card packs need to be further scrutinized and how they felt that loot boxes have received an unfair amount of regulatory attention, in comparison to more traditional and socially accepted products like card packs (Macey & Bujić, 2022, p. 211). For example, it is generally agreed among players that loot boxes that offer purely cosmetic rewards that do not give players who spend more money a competitive advantage (e.g., a costume for a player character that is merely more visually attractive) are more acceptable and perceived more positively than so-called "pay to win" (Mattinen et al., 2023, p. 6; Petrovskaya & Zendle, 2022, pp. 1073–1078) loot boxes that contain rewards that *do* provide gameplay advantages (e.g., a weapon that defeats enemies quicker). There are many games whose loot boxes provide only cosmetic rewards (Zendle, Cairns, et al., 2019, p. 182), such that engaging with loot boxes in those games is more optional and not required for gameplay, unlike in video games whose loot boxes must be engaged with in order to gain more in-game power, unlock additional content, and thus make meaningful progress.

Card packs on the other hand contain crucial gameplay pieces that can and are expected to provide a competitive advantage. The rare cards that players open packs to "chase" after often provide even more obvious gameplay advantages by being strictly better in every situation than a more common card. Most cards can be obtained only through random distribution from card packs. Even through a player might buy a card directly through the secondary market (as discussed below), ultimately, someone was initially required to have opened that card through a card pack (Mattinen et al., 2023, pp. 16–17). This means that card pack engagement by someone is required for the most traditional and originally intended mode of gameplay of these card games to operate (i.e., building the strongest deck using cards randomly obtained from packs). Card packs can therefore be said to be "integral to the core gameplay experience" of trading and collectible card games (Mattinen et al., 2023, pp. 16–17). Card packs are therefore more comparable to the more pay-to-win and negatively perceived implementations of loot boxes than the ones that only provide cosmetic rewards. One would therefore expect card packs to receive more scrutiny than at least the less controversial types of loot boxes. Indeed, for example, the UK Government's consultation on loot boxes specifically asked for evidence on whether loot box-related harms are also present in relation to card packs (Department for Digital, Culture, Media and Sport, 2020, p. 5).

Conceptualising paid loot boxes as a form of gambling that is potentially harmful is supported by repeated findings of a positive correlation between players' self-reported problem gambling severity and loot box expenditure (Brooks & Clark, 2019; Garea et al., 2021; González-Cabrera et al., 2022; Li et al., 2019; Spicer et al., 2022; von Meduna et al., 2020; Wardle & Zendle, 2021; Xiao, Fraser, et al., 2024; Zendle & Cairns, 2018, 2019): "On average, individuals with problem gambling issues spent approximately $13 USD per month more on loot boxes than those with no such symptoms" (Drummond, Sauer, Ferguson, et al., 2020, p. 1). More recent longitudinal evidence also found that young people who purchased loot boxes were more likely to participate in and to spend more money on traditional gambling 6 months later (Brooks & Clark, 2023; González-Cabrera et al., 2023; Palmer et al., 2025).

Link Between Card Pack Purchasing and Problem Gambling

Logically, given the structural similarities between card packs and loot boxes (specifically, both take advantage of the variable ratio schedule of reinforcement, as does traditional gambling), if loot boxes are positively correlated with problem gambling, then so too should card packs. The link between loot box purchasing and problem gambling is well-established (Garea et al., 2021; Spicer et al., 2022). However, in contrast, the link between card pack

purchasing and problem gambling has hitherto only been assessed in one prior study, Zendle et al. (2021), that found *no* correlation between the two.

Unlike loot box purchasing, which involves the player purchasing *virtual* items in *digital* stores, card pack purchasing can be done in a variety of manners. First, *physical* card packs, as described above, can be bought in *physical* stores (which allows for the packs to be opened immediately) or in *digital* online stores (which would deliver the physical products after some time and so would not allow for the packs to be opened immediately). Second, physical card games monetized with card packs, like *Magic: The Gathering*, are now also published in digital versions as video games, such as *Magic: The Gathering Arena* (Wizards of the Coast, 2019–Present). Zendle et al. (2021) only engaged with the first distinction: that *physical* card packs could be bought from either *physical* or *digital* stores.

The results of Zendle et al. (2021) suggested that *physical* card packs and virtual generic loot boxes are fundamentally different products posing varying levels of harms despite their apparent similarities. This might be explained by various differences between the two products, such as how physical card packs take significantly more time to purchase and open in bulk (even when purchased in a physical store that allows for them to be immediately opened because each pack must be physically torn open, generating plastic waste and environmental concerns, and the cards contained within must then be physically reviewed and sorted) as compared with digital loot boxes, whose results can be revealed almost instantaneously and in bulk, as detailed in Zendle et al. (pp. 4–5). In addition, loot box openings are accompanied by audio–visual stimuli (e.g., loud and celebratory music and exciting and flashy animation) that enhance the experience and might encourage more spending (Kao, 2020; King & Delfabbro, 2019, p. 172). These are not obviously present in physical card pack opening experiences, although companies have recently reported expending significant effort to design the physical opening experience to make it more exciting and appealing, such as the Project Booster Fun of *Magic: The Gathering* (e.g., a build-up from less exciting cards toward more exciting ones; Rosewater, 2019), and other players that are present at physical card stores might exert peer pressure and change spending behavior.

One further crucial difference between physical card packs and loot boxes is how the existence and popularity of the permitted secondary market for physical cards means that players can technically obtain all potential random card pack rewards through direct purchase as an alternative to randomly obtaining them through opening card packs. This is not possible with most loot box rewards, which generally cannot be alternatively directly purchased and must be obtained only through opening loot boxes. Additionally, such secondary markets provide indirect information about the probabilities of "winning" specific cards and the "expected value" (i.e., the average value of potential content that could be obtained) of opening packs. This would suggest that certain design features of gambling-like products (e.g., more transparency and more salient demonstration of a random result's real-world monetary value) may increase or reduce their potential harms. However, importantly, the participants of Zendle et al. (2021) were not asked about their video game loot box purchasing and spending behaviors, and so whether that original correlation concerning loot boxes would have replicated in that particular sample of physical card game players, who might be idiosyncratic, could not be known.

Further, Zendle et al. (2021) focused only on *physical* card packs and did not ask about the purchasing of *virtual* card packs, which would be a subcategory of loot boxes implemented in a specific video game genre (i.e., digital card games). Zendle et al. did not consider whether purchasing *virtual* booster packs in online collectible card games (i.e., a specific subcategory of video game loot boxes) is positively correlated with problem gambling. Given the well-replicated nature of the positive correlation between purchasing generic loot boxes and problem gambling (Garea et al., 2021; Spicer et al., 2022), it would be surprising if the positive correlation cannot be replicated between virtual booster pack-like loot boxes and problem gambling. Such a finding (if made) would suggest virtual booster packs might be a type of loot box that needs to be differentiated from other loot boxes on psychological grounds due to some aesthetic or design features (e.g., cards that provide gameplay advantages were drawn from a pack, as compared with character costumes that give any competitive advantages being obtained from a box) or their player demographics (e.g., players who buy booster packs naturally prefer card-based strategy games and may be less impulsive than players of other genres of video games when making purchasing decisions; Ballou et al., 2022, p. 14).

Finally, the loot box literature has presented conflicting results as to whether loot boxes are associated with worse mental health (Etchells et al., 2022; Xiao, Fraser, et al., 2024; cf Drummond et al., 2022). One study found that "loot boxes … appear to be disproportionately purchased by people who are psychologically distressed and, by extension, vulnerable" (Drummond et al., 2022, p. 7), while another study found no evidence of an association between loot box spending and mental well-being and psychological distress (Etchells et al., 2022). A third study even found that loot box spending was *negatively* associated with experiencing psychological distress, meaning that there is a positive relationship between loot box purchasing and mental health (broadly defined; Xiao, Fraser, et al., 2024). One could hypothesis that card packs, given their structural similarities with loot boxes, might also be potentially harmful. In the absence of longitudinal data, besides potentially establishing a link between problem gambling and card pack purchasing, it is important to consider whether overengagement with card packs is associated with worse mental health, although causality in either direction (if any) cannot be thusly determined. This aspect of card packs' potential practical harms was not considered in Zendle et al. (2021).

The Present Study

A conceptual replication and extension of Zendle et al. (2021), making the following improvements, was conducted. The present study was informed by the lived experience of some of the authors as physical card game players (as detailed in the Positionality Statement) and that of certain original participants of Zendle et al., who left comments on the merits and weaknesses of said study's methodology in response to Reddit recruitment posts for the original study (u/davidzend, 2019a, 2019b). The original authors did not respond to the criticism and suggestions to amend the survey's wording.

First, the original Zendle et al.'s (2021) data set was collected from online forums for card games, meaning that those participants

($N = 726$) were likely highly engaged players and potentially not representative of all players who engage with card packs, although one might argue that they might also be the most likely to experience harm. The present study instead recruited a paid panel of participants "interested in playing collectible card games" through Prolific, a leading, paid research data crowdsourcing platform, and obtained a larger and potentially more diverse sample.

Second, the original Zendle et al.'s (2021) study did not pose a question specifically asking about video game loot box spending. It was considered possible that the correlation between problem gambling and loot box purchasing may not be present among card game players. The present study therefore additionally asked about loot box spending to attempt to replicate that correlation and identify whether this population is potentially idiosyncratic. Indeed, rather confusingly, the original Zendle et al.'s study asked participants about their spending on *physical* packs in *digital* stores and provided the example of "a website that sells boosters and posts them to you" (p. 7). Critical comments left by participants who identified as having taken the original survey indicated that this question may have been misunderstood by some participants as asking for spending on *digital* packs in *digital* stores (i.e., a specific subcategory of video game loot boxes implemented in the card game genre; u/davidzend, 2019a). The present study additionally asked participants to self-report spending on digital card packs in video games to ensure both issues could be examined.

Third, the original Zendle et al.'s (2021) study simply asked how much money the participant has "spent on booster packs" (p. 7). This failed to account for how card packs can be used in many other ways besides being directly opened to obtain random cards, unlike video game loot boxes (which generally can only be used for this one purpose). Card packs can, for example, be used to play certain variations of the game (e.g., *Magic: The Gathering*'s "drafts" and "sealed" formats, which are collectively known as "limited" formats; Wizards of the Coast, 2023a, 2023b) where the player would open packs not necessarily just to obtain random, new cards but also to play in specific modes. It was considered possible that problem gambling may only be associated with card pack purchasing when that is done *only* to attempt to obtain rare and valuable cards and *not* when done for other less gambling-like purposes, such as in order to participate in those other modes. The present study asked about card pack spending in a more nuanced way by asking players to detail their purpose(s) for purchasing card packs and how much they have spent for each purpose.

Fourth, the original Zendle et al.'s (2021) study asked about spending in the "past month" (p. 9). However, card games tend to release card packs with new content every few months (Wikipedia, 2023). This means that depending on which games the original study participants played and those games' product release schedules, it was possible that many participants answered the spending question with an extreme answer due to seasonality. A player's spending in any given month is not necessarily reflective of their total or average spending over a sustained period of time. The latter value would be less prone to noise and more useful for better understanding any potential relationships between card packs and problem gambling broadly. (The former value might alternatively be useful for studying specific spending patterns if that could be matched-up with a game's product release schedule.) This data quality issue was also exacerbated by the fact that the original Zendle et al.'s survey was advertised on Reddit between 11–12 January 2019, which meant that the relevant "past month" period at the data collection time included the Christmas holiday period. One critical comment left by a participant who identified as having taken the original survey indicated that players may have spent less money than usual during this holiday period because they did not physically attend card stores (u/davidzend, 2019b). Loot box studies have asked about spending in relation to different time frames ranging from lifetime to daily (Montiel et al., 2022, p. 15). If the relationship between spending on a product and problem gambling is robust, it should be replicable across different time frames. Accounting for the above, the present study asked participants to self-report spending over the "past year."

Fifth, the original Zendle et al.'s (2021) study did not assess whether spending on card parks is higher among participants experiencing worse mental well-being and psychological distress. The present study additionally asked participants to complete mental well-being and psychological distress self-assessment scales.

Research Questions and Hypotheses

The following research questions and hypotheses were preregistered on the Open Science Framework (Xiao, Petrovskaya, et al., 2024). We slightly amended them here to clarify that "card pack" refers to "physical card pack" specifically.

Research Question 1: Is physical card pack purchasing associated with problem gambling similarly to loot box purchasing?

Hypothesis 1: Total physical card pack expenditure will positively correlate with problem gambling.

Hypothesis 2: Physical card pack expenditure purely to open packs and obtain new cards will positively correlate with problem gambling.

Hypothesis 3: Physical card pack expenditure for other purposes besides purely to open packs and obtain new cards will positively correlate with problem gambling.

Research Question 2: Is loot box purchasing associated with problem gambling among card game players?

Hypothesis 4: Loot box expenditure will positively correlate with problem gambling.

Hypothesis 5: Loot box expenditure in digital card games (i.e., on so-called virtual "card packs") will positively correlate with problem gambling.

Research Question 3: Is physical card pack purchasing associated with worse mental health?

Hypothesis 6: Physical card pack expenditure will negatively correlate with mental well-being.

Hypothesis 7: Physical card pack expenditure purely to open packs and obtain new cards will negatively correlate with mental well-being.

Hypothesis 8: Physical card pack expenditure will positively correlate with psychological distress.

Hypothesis 9: Physical card pack expenditure purely to open packs and obtain new cards will positively correlate with psychological distress.

Method

A paid panel of 2,000 adults from the United States, Canada, the United Kingdom, Ireland, Australia, and New Zealand were recruited through Prolific to answer the survey. A quota of 1,000 participants was set for each sex (male and female). Prolific has a filter that allowed for the preselection of only participants who expressed that they are "interested in playing collectible card games at least occasionally." More than 9,000 such potential participants were active on the platform in the last 90 days as of 26 April 2024 according to Prolific. Not all potential or actual participants would have spent money on card packs, but this filter allowed for the recruitment of a relevant sample of card game players.

The desired sample size of 2,000 participants was justified on the basis of a priori power analysis: G*Power (Buchner et al., 2020) determined that, given an α value of 0.05, that 1,828 survey participants are sufficient to achieve 0.99 power for detecting a correlation of $r = 0.1$ (or conversely of $r = -0.1$), the conventional smallest correlation of interest (or the so-called smallest effect size of interest, SESOI) for research on media effects (Drummond, Sauer, Ferguson, et al., 2020, p. 11; Ferguson, 2009, pp. 532–533, 2023, p. 3).

Prolific automatically filtered and invited only participants (a) aged 18 years or older, (b) who were located in the United States, Canada, the United Kingdom, Ireland, Australia, and New Zealand, and (c) who indicated that they are "interested in playing collectible card games at least occasionally." The instruction page of the survey set out the same three participation requirements, and the participant were then asked to affirm that they fulfill those requirements and explicitly consent to participation. For completing the survey, participants were paid at an hourly rate of £6.02. Participant recruitment was completed in less than 2 days between June 11, 2024 and June 12, 2024.

We preregistered that we would exclude any participants who fail both of two attention check tasks. The first attention check was a so-called instructional manipulation check that instructed the participant to choose one specific option from a list of multiple options (Prolific, 2023a). By checking whether the participant had indeed chosen that option, we confirmed whether the participant was paying attention to the survey by reading and following the instructions carefully. The second attention check was a so-called nonsensical item with only some responses being objectively correct and justifiable (Prolific, 2023b). Participants who failed to provide a correct response was therefore deemed as having either not paid attention or intentionally provided a nuisance response. Seven participants failed the first question, while 13 participants failed the second, but only the two participants who failed both were excluded as preregistered.

We additionally excluded 37 participants who told us not to use their data in response to a question asking them about this at the end of the survey (the *SRSI UseMe* variable detailed below), as preregistered.

Our final sample of 1,961 achieved 0.99 power across both correlational and equivalence testing.

The following variables were measured.

Demographics

Age, *sex*, *ethnicity*, *country of birth*, *country of residence*, *nationality*, *language*, *student status*, and *employment status* were collected and provided by Prolific.

Card Pack Spending

We provided participants with a definition of "booster packs," as shown in Figure 1. We then provided participants with a list of eight trading and collectible card games and asked them to indicate whether they have spent money on the card packs of those games. This list was provided with the intent to help participants better understand the card pack definition through multiple illustrative examples and to obtain contextual information from the participants on what card games they played and spent money on. Alongside that list, we also provided three open text entry boxes for participants to enter up to three other nonlisted games. Participants could choose multiple options, except that the final option of "I did not spend any money buying *physical* booster packs in the games listed or any other games." was exclusive and could not be chosen alongside other options.

We then asked them how much money they spent on card packs in the past year as shown in Figure 1. Subsequently, we asked participants who spent money on card packs to explain why they spent money on card packs and how much they spent for each purpose. We listed two predetermined purposes that participants may select (a) "To open packs and obtain cards" and (b) "To participate in drafts and sealed format games." Participants were given the opportunity to list three additional purposes, and, as it transpired, those who did mostly listed either (c) to give as gifts to family members or (d) to spend time with friends and family members.

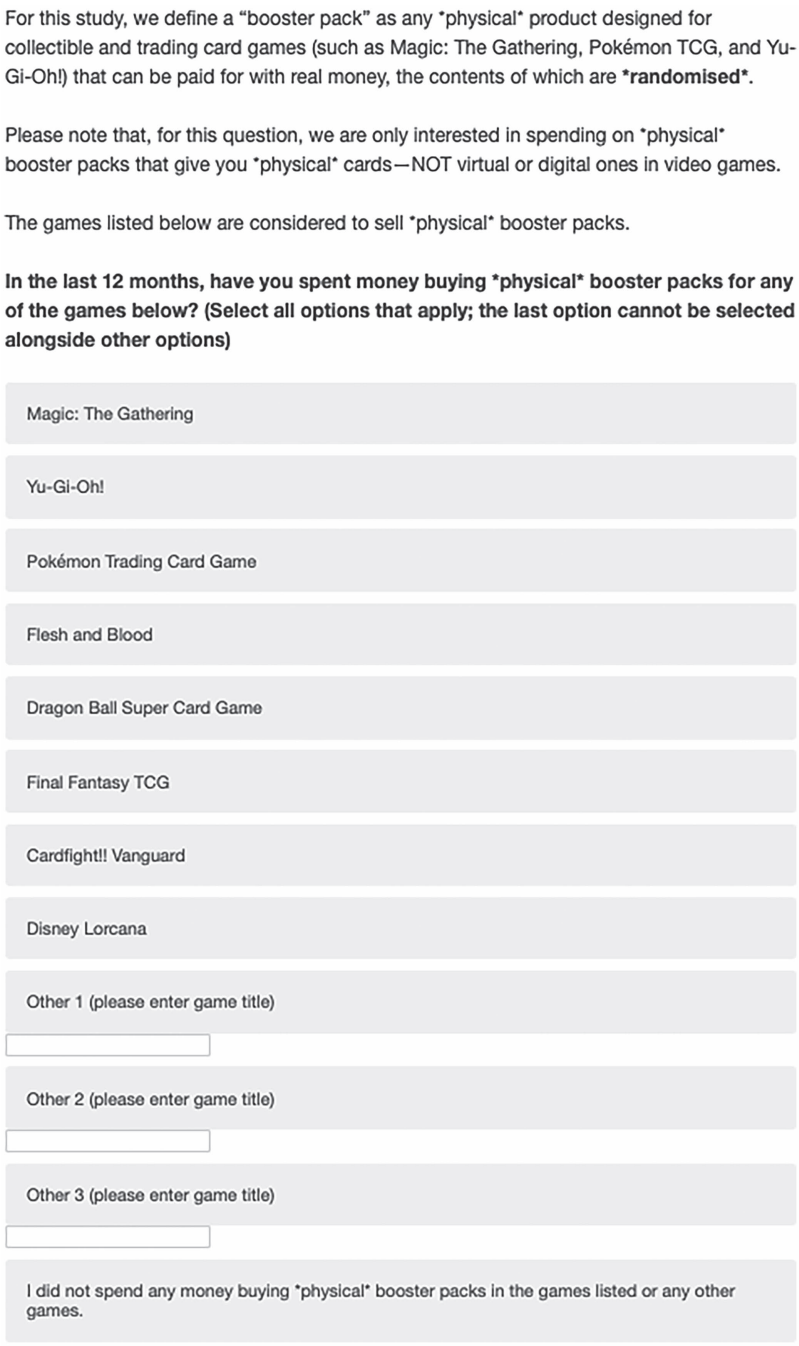
Participants were asked to provide their spending "in the currency used in the country you are currently residing in." The survey had already asked for the participant to indicate "In what country do you currently reside?" as a prescreening question. Their answer to that question was used to determine their current country of residence and the currency they presumably used when answering the survey. The reported amount from non-United States participants was converted into US$ based on the exchange rate on the date of data analysis.

Loot Box Spending

We provided participants with a definition of "loot boxes" that was previously used with the United Kingdom videogame players and since slightly amended to improve readability (Lloyd et al., 2021; Xiao, Newall, et al., 2024). We then provided participants with a list of ten video games and their respective loot box mechanic and asked them to indicate whether they have spent money on the loot boxes in those games. This list was again provided with the intent to help participants better understand the loot box definition through multiple illustrative examples and to obtain contextual information from the participants on what video games they played and spent money on. Alongside that list, we also provided three open text entry boxes for participants to enter up to three other nonlisted games. Participants could choose multiple options, except that the final option of "I did not spend any money buying loot boxes in the

Figure 1

The Initial Card Pack Spending Question Presented to Participants



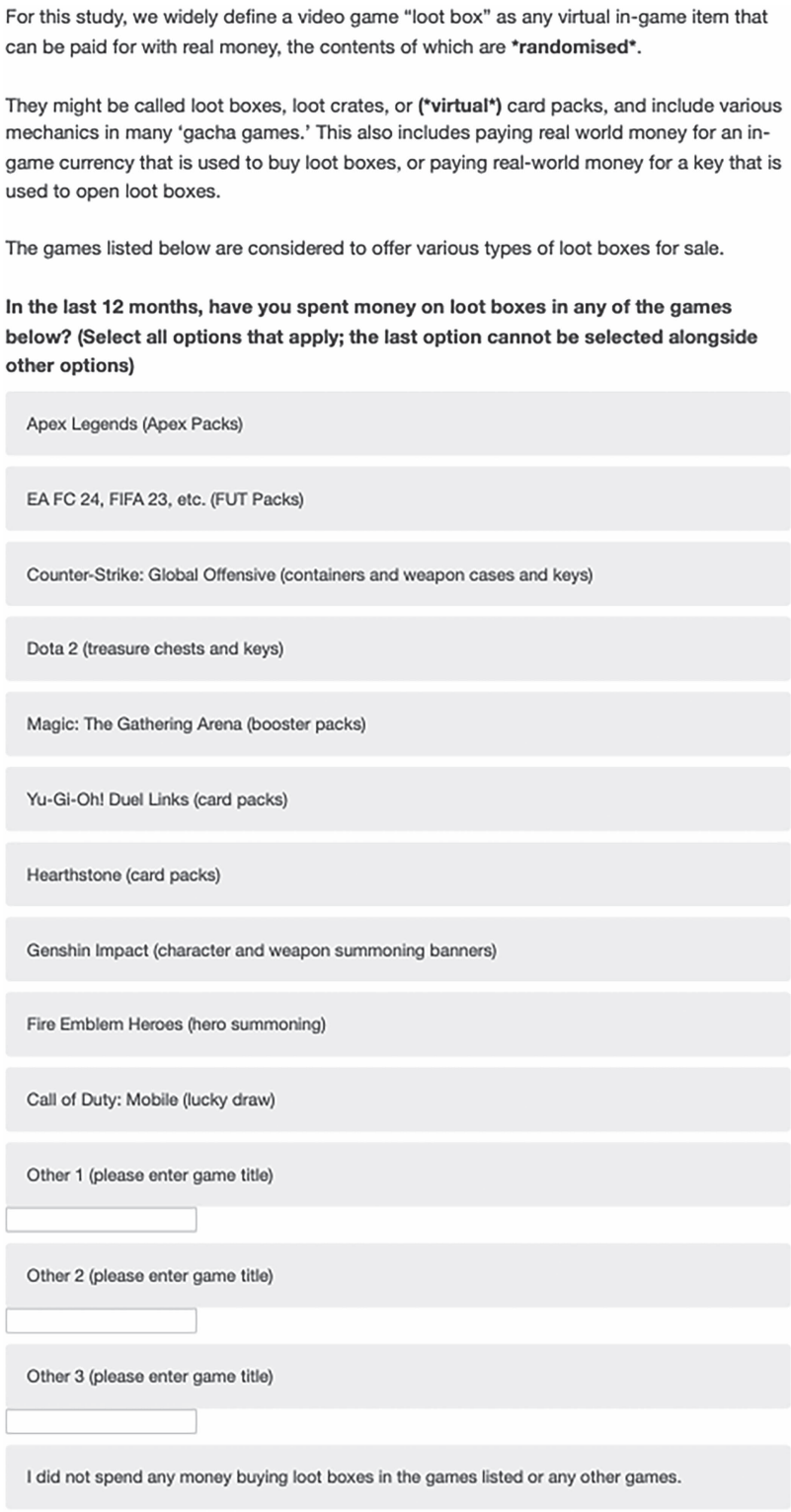
Note. Values in bold is used to highlight important information to participants. TCG = Trading Card Game.

games listed or any other games." was exclusive and could not be chosen alongside other options.

We then asked participants how much money they spent on loot boxes in the past year as shown in Figure 2. Subsequently, we asked participants who spent money on loot boxes how much they have spent on "*virtual* card packs in digital card games (such as *Hearthstone* and *Magic: The Gathering Arena*)," which we noted are a type of "loot boxes" for the purposes of the present study. The same currency conversion process described for *card pack spending* was used.

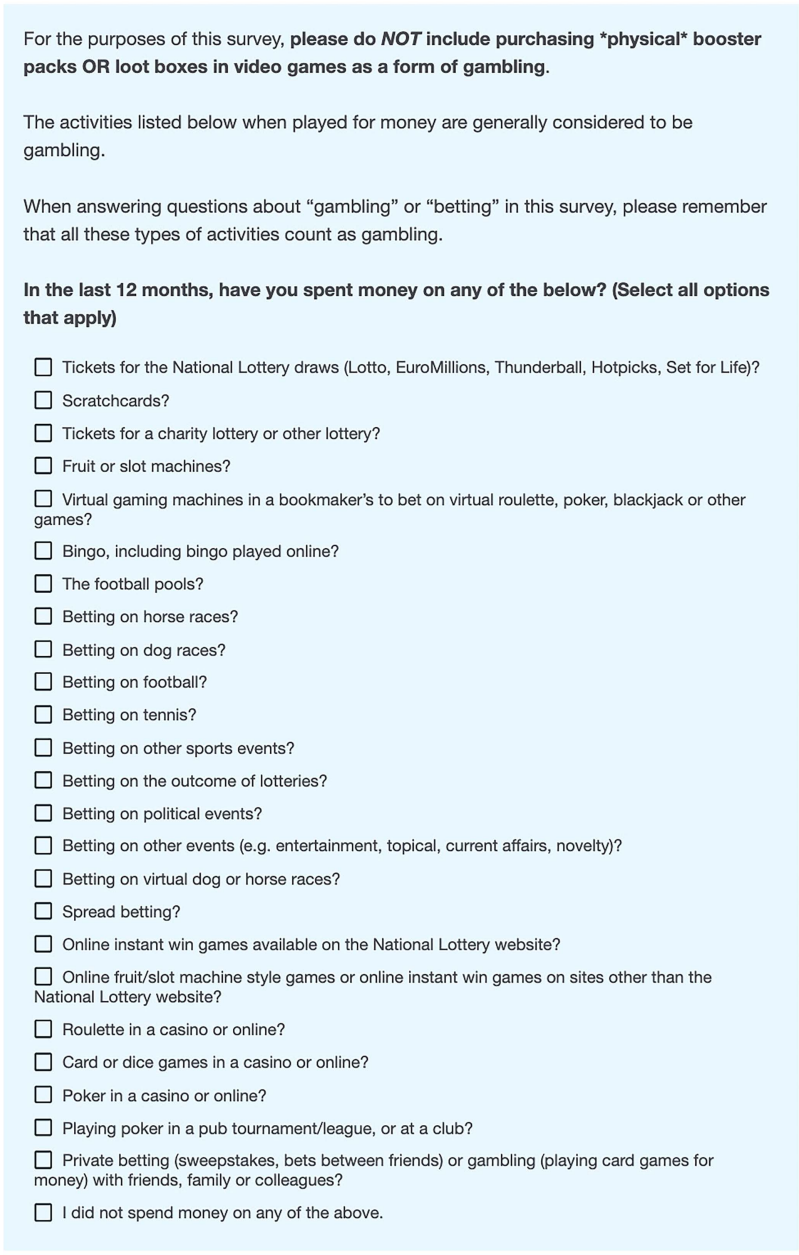
Figure 2

The Initial Loot Box Spending Question Presented to Participants



Note. Bold formatting was used to highlight important information to participants.

Figure 3
The Past-Year Gambling Participation Screening Question Presented to Participants



Note. Bold formatting was used to highlight important information to participants. See the online article for the color version of this figure.

Past-Year Gambling Participation Status

All participants were presented with a past-year gambling participation screening question: "For the purposes of this survey, please do NOT include purchasing *physical* booster packs OR loot boxes in video games as a form of gambling. … In the last 12 months, have you spent money on any of the below?" and with a detailed list of activities that were considered to be "gambling," as shown in Figure 3. This gambling participation screening question is adapted from the U.K. Gambling Commission's survey questionnaires (2020, 2022) on gambling participation and does *not* explicitly include more novel activities that may also be considered as forms of "gambling," such as esports betting with virtual in-game items or "skins" (Macey & Hamari, 2019) and "investing" in cryptocurrencies (Andrade & Newall, 2023). We specifically asked participants to not consider buying card packs and loot boxes to be

"gambling" following previous recommended improvements on the methodologies for studying gambling-like behaviors (Sidloski et al., 2022; Xiao, Newall, et al., 2024). Participants could choose multiple options, except that the final option of "I did not spend money on any of the above" was exclusive and could not be chosen alongside other options.

Problem Gambling Severity

Problem gambling severity was measured using the Problem Gambling Severity Index (PGSI; Ferris & Wynne, 2001) consisting of nine 4-point Likert scale items, which all participants were asked to complete regardless of their *past-year gambling participation status*, following previous Western loot box (e.g., Zendle & Cairns, 2018, 2019) and card pack studies (Zendle et al., 2021). Participants were categorized for *problem gambling status* using the revised PGSI scoring system of Currie et al. (2013). Internal reliability was excellent (Cronbach's $\alpha = .91$).

Mental Well-being

Mental well-being was measured using the Short Warwick–Edinburgh Mental Well-being Scale (SWEMWBS; Stewart-Brown et al., 2009) consisting of seven 5-point Likert scale items. The raw SWEMWBS score was converted into the metric SWEMWBS score in accordance with Stewart-Brown et al. (2009). Internal reliability was good (Cronbach's $\alpha = .89$).

Psychological Distress

Psychological distress was measured using the six-item, 5-point Likert Kessler Psychological Distress Scale (K6+; Kessler et al., 2003). Internal reliability was excellent (Cronbach's $\alpha = .91$).

Participant's Confidence in Their Spending Estimation

At the end of the survey, participants were asked whether they feel they (a) overestimated, (b) underestimated, (c) both overestimated and underestimated, or (d) accurately estimated their spending in response to spending-related questions. We informed them that their answer to this question would not affect their payment.

SRSI UseMe

Also, at the end of the survey, participants were asked the binary question of whether, in their honest opinion, their data should be used for the researchers' analyses (Meade & Craig, 2012). We again informed them that their answer to this question also would not affect their payment.

Open-Ended Comment Box

Finally, we provided a text entry box for participants to provide any comments or feedback. These mostly consisted of participants sharing their own views and experiences on spending money in games, with some participants also reflecting on their behaviors and clarifying their motivations. Many participants mentioned that they enjoyed the survey and thought the research was interesting. Some examples are provided below:

> Comment on card buying habits—I prefer to buy single cards through resellers precisely to avoid the gambling/randomness aspect of boosters [card packs]. This aspect of card games has low appeal for me other than as an occasional novelty.

> I don't open booster packs for the feeling of gambling or anything like that. I have friends that I play Commander with that we pay the entry fee to play at our store, and we win 1–2 packs with our entry.

> This is a very interesting study. I'm only an occasional gambler and have a strict budget for anything non-necessity related, but still can see the possibilities of the two things being interrelated. Thank you for such a different survey from the norm!

Further qualitative analysis of these comments might prove fruitful in better understanding why people buy card packs, but that is beyond the scope of the present study.

Statistical Analysis

Hypotheses 1–9 were tested using two-sided Spearman's rank-order correlation tests between the rank-transformed card pack or loot box expenditure variable and the relevant summed PGSI, K6+, and duly adjusted SWEMWBS measurement scores. An α level of .05 was used for all tests. This α level was selected after balancing the error rates and our resource constraints: We could have alternatively opted for a more conservative α level of .01 at a lower power level of 0.95, which would have led to the same error rate as an α level of .05 and power of 0.99 (Lakens et al., 2018).

We also conducted equivalence tests for each hypothesis. These tests enabled us to declare the absence of a meaningful effect if this was indeed the case. For this study, our SESOI in the population was deemed to be .1, which is the conventional SESOI for research on media effects (Drummond, Sauer, Ferguson, et al., 2020, p. 11; Ferguson, 2009, pp. 532–533, 2023, p. 3). We therefore set equivalence bounds based on this effect size symmetrically around zero at -0.1 and 0.1, respectively. We tested whether the observed difference fell outside of these boundary values (or equivalence bounds). The testing was conducted using the two one-sided tests (TOST) procedure. For each test, the null hypothesis was that the correlation was within the equivalence margin, while the alternative hypothesis was that the correlation was not within the significant margin. When the null hypothesis could not be rejected, we concluded that there was no practically meaningful effect, given that the effect would be close enough to zero to be practically equivalent to zero.

Accordingly, we considered a hypothesis as having been confirmed only if both (a) a significant correlational result was obtained at an α level of $<.05$ and (b) the null hypothesis was also rejected for the matched equivalence tests.

The raw data, survey materials, and analysis scripts and results are publicly available on the Open Science Framework (Xiao, Zendle, et al., 2023).

Ethics approval for the present study was obtained from the University of Bristol's School of Psychological Science Research Ethics Committee (No. 14906).

Results

Demographics and Games Played

Age data were available for 1,957 of 1,961 participants ($M_{age} = 34.9$, $SD = 9.7$, age range = 18–78 years). Table 1 further details the

Table 1
Demographics (N = 1,961)

Characteristic	*N* (%)
Age	
18–24	246 (12.5%)
25–29	378 (19.3%)
30–34	456 (23.3%)
35–39	348 (17.8%)
40–45	267 (13.6%)
45+	262 (13.4%)
Missing data	4 (0.2%)
Sex	
Male	996 (50.8%)
Female	962 (49.1%)
Missing data	3 (0.2%)
Ethnicity	
White	1,414 (72.1%)
Asian	222 (11.3%)
Black	151 (7.7%)
Mixed	127 (6.5%)
Other	39 (2.0%)
Prefer not to say	1 (0.1%)
Missing data	7 (0.4%)
First language	
English	1,792 (91.4%)
Chinese	22 (1.1%)
Others	143 (7.3%)
Missing data	4 (0.2%)
Country of residence	
United States	848 (43.2%)
United Kingdom	831 (42.4%)
Canada	162 (8.3%)
Australia	82 (4.2%)
New Zealand	18 (0.9%)
Ireland	17 (0.9%)
Missing data	3 (0.2%)
Student status	
Yes	402 (20.5%)
No	1,435 (73.2%)
Missing data	124 (6.3%)
Employment status	
Full-time	1,158 (59.1%)
Part-time	270 (13.8%)
Unemployed (and job seeking)	184 (9.4%)
Not in paid work (e.g., homemaker, retired or disabled)	127 (6.5%)
Due to start a new job within the next month	22 (1.1%)
Other	66 (3.4%)
Missing data	134 (6.8%)
Spending status	
Spent on both physical card packs and loot boxes	737 (37.6%)
Spent on physical card packs but not loot boxes	724 (36.9%)
Spent on loot boxes but not physical card packs	158 (8.1%)
Spent on neither physical card packs nor loot boxes	342 (17.4%)

participants' age group, sex, ethnicity, first language, country of residence, student status, and employment status.

About a quarter of the sample did not spend any money on card packs, while just over half did not spend any money on loot boxes, as further detailed in Table 1. The trading and collectible card games whose card packs and loot boxes the participants spent money on are presented in Table 2. More than half the sample spent money on the card packs of the *Pokémon Trading Card Game*, while over a quarter spent money on *Magic: The Gathering* card packs. Over 70% of participants (1,376) reported that they spent money on card packs in order to open them to obtain cards, while only 18.8% (368) reported doing so to participate in so-called limited formats, and 11.1% (217) reported at least one other motivation for purchasing card packs.

Problem Gambling and Card Pack and Loot Box Spending

Among all 1,961 respondents, 1,536 (78.3%) participated in at least one recognized form of traditional gambling activity, while 425 (21.7%) did not gamble. The most popular gambling activities were purchasing lottery tickets or scratchcards (participation rates of more than 40%) and betting on various sports (e.g., a participation rate 25% for football betting specifically, which was the most prevalent), followed by playing online and offline slot machines, bingo, roulette and poker (participation rates of between 10%–15%). The problem gambling categories of the participants are shown in Table 3. Of note, 67 of 425 nongamblers (15.8%) reported a nonzero PGSI score, which prior research has identified as being curious and requiring further scrutiny as to why a noninsignificant minority of nongambling participants nevertheless report experiencing gambling-related harms (see Sidloski et al., 2022; Xiao, Newall, et al., 2024).

Participants' Confidence in Their Spending Estimation

For context, and due to legitimate concerns about the accuracy of self-reported data (Bastiani et al., 2023; Montiel et al., 2022), participants were asked to reflect on whether or not they were confident when estimating their card pack and loot box spending. Nearly, all participants (1868; 95.3%) said that they were confident that their estimates were accurate, while 0.9% said they may have overestimated for all questions; 1.2% said they may have underestimated for all questions; and 2.7% said they may have overestimated for some questions and underestimated others.

Hypotheses Testing

The results across all the hypotheses are presented in Table 4.

Hypothesis 1: Total card pack expenditure was predicted to positively correlate with problem gambling. The effect size exceeded our SESOI (Spearman's $r = 0.1$), indicating a meaningful relationship (by falling entirely outside of the interval for which a magnitude would be equivalent to the absence of a practical effect).

Hypothesis 2: Spending on packs to obtain new cards was expected to positively correlate with problem gambling. The effect size exceeded our SESOI, suggesting a meaningful relationship.

Hypothesis 3: Expenditure for other card pack purposes also showed a positive correlation with problem gambling, with an effect size larger than our SESOI.

Hypothesis 4: Loot box spending was predicted to positively correlate with problem gambling, and the effect size exceeded our SESOI, supporting this.

Table 2
Games With Card Packs and Loot Boxes That Players (N = 1,961) Spent Money on

Game	*N* (%)
Trading and collectible card games	
Pokémon trading card game	989 (50.4%)
Magic: The gathering	494 (25.2%)
Yu-Gi-Oh!	268 (13.7%)
Disney Lorcana	170 (8.7%)
Dragon Ball Super Card Game	102 (5.2%)
Final Fantasy Trading Card Game	70 (3.6%)
Flesh and Blood	28 (1.4%)
Cardfight!! Vanguard	25 (1.3%)
ONE PIECE CARD GAME	25 (1.3%)
No physical card pack spending	495 (25.2%)
Video games with loot boxes	
EA FC 24, FIFA 23, so forth (FUT packs)	195 (9.9%)
Call of Duty: Mobile (lucky draw)	153 (7.8%)
Magic: The Gathering Arena (booster packs)	148 (7.5%)
Hearthstone (card packs)	128 (6.5%)
Genshin Impact (character and weapon summoning banners)	119 (6.1%)
Counter-Strike: Global Offensive (containers and weapon cases and keys)	117 (6.0%)
Yu-Gi-Oh! Duel Links (card packs)	105 (5.4%)
Apex Legends (Apex packs)	100 (5.1%)
Dota 2 (treasure chests and keys)	49 (2.5%)
Fire Emblem Heroes (hero summoning)	28 (1.4%)
Honkai: Star Rail (character and light cone summoning banners)	25 (1.3%)
No loot box spending	1,057 (53.9%)

Note. Some players are reported spending on multiple games, so the categories are not mutually exclusive.

Hypothesis 5: Loot box spending in digital card games was linked to problem gambling, with an effect size larger than our SESOI. Notably, 52 participants self-reported a virtual card pack spending that was higher than their loot box spending, meaning that they misinterpreted our survey intending for all virtual card pack spending to be counted as loot box spending. Hence, they were excluded from this analysis, which included the remaining 1,909 participants.

Hypotheses 6–9: No significant relationships were found between card pack spending and mental well-being or psychological distress, with the effect sizes within the range of practical insignificance (between −0.1 and 0.1). This suggests that the relationships between any form of card pack expenditure and worse or better mental health were equivalent to practical insignificance.

In addition to the formal testing of our preregistered hypotheses, we also conducted four further exploratory analyses in order to estimate the relationship between loot box spending (both in total and in digital card games only) and two mental health-related, psychometric outcomes: namely, psychological distress and mental well-being.

Exploratory 1: The relationship between psychological distress and total loot box spending was estimated at a Spearman's r of 0.035 (90% CI [0.00, 0.07]). Its effect size was thus entirely outside the range of practical significance.

Exploratory 2: The relationship between mental well-being and total loot box spending was estimated at a Spearman's r of 0.06 (90% CI [−0.03, 0.099]). Its effect size was thus entirely outside the range of practical significance.

Exploratory 3: The relationship between psychological distress and loot box spending in digital card games was estimated at a Spearman's r of 0.02 (90% CI [−0.04, 0.07]). Its effect size was thus entirely outside the range of practical significance.

Exploratory 4: The relationship between mental well-being and loot box spending in digital card games was estimated at a Spearman's r of 0.09 (90% CI [0.04, 0.15]). Among all analyses, this confidence interval uniquely includes our SESOI of $r = 0.1$.

We also conducted a fifth exploratory analysis to assess the relationship between spending on video game loot boxes that are *not* virtual card packs and problem gambling to provide further context for interpreting the results of Hypotheses 4 and 5. This was done using 1,909 participants as explained above because the 52 participants who self-reported a virtual card pack spending that was higher than their loot box spending were excluded.

Exploratory 5: The relationship between spending on nonvirtual card pack-type video game loot boxes and problem gambling was estimated at a Spearman's r of 0.22 (90% CI [0.19, 0.26]), meaning that its effect size was practically significant.

Finally, we conducted a sixth exploratory analysis on the relationship between loot box spending and problem gambling among the 1,909 participants.

Exploratory 6: The relationship between loot box spending and problem gambling among participants who did not report a virtual card pack spending that was higher than their loot box spending was estimated at a Spearman's r of 0.29 (90% CI [0.26, 0.32]). The results did not meaningfully change due to the aforementioned exclusions.

Table 3
Problem Gambling Severity Categories (N = 1,961)

Problem gambling severity category	All participant	All participants with nongamblers separately listed	Gamblers (n = 1,536)	Card pack spending in US$	Loot box spending in US$
				M (*SD*)	*M* (*SD*)
Nongamblers		425 (21.7%)		116 (309)	77 (436)
Nonproblem gamblers	1,083 (55.2%)	725 (37.0%)	725 (47.2%)	111 (470)	35 (203)
Low risk gamblers	600 (30.6%)	550 (28.1%)	550 (35.8%)	129 (293)	63 (207)
Moderate risk gamblers	138 (7.0)	126 (6.4%)	126 (8.2%)	125 (217)	87 (236)
Problem Gamblers	140 (7.1%)	135 (6.9%)	135 (8.8%)	232 (596)	143 (257)

Table 4
Hypotheses Testing

Hypothesis	Spearman's *r*	Lower 90% CI	Upper 90% CI	Is SESOI excluded within bounds? (i.e., hypothesis supported?)
Hypothesis 1	0.15	0.12[a]	0.19[a]	Yes
Hypothesis 2	0.15	0.10[a]	0.21[a]	Yes
Hypothesis 3	0.19	0.14[a]	0.24[a]	Yes
Hypothesis 4	0.31	0.27[a]	0.34[a]	Yes
Hypothesis 5	0.22	0.19[a]	0.26[a]	Yes
Hypothesis 6	0.05	0.01	0.08	No
Hypothesis 7	0.00	−0.05	0.06	No
Hypothesis 8	0.04	−0.00	0.07	No
Hypothesis 9	0.02	−0.03	0.07	No

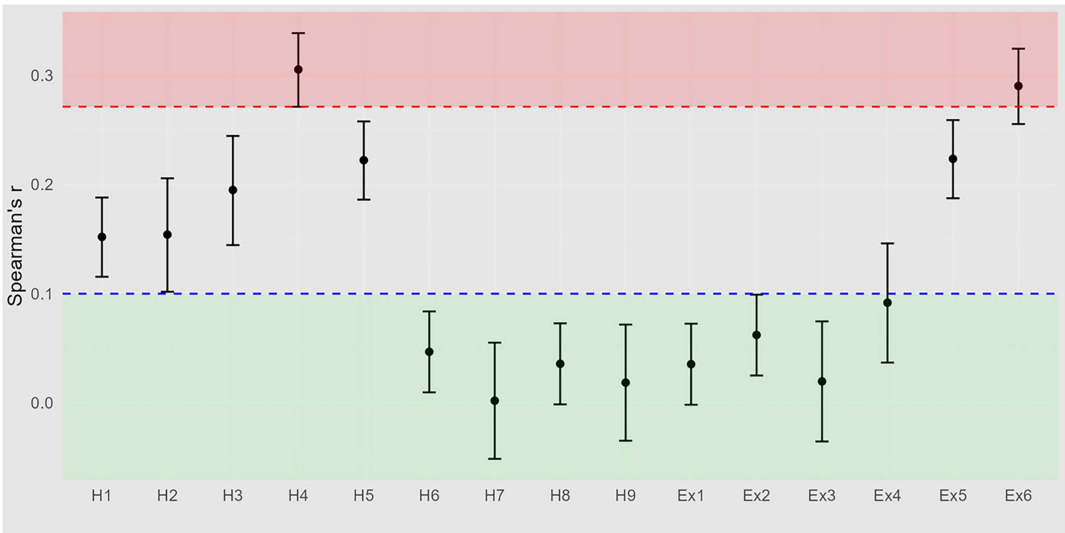
Note. CI = confidence interval; SESOI = so-called smallest effect size of interest.
[a] The exclusion of the SESOI from the interval bounds (−0.1 and 0.1).

These relationships are depicted below in Figure 4.

Discussion

The present study found that there was a meaningful positive correlation between card pack spending and problem gambling. This conclusion is based on our SESOI having been set to Spearman's $r = 0.1$, based on a more conservative convention (Ferguson, 2009, pp. 532–533, 2023, p. 3) that was used in some previous loot box studies (Drummond, Sauer, Ferguson, et al., 2020, p. 11; Xiao, Fraser, et al., 2024, p. 3). In contrast, Zendle et al. (2021), which concluded that there was no relationship between card pack spending and problem gambling, instead set their SESOI less conservatively at Spearman's $r = 0.2$ and their equivalence bounds accordingly (p. 10). Zendle et al. was too unequivocal in utterly dismissing the potential link between card pack spending and problem gambling. A Spearman's $r = 0.15$ might be noise in some contexts but could also indicate a meaningful effect that stakeholders would care about and so should be further studied. In particular, beyond academic research, national youth gambling surveys, such as the annual survey conducted by the U.K. Gambling Commission (2023) and works by other governments (Department for Communities [Northern Ireland], 2023; Dirección General de Ordenación del Juego [Directorate General for the Regulation of Gambling, Spain], 2023), have, laudably, already included questions about video game loot boxes and should also start including questions on other gambling-like products, such as card packs, blind boxes (which contain random, collectible, physical toy figurines

Figure 4
Effect Size Estimates Associated With Each Hypothesis and Exploratory Analysis



Note. Effects below the blue dotted line were deemed to be not practically relevant considering our SESOI of $r = 0.1$. The red dotted line shows the lower bound of the 90% CI for the loot box and problem gambling effect. Said interval excludes all other effects tested (except for Exploratory Analysis 6 which tested the same effect using a slightly different sample). SESOI = so-called smallest effect size of interest; CI = confidence interval; H = hypothesis; Exp = exploratory. See the online article for the color version of this figure.

from a series, including ones that are rarer than others; Xiao, 2022), and claw machines (Bastiani et al., 2023).

Notwithstanding, besides being inequivalent to our SESOI, the card pack effect was also inequivalent to the loot box effect we observed (i.e., the 90% confidence interval calculated over the loot box spending for Hypothesis 4 entirely excludes all of the 90% confidence intervals calculated over the card pack spending variables for Hypotheses 1–3). This suggests that the positive correlation between card pack spending and problem gambling is weaker than that between loot box spending and problem gambling. Although we found support for the contention that the relationship between card packs and gambling should be further investigated, we must also recognize that this relationship may be weaker and arguably less concerning than that between loot boxes and gambling.

Importantly, the card pack effect being weaker than the loot box effect was observed in the context of the participants having spent more money on average in the past-year on card packs (US$116) than loot boxes (US$77). (This holds true among participants who spent money on each activity.) Besides examining the potential links between spending on a certain product and problem gambling, we should also consider the amount of money actually spent on that product and whether that amount could be potentially practically harmful in light of an individual participant's economic situation. For example, even among participants who were categorized as problem gamblers, self-reported past-year mean spending was only US$232 for card packs and US$143 for loot boxes. Spending such amounts annually on an important hobby in developed Western countries (where our participants lived) is unlikely to raise eyebrows. For context, the maximum card pack and loot box spending amounts reported were US$10,000 and US$5,000, respectively. These sums might be more concerning, although the individual circumstances of the participants in question are not known and may well justify the spending. Indeed, as to the potential practical harms of card packs, we found no relationships between various forms of card pack spending and mental well-being or psychological distress, which aligns with some, but not other, previous findings in the loot box literature (Etchells et al., 2022; Xiao, Fraser, et al., 2024; cf. Drummond et al., 2022). Exploratory analyses additionally found no evidence of a meaningful relationship between loot box spending and negative mental health (i.e., either lessened mental well-being or increased psychological distress). Notably, we could not dismiss the possibility that spending on virtual card packs (loot boxes in digital card games) is actually associated with *positive* mental well-being.

Curiously, under current law (if properly enforced), card packs should be (but are not) perceived as being more deserving of regulation than most loot boxes because card packs would *already* legally constitute gambling in many countries, such as the United Kingdom, because their content is actively traded on secondary markets and therefore have real-world monetary value (i.e., "money's worth," which most loot box rewards do not possess; Xiao, 2022; Xiao & Henderson, 2024). The small minority of loot boxes whose rewards can also be traded would be treated in the same way as card packs under current laws. Given that card pack sales are unlicensed gambling (as no card game company is known to possess a gambling license), these arguably constitute direct infringements of the gambling laws of many countries, for example, Section 6 of the Gambling Act 2005 in the UK and Article 2 of the Belgian Gambling Act of 7 May 1999 (Belgische Kansspelcommissie [Belgian Gaming Commission], 2022, pp. 7–11), although the law has not been actively enforced (Xiao, 2022; Xiao & Henderson, 2024). The present results suggest that the current legal definitions of "gambling" *includes* products (card packs) that are less linked to problem gambling and therefore arguably less psychologically akin to gambling but, contrarily, *excludes* products (loot boxes) that are more related to traditional gambling. These definitions are therefore arguably not fit for purpose and should be rephrased to explicitly carve out products, such as card packs, that are less gambling-like and which regulators do not actually intend to regulate as a form of gambling in practice. Simultaneously, more gambling-like products, such as loot boxes, should perhaps be included within the ambit of regulation. Another middle-ground alternative, which the U.K. government follows for coin pushers and claw machines, is to regulate the activities as a type of gambling with certain licensing conditions but without a minimum legal age for use (i.e., regulate, but less restrictively; Parrado-González & Newall, 2023).

A surprising finding was that the effect observed between spending on digital card packs (which are a subcategory of loot boxes found in a specific genre of video games) and problem gambling (Hypothesis 5) was inequivalent to the overall loot box effect (Hypothesis 4). At first glance, this may suggest that not all loot boxes have the same degree of relationship to problem gambling: for example, not being as attractive as other loot boxes to people experiencing problem gambling, thus reducing the strength of the relationship. Virtual card packs are potentially less harmful than other forms of loot boxes, which means that there might be particularly harmful forms of loot boxes that remain to be uncovered (e.g., social casino games, see Zendle, Flick, Deterding, et al., 2023, p. 16, which are arguably another subcategory of loot boxes; Xiao, Henderson, & Newall, 2022; cf. Zendle et al., 2022). Previous studies have identified the many aspects in which loot boxes could differ from each other (Ballou et al., 2022; Sato et al., 2024); however, the one study that empirically looked at certain aspects thought to be potentially particularly problematic and harmful (such as the ability to "cash out" loot box prizes, i.e., convert them into real-world money) concluded that those aspects did not obviously strengthen the relationship between loot box spending and problem gambling (Zendle, Cairns, et al., 2019, p. 188). Other aspects of loot box design that have hitherto not been investigated should also be scrutinized to explain why spending on certain loot boxes might be less strongly correlated with problem gambling than spending on other loot boxes. However, considering our Exploratory Analysis 5, which investigated the strength of the relationship between noncard pack-type loot boxes and problem gambling and gave the effect size as being identical to that between virtual card packs and problem gambling (both $r = 0.22$), it is also possible that the strength appears weaker for virtual card packs simply because spending on any subcategories of loot boxes is a worse predictor of problem gambling as fewer participants engage with those specific products than with the loot box concept as a whole. Approximately 55% of the sample did not spend any money on loot boxes, while around 75% did not spend on virtual card packs, meaning that there were significantly more *0*-answers for the virtual card pack analysis, thus dampening the strength of the relationship.

Contemporary product and service offerings are increasingly involving elements of chance and aspects of randomization. This broader trend has been described as "gamblification" (Andrade & Newall, 2023; Brock & Johnson, 2021; Macey & Hamari, 2022;

Newall & Weiss-Cohen, 2022; Xiao, 2022). Loot boxes in video games, in particular, have garnered significant academic, media, regulatory, and public attention across the world (Etchells, 2024, pp. 157–165; Xiao, 2024). This positive correlation between loot box spending and problem gambling has arguably been the only scientific basis in favor of stricter regulation, although longitudinal evidence has since emerged (Brooks & Clark, 2023; González-Cabrera et al., 2023; Palmer et al., 2025). The present study presents evidence that spending on at least one other gambling-like product that has already existed for many decades and has not been regulated as a form of gambling (Mudd, 2003) is also linked to problem gambling. However, there is no evidence that said product has caused widespread harm in the ensuing decades since its invention and popularization. This means that the relationship found for loot boxes may not be as concerning as first propounded. On the other hand, we should also acknowledge that the strength of the relevant relationship for loot boxes is significantly stronger: Given the respective Spearman's *r*, loot box spending "explains" about 6.3% of the variance in problem gambling ($\eta^2 = 0.063$), while card pack spending explains merely 2.2% thereof ($\eta^2 = 0.023$). This is a near three-time difference meaning that the practical explanation for the correlation between each respective activity and problem gambling may not be the same. Beyond identifying it, the present study is incapable of explaining what this difference could mean in practice.

Beyond card packs and loot boxes, we recognize that many other novel gambling-like products have recently been invented and gained popularity, especially among young people (Wardle, 2021). More research is needed, particularly beyond loot boxes, which previous studies have been preoccupied with. As these novel products are unlikely to be legally regulated in the foreseeable future, we urge carers, schools, and gambling harm reduction organizations to raise awareness of potential risks among young people and discuss possible strategies to limit consumption and minimize harm (Gong & Rodda, 2022). For the avoidance of doubt, we do not wish to promote a "responsible gambling" or "responsible loot box consumption" narrative; however, given the lack of public health interventions in this domain, we must be practical and do what is within our powers. Indeed, although stakeholders are more concerned about children's engagement with gambling-like products, we should not disregard the experience of older people, who might also experience harm due to a lack of media and technological literacy.

As to limitations, like most previous loot box studies (e.g., Drummond, Sauer, Ferguson, et al., 2020; Etchells et al., 2022; Zendle & Cairns, 2018), and the one single previous card pack study (Zendle et al., 2021), our study was cross-sectional, meaning that we could not draw any conclusions as to causality. To do so would require longitudinal research, which has started being conducted in the loot box domain (Brooks & Clark, 2023; González-Cabrera et al., 2023; Palmer et al., 2025) and should also be conducted in the future in the physical card pack domain. Further, as in similar previous studies, the data relied upon were self-reported, meaning that they are prone to potential unintentional misremembering and misreporting (Althubaiti, 2016) and intentional mischievous responding by participants (Przybylski, 2016). Although over 95% of participants reported being confident in their spending estimations (and presumably also in their answers to other questions), certain seemingly inaccurate or incorrect responses can be perceived in the title of games reported by players: for example, some players reported spending money on physical card packs in video games, which would be impossible, meaning that they either misunderstood the question or responded mischievously. We did not exclude such participants. More recently, video game research has started using nonself-reported, objective data collected by the industry (Johannes et al., 2021; Zendle, Flick, Gordon-Petrovskaya, et al., 2023), although concerns have been raised about potential conflicts of interest and data selection bias (Xiao, 2023; Zendle & Wardle, 2023), or data collected by the participants' hardware device (Petrovskaya & Zendle, 2023) or through a software platform (Ballou et al., 2024). Unfortunately, these advances applicable to research on digital technology might not be easily applicable to research on physical products because, to illustrate, spending on digital card packs in a video game would always be tracked by the video game company, while spending on physical card packs is highly unlikely to ever be tracked by a physical card shop employee. Some exceptions do exist, for example, spending money on physical cards and card packs using online shopping platforms, such as https://TCGplayer.com or https://Cardmarket.com. However, the data captured by these platforms are unlikely to be complete, in contrast to video game loot box spending data. Other measures of engagement beyond monetary spending over a prolonged period, such as frequency of use or intense spending sprees, could be used by future research as alternative or complementary markers of problematic consumption.

Our sample consisted of people living in developed, English-speaking, Western countries. A majority of participants identified as White (72.1%). The present results should not be overinterpreted beyond its cultural context: The relationship between card pack spending and problem gambling might be different in other countries (Xiao, Fraser, et al., 2023), even though the relationship between loot box spending and problem gambling has at least been replicated in Mainland China, beyond Western countries (Xiao, Fraser, et al., 2024). Future studies should look beyond Western countries as card packs and loot boxes are also popular, if not even more popular, in other regions of the world (Sato et al., 2024; Xiao, Henderson, et al., 2024). It should also be noted that our sample consisted only of adults with a mean age of 34.9. Arguably, stakeholders are more concerned about potential harms being experienced by children and young people (including even young, emerging adults) who engage with card packs and loot boxes and the potential normalization and development of gambling behaviors (Brooks & Clark, 2023; Denoo et al., 2023; González-Cabrera et al., 2022, 2023; Wardle & Zendle, 2021; Zendle, Meyer, et al., 2019): Our study could not account for their perspectives. Indeed, 68.0% of the sample was aged over 30, and 27.0% was aged over 40, meaning they might have been playing physical card games and been exposed to gambling-like products for many years or even decades (we did not ask participants about these, which future research should). Long-term players who have been exposed to gambling-like products for far longer, and older players in general, may have developed better individual techniques for controlling their spending and thus experience less harm (see Gong & Rodda, 2022). Our results may have been biased in that direction, that is, showing lower incidences of harm. Players who are newly encountering gambling-like products and younger players might be less aware of potential risks and be more vulnerable; future research should specifically survey them. Finally, the loot box engagement aspect of our sample is likely biased because it shows what video game loot boxes physical card game players purchase, rather than what all

video game players purchase: the engagement rates of video game-versions of card games (e.g., *Hearthstone* and *Magic: The Gathering Arena*) might have been higher than normal.

Conclusion

Spending money on physical card packs containing random cards of varying value offered by collectible and trading card games is linked to problem gambling. This relationship is weaker than that between spending on video game loot boxes containing random prizes and problem gambling. Notwithstanding, we found no links between spending money on card packs and mental well-being or psychological distress in either direction. Surprisingly, we also found evidence that spending on specific types of video game loot boxes is significantly less related to problem gambling than spending on loot boxes overall: Specifically, virtual card packs in video game-versions of collectible and trading card games are merely weakly correlated with problem gambling. This suggests that perhaps not all loot boxes were created equal: Some are arguably more deserving of regulation than others. Alternatively, spending on specific subcategories of loot boxes is a worse predictor for problem gambling because a lower percentage of people engage, thus resulting in more participants reporting zero spending being included in the analysis and dampening the relationship's strength. A more nuanced understanding is needed. Indeed, the legal definitions of "gambling" in many countries currently includes products that are weakly linked to problem gambling (card packs) but excludes products that are more strongly linked to problem gambling (loot boxes). These definitions used for regulation should be reconsidered and, if deemed appropriate, updated to account for recent commercial developments, such as the "gamblification" phenomenon that has been observed in many industries.

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