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The relationship between videogame micro-transactions and problem gaming and gambling: A systematic review

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ABSTRACT

Background: Micro-transactions are an increasingly popular form of monetisation for videogame companies. The similarities between specific micro-transaction types and forms of gambling have been identified in literature. However, the relationship between all forms of micro-transaction and both problem gaming and gambling is currently unclear.
Purpose: The present review assessed the outcomes of studies investigating the relationship between videogame micro-transactions, problem gaming, and problem gambling.
Method: A systematic review was conducted searching for relevant literature since 2010. Four databases were searched. These were *PsycINFO, Web of Science, Scopus,* and *Pubmed*.
Results: A total of 19 cross-sectional studies met the inclusion criteria and were categorised into three groups, (i) loot boxes, problem gaming and gambling, (ii) pay-to-win micro-transactions, problem gaming and gambling, and (iii) multiple micro-transaction types, problem gaming and gambling. Links between loot boxes and problem gambling were identified. The reviewed studies also indicated demographic differences in micro-transaction preference. Frequency of payment for micro-transactions was suggested as a key factor in the relationship between micro-transactions, problem gaming and problem gambling.
Conclusion: Further research is necessary to provide further evidence for and to understand the causality of these relationships. It is recommended that purchasing loot boxes is classified as a form of gambling and that frequency of micro-transaction purchase is regulated in videogames.

1. Introduction

It has been estimated that the global videogame market made $159 billion in 2020, with over 70% of the revenue being generated from in-game micro-transactions (Strickland, 2020). Micro-transactions are defined as in-game payments for items or unlockable content made directly from real-world money or indirectly through the buying of virtual currency (Schwiddessen & Karius, 2018). These micro-transactions have gained both academic and media attention due to their potentially similar features to gambling activities (King & Delfabbro, 2020). However, there is less regulation in the gaming industry compared to gambling, meaning potentially vulnerable videogame players are exposed. Subsequently, it has been questioned whether the use of these micro-transactions could lead to problem gambling or excessive gaming-related harm.

While research into the convergence of gaming and gambling is prevalent, the distinctions between gaming and gambling are becoming increasingly blurred in digital spaces. Simulated gambling through social casino games, where players 'gamble' using virtual currency, is arguably an overt form of such convergence, due to their direct association with real-life casino and casino games (Derevensky & Griffiths, 2019). A less apparent form of this blurring is micro-transactions. In some cases, these micro-transactions look, sound, and function exactly like gambling games and are paid for using real-world currency yet, for the most part, remain unregulated (Kim & King, 2020).

There has been little research examining the specific micro-transactions available to videogame players and the psychological impact these may have. A variety of micro-transactions are now available in videogames, including virtual currency (i.e., a currency that can only be used in the specific videogame in which it is purchased. It is commonly used to buy cosmetic items or extra videogame 'lives'), skins (i.e., cosmetic items to change the look of avatars or in-game items),

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battle passes (i.e., tiered level systems, where each level achieved rewards the player, with levels getting increasingly hard to achieve as the player 'ranks' up), and loot boxes (i.e., a virtual box or chest that is opened to reveal a random pick of in-game items or currency). Items included in loot boxes can be purely cosmetic or game-enhancing, including weapons or unlockable characters (Griffiths, 2018). It is worth noting that in some videogames, these micro-transactions can also be 'purchased' using experience points (XPs) earned through completing in-game levels or challenges. A summary of videogame micro-transactions found during the research process and their features can be found in Table 1.

Both gambling addiction and videogame addiction have been categorised as behavioural addictions because there is no ingestion of psychoactive substances. Behavioural addiction has been defined by Griffiths (2005) as having six key components. These are salience (i.e., when the activity becomes the sole focus of the individual's life, leading to cravings to engage in the activity and potentially distorted behaviours and thoughts), mood modification (i.e., using the activity to experience specific feelings, like the feeling of escape or excitement), tolerance (i.e., needing a continual increase in engagement with the activity to feel the same mood modification effects), withdrawal symptoms (i.e., experiencing negative or unpleasant psychological effects, like irritability, or physical effects, like headaches, as the activity is reduced.), conflict (i.e., this can be both with the individual's self through loss of control or within personal relationships, due to too much time/resources spent engaging with the activity) and relapse (i.e., the return to previous patterns of engagement with the activity after the individual has temporarily ceased to take part in the activity). It is asserted by Griffiths (2005) that a behavioural addiction cannot be classified as 'genuine' without all the aforementioned components being present.

Table 1
A summary of micro-transaction types found during the research process.

Micro-transaction type	Description	Purchase method	Examples of games that include micro-transaction type
In-game currency	A form of money connected to a specific game or game series, used for in-game purchases. Once purchased, it cannot be exchanged back into real-world currency.	Real-world currency	*Fortnite* (VBucks); *FIFA Series* (FUT coins); *Overwatch* (Credits)
Loot boxes	Virtual crates, boxes or card packs that are opened to reveal a random selection of in-game items	Real-world currency; in-game currency; in-game items	*FIFA Series* (Packs), *Overwatch, Counter-Strike: Global Offensive*
In-game items	A virtual item that can be purchased from a videogame store or integrated marketplace. These can be used to customise in-game avatars or provide advantages to gameplay	Real-world currency; in-game currency	*Fortnite* (Skins, weapons); *Overwatch* (skins, emotes, victory poses); *World of Warcraft* (pets, mounts)
Battle Pass	An in-game tiered level system available for a set amount of time (seasons). Players can unlock in-game rewards as they progress through levels of the battle pass. Battle pass tiers are usually unlocked through acquiring experience points (XP) or through completing challenges. Tiers may also have a 'pay to win' option.	Real-world currency; in-game currency	*Fortnite, Call of Duty: Modern Warfare, Rocket League* (Rocket Pass); *DOTA 2*
Downloadable Content (DLC)	Additional content for an already purchased game, such as bonus levels, chapters or explorable areas.	Real-world currency	*The Witcher Series; The Last of Us; Legend of Zelda: Breath of Wild*
Pay-to-win	Micro-transactions that allow players to continue playing a game or game level. Often offered for a limited time. Players can also pay to complete levels without playing.	Real-world currency; in-game currency	*Candy Crush Saga; Scrabble Go; Dungeon Keeper*

The convergence of gaming and gambling through these monetisation methods and the escalating financial components involved in videogames has brought the distinction between problem gaming and problem gambling into question. If micro-transactions in videogames could lead to problem gaming and gambling behaviour and subsequently addiction or if they are particularly harmful to those at risk of developing such addictions (Drummond & Sauer, 2018; Griffiths, 2019), it is necessary to assess their potential contributions to each of these components and their relationships to problem gambling and videogame playing.

1.1. Micro-transactions and problem gambling

As 'paid-for' features of videogames, micro-transactions have the potential for a negative psychological impact on those who purchase them. With gambling addictions, more so than with gaming addictions, there is a motivation for financial gain (Griffiths, 1991). In the case of videogame micro-transactions, there are limited options for gaining real-world financial rewards. However, it is suggested that instead, specific features of micro-transactions share structural similarities with popular forms of gambling and the use of real money to purchase these may lead players to move to monetary forms of gambling (Drummond & Sauer, 2018). With loot boxes, a specific form of micro-transaction found in videogames (see Table 1), the randomised events of paying to win 'loot' or in-games items of varying value shows similar features to slot machines through the process of revealing the items won. Often, upon opening a loot box, 'near misses' are shown to the player. These near misses show the player what they could potentially have won. Near misses in gambling games have been shown to increase the desire and motivation for continued play due to the players' perception that they are close to a win, which can potentially trigger the same psychological reward process as an actual win. This reinforcement can subsequently lead to excessive and problematic gambling (Parke & Griffiths, 2004).

In some cases, micro-transactions in videogames mirror digital gambling games by stimulating players with sounds of spinning wheels (such as with slot machines) to build anticipation and using visuals depicting bright colours and animations during the anticipatory period, as well as bursts of light and colour when 'wins' occur. This could be suggested to positively reinforce the purchase of the micro-transaction itself, as well as the use of the related gambling game (King & Delfabbro, 2019). Moreover, rewards from in-game micro-transactions are often random and not based on skill, much like slot machines and lottery games. Random rewards can lead a player to believe that there is skill involved, or that wins occur more often than they really do, leading to the overinvestment of both player time and money in videogames (King & Delfabbro, 2018). If it is the case that specific micro-transactions have similarities to forms of gambling by using gambling-like features and that they act as a potential gateway to real-life gambling, the potential for gambling-related harm must be assessed.

Additionally, there are other features of videogames that, structurally, are like gambling games in their methods to provide continuous reward reinforcement for players. An example of this is the *FIFA* videogame series, in which football player 'cards' are obtained and used to assemble and build teams. Each player 'card' has a rating (bronze, silver and gold). In some cases, 'special' cards with higher ratings and abilities can be obtained. These cards are obtained by purchasing loot boxes, known as packs. These are purchased using in-game currency. The *FIFA* series also includes an integrated marketplace that allows for the selling of in-game items received from loot boxes for in-game currency. While there is no real-world financial gain in integrated marketplaces (unlike external marketplaces, where items and player accounts can be sold for real-world money), it could be suggested that players may be motivated to continuously purchase micro-transactions to gain 'profit' and to purchase further in-game items. Although different to 'cash out' options available in gambling, which allow players to settle their bets earlier at a potentially lower value (Lopez-Gonzalez & Griffiths, 2017), marketplaces may lead to players' perception of micro-transaction value increasing. By allowing players to believe that they can 'earn' some in-game currency back (even if the value earned back is less than most of the initial micro-transaction itself) through selling their items, they may be more inclined to make purchases in higher frequencies, as they do not perceive their loss to be as great. The ability to then sell items on the games' marketplace (and often with 'instant sell' options) may shorten the length of time between pay out intervals, which is suggested by Griffiths (1999) to be a fundamental factor in the addictiveness of gambling games.

1.2. Micro-transactions and problem gaming

Multiple features of micro-transactions (Table 1) may cause players to increase their play time and become at-risk of developing gaming disorder (King & Delfabbro, 2020). The continuous need to gain experience points (XPs) to purchase these micro-transactions could lead to an increase in videogame play time which, in turn, may increase the risk of videogame addiction/gaming disorder. Motivational models associated with gaming disorder highlight that frustration with daily needs or lack of need fulfilment in real life is positively correlated with internet gaming disorder (IGD). Need fulfilment can fall into three categories: *autonomy* (i.e., internally driven actions, based on personal choice), *relatedness* (i.e., how connected individuals are to others), and *competence* (i.e., the ability to carry out actions successfully or with skill) (Mills & Allen, 2020). The relationship between need fulfilment and addictive behaviour is observed in other online spaces. Young adults are suggested to use social networking sites in order to satisfy their needs and gain immediate gratification. Consequently, they experience addictive behaviour in the form of constantly checking their social networks (Urista et al., 2009). Therefore, it is possible that micro-transactions aiding in the fulfilment of needs could potentially strengthen the relationship between frustration with daily needs and IGD. In other words, those who play videogames to fulfil their psychological needs may be more motivated to increase their play time when being continuously rewarded by micro-transaction that are purchased using in-game currency or XPs.

In the case of the 'battle pass' micro-transaction (Table 1), the initial battle pass is purchased using in-game currency. Then, the player gains XPs to unlock rewards at increasing levels. These rewards are ranked in 'quality or 'rarity'. The higher the XPs gained, the higher the level of rewards unlocked. The reinforcement schedule of these rewards and the need to unlock these levels in a set amount of time could be suggested to address each of the three categories. While external rewards (i.e., specific loot from micro-transactions) may be a motivating factor, an individual's own need for achievement, or to obtain autonomy, could be a driving factor for the continued use of XP-based micro-transactions. Moreover, there are social factors involved in gaming and therefore the purchase of micro-transactions that may lead to the fulfilment of the relatedness need. In the case of *DOTA 2*'s battle pass, the guild feature allows players to level up in small groups and work together to achieve levels (Petrovskaya & Zendle, 2020). Moreover, players may feel like they are gaining skills or 'mastering' the game by completing 'tier' levels of XP-based micro-transactions, such as the battle pass, and in turn, fulfilling the competence need. For example, with *DOTA 2*'s battle pass system, the higher the level of battle pass completed, the higher rating the items received and the higher the status marker for the players' account, when using the items in-game (Zanescu et al., 2021).

1.3. Micro-transactions, public policy, and regulations

To date, several regulations surrounding specific micro-transactions (most notably loot boxes) have been implemented in various countries, typically reflecting the gambling law of the location and lacking consistency globally. The controversy surrounding loot boxes became prominent in 2017, with the *Electronic Arts* (*EA*) videogame *Star Wars Battlefront II* receiving criticism for its use of game-advancing loot rewards (Good, 2018). Investigation into loot boxes in popular games, conducted by the Belgian Gaming Commission, found that loot boxes did not give players their 'money's worth' and so these were categorised as unlicensed gambling. The games investigated in this instance were *Overwatch*, *FIFA Ultimate Team* and *Star Wars Battlefront II*. Similarly, the Netherlands fined *EA* for their use of loot boxes, and they were removed from the game. In the UK, it was suggested by the House of Lords Gambling Committee that loot boxes should be identified as games of chance. This would enable them to be covered by the Gambling Act 2005 and be regulated as such (BBC, 2020).

However, these regulations are only specific to loot boxes and do not consider other forms of micro-transactions and how these may lead to the risk of harm in videogame players, as well as their potential impact on problem gaming behaviour. For example, pay-to-win micro-transactions (Table 1) have recently been suggested to increase levels of problem gambling severity and to be associated with problem gaming behaviours (Lelonek-Kuleta et al., 2021; Steinmetz et al., 2021). Therefore, a more thorough examination of the relationship between a more varied selection of micro-transactions and problem gaming and gambling is necessary to establish any regulatory needs, which could be implemented consistently worldwide.

1.4. The present review

The potentially negative psychological impacts of gaming, gambling, and the association between the two have been explored in the academic sphere (e.g., Griffiths, 1999; Griffiths, 2005; Kim & King, 2020). However, a specific focus on micro-transactions within the playing of videogames and the potentially addictive nature of these is an emerging research area. To the authors' knowledge, there has been no systematic review of the relationship between a larger range of micro-transactions, gaming, and gambling. To address this research gap, the present study reviewed current knowledge concerning the potential psychological and physiological effects of micro-transactions in videogames on those buying in-game items. For the present review, micro-transactions are defined as purchases made in-game, which can comprise of either content expansion or useable in-game items (Evers et al., 2015). Consequently, the present review is not limited to research solely focusing on loot boxes and explores a variety of micro-transactions available in-game and their respective relationships with gaming and gambling behaviours.

The aims of the review were to: (i) explore the empirical research literature concerning the relationship between micro-transactions in videogames and problem gaming and gambling behaviours, (ii) evaluate potential at-risk demographics, as well as risk factors associated with the purchasing of micro-transactions, and (iii) discuss the findings and implications of these studies for public policy concerning the use of micro-transactions in videogames as well as for future research.

2. Method

The present systematic review followed the PRISMA guidelines for the identification, screening, and eligibility stages of the review process (Moher et al., 2009).

2.1. Eligibility criteria

The inclusion criteria for thei present paper were that any studies included in the review must: (i) assess the relationship between micro-transactions, problem gaming and/or problem gambling, (ii) include primary and empirical research, (iii) be written in English, (iv) be peer-reviewed, and (v) be published after 2010 (micro-transactions developed from simple customisation options to their more commonly recognised complex forms in the late 2000s to early 2010s and so studies before this date were excluded). Studies were also excluded if they solely assessed consumer psychology (i.e., business models relating to micro-transactions in videogames), ethical issues and/or regulatory issues concerning micro-transactions in videogames. Study collection ended in July 2021.

2.2. Sources

Studies for the review were searched for on electronic databases. These were *PsycINFO, Web of Science, Scopus,* and *Pubmed*. Reference lists of relevant studies were also hand searched to identify any additional studies for inclusion. Following best practice guides (Siddaway et al., 2018), the review followed several stages to ensure a high-quality systematic review. These stages were: (i) formulating research questions, (ii) identifying relevant literature, (iii) assessing literature eligibility, (iv) analysing eligible literature and (v) reporting the results of the review.

2.3. Search strategy

To identify studies analysing the relationship between in-game micro-transactions (such as loot boxes, cosmetic items and battle/season passes) and problem gaming and gambling behaviours, the following search terms were used: (micro-transaction OR micro transaction Or loot box* OR battle pass OR skin gambling OR purchasable content OR in-game buying* OR in-game item* OR virtual goods* OR surprise mechanic* OR moneti*ed gaming activit* OR gaming moneti*ation scheme OR simulated gambling active*) AND (video game* OR videogame* OR gam* OR mobile gam* OR game play OR esport*) AND (gambling behavi*r* OR addict* OR problem gambling OR pathological gambling OR increased spending OR bet* OR wager* OR self-regulation OR impulsivity* OR risk* behave*r*); Initially, the search term 'skin' was used. This was later changed to 'skin gambling' to exclude non-relevant papers relating to biological skin reactions and exposure during experiments. Consequently, the search term yielded 1011 results. Of these 1011, 13 papers were identified as duplicates. A total of 998 papers were assessed for eligibility.

2.4. Data collection process

An initial total of 998 studies were assessed for eligibility, after duplicates were removed. Studies were deemed as relevant through the analysis of titles and abstracts in accordance with the inclusion criteria. Studies that did not meet the eligibility criteria included: (i) studies not related to videogames, micro-transactions, or problem gaming and/or gambling and (ii) papers that did not include empirical research. A total of 977 studies were excluded from the searched literature. Full-text copies of the remaining 21 papers were then examined for eligibility using the inclusion criteria. During the full-screen process, four papers were removed as they were not relevant to the outcomes of the present review. An additional two papers found from reference lists were assessed for eligibility and subsequently included in this review. In total, 19 studies were included in the present review. The paper selection process is depicted in Fig. 1.

3. Results

The 19 studies included in the present review were divided into three overarching categories. These were: (i) loot boxes, problem gaming and gambling, (ii) pay-to-win micro-transactions, problem gaming and gambling, and (iii) multiple micro-transaction types, problem gaming and gambling. A total of eight studies assessed were included in the *loot boxes* category, two were included in the *pay-to-win* category, and the remaining nine were included in the *multiple microtransaction type* category. Each of these categories had sub-sections based on the variable they assessed. These were solely problem gaming, solely problem gambling, or both problem gaming and gambling.

Of the eight studies that solely assessed loot boxes, two examined the physiological similarities between opening a loot box and gambling games. Four of the studies assessed the relationship between loot boxes and problem gambling. The remaining two studies assessed the relationship between loot boxes and both problem gaming and gambling. Of the two studies assessing pay-to-win micro-transactions, one solely examined problem gaming and one examined both problem gaming and gambling. Of the nine studies that assessed more than one micro-transaction type, one solely examined problem gaming, five solely examined problem gambling and the remaining three studies examined both problem gaming and gambling.

3.1. Loot boxes and their relationship to problem gaming and problem gambling

3.1.1. Loot boxes and their relationship to problem gambling

Of the four studies solely assessing loot boxes and problem gambling (see Table 2), one examined adult participants aged 18–40 plus (n = 1200) (Zendle et al., 2020) and one examined adult *Heroes of Storm* players aged over 18 years (n = 112) (Zendle, 2019). The final two studies examined British 16–24-year-olds (n = 3549) (Wardle & Zendle, 2021) and Danish adolescents aged 12–16 years old (n = 1137) (Kristiansen & Severin, 2020).

The first study (Zendle et al., 2020), a survey examining loot box spending habits and participants' scores on the Problem Gambling Severity Index (PGSI) (Ferris & Wynne, 2001), found a significant positive association between loot box spending and problem gambling. The greater the loot box spend, the more severe the problem gambling classification. This relationship had a moderate to large effect size. The ability to cash out strengthened this association. However, the effect size for this relationship was small and the relationship between loot box spending and problem gambling remained significant even when controlling for the ability to cash out. Furthermore, pay-to-win (P2W) options, as well as showing near misses and using in-game currency to purchase loot boxes also strengthened associations between loot box spending and problem gambling. However, the effect sizes for all these factors were small. Crate and key mechanics, as well as item exclusivity, did not moderate the relationship between loot box spending and problem gambling. The amount of money made from selling loot box items significantly moderated the relationship between loot box spend and problem gambling. However, it weakened associations between the two.

The second loot box and problem gambling study (Zendle et al., 2019) examining adult participants focused specifically on *Heroes of Storm* players. The study assessed loot box spending levels, as well as scores on the PGSI (Ferris & Wynne, 2001) at two periods of time. The first, when loot boxes were included in the *Heroes of Storm* game, and the second after they were removed. Results reported that no significant difference in spending was found among non-problem gamblers, low-risk gamblers, and moderate-risk gamblers. A significant reduction

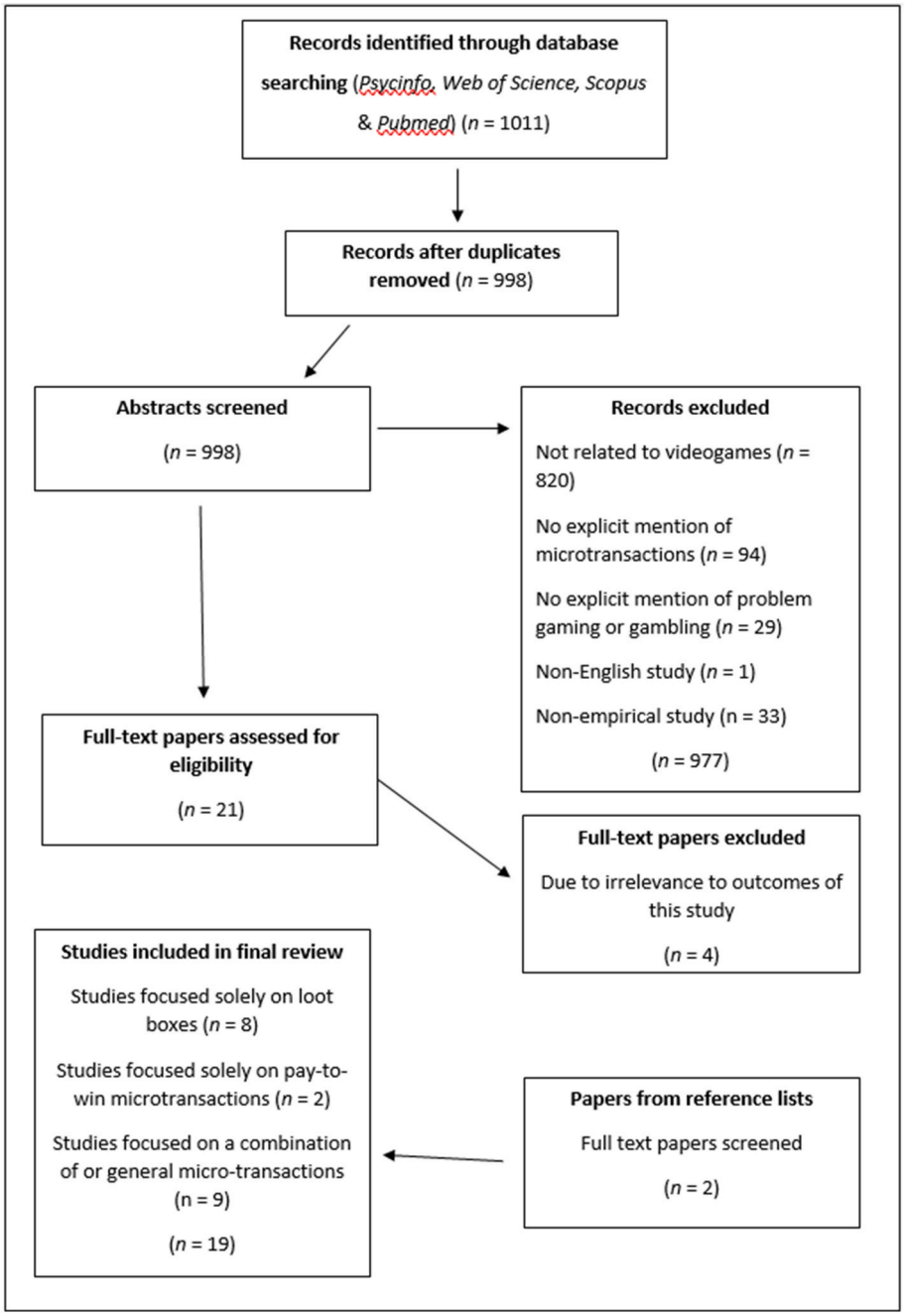


Fig. 1. *PRISMA flow chart depicting the literature selection process.*

in spending was reported among problem gamblers, with spending being reduced by a small to moderate amount. However, when Bonferroni corrections were applied to these results, a significant relationship was no longer observed.

In their survey-based investigation of British 16–24-year-olds, Wardle and Zendle (2021) assessed loot box spending habits, as well as problem gambling severity and impulsivity scores. Of the sample surveyed, 12.1% had purchased a loot box in the previous 12 months. Loot box purchasers were more likely to have gambled in the previous 12 months (62.8%). Those who did not purchase loot boxes were less likely to gamble (39.7%). Loot box purchasers were also more likely to spend more money on gambling a week, as opposed to those who did not purchase loot boxes (£19.20 vs. £15.50). Moreover, loot box purchasers were more likely to experience problems with gambling (16.9%) than those who did not purchase loot boxes (1.8%). Even when controlling for socio-demographics, impulsivity and gambling participation, loot box purchasers were 4.4 times more likely to experience problems with gambling. Mean impulsivity scores were higher for those who purchased loot boxes (2.6) than those who did not (2.2). Overall, loot box purchasers were reported to more likely be younger and male. Loot box purchasing was found to be more strongly related to problem gambling than common types of gambling, like slot machines and online betting.

The final study focusing solely on loot boxes and problem gambling was a survey examining Danish adolescents aged 12–16 years (Kristiansen & Severin, 2020). The study found that 56% of participants had engaged in loot box-related activities at some level. Of those who engaged in loot box-related activities, more than 40% had earned loot boxes, 20% had purchased a loot box and 10% had sold items from a loot box. Similar to the findings of Wardle and Zendle (2021), young loot box users were more predominantly male. Furthermore, Kristiansen and

Table 2
A summary of the reviewed studies.

Paper	Aims	Sample	Micro-transaction type assessed	Behaviours/variables being assessed	Key Findings
Zendle and Cairns (2018)	To address the lack of research surrounding loot box purchase that require monetary outlay and the spending associated with these loot boxes.	Adult gamers from across 95 countries ($n = 7422$); Ages 18–45+	Loot boxes; non-specified other micro-transactions	Problem gambling	The more severe an individual's severity of problem gambling, the more they spent on loot boxes. This was a statistically significant relationship, with a small to medium effect size. There was also a statistically significant relationship between problem gambling and the purchase of other micro-transactions.
Brady and Prentice (2019)	To evaluate the addictive qualities of micro-transactions based on increases in physiological arousal.	Experienced *FIFA Football* gamers; ($n = 25$, $M = 24.56$, SD = 3.5)	Loot boxes	Physiological arousal (GSR, HR); Problem gaming; problem gambling	Galvanic skin response (GSR) increased from an established baseline while participants played a game of FIFA and opened a loot box. However, this was not statistically significant. Heart rate (HR) did not change from the established baseline while participants opened loot boxes Those with higher GAS scores got less of an increase in GSR while loot box prizes were displayed.
Brooks and Clark (2019)	To test the associations between loot box engagement and gambling behaviours	Study 1: North American adults ($n = 144$); Aged 21+ Study 2: Students from the University of British Columbia ($n = 113$); Aged 19+	Loot boxes	Problem gambling; problem gaming	Moderate to strong relationships were observed in study 1 for correlations between scores for the Risky Loot Box Index (RLI) and the Problem Gambling Severity Index (PGSI), the RLI and the Gambling Related Cognitive Scale (GRCS) and the RLI and three of the Darker and Freedman Beliefs Around Luck (BALS) subscales. The same relationship was observed in study 2, however the effect size was smaller. Across both studies, gambling measures were more strongly related to risky loot box use than problematic gaming measures.
Larche et al. (2021)	To determine whether *Overwatch* players who use loot boxes treat loot boxes of varying values in similar ways to slot machine gamblers	Study 1: University of Waterloo students who played *Overwatch* ($n = 47$) Study 2: University of Waterloo students who played *Overwatch* ($n = 46$)	Loot boxes	Study 1: Arousal; valence; urge Study 2: Post-Reinforcement Pauses (PRPs); Skin Conductance Responses (SCRs); force; arousal; valence; urge; disappointment	More valuable loot boxes were more arousing, positively valanced and urge inducing. Loot boxes containing at least one 'legendary' item showed the greatest arousal scores compared to 'epic' and 'rare' loot boxes. As tier rankings increased, so did ratings of valance and urge. Disappointment increased as tier rankings of loot boxes decreased. There was a significant SCR difference for 'legendary' rated boxes. A significant for of click difference was found for 'legendary' boxes. Larger PRPs were reported for 'legendary' and 'epic' tier loot boxes. This was statistically significant. There were increased levels of arousal during the anticipatory period in loot box opening.
Li et al. (2019)	To explore the experience of videogame players with loot box purchases. Also, to explore the relationship among loot box purchasing, videogame/gambling behaviours and mental distress.	Adult video gamers; ($n = 686$; M = 27, SD = 8.9)	Loot boxes	Problem gaming; problem gambling; mental distress	Loot box purchasers were more likely to report significantly higher videogame engagement and longer gaming score higher on problem gambling measures and meet the proposed criteria for Internet Gaming Disorder (IGD). Loot box purchasing was significantly associated with problem video gaming, even after controlling for videogame

(*continued on next page*)

Table 2 (*continued*)

Paper	Aims	Sample	Micro-transaction type assessed	Behaviours/variables being assessed	Key Findings
					engagement. The frequency of online gambling partly explained the effect of loot box purchasing on problem video gaming. Loot box purchasing was indirectly related to stress through the effect of problem video gaming.
Macey and Hamari (2019)	To provide an overview of newly emergent behaviour in its relative infancy, thereby laying the groundwork for future study. Also, to form one of the first assessments of participation rates and prevalence of problem gambling behaviours from an academic perspective.	esports spectators who gamble; (n = 582; Ages 14–50+	Loot boxes; skins	Problem gambling	Loot box consumption had a significant negative relationship with esports engagement. The PGSI had a strong association with loot box engagement, but this relationship was not as strong as with online gambling and videogame related gambling. Those who used more channels to gamble (including the purchase of loot boxes) were more likely to display problem gambling behaviours.
Zendle and Cairns (2019)	To replicate the existence of a link between problem gambling and loot box purchase using a different methodology to the previous study	Adult US gamers (n = 1172); Ages 18–40+	Loot boxes; non-specified other micro-transactions	Problem gambling	There was a significant link between PGSI scores and loot box spending. There was a stronger relationship between problem gambling and other micro-transactions. This was less significant than with loot boxes and problem gambling.
Zendle et al. (2019)	To investigate the size and importance of links between loot box spending and problem gambling in adolescents. To provide clarity as to whether specific features of loot boxes strengthen this link. Also, to outline qualitative research asking how adolescents engage in loot box spending.	Adolescent gamers; (n = 1155); Ages 16-18	Loot boxes; non-specified other forms of micro-transaction	Problem gambling	A significant positive correlation between loot box spending and problem gambling was found, specifically the purchasing of loot boxes (as opposed to free to open options). There was a significant relationship between other micro-transactions and problem gambling. Eight distinct motivations for loot box spending were found. These were gameplay advantages; to gain items/to build a collection; For fun/excitement; for appearance; to support game developers; the perception that the items were of good value; time advantages and for profit.
Zendle (2019)	Investigate which pathways are responsible for the observed relationship between loot box spending and problem gambling	Adult *Heroes of Storm* players (n = 112); Aged 18+	Loot Boxes	Problem gambling	No significant reduction in spending was observed amongst either non-problem gamblers, low-risk gamblers, or moderate-risk gamblers. A significant reduction in spending was observed amongst problem-gamblers, with mean spending dropping by a small to moderate amount. The more severe an individual's problem gambling, the more reduction in spending once loot boxes were removed from the game.
King et al. (2020a)	To empirically evaluate the possible co-occurrence of problem gambling and gaming behaviours in US emerging adult non-students. Also, to investigate the role that micro-transactions have in this relationship	Emerging adult non-students in the US (n = 300, M = 22.79)	A variety of micro-transactions including loot boxes	Problem gaming; problem gambling	Obligation to purchase micro-transactions as well as monthly spending rates had the strongest direct associations between IGD and GD severity. Micro-transaction purchase partially explained the relationship between the severity levels of IGD and GD. Micro-transaction spending was more closely related to problematic gaming symptomology.
King et al. (2020b)	Address which psychosocial variables are the best predictors of Fortnite micro-transaction	*Fortnite* players; (n = 428; M = 23.5, SD = 7.3); Ages 18–60+	Loot boxes; skins	Problem gaming	Micro-transaction spending was predicted by spending of participants' closest friend, greater

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Table 2 (*continued*)

Paper	Aims	Sample	Micro-transaction type assessed	Behaviours/variables being assessed	Key Findings
	spending, as well as to what extent cognitive factors and social influences affect players micro-transaction spending. Also, to assess the extent to which Fortnite micro-transaction spending is associated with gaming disorder symptomology.				access to *Fortnite* across multiple devices and having a higher in-game level. Spenders scored more highly than non-spenders on scales measuring motivation to acquire in-game rewards and the perception of the items being good value. Gaming disorder symptoms were not associated with micro-transaction purchase. *Fortnite* spending was more closely related to social influences, including belonging to a larger online social network more so than common gaming disorder symptoms, including impulsiveness.
DeCamp (2020)	To examine one dimension of potential similarities between loot box, downloadable content (DLC) and gambling: risk and protective factors. Also, to investigate similarities and dissimilarities of the risk and protective factors for potentially related behaviours.	American Youth from the state of Delaware (n = 13,042); Ages 13–14 and 16-17	Loot boxes; DLC	Problem gambling	Loot box and DLC purchase was poorly predicted by gambling predictors. In the 8th grade sample, being bullied outside of school was associated with more loot box purchases. In the 8th grade sample, DLC purchase was best predicted by depression, anxiety, cigarette use and being Hispanic. In the 11th grade sample, being bullied at school, cigarette use, vape use and marijuana use were significant predictors of loot box purchase. In the 11th grade sample, depression and anxiety were more associated with DLC purchases.
Drummond et al. (2020)	To examine whether problem gambling or gaming symptomology made contribution to predicting loot box spending. Also, to examine theb relationship between the Risky Loot Box Index (RLI) [], loot box spending and IGD symptomology.	Three national samples from Australia (n = 339), Aotearoa New Zealand (n = 323) and the US (n = 387). Total n = 1049.	Loot boxes; non-randomised virtual items	Problem gambling; excessive gaming; positive and negative mood; psychological distress	Participants with higher problem gambling symptoms and more risky loot box engagement spent more on loot boxes. Participants with greater loot box spend experienced greater negative mood and psychological distress. Increased loot box spending was associated with increased positive mood. Participants with higher problem gambling severity spent higher amounts on other micro-transactions. Risky engagement with loot boxes was associated with higher spending amounts.
Kristiansen and Severin (2020)	To explore loot box engagement patterns amongst young gamers. Also, to examine whether different levels and forms of engagement in loot box purchasing is associated with problem gambling.	Danish adolescents; (n = *1137);* Ages 12-16	Loot boxes	Problem gambling	There was a significant positive correlation between loot box engagement and problem gambling severity.
von Meduna et al. (2020)	To underpin the ongoing debate via results of a large-scale population survey helping to explain the user structure of loot boxes. Also, to evaluate usage intensity and related gambling problems and to understand the influences on purchase of loot boxes.	German online gamblers and play to win gamers (n = 6000)	Loot Boxes; Pay-to-win micro-transactions	Problem gambling; Problem pay-to-win gaming	There was a significant positive relationship between both loot box purchasing and the frequency of loot box purchases with real money gambling spend. Online sports betting and esports betting participation had a significant negative relationship with loot box purchasing. Casino gaming and lottery participation both had significant positive relationships with loot box purchase frequency. Participation in gambling for play money (virtual currency) and the frequency of this gambling had

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Table 2 (*continued*)

Paper	Aims	Sample	Micro-transaction type assessed	Behaviours/variables being assessed	Key Findings
					significant positive relationships with both loot box purchasing and the frequency of these purchases. Frequency of loot box purchase had a significant positive relationship with problem gambling when accounting for age and employment status. Problems with P2W gaming had a significant positive relationship with loot box purchasing.
Zendle et al. (2020)	To replicate prior findings that individuals who purchase loot boxes are more likely to score high on a measurement of problem gambling behaviour. Also, to explore the moderating relationship on each of the factors mentioned.	Adult sample; ($n = 1200$); 18–40+	Loot boxes	Problem gambling	A significant positive correlation between loot box spending and problem gambling was found. The ability to cash out strengthened links between loot box spending and problem gambling. The amount of money made from selling loot boxes weakened links between problem gambling and loot box spending. The greater the loot box spend, the more severe the problem gambling classification. Pay-to-win options, as well as showing near misses and using in-game currency to purchase loot boxes strengthened links between problem gambling and loot box spend.
Lelonek-Kuleta et al. (2021)	To estimate involvement in P2W games in Poland and to observe characteristics on P2W gamers. Also, to identify the behavioural patterns of playing P2W games and making payments, as to investigate their relationship with problem gaming symptoms.	Study 1: Adult Poles; ($n = 2000$, $M = 45.6$, SD - 1.46); Study 2: P2W gamers ($n = 1702$, $M = 33.86$, SD = 10.05)	Payments to gain in-game advantage	Problem gaming	P2W for women is based on monthly household income, whereas for men, it is based on education level. P2W spenders played several times a week, bought add-on content once a month, spent PLN 11–18 and had average gaming sessions of 30 min to an hour. Five patterns of P2W behaviour were identified. Severity of problem P2W gaming is concurrent with levels of involvement with the game.
Steinmetz et al. (2021)	Address what gamers motives are for purchasing pay to win products and what relevance these have to in-game advancement. Also, to address demographics and socioeconomics surrounding P2W gaming. Finally, to address the relationship between P2W gaming and gambling	German adults who had either gambled or purchased P2W products ($n = 6000$)	Pay to win micro-transactions	Problem gambling	The most important motivations for making P2W purchases were those relating to advancing in the game, especially increasing the chances of winning. Frequency of payments in P2W gaming is a strong predictor of higher frequency payments in other forms of gambling and vice versa. Over-involvement in either P2W gaming or gambling predicts involvement levels in the other. Those who are categorised as high-risk for P2W gaming are more likely to be categorised as high-risk for problem gambling. Frequency of payment in either P2W gaming or gambling rather than cumulative spending and general participation is more influential in predicting participation and play frequency in the other.
Wardle and Zendle (2021)	To investigate the relationship between loot box purchasing and problem gambling within a high – quality online panel survey of 16–24-year-olds	British 16–24-year-olds ($n = 3549$)	Loot boxes	Problem gambling	Impulsivity scores were higher in those who purchased loot boxes than those who didn't. Loot box purchasers were more likely to experience problem gambling than those who did not purchase loot boxes. Loot box purchasing was more

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Table 2 (*continued*)

Paper	Aims	Sample	Micro-transaction type assessed	Behaviours/variables being assessed	Key Findings
					strongly related to problem gambling than other forms of gambling, like slot machines and online betting.

Severin (2020) found that the largest proportions of problem gamblers (4.9%) and those at risk of problem gambling (7.8%) were found to be among those who had sold items from a loot box. As was found in all of the studies focusing solely on loot boxes and problem gambling, it was reported that there was a statistically significant positive association between loot box engagement and problem gambling severity.

3.1.2. Loot boxes, problem gaming and problem gambling

Two studies (see Table 2) examined loot boxes and their relationship to both problem gaming and problem gambling. The first (Brooks & Clark, 2019) consisted of two studies, the first examining North American adults aged 21 years and older ($n = 144$) and the second examining students from the University of British Columbia aged 19 years and older (n = -113). The survey assessed problem gambling severity, symptomology of Internet Gaming Disorder (IGD), financial risk-taking, gamblingrelated cognitions and beliefs around luck. As an outcome of the study, Brooks and Clark (2019) developed the Risky Loot-box Index (RLI), which assessed risky loot box engagement levels. The results indicated that 88.9% of the North American adult sample and 94.8% of the student sample had opened loot boxes. Around half of each sample (49.3% in Study 1 and 60.3% in Study 2) reported purchasing a loot box before. A similar skew was found for those who had spent time playing videogames to earn loot boxes. Those who preferred games with integrated marketplaces were more likely to buy loot boxes with the specific aim of selling items. Around a quarter to two-fifths(27.8% of the North American sample and 39.7% of the student sample) reported selling items loot boxes. Study 1 found a moderate to strong relationship for the association between scores for the RLI and problem gambling severity, the RLI and gambling-related cognitions and the RLI and three of the beliefs surrounding luck subscales. This was mirrored in the second study. However, a smaller effect size was observed. It was reported that across both studies, risky loot box use was more strongly correlated with problem gambling measures, as opposed to problem gaming measures.

Li et al. (2019) conducted a survey amongst adult videogame players ($n = 686$) assessing problem gaming and gambling behaviours, as well as mental distress. Their results indicated that 44% of the sample had purchased a loot box in the previous 12 months. In regard to demographics of loot box purchasers, it was reported that loot box purchasers were typically older than non-buyers, married or with partners, and reported higher levels of mental distress than non-buyers. Loot box purchasers were more likely to report significantly higher videogame engagement and gaming sessions, as well as being more likely to score higher on problem gambling measures and meet the criteria for IGD. Unlike Brooks and Clark (2019), the researchers found that loot box purchasing was significantly associated with problem gaming behaviours, even after controlling for videogame engagement. Online gambling frequency was found to partly explain the relationship between loot box purchasing and problem video gaming. However, loot box purchasing was not directly related to mental distress but was found to indirectly impact distress levels through the effect of problem gaming.

3.1.3. Physiological similarities between purchasing and opening loot boxes, problem gaming and problem gambling

The remaining two studies examined physiological changes (Brady & Prentice, 2019; Larche et al., 2021) (see Table 2). Both studies focused on adult populations of a specific subset of gamers. One study (Brady & Prentice, 2019) examined the galvanic skin response (GSR) and heart rate of experienced *FIFA* players ($n = 25$) as they opened the least expensive form of loot box in the *FIFA Ultimate Team* game. The results of this study suggested that those with higher Gaming Addiction Scale (Lemmens et al., 2009) scores had less of an increase in GSR when opening loot boxes. GSR was found to increase from an established baseline while the sample both played a game of *FIFA* and opened loot boxes. However, this result was not statistically significant. The heart rates of the sample did not significantly change when opening loot boxes.

The other study included in this category (Larche et al., 2021) examined self-reported arousal, valence, urge, and disappointment as well as the post-reinforcement pauses (PRPs), skin conductance response (SCR), and force exerted in a mouse-click of *Overwatch* players who attended the University of Waterloo (Canada) across two studies ($n = 47$, $n = 46$). The first study solely assessed self-reported arousal, valence, and urge in participants after they are shown a clip of a short sequence of a loot box being opened. The results indicated that loot boxes that had a higher objective reward rating (i.e., 'rare', 'epic' and 'legendary' boxes, where rare boxes cost the least amount of in-game currency and legendary cost the highest amount of in-game currency) were rated by participants to be higher in subjective value, arousal, and valence. Loot boxes that contained at least one 'legendary' item showed the greatest arousal scores compared to 'epic' and 'rare' rated loot boxes. The participants also rated higher levels of an urge to keep opening loot boxes for higher objectively rated loot boxes. The relationships between these scores were all statistically significant.

The results of Larche et al.'s (2021) second study mirrored the first for ratings of arousal, valence, subjective value, and urge to continue opening further loot boxes. Disappointment levels were found to increase as objective value ratings of loot boxes decreased. No significant difference was found in SCR for 'rare' and 'epic' loot boxes. However, there was a statistically significant difference in SCR for 'legendary' tier loot boxes. More specifically, when the participants opened a legendary tier loot box, they were reported to have greater SCR levels. Reports of the force of click at each level of loot box opening mirrored findings for SCR levels. Additionally, PRPs were assessed after participants watched clips of the loot boxes being opened. It was found that larger PRPs were reported for 'legendary' and 'epic' tier loot boxes. This was a statistically significant relationship. Finally, it was reported that arousal levels increased during the anticipatory period in the loot box opening process.

3.2. Pay-to-win micro-transactions and their relationship to problem gaming and gambling behaviours

3.2.1. Pay-to-win micro-transactions and problem gaming

One of the two studies (see Table 2) addressing pay-to-win microtransactions focused on their relationship with problem gaming. Lelonek-Kuleta et al. (2021) examined two samples of adult Polish gamers ($n = 2000$, $n = 1702$), the second of which were specifically pay-to-win gamers. The results of the first study provided key demographic details for Polish pay-to-win gamers. Of the full sample for the first study, 1.7% had played pay-to-win games in the previous 12 months. A further 20% of which had made payments while playing these games. The first study found that pay-to-win gamers were more likely to be females from single person households but who had families with children aged 7–14 years old.

The results from the second study provided more in-depth details of

pay-to-win gamers. Here, 67.9% of the sample had made in-game payments. 59.2% of the 67.9% identified that this was specifically to advance in the game. Their findings indicated that age was the only predictor of purchase and that predictors for purchase differed between males and females. For females, household income was a predictor but for males, education level was a predictor.

From these data, Lelonek-Kuleta et al. (2021) identified five different patterns of pay-to-win gaming . These were *regular very involved/high payment* (i.e., played every day for an average of two to 3 h, and paid to advance several times a times month with a spend of Polish zloty [PLN] 19–39); *regular involved/low payment* (i.e., played several times a week for an average of 30–60 min and paid once a week with a spend of PLN 11–18); *moderately involved/occasional payment* (i.e., played several times a month for an average of one to 3 h and rarely paid but spent PLN 11–39); *regular uninvolved* (i.e., played every day for up to an hour and rarely paid but spent PLN 4–10) and *occasional uninvolved* (i.e., played several times a month for up to 30 min and rarely paid but spent less then PLN 4 if they did so).

More severe problem gaming symptoms occurred in the *regular involved/low payment* group, with nine out of ten symptoms appearing more intense than other groups. This pattern was also represented by the highest number of participants. The *regular very involved/high payment* group was the second most represented group, showing moderate to severe levels of symptom intensity. The *moderately involved/occasional* payment group showed a moderate level of symptom intensity, with the *regular uninvolved* group showing the least. Overall, their results indicated that the intensity of problem gaming symptomology was not related to play time but rather to the frequency of payment and involvement in the game.

3.2.2. Pay-to-win micro-transactions, problem gaming and problem gambling

One out of the two studies (see Table 2) focusing specifically on pay-to-win micro-transactions analysed their impact on both gaming and gambling behaviours. Steinmetz et al. (2021) investigated a sample of German adults who had either gambled or purchased pay-to-win products ($n = 6000$). Their results indicated that advancing in the game was the most prominent motivation for paying to win, particularly for increasing the chances of winning. Similar to Lelonek-Kuleta et al. (2021), Steinmetz et al. (2021) found that employed females aged in their early forties were more likely to be pay-to-win gamers but pay-to-win gamers who also gambled were more likely to be younger, less educated, and have lower incomes.

Those who participated in specific forms of gambling, such as slots, poker, and casino games were more likely to participate in pay-to-win gaming. The frequency of payments of pay-to-win gaming was found to be the strongest predictor of the frequency of payments in gambling games. This relationship also worked in the opposite direction – those who made higher frequencies of payments in gambling games were more likely to make higher frequencies of pay-to-win payments. Overall, frequency of payment in either pay-to-win or gambling games, rather than cumulative spending amounts was more influential in predicting participation and play frequency in the other.

3.3. Multiple micro-transaction types and their relationship to problem gaming and gambling

3.3.1. Multiple microtransaction types and problem gaming

Of the eight studies assessing multiple micro-transaction types included in this review, one (King et al., 2020b) (see Table 2) assessed micro-transactions and problem gaming. The study investigated *Fortnite* players aged 18–60+ years ($n = 428$) and the purchase of both loot boxes and skins and how these may impact gaming behaviours. The results of the survey found that micro-transaction spending was most influenced by peers, particularly close friends and greater access to the *Fortnite* videogame across different devices. Those who spent more were typically older, had a close friend who also spent money on micro-transactions, were more likely to use more than one type of payment method, and spent more hours playing the game. However, King et al. (2020b) found that gaming disorder symptoms were not associated with micro-transaction purchase and instead were more closely related to social factors, including belonging to large online social networks. This result contradicts the findings of Li et al. (2019) who suggested that those who purchased micro-transactions were more likely to score higher on the IGD criteria. However, Li et al.'s research only addressed loot boxes, while King et al.'s (2020b) study addressed more than one kind of micro-transaction, which may explain the difference in findings.

3.3.2. Multiple micro-transaction types and problem gambling

Five of the studies in the present review assessed multiple micro-transaction types and problem gambling (see Table 2). One study (Macey & Hamari, 2019) assessed esports spectators aged 14–50+ years ($n = 582$), one study (Zendle et al., 2019) assessed adolescent gamers aged 16–18 years ($n = 1155$) and one study (DeCamp, 2020) assessed American youth from the state of Delaware aged 13–14 years and 16–17 years ($n = 13{,}042$). One of the studies (Zendle & Cairns, 2019) assessed US adult samples ($n = 1172$) and the final study (Zendle & Cairns, 2018) investigated adult samples from a variety of countries ($n = 7422$).

Macey and Hamari (2019) investigated the impact of both loot boxes and skins. Their results indicated that 67.18% of the sample had both spectated esports and gambled in the previous 12 months, including loot box purchasing as a form of gambling. Of these, 61.6% had used multiple channels to gamble, including the purchase of loot boxes. Loot box purchasing was found to be the most popular form of gambling (with 42.6% participating), followed by videogame-related gambling (19.8%), which included betting. It was found that 121 of the 177 participants who opened loot boxes also used skins to gamble. Contrary to the researchers' hypotheses, loot box consumption had a significant negative relationship with esports spectating. Loot box engagement had a strong association with the PGSI. However, Macey and Hamari (2019) suggest that this relationship was not as strong as relationships between problem gambling and both online gambling and videogame-related betting. Their results also suggested that those who used multiple channels to gamble, including those used channels to purchase loot boxes, were more likely to display problem gambling behaviours.

Zendle and Cairns (2018) assessed the relationship between loot boxes and other non-specified micro-transactions and problem gambling in a large-scale survey. Of the total sample, 78% had purchased loot boxes and 17% had engaged in other forms of micro-transaction purchases. The results indicated that the more severe an individual's loot box spending, the more severe their problem gambling score. This was a statistically significant relationship of small to medium effect size. The relationship between other micro-transaction purchases and problem gambling was also statistically significant overall, but the specific purchase difference between non-problem gamblers versus problem gamblers was not statistically significant.

In an attempt to replicate their earlier findings, Zendle and Cairns (2019) conducted an online survey, once again investigating the relationship between loot boxes and other micro-transactions and problem gambling severity. Similar to their earlier results, it was found that there was a significant association between PGSI scores and loot box spending, with a small to moderate effect size. In this study, the relationship between other micro-transaction purchases and problem gambling was significantly stronger. However, once again, this relationship was less significant than between loot box purchase and problem gambling. Moreover, their results indicated that there was no significant spending difference between low-risk, moderate-risk, and problem gamblers, but that non-problem gamblers did spend less money on loot boxes.

Zendle et al. (2019) investigated loot boxes and other non-specified micro-transactions (any paid-for ingame items). As with previous studies (Kristiansen & Severin, 2020; Wardle & Zendle, 2021; Zendle,

2019), their results indicated there was a significant positive association between loot box spending and problem gambling (more specifically, the purchase of loot boxes, as opposed to free to open loot box options) The effect size of this relationship was found to be moderate to large, suggesting a significant real-world impact. Out of the loot box features assessed (i.e., cash-out options, for gameplay advantages, showing 'near misses', can only be bought using in-game currency, given away for free, the ability to 're-invest loot box content in further loot boxes and limited-time content), only two strengthened the associations between loot box purchasing and problem gambling. These were items in loot boxes only being available for a limited time and loot boxes sometimes being given away for free. From these findings, eight motivations for loot box purchasing were found. These were for gameplay advantages (21.9%), to gain items to build a collection (19.2%), for fun/excitement (16%), for avatar appearance (15.3%), to support game developers (10.7%), the perception that items received were of good value (9.8%), for time advantages (6.2%), and to make a profit (0.9%). Regarding the relationship between other non-specified micro-transactions and problem gambling, a significant relationship was found. However, the effect size was four times smaller than that of loot boxes and problem gambling.

Of the 19 studies discussed in the present review, DeCamp (2020) is the only study to investigate the risk factors associated with micro-transaction purchase and their similarities and differences to those for gambling. DeCamp's study investigated similarities in predictors between loot box purchasing, downloadable content (DLC) purchasing, and gambling. The sample comprised two age groups. These were 13–14-year-olds (8th grade) and 16–17-year-olds (11th grade). The study found that prevalence rates for both loot box and DLC purchasing were low in both samples, but that gender was the strongest predictor for these purchases. For the 8th grade sample, another significant predictor of loot box purchasing included being bullied outside of school, whereas for DLC purchasing, strong predictors included depression, anxiety, cigarette use, and being Hispanic. This differed from the 11th-grade sample, with strong predictors for loot box purchasing being bullied inside of school environments, cigarette, vape, and marijuana use. For DLC purchasing, strong predictors were depression and anxiety. Overall, loot box and DLC purchasing were poorly predicted by typical gambling predictors.

3.3.3. *Multiple micro-transaction types, problem gaming and problem gambling*

Three of the studies (see Table 2) discussing multiple micro-transaction types investigated relationships with both problem gaming and problem gambling. Drummond et al. (2020) conducted an online survey with samples from Australia ($n = 339$), Aotearoa, New Zealand ($n = 323$) and the US ($n = 387$) assessing the relationship between loot boxes and non-randomised virtual items, and a variety of variables relating to both problem gaming and gambling (i.e., symptomology of problem gambling, excessive gaming, positive and negative mood, and psychological distress). They also examined the relationship between the RLI (Brooks & Clark, 2019) and IGD symptomology. Their results showed that participants with higher problem gambling severity spent more on loot boxes. However, they found that risky loot box engagement also contributed to this relationship. Moreover, participants with higher problem gambling severity were also more likely to spend higher amounts on non-randomised in-game items. Participants with higher loot box spending experienced greater negative mood and psychological distress but also experienced increased positive mood. Whilst these results may seem to be contradictory, Drummond et al. (2020) suggest that this could be due to participants finding loot boxes exciting or fun to open, regardless of the negative mood and psychological distress as a result of opening loot boxes. However, the effect size of the relationship between higher loot box spending and increased positive mood was small. Excessive gaming was also found to have an association with loot box spending, although excessive gaming is not necessarily indicative of problematic gaming (Griffiths, 2010). Overall, risky loot box engagement was associated with spending higher amounts of money, more so than any other variable examined.

King et al. (2020a) investigated the co-occurrence of problem gaming and problem gambling in emerging non-student adults in the US and the role those micro-transactions play in this relationship. Their results indicated that 157 participants from the total sample ($n = 300$) played videogames that included micro-transactions. Of the 157, 55.4% spent money on micro-transactions each month, with 6.4% spending over $100 on one videogame title. Two of the 55.4% spent between $1000 and $2000 on a single title. Of the total sample, 31.4% reported having problems with micro-transactions and 37.1% reported having intensifying urges to purchase more micro-transactions as time increased. Of the variables examined, obligation to purchase micro-transactions and monthly spend had the strongest direct associations with IGD and disordered gambling. Micro-transaction purchase was found to partially explain the relationship between severity levels of IGD and disordered gambling. However, overall, micro-transaction purchase was more closely related to problematic gaming symptomology. The results from this study align with those from Li et al. (2019) but contradict those of King et al. (2020b).

Von Meduna et al. (2020) assessed both loot boxes and pay-to-win micro-transactions and their relationships to problem gambling and problem gaming in a large-scale German population. Their results indicated that 1508 of the total sample ($n = 6000$) were P2W gamers. 38.9% of the 1508 had also purchased loot boxes in the previous 12 months. Demographic differences between loot box purchasers and P2W gamers were established. Similar to the findings of Lelonek-Kuleta et al. (2021), it was found that P2W gamers were more often female and older than those who purchased loot boxes. In terms of the frequency of purchase, the study identified that 81.8% of those who purchased loot boxes every day had problems with P2W gaming (assessed using an adapted form of the PGSI specifically for game related spending and time expenditure). A total of 64.8% of the sample who purchased loot boxes every day were classified as problem gamblers using the PGSI. However, of the group who did not purchase loot boxes every day, 66.72% had problems with P2W gaming and 42.6% were classified as problem gamblers.

The results of their survey also indicated a variety of statistically significant relationships. Age was negatively associated with loot box purchase but not the frequency of these purchases. This result is in alignment with other findings that loot box purchasers are typically younger (Steinmetz et al., 2021; Wardle & Zendle, 2021). Being male was also positively related to loot box purchasing but no significant relationship was found between gender and the frequency of loot box purchase. Like age, this finding has been identified across as range of the reviewed literature (Kristiansen & Severin, 2020; Wardle & Zendle, 2021). Both lower education levels and employment status were positively related to loot box purchasing, with employment status also having a significant positive relationship with purchase frequency.

Looking at loot box engagement in relation to forms gambling, both loot box purchasing, and the frequency of these purchases were positively related to real money gambling spend. That is, the more an individual spent on real money gambling, the more they engaged with loot boxes. The only specific forms of gambling positively associated with loot box purchase frequency were casino games and lottery participation. Like the findings of Macey and Hamari (2019), online sports betting, as well as esports betting were significantly negatively associated with loot box purchasing. Further to real money gambling spend, gambling with play money (virtual currency) was also assessed. Both loot box purchasing, and the frequency of these purchases were positively associated with gambling for play money. When accounting for age and employment status, frequency of loot box purchase had a positive relationship with problem gambling. Problems with P2W gaming also had a positive relationship with loot box purchasing but not frequency of purchase.

4. Discussion

The present study reviewed the literature published after 2010 within the field of problem gaming and problem gambling and the relationship between these and videogame micro-transactions, including a variety of micro-transactions and physiological relationships between micro-transactions and problem gambling. As a result, the present review is currently the most comprehensive and contemporary review examining the relationship between videogame micro-transactions and both problem gaming and gambling.

Overall, the present review found that the higher-rated an individual scored on scales for problem gambling, the more likely they spent more money on purchasing loot boxes. In fact, 11 of the 19 studies reviewed found this relationship to be significant. This appeared to be the case across the samples, irrespective of demographic differences. Even in studies with younger participants (Kristiansen & Severin, 2020; Macey & Hamari, 2019; Wardle & Zendle, 2021; Zendle et al., 2019), this relationship remained significant. The significance of the relationship with youth samples brings about two important points. Firstly, while it is possible that youth samples are engaging in illegal and unlicensed forms of gambling or more accessible forms of gambling are available (Calado et al., 2017; Macey & Hamari, 2019), the relationship between loot box purchasing and problem gambling severity observed in this review may also suggest that loot box purchasing acts as a gateway to further gambling, leading to higher severities of problem gambling. Secondly, papers using expenditure as a measure with younger participants still found significant increases in spending, even though youth samples typically have less disposable income than older samples. Therefore, it could be the case that youths are spending more money on videogame micro-transactions than older samples, relative to their total disposable incomes.

Young males in particular were found to be more prominent users of loot boxes (DeCamp, 2020; Kristiansen & Severin, 2020). Macey and Hamari (2019) found that *underage* males specifically were the most prominent forms of esports gambler (including the purchase of loot boxes). It could be the case that these demographics are reflective of problem gambling demographics, as males are more likely to be problem gamblers when assessing youth problem gambling prevalence internationally (Calado & Griffiths, 2016) and this may be a further indication of the relationship between loot box purchasing and problem gambling. This may also be explained by wider gaming-related literature, because gender differences between game genre preference and motivations for play are established, with females typically enjoying puzzle or skill-based games, and males enjoying action and competitive games (Romrell, 2013). Therefore, it could be the case that males are less likely to purchase other forms of micro-transaction, such as pay-to-win (Table 1) types because they play for competition and, as some loot box items enhance gameplay and give gameplay advantages, this may be appealing for those motivated by competition (Li et al., 2019). Given that males are typically found to play videogames for achievement (Carlisle et al., 2019), this aligns with the findings of the present review.

Only one study from the 19 reviewed discussed motivations for loot box purchasing specifically (Zendle et al., 2019). The most prevalent motivation for loot box purchase was for gameplay advantages, with the second being for the collection of items. Of the motivations identified, the least prevalent was purchasing loot boxes for profit. While this may initially seem to differ from gambling motivations, suggesting a dissimilarity between loot box purchasing and gambling, wider literature suggests that factors such as excitement, social reasons and gambling for boredom are also found to be reasons for gambling (Canale et al., 2015; Griffiths, 2007; Neighbors et al., 2002). Motivations relating to collecting items and competitions are also found in gaming-related literature, in the category of achievement (Yee, 2006). However, further research into motivations for the purchase of a variety of micro-transactions may provide a more in-depth discussion necessary to identify similarities and dissimilarities and how these may contribute to problematic gaming and gambling behaviour.

The present review identified two studies (Brady & Prentice, 2019; Larche et al., 2021) that assessed the physiological similarities between opening a loot box and participating in gambling games. Brady and Prentice (2019) reported small increases in galvanic skin response (GSR) while both playing a game of *FIFA* and opening loot boxes in the game, indicating a small increase in excitement levels. The study found no changes in participants' heart rates. However, the methodological limitations of this study may have contributed to the lack of arousal observed. By conducting the study on experienced *FIFA* players yet using the cheapest loot box available (containing the lowest rated players), it is possible that participant expectations limited their arousal levels. If participants were allowed to open the highest level of loot box (potentially containing the best-rated players), their arousal levels may have shown greater increases upon opening of the loot boxes.

This was shown to be the case in Larche et al.'s (2021) study, which used a range of loot box ratings. Skin conductance response (SCR), which is also a measure of electrodermal activity like GSR, was found to significantly increase with loot boxes containing rarer rewards. Moreover, longer post-reinforcement pauses (PRPs) were found when loot boxes containing more rare items were opened. In the case of electronic gambling, research suggests that wins produce increased SCR responses, whereas losses do not, or they produce less of an SCR response (Lole et al., 2012). This could indicate that the opening of loot boxes with rarer items is physiologically like gambling and more specifically, winning in gambling games. Loot boxes with less rare items did not produce as great a level of SCR. Self-reported rating for an urge to continue opening loot boxes in Larche et al.'s (2021) study showed that loot boxes that contained rarer items were rated higher than those that contained less rare items. These 'wins', as well as an urge to continue opening rarer loot boxes, could contribute to continued and problematic use and help explain the associations between loot box opening and problem gambling severity observed among studies in the present review.

Looking at papers addressing other and multiple forms of micro-transaction, Lelonek-Kuleta et al. (2021) found that those who spent money on pay-to-win micro-transactions more frequently were more likely to exhibit problematic gaming behaviours and have higher levels of involvement in the games. Similarly, Li et al. (2019) reported a significant association between loot box purchasing and problematic video gaming. Those who purchased and engaged with loot boxes were more likely to meet the criteria for IGD. This relationship was explained further by King et al. (2020a) who suggested that obligation to engage in micro-transaction purchasing and monthly spending rates had the strongest associations with the criteria for IGD. These associations could be suggested to be underpinned, by the structural characteristics of some videogames and the reward reinforcement schedules used.

For pay-to-win gamers, the speed of reward reinforcement may explain the associations to problematic gaming and gambling behaviour (Griffiths & Nuyens, 2017). It may be the case that multiplayer online battle arena (MOBA) style games, such as *DOTA 2*, have shorter rounds that may lead to more micro-transaction purchases. This could be due to the reward reinforcement schedule involved (Griffiths, 1999). If micro-transactions are offered to the player as rewards for winning after every 15-40-min round, this may shorten the time between reward processes taking place. With shorter or fewer post-reinforcement pauses occurring, players may be inclined to continue purchasing micro-transactions, like slot machine gambling (Griffiths, 1993). For those who pay-to-win, there is no limit in the number of purchases that can be made in a specific timeframe, indicating even fewer post-reinforcement pauses. In line with this, the literature reviewed in the present study indicates that the frequency of micro-transaction purchasing is a key component in their impact on problem gambling severity and problem gaming behaviour (Lelonek-Kuleta et al., 2021; Steinmetz et al., 2021; von Meduna et al., 2020).

Conversely, King et al. (2020b) found that the purchase of *Fortnite* micro-transactions (loot boxes and skins) were not associated with

gaming disorder symptomology and instead were more closely related to social influence. Having a close peer that also purchased micro-transactions in *Fortnite* was a more influential factor than those relating to gaming disorder and impulsivity. This finding concurs with wider literature surrounding the purchase of virtual goods, with Wohn (2014) suggesting that those with more friends involved in a videogame tend to spend more money on virtual goods. However, it should be noted that the sample size used in this study was considerably smaller than others in the present review assessing gaming disorder symptoms, which could explain the contradiction in significance of the relationship between micro-transactions and gaming disorder. This disparity in sample size could also indicate reduced study quality in comparison to papers also assessing the relationship between gaming disorder and micro-transaction purchase.

Overall, it could be the case that competition between friends is a driving factor for micro-transaction purchase, especially when considering motivations for gaming and gambling and the demographic distinctions found in the present review. This also brings about questions of external social influence on players and how this may impact micro-transaction purchase. To date, little research has been conducted into the influence of videogame streamers and content creators on their audiences. Although spectating esports, as well as participating in esports betting, lowered loot box consumption (Macey & Hamari, 2019; von Meduna et al., 2020), more casual videogame streamers and *YouTube* personalities are less restricted in the content they produce. Digital 'influencers' have been found to impact brand engagement, expected value, and intention to purchase (Jiménez-Castillo & Sánchez-Fernández, 2019). If this is the case, then it could be suggested that videogame players who also engage with *YouTube* communities and online streaming platforms may engage in more micro-transaction purchases.

4.1. Implications of the present review and regulatory recommendations

Firstly, it is clear from the aforementioned research that even though micro-transactions may have different functions or structures (i.e., P2W versus loot boxes), frequency of payment is an important factor when looking at the potential relationships between micro-transactions, problem gaming and problem gambling. Both classical and operant conditioning theories suggest that more frequent events or quicker pay out frequencies could increase the likelihood of problematic micro-transaction purchase behaviour and problem gambling symptoms through reinforcement (Griffiths, 1993; Harris et al., 2021; Harris & Griffiths, 2018; Parke & Griffiths, 2004). If this is the case, it is crucial that regulations regarding frequency of micro-transactions are considered. For example, limiting the amount of micro-transaction purchases available in videogames in a set amount of time may reduce the frequency of event or pay out, allowing for larger pauses between reward reinforcement.

Moreover, the research studies assessed a large range of ages, from youths to adults and spans various countries. Although in some countries, loot box regulations and policy have been implemented, there are still hesitations to declare loot boxes as forms of gambling. Given the accessibility of videogames, the samples assessed in current literature and the general consensus that loot boxes are linked to problem gambling, it is clear that loot boxes should be regulated in some form globally. Although the direction of the relationship between problem gambling and loot boxes is currently unknown, there is still a potential for harm to vulnerable populations regardless of the direction of this relationship. As videogames and subsequently the micro-transactions within them are accessible to younger audiences of players, the potential for early exposure to gambling-like mechanisms should be addressed. For example, classifying loot boxes as a form of gambling would allow for regulation based on each countries'- gamblingrelated policy and minimise harm to those under the legal gambling age. In terms of other forms of micro-transaction (i.e., skins, P2W and battle passes) and associations with problem gaming and gambling, further research is necessary to clarify these relationships before regulatory methods are discussed.

However, an interesting result found in the present review was that an increase in spending in loot boxes increased positive mood (Drummond et al., 2020). If this is the case, then non-recreational games, often called 'serious' games, that focus on self-improvement could potentially utilize specific types of micro-transactions to increase engagement and excitement when playing. For example, apps that use gamified methods to teach users, such as the *Duolingo* language learning app, are increasingly using pay-to-win forms of micro-transaction, in order to restore in-game health. In this case, including other forms of micro-transaction, such as loot boxes, may be beneficial for videogame companies.

4.2. Future research

The present review paper demonstrates the limited research within the field of micro-transactions, problem gaming and problem gambling. Current literature does not go beyond establishing a correlational relationship between these and in the case of the relationship between engaging in micro-transactions and problem gaming, the arguments presented are not cohesive. Therefore, only inferential analyses into the relationship between videogame micro-transactions, problem gaming, and problem gambling can be discussed. However, there is a clear established association between loot box purchasing and problem gambling, with most of the research presented indicating that those who purchase more loot boxes were more likely to score higher on problem gambling measures (however, this relationship could be bi-directional). Given the diversity of samples included in the research, over a span of ages and in a variety of countries, this is perhaps the only consistent finding of the present review. As research within this field is in its infancy, there is also an apparent lack of methodological diversity in the research presented. As such, future studies should consider in-depth and methodologically diverse research, focusing on multiple micro-transaction types and the differences between these. Further analyses of micro-transaction relationship to problem gaming would also be beneficial. Finally, more experimental and longitudinal research is necessary, in order to establish causality (Griffiths, 2018, 2019).

4.3. Limitations

Although the present review followed best practice guidelines (Siddaway et al., 2019), there are several limitations that should be considered. Firstly, the inclusion criteria for the present review excluded secondary and non-empirical research. In doing so, relevant literature discussing theoretical underpinnings and implications of the relationship between micro-transactions, problem gaming and problem gambling may have been excluded. Moreover, research surrounding micro-transactions, problem gaming and problem gambling is in its relative infancy. This means that conclusions of the review are based on a limited body of research. Furthermore, the fast pace of the videogame industry means that new forms of micro-transactions not discussed in this review may be developed. Due to this, it may be necessary to update this review in the near future, to ensure that conclusions are relevant.

5. Conclusion

The research investigated in the present review suggests that a relationship between loot box purchasing and problem gambling is observed across a variety of samples with differing demographics. However, the purely correlational nature of this research means that only inferences regarding the cause or direction of this relationship can be made. While there is evidence to suggest that other forms of micro-transaction purchasing may also have relationships with problem gambling, further research to establish the strength of this relationship is necessary. Associations between micro-transaction purchasing

(including loot box buying) and problem gaming have also been established. However, conflicting evidence suggesting that there is a limited link between micro-transaction purchasing and problem gaming indicates the need for further study. Finally, recommendations for potential regulations and policy have been made as a result of the present review.

Credit author statement

Erin Gibson: Formal analysis, Writing – original draft preparation, Writing – review & editing **Mark D. Griffiths**: Supervision, Writing – review & editing **Filipa Calado**: Supervision, Writing – review & editing **Andrew Harris**: Supervision, Writing – review & editing.

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The fourth author has previously worked for the Responsible Gambling Trust Aware (now GambleAware), a charitable body in the UK which funds its research program based on donations from the gambling industry. The fourth author received a small research grant from GambleAware in 2017. The fourth author has also previously received payment for consultancy work in the area of social responsibility and gambling harm-minimisation for a major high street and online bookmaker.

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