

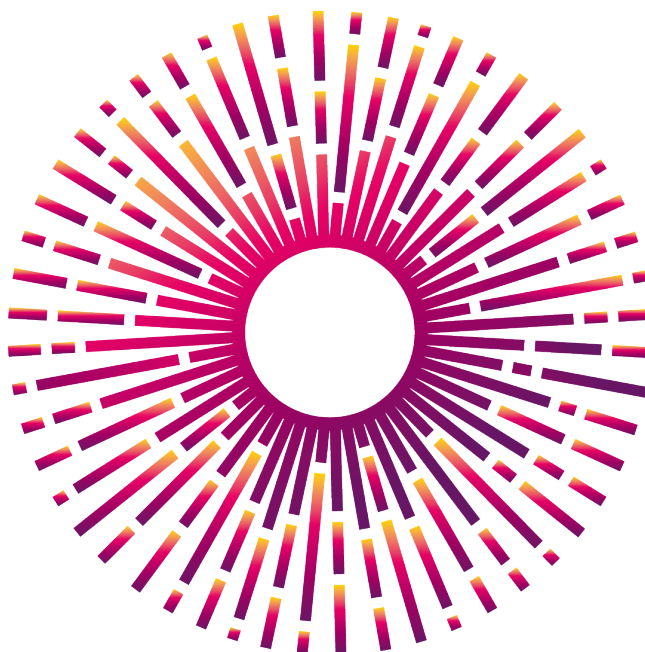


Harms associated with loot boxes, simulated gambling and other in- game purchases in video games: a review of the evidence

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Executive summary

Key definitions

Loot boxes

An in-game purchase of a virtual container (i.e. loot box, mystery box or chest) that randomly awards players with functional items or modifications (such as cosmetic items or weapons) based on chance or adjusted probabilities (King & Delfabbro, 2020). Loot boxes can also be obtained for free via gameplay (Rockloff et al., 2020).

Simulated gambling

Games with features that resemble or function like commercial gambling activities (King, 2018). This includes social casino games, free demo (demonstration) games, and other games with gambling-like components. Some, but not all, simulated gambling activities have in-game purchases; however, these in-game purchases operate in a closed-loop economy where they cannot be redeemed for money or traded among players.

In-game purchases

Financial purchases in games for digital goods or services, also referred to in the literature as 'microtransactions'. In-game purchases may be purely aesthetic (e.g. cosmetic items or 'skins'), confer gameplay advantages (e.g. pay-to-win), contain these items as randomised contents of uncertain value (e.g. loot boxes), or include any other in-game expenditure (Zendle, Meyer, & Ballou, 2020).

The past decade has seen an increase in the monetisation of video games, games with chance-based outcomes (e.g., loot boxes), and simulated gambling. Policy makers, researchers and the general community have raised concerns that these products have the potential to expose, normalise and encourage monetary gambling, especially among children and young people, and that people who engage with these products may be at risk of gambling problems and other types of harm.

Background

The value of the global video game industry is projected to grow to US\$160 billion by 2022, and it is estimated that approximately 47% of the industry's revenue will be sourced from in-game purchases (Commonwealth of Australia, 2018). Virtual items and currency purchased in games can hold significant value to video game users based on their potential to provide desirable cosmetic features (e.g. 'skins') or facilitate or assist with game play (e.g. more powerful weapons) (Deblaquiere, Carrol, & Jenkinson, 2018).

While in-game purchases have many of the distinguishing features of gambling, they are not currently regulated as gambling in Australia (Hing et al., 2021). Submissions to the Australian Government's 2018 inquiry into gaming microtransactions for chance-based items raised concerns that loot boxes, as functionally and psychologically akin to monetary gambling and providing the opportunity for in-game purchases, may be associated with harmful outcomes such as problematic or addictive video gaming, financial losses, and risk for gambling problems. The inquiry concluded that further research was required to develop an evidence-based regulatory approach to mitigate harm from loot boxes (Commonwealth of Australia, 2018).



Games that structurally resemble traditional gambling activities are commonly referred to as 'simulated gambling'. As with loot boxes, increasing dialogue from researchers, policy makers and the community has identified concerns that simulated gambling activities (particularly where in-game purchases are involved) have the potential to normalise gambling for children/adolescents, encourage real-world monetary gambling, and have other harmful impacts (Armstrong, Rockloff, Browne, & Li, 2018; Derevenksy & Gainsbury, 2016; Department of Communications and the Arts, 2019; Dickins & Thomas, 2016).

To improve understanding and inform policy and regulatory responses, this evidence review aimed to assess the **harm** associated with the use of loot boxes, simulated gambling, and other in-game purchases, as well as recommendations in the literature for harm mitigation and regulatory responses.

Key research findings

A review of the current Australian and international literature was conducted (see Table 1 in the Methodology section for inclusion criteria and search terms). A total of 64 research outputs were reviewed and assessed on their strength and value of evidence on the harms associated with loot boxes, simulated gambling and other in-game purchases, as well as their generalisability to the Australian context. Harms, such as financial stress or mental-health impacts, differ from risky behaviours which *may* or *may not* cause harm (e.g., monetary gambling). The primary outcomes included in the reviewed studies were problem gambling, internet gaming disorder, and other harms (e.g., psychological distress). These were often defined by DSM-V diagnostic criteria (i.e., Problem Gambling, Internet Gaming Disorder) and were measured by validated scales, such as the Problem Gambling Severity Index (PGSI), Internet Gaming Disorder Scale (IGDS), and Kessler's Psychological Distress Scale (K-6).

Findings relating to evidence of harms

The review found reliable evidence that:

- **Loot box** engagement, including viewing, opening, and especially purchasing, was associated with problem gambling and internet gaming disorder.
- **Simulated gambling** engagement, especially in-game purchasing in social casino games, was associated with problem gambling.
- **Other in-game purchasing** (not including expenditure on loot boxes or in simulated gambling games) was associated with problem gambling.

In addition, there was some evidence of an association between:

- **Loot box** purchasing and increased psychological distress and financial harm.
- **Simulated gambling** engagement with internet gaming disorder, psychological/emotional harm, and other negative consequences.
- **Other in-game purchasing** and internet gaming disorder, financial harm and emotional and behavioural problems among adolescents.

The limited research available suggests that children/adolescents, females (loot boxes), males (other in-game purchases), pay-to-win gamers, and people at-risk of gambling problems may be more likely to experience harm.

The evidence review found that *greater* engagement predicted *more* harm, although it was unclear if engagement *caused* these harms. There was some evidence that the associations between engagement with these products and harm may be influenced by other factors,



including player characteristics (gender, age, ethnicity, impulsivity), video gaming behaviours, game features (e.g., pay-to-win), and involvement in monetary gambling.

Mitigation and regulation responses raised in the literature

Recommendations from the literature for harm mitigation and/or regulation of loot boxes, simulated gambling, and other in-game purchases centred around consumer protection measures. These included:

1. Age restrictions for people aged under 18 years, especially for spending money on loot boxes, simulated gambling, or other in-game purchases in video games
2. Options for limit setting and self-exclusion, e.g., deposit limits, self-exclusion register
3. Prominently displaying the odds of obtaining chance-based rewards
4. Clear labelling of gambling-like products and features in video games and messages on the potential risks associated with these products
5. Removing or reducing game features that encourage excessive expenditure and gameplay, e.g., pay-to-win features, rare items, item selling or trading
6. Provision of support information, e.g., help services, educational material.

Other recommendations in the literature for the mitigation and regulation of these products included: education and public awareness campaigns/strategies; identification and intervention for those at risk of harm; the gaming industry's role to engage in prevention and harm minimisation strategies; and regulation of products via existing gambling laws.

Gaps in evidence

Although there is consistent evidence of associations between engagement with these products and the harms outlined above, the direction of the relationship remains unclear - that is, which came first? Determining causality and observing changes over time (e.g., via longitudinal research) are important next steps to help inform policy development in relation to loot boxes, simulated gambling, and in-game purchases.

Further information about how factors such as player characteristics, product features and engagement in monetary gambling affect the degree or risk of harm related to these products would enhance our current understanding, and a greater focus on children and parents' experiences would help to inform targeted policy responses.



Background

This section provides key insights into the patterns of consumption and motivations for engagement with loot boxes, simulated gambling and other in-game purchases. Research suggests that some subpopulations (e.g. young people, males, people who gamble) are more engaged in these products and, either via exposure or normalisation, may be more likely to migrate to or increase their monetary gambling. Further, engagement with these products may be associated with experiences of harm, either via the products themselves (e.g. gaming disorder) or involvement in monetary gambling (e.g. problem gambling/harm).

Patterns of use and consumer profiles

Loot boxes

Some game publishers offer users the ability to purchase 'loot boxes' (sometimes known as mystery boxes, cases or chests) containing random in-game items (Deblaquiere, et al., 2018; King, 2018). A common variation is to periodically give users loot boxes for free but require them to purchase a 'key' to open the box (Deblaquiere et al., 2018). Some research suggests that loot boxes approximate electronic gambling machines (EGMs or 'pokies') or scratch tickets in their design; they have a low probability of obtaining certain rare items, encourage continued play and expenditure to obtain the desired reward, and meet an intrinsic motivation or need (e.g., feelings of excitement, social benefits, investment in the game, fear of missing out) (Drummond & Sauer, 2018; Hing et al., 2021; King & Delfabbro, 2018b; Rockloff et al., 2020, 2021; Zendle, Meyer, & Over, 2019).

An estimated 3% of Australian adults purchased loot boxes in 2019 (Hing et al., 2021), but research suggests that loot box engagement in Australia is higher among adolescents and young adults than the general adult population (Hing et al., 2020; Rockloff et al., 2020; Russell et al., 2020).

Recent studies of adolescents and young adults in NSW found that between 24% and 37% of participants reported purchasing loot boxes in the past 12 months (Hing et al., 2020; Rockloff et al., 2020; Russell et al., 2020). Higher rates of loot box purchasing were reported among adolescents aged 12–17 years (37%; Hing et al., 2020) compared to young adults aged 18–24 years and 25–29 years (29% and 24% respectively; Russell et al., 2020), and adolescent males were more likely than females to purchase loot boxes (48% vs 26%) (Hing et al., 2020).

The NSW Youth Gambling Study found that around one in three participants (34%) reported having bought loot boxes using virtual currency (purchased with real money), and 22% reported purchasing a loot box directly with real money (Hing et al., 2020). Though estimates vary, research has found that median monthly expenditure on loot boxes ranges between around \$10 to \$70 per month (Hing et al., 2020; Russell et al., 2020; Rockloff et al., 2020), but is commonly reported to be around \$20 per month (Russell et al., 2020; Hing et al., 2021).

Simulated gambling

Games that structurally resemble traditional gambling activities are commonly referred to as 'simulated gambling'. Although simulated gambling appears in many forms in video games, social casino games are the most common. Social casino games resemble chance or skill-based gambling activities and offer in-game purchases but exist in a closed-loop economy where money cannot be withdrawn from the game (King, 2018).



Reported participation in simulated gambling (in the previous 12 months) among Australian adolescents aged 12-17 years ranges from 15-40% (Hing et al., 2020; King et al., 2014; Warren & Yu, 2019). Factors associated with participation in simulated gambling among adolescents include being male, lower wellbeing, higher impulsiveness, parents not talking about safety online, parents not setting rules about online use, feeling a strong sense of belonging to an online community, and gambling with money in the past 12 months (Hing et al., 2020; King et al., 2014; Warren & Yu, 2019).

The main form of simulated gambling is social casino games. The 2019 Australian Interactive Gambling Study (Hing et al., 2021) found that online gamblers were significantly more likely than land-based gamblers to play social casino games. Other Australian studies with adolescents and adults have examined differences between social casino game users who make in-game purchases, compared to those who do not (Gainsbury, King et al., 2016; King et al., 2016). One study of adolescent social casino game users found that participants who made in-game purchases were significantly more likely to be male, play social casino games more frequently, and engage in more social casino games activities, compared to those who did not make purchases (King et al., 2016). Another study with adult social casino game users found those making in-game purchases were more likely than non-purchasers to be male, younger, speak a language other than English, have a university education, have started playing social casino games earlier, use social features on social casino games, and be more highly involved players (frequency, length, forms) (Gainsbury, King et al., 2016). The few studies that have examined in-game expenditure for social casino games found the median spend was around \$15 per month for adolescents and adults aged 18-29 years (King et al., 2016; Russell et al., 2020).

Other in-game purchases

Australian research on in-game purchases separate to buying loot boxes or spending money on simulated gambling games is relatively scarce. A nationally representative study conducted in 2017 with Australian youth aged 8-17 years found that 34% reported having made in-game purchases in the previous 12-months (Office of the eSafety Commissioner, 2018). In this sample, in-game purchases were more common among adolescents (38%) than younger children (32%), and males (51%) compared to females (34%). In 2019, the annual Digital Australia study found that 65% of Australian adult video-gamers reported having made in-game purchases for themselves, and 40% for others (e.g. their children) (Brand, Jervis, Huggins, & Wilson, 2020). A recent study with NSW adolescents aged 12-17 years reported a median expenditure of \$10 per month on in-game purchases, excluding money spent on loot boxes (Hing et al., 2020).

Motivations for use

Loot boxes

The most common motivations for loot box engagement reported in the Australian and international literature include:

- To obtain items for cosmetic reasons (e.g., skins) or to collect rare items of value (Hing et al., 2020; Rockloff et al., 2020; Zendle, Meyer, & Over, 2019)
- Excitement of unboxing items (Nicklin et al., 2021; Rockloff et al., 2020; Zendle, Meyer, & Over, 2019)



- Gameplay progression (Hing et al., 2020; Nicklin et al., 2021; Rockloff et al., 2020; Zendle, Meyer, & Over, 2019)
- Receiving in-game currency (Hing et al., 2020; Rockloff et al., 2020)
- Competitive gameplay advantages/pay-to-win (Hing et al., 2020; Nicklin et al., 2021; Rockloff et al., 2020; Zendle, Meyer, & Over, 2019)
- Social influences (e.g., peer engagement, status/esteem, because of streamers/pro gamers) (Nicklin et al., 2021; Rockloff et al., 2020)
- Investment in games (e.g., by supporting the game developers, especially for free games) (Nicklin et al., 2021; Rockloff et al., 2020; Zendle, Meyer, & Over, 2019)
- Emotive/ impulsive influences (urges, temptation, lack of control, boredom, escapism) (Nicklin et al., 2021; Rockloff et al., 2020)
- Fear of missing out (Nicklin et al., 2021; Rockloff et al., 2020)
- Triggers/facilitators (promotions, special events, ease of purchase) (Nicklin et al., 2021).

The authors of these studies suggest that many of these motivations for loot box engagement overlap with those of traditional monetary gambling.

Simulated gambling

A narrative review of young people's engagement with simulated gambling games, including social casino games and other types of gambling-like or themed games, found the main motivations for participation were for fun or entertainment, as a way to relax, relieve boredom or pass the time, relieve negative emotions (e.g. anxiety, depression) and/or escape from problems, practice for 'real money' gambling activities, or for the challenge or the competition (Dickins & Thomas, 2016). Gainsbury, King, Delfabbro and colleagues (2015) found similar key motivations for playing social casino games among Australian adults, including: to learn games before trying monetary gambling, to practice to improve gambling skills, as a substitute for gambling, to gain gambling-like experiences but spend less money, to extend playing time, and to earn credits/bonuses/prizes.

An Australian study with adolescent social casino gamers (12–17 years) found those who made in-game purchases in social casino games (compared to those who didn't) were more motivated by social interaction, to relieve stress/escape from worries, to pass the time/avoid boredom, to improve gambling skills, to make money (i.e. via selling gaming account online), and for the competition/challenge (but not excitement/fun) (King et al., 2016). Another cross-sectional study of adult social casino gamers found that the main motivations for in-game purchases were to increase enjoyment, to take advantage of special offers, to get ahead in the game, an impulsive decision to continue play, to make the game fun, to purchase gifts for friends, and to avoid waiting for or earning credits (Gainsbury, King et al., 2016).

Other in-game purchases

Research has found that motivations for making in-game purchases in general are similar to motivations for purchasing loot boxes or spending in simulated gambling. For example, a study of Australian households in 2019 found that motivations for making in-game purchases among adult video-gamers, either for themselves or others, were to: continue playing, unlock new content, support a game, personalise gameplay, speed up gameplay, avoid ads or spam, make gameplay more enjoyable, enable multiplayer mode, and gain advantage over others (Brand et al., 2020).



Association with monetary gambling: co-occurrence and migration

Gaming and gambling are defined as separate activities, but they share features of interactivity, presentational qualities and elements of skill and chance (Hing et al., 2020). Research exploring associations between loot boxes, simulated gambling and other in-game purchases and monetary gambling has examined:

- i. the association between engagement in these products and monetary gambling (co-occurrence)
- ii. retrospective self-reports of the influence of these products on uptake or increased involvement in monetary gambling (self-reported migration)
- iii. longitudinal studies directly measuring how engagement in these products at time one influences later monetary gambling at time two (directly measured migration).

Loot boxes

To date, Australian and international research has examined the relationship between loot box engagement (opening, buying, or selling) and participation in monetary gambling using cross-sectional surveys. These studies have provided evidence of co-occurrence of these behaviours, but not a transition effect (i.e., migration to monetary gambling), among samples of adolescents, young adults, and older adults (Hing et al., 2020; Li, Mills, & Nower, 2019; Rockloff et al., 2020; von Meduna, Steinmetz, Ante, Reynolds, & Fiedler, 2021; Wardle & Zendle, 2021). In addition to the relationship found between loot box engagement and monetary gambling participation, research has found loot box purchasing to be associated with higher gambling frequency (Li, Mills, & Nower, 2019; Rockloff et al., 2020; von Meduna et al., 2021; Zendle, 2020), expenditure (Rockloff et al., 2020; Wardle & Zendle, 2021), and session length (Li, Mills, & Nower, 2019), as well as positive attitudes towards gambling (Rockloff et al., 2020) and future intentions to gamble with money (Hing et al., 2020).

Simulated gambling

Several literature reviews and commentaries have examined the 'gateway hypothesis' that simulated gambling leads to monetary gambling (Armstrong et al., 2018; Delfabbro & King, 2021; King, 2018; King, Russell, & Hing, 2020; Kolandai-Matchett & Abbott, 2021). Although there appears to be consensus from the authors that simulated gambling is associated with a greater likelihood of engagement in monetary gambling, particularly among young people, the evidence to date is mostly based on cross-sectional studies and has only examined co-occurrence/correlational relationships. For example, Australian and international studies show evidence of a relationship (co-occurrence) between simulated gambling and monetary gambling among adolescents (Gainsbury, King, Delfabbro et al., 2015; Hing et al., 2020; Kim, Wohl, Gupta, & Derevensky, 2017; King et al., 2016; Macey & Kinnunen, 2020) and adults (Gainsbury, King, Delfabbro et al., 2015; Gainsbury, Russell et al., 2016; Macey & Kinnunen, 2020; Rockloff et al., 2018; Zendle, 2020), and research with adolescent social casino gamers has found that those making in-game purchases (versus those not) were more likely to engage in monetary gambling, and with higher frequency and expenditure (King et al., 2016).

Unlike for loot boxes, however, there is some evidence from retrospective self-report surveys and longitudinal studies of migration from simulated gambling games to monetary gambling among both adolescents and adults (Brosowski, Turowski, & Hayer, 2020; Dussault et al., 2017; Gainsbury King, Delfabbro et al., 2015; Gainsbury, Russell et al., 2016; Kim et al., 2015;



Rockloff et al., 2018). Gainsbury and colleagues (2015) found that self-reported migration from social casino games to monetary gambling was more common among males (adolescents and adults), younger adults, adults engaging in higher frequency social casino game play, adults making in-game purchases, and adults experiencing higher levels of problem gambling. The most common reason to migrate from a social casino game use to monetary gambling was to win money.

Self-reported migration in the other direction from monetary gambling to social casino game engagement has also been reported; the main reported motivations for this were to play without spending money, and that social casino games were easier to play, more social, and more fun/better than monetary gambling (Gainsbury, King, Delfabbro et al., 2015).

Other in-game purchases

There is limited research examining the association between in-game purchases and monetary gambling (separate to in-game purchasing made specifically for loot boxes and simulated gambling). A study with German adults on in-game purchasing for game advantage (called pay-to-win) found that making more frequent pay-to-win payments was associated with more frequent gambling participation in lotteries, slots, poker and casinos (Steinmetz, Fiedler, von Meduna, & Ante, 2021). Another Finnish study with 15–16-year-olds found that using money in digital games increased the risk of gambling in the past 12 months, and that this was more likely among males than females (Castrén, Järvinen-Tassopoulos, & Raitasalo, 2021).

Harms associated with loot boxes, simulated gambling and other in-game purchases: the importance of reviewing the evidence

Over the past decade, concerns have been raised that video game features such as loot boxes, simulated gambling and in-game purchases are potentially harmful to consumers, especially those who may be at greater risk of harm (e.g. young people, people who gamble) (Derevensky & Gainsbury, 2016; Drummond & Sauer, 2018; King et al., 2019; King & Delfabbro, 2018a, 2018b; Petrovskaya & Zendle, 2021). Understanding the types and amount of harm associated with engaging with a product or activity is crucial to informing effective harm-minimisation strategies and regulation.

Harms associated with loot boxes, simulated gambling and in-game purchases can be direct (e.g. financial harm, gaming disorder) or indirect (e.g. via monetary gambling and gambling problems). As these products often simulate gambling-like features, the experience of gambling harm is a key concern. Individuals can be harmed from gambling in a variety of ways, including impacts on finances, relationships, health, emotional/psychological wellbeing, and work/study (Browne et al., 2016). The most common measure of gambling harm is the Short Gambling Harm Screen (SGHS; Browne, Goodwin & Rockloff, 2017).

Behaviours are often easier to measure than harms. Risk of 'Problem Gambling', or symptoms of 'Gambling Disorder' are often measured instead of harms. Scales designed to screen for these issues often probe certain 'high-risk' gambling behaviours (e.g., 'Gambled more than I could afford to lose'). The most common measure of 'Problem Gambling' is the Problem Gambling Severity Index (PGSI; Ferris & Wynne, 2001).

Another type of harm relevant to simulated gambling activities is harm associated with video game consumption. Excessive or harmful video game consumption can be associated with



health problems, psychological distress, lack of motivation, lack of sleep and poor hygiene (Lemmens, Valkenburg, & Gentile, 2015). Internet gaming disorder is a measure of disordered gaming based on the Diagnostic and Statistical Manual for Mental Disorders (DSM-V) (Petry et al., 2014).

Causal relationships between engagement with loot boxes, simulated gambling, and other in-game purchases and harm are theorised but are difficult to assess definitively. This is similar to our understanding of how monetary gambling products (e.g. EGMs/pokies) relate to gambling problems. Understanding the strength of association and accounting for other factors that may influence harm, such as demographic characteristics and other gambling consumption (see Appendix E for definition of 'predictors, mediators, and moderators'), can help to provide a more nuanced understanding of the relationship between these products and harm.



Methodology

This research aimed to evaluate the evidence on the impacts of loot boxes, simulated gambling and other in-game purchases. Focusing on the harm related to the use of these products, the literature review sought to answer four key research questions:

1. What types of harm, if any, are associated with the use of these products?
2. What is the strength of the relationship between the use of these products and harm?
3. Which groups are most at risk or vulnerable to harm?
4. What are the key predictors, mediators and moderators of harm?

We also examined recommendations in the literature for mitigation and regulatory responses to reduce harm related to the consumption of these products.

The review process included two main stages:

1. We undertook a literature search to identify research evidence from the past 10 years on the harms associated with loot boxes, simulated gambling and other in-game purchases.
2. We reviewed the in-scope literature to identify the generalisability, strength, and value of the evidence as they relate to the four research questions (described above), as well as recommendations for harm mitigation and regulatory responses.

A glossary of key terms used in the review are included in Appendix A and sources of literature in Appendix B. Included studies were drawn from empirical research, literature reviews, and meta-analyses. Appendix C provides a flow chart of the review process.

Articles were collected and reviewed independently during November 2021 to February 2022 by two researchers based on the six inclusion criteria outlined in Table 1 below. Several studies met the search criteria but did not meet one or more of the specified inclusion criteria. The most common reasons for exclusion were for not meeting the study type (inclusion criteria 5) or topic (inclusion criteria 6). A total of 64 research outputs met the criteria for inclusion. Detailed information about the individual articles evaluated in the current review is provided in Supplementary Document 1: Evidence table.

Table 1: Inclusion criteria and search terms for research articles

#	Parameter	Inclusion criteria	Number excluded
1	Publication date	January 2011 – December 2021	0
2	Language	English	0
3	Publication type	Journal articles, reports	0
4	If journal article:	Peer reviewed, exclude pre-prints	12
5	Study type	Empirical research (qualitative or quantitative), meta-analyses, and systematic reviews including scoping and rapid reviews.	64
6	Topic	Research that examined harms associated with loot boxes, simulated gambling activities, or games that involve in-game purchases (microtransactions).	95
	Search terms	loot box* (NOT esports, skin* in Title), 'social casino', 'simulated gambling' (NOT cue, experiment*, cognit*), microtransact*, 'in-game purchase', 'in-app purchase' AND harm*, impact*, risk*, problem*, addict* (Abstract and Title Only), disorder*	



Assessing the evidence

The research included in this review was assessed against three key criteria: strength of evidence, value of evidence, and generalisability to the Australian context (as they related to the four research questions). Each criteria included three levels: low, medium and high (described in Appendix D).

Strength of evidence related to the *types* of articles reviewed. Articles that synthesised information from multiple resources or studies – such as meta-analyses – were rated more highly than those from a single source. Quantitative evidence was rated higher strength than qualitative evidence for this topic. Similarly, studies with larger or more representative sample sizes were considered stronger evidence than smaller or less representative samples.

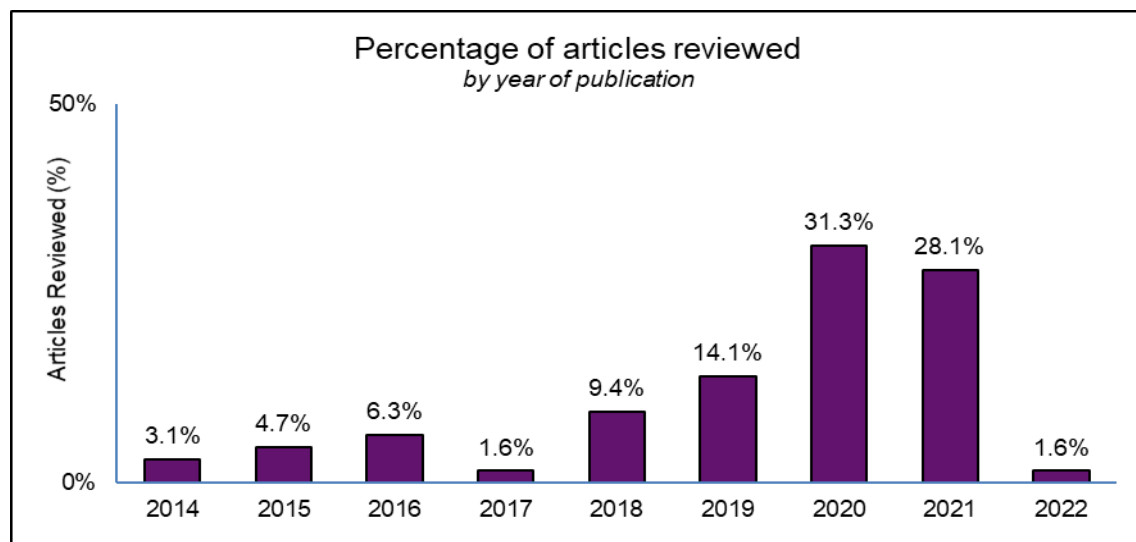
Value of evidence related to the *content* of articles reviewed; specifically, how much each article could help answer the research questions. ‘Value’ in this context incorporates some elements of article quality, such as appropriateness of methodology and conclusions (Appendix D), in addition to context-specific assessments of the quality of the articles reviewed. For example, articles that directly (as opposed to incidentally) examined harm associated with these products (e.g., problem gambling, internet gaming disorder and other relevant harms) were rated as of higher value. Criteria for this rating were assessed based on reviewers’ judgement, considering the key features of each article and each research question.

The generalisability of the available evidence to the Australian context was based on the country/countries from which the sample(s) or articles reviewed were drawn.

Articles reviewed

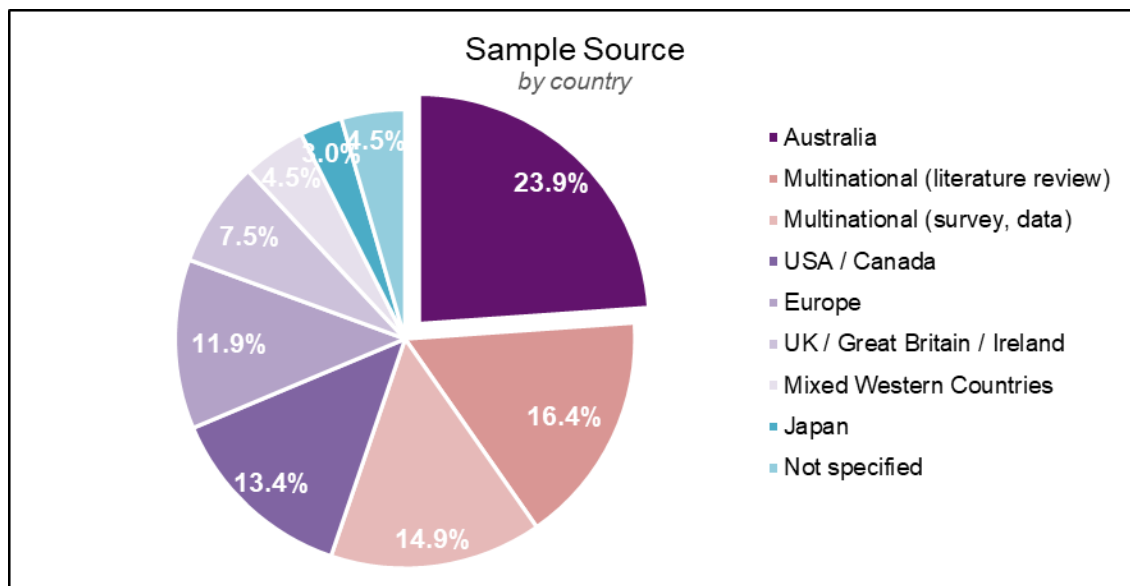
In total, 64 in-scope sources of literature addressed the research questions: 52 journal articles, 10 reports, one discussion paper, and one letter to the editor with data. One report contained four research studies (Hing et al., 2021), bringing the total number of sources assessed to 67. The products the literature focused on were predominantly loot boxes ($n = 38$), followed by simulated gambling ($n = 23$), and other in-game purchases ($n = 19$). Nearly two-thirds of the reviewed articles were published between 2019 and 2021 (see Figure 1).

Figure 1: Articles reviewed by year of publication (%)



The countries the studies sourced their sample/data from are shown in Figure 2. The largest proportion were from Australia (24%), multinational literature reviews (16%), multinational surveys or data (15%), the USA/Canada (13%), or European countries (12%). Three studies did not specify sampled countries and could not have a generalisability rating applied. Overall, most reviewed articles were either Australian or from culturally and economically similar jurisdictions and were highly generalisable to the Australian context (see Table 1).

Figure 2: Sample source by country (%)



Note: Purple indicates articles focused on Western countries; red multinational; and teal other countries.

Strength and value of evidence related to the four key research questions varied between articles (individual ratings for each article are shown in Supplementary Document 1: Evidence table). Overall, the strength of evidence was medium (see Table 1). While there were several higher strength articles, such as meta-analyses and pre-registered studies, most reviewed studies were low-medium strength articles, such as reports, conceptual frameworks and qualitative studies. Stronger evidence is required – particularly from longitudinal studies – to determine if there is a causal link between these products and harm.

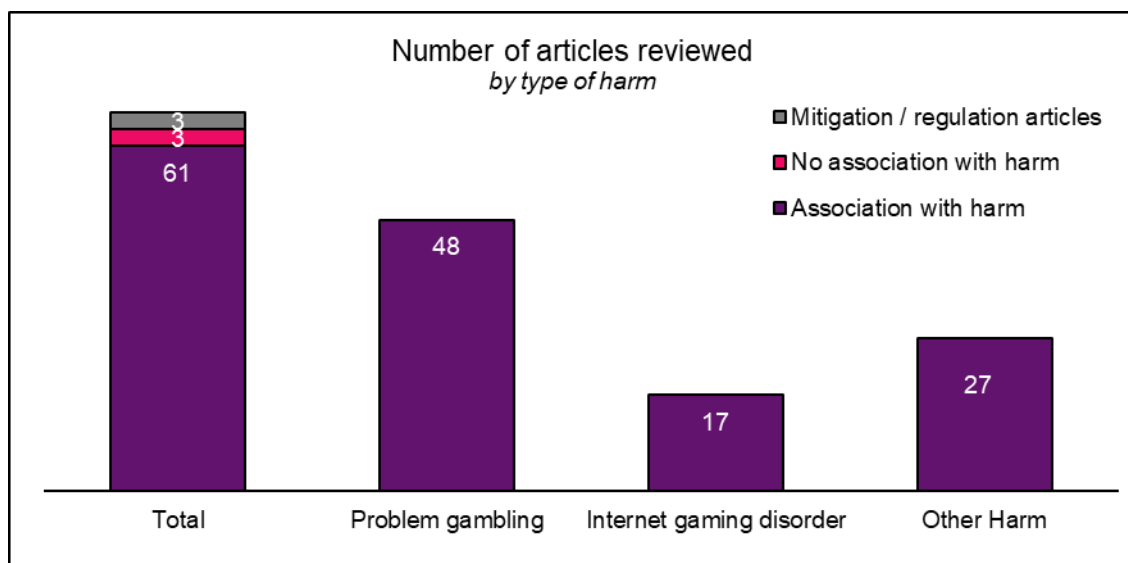
Similarly, the value of the evidence available was generally rated as medium (see Table 2). Though there were some very high-value articles (e.g. Drummond, Sauer, Ferguson, & Hall, 2020; Zendle, Meyer, & Over, 2019), some had methodological issues, stratified samples, unconventional analysis/statistics or other factors reducing the robustness of their findings. Additionally, while several articles were of high technical quality, they did not include detailed analyses of relevant outcome(s) (i.e. harms). While these articles were assessed as lower value for this review (which focused on harms), these value ratings should not be considered as an indication of the academic rigour, skill, original contribution, or technical quality of the authors' work.

In addition to assessing the strength and value of the evidence, we examined how strong the reported association/relationship was between engagement with each product and harm outcome. The strength of the relationship was rated more highly if scores on harm outcomes (e.g. problem gambling or internet gaming disorder) increased (or decreased) with more (or less) engagement. A lower rating suggests there may be some association between engagement and harm, but other factors may have affected harm scores as well.

**Table 2: Assessment of criteria by study design**

Article type	Average strength of evidence	Average value of evidence	Average generalisability to Australia
Cross-sectional ($n = 42$)	Medium	Medium	High
Literature reviews ($n = 12$)	Medium	Low-Medium	Medium-High
Qualitative ($n = 4$)	Low	Low	High
Meta-analyses ($n = 2$)	High	High	Medium
Secondary analysis of data ($n = 2$)	Low-Medium	Medium-High	Low-Medium
Longitudinal studies ($n = 2$)	Medium	Medium	Unclear
Other ($n = 3$)	Low	Low	High
Overall ($n = 67$)	Medium	Medium	High

Overall, Australian and international research suggests that engagement with loot boxes, simulated gambling and other in-game purchases is associated to various degrees with problem gambling, internet gaming disorder and other harms (such as financial harms and mental ill-health). Most studies (61 of the 67 studies; 91%) reported a relationship with **problem gambling** ($n = 48$), **internet gaming disorder** ($n = 17$), or **other types of harm** ($n = 27$) (see Figure 3). Of the six remaining studies, three found no relationship between these products and harm, and three articles only provided recommendations on the harm mitigation and regulation associated with loot boxes and/or social casino games. See Appendix E for a detailed description of the main measures of harm included in the reviewed research.

Figure 3: Articles reviewed by relationship (yes/no) and type of harm evaluated



Definition: Loot boxes

An in-game purchase of a virtual container (i.e. loot box, mystery box or chest) that randomly awards players with functional items or modifications (such as cosmetic items or weapons) based on chance or adjusted probabilities (King & Delfabbro, 2020). Loot boxes can also be obtained for free via gameplay (Rockloff et al., 2020).

Key findings

- There was reliable evidence (high strength and value) from literature reviews, meta-analyses, and cross-sectional studies in Australia and internationally that loot box engagement was associated with gambling problems. Risk of gambling problems increased with greater loot box engagement (opening, purchasing, purchase frequency, higher monthly expenditure). The overall strength of the relationship between loot box engagement and gambling problems was medium.
- Several Australian and international studies indicated that while loot box purchasing may be more common among males, females who purchase loot boxes may be at greater risk of experiencing gambling problems. Studies reported mixed findings about whether adolescents were at greater risk than adults of gambling problems associated with loot box purchasing.
- Loot box engagement (primarily spend) was associated with internet gaming disorder. The strength of this association was medium-high, stronger than the association between loot box engagement and gambling problems. This evidence was drawn from literature reviews and cross-sectional studies both domestically and internationally.
- International research among adults found that purchasing loot boxes was related to a higher likelihood of reporting internet gaming disorder symptoms, even after controlling for demographic characteristics, other types of gaming-related behaviours (e.g., social casino games), and monetary gambling.
- Although there was limited research on other types of harms associated with loot boxes, there was some evidence that loot box purchasing was associated with increased psychological distress and financial harm. In addition, problematic loot box use, as measured by the Risky Loot Box Index (RLI), was associated with problem gambling, internet gaming disorder, gambling-related cognitive distortions, and risk-taking. The reliability of evidence for these associations was low-medium.



Loot boxes: what does the evidence tell us?

What types of harm, if any, are associated with the use of loot boxes?

Table 3: Assessment of the evidence and strength of relationship between loot boxes and harm

	Assessment of the strength and value of evidence	Assessment of the strength of relationship
<i>Description</i>	<i>Strength and value of evidence of an association between loot boxes and harm</i>	<i>Strength of the relationship between loot boxes and harm</i>
Problem gambling	High	Medium
Internet gaming disorder	Medium	Medium-high
Other types of harm	Low-medium	Insufficient evidence

Problem gambling

A total of 30 Australian and international studies found an association between loot boxes and either gambling problems (typically measured by the PGSI; further detail is provided in Appendix D) or gambling harm (typically measured by the SGHS). The overall rating of the strength and value of these articles was considered **high**.

There was reliable evidence to suggest that more involved loot box engagement was associated with increased problem gambling risk. The average strength of this relationship was **medium**. There is currently insufficient evidence available to determine the direction of this relationship.

Loot box engagement

Several medium-high value literature reviews explored the association between loot boxes and gambling problems (see Supplementary Document 1: Evidence table for the full article list). The reviews found that a reliable association exists between loot box engagement (measured primarily by expenditure) and gambling problems (Cerulli-Harms et al., 2020; Delfabbro & King, 2020; Hing et al., 2021; Kolandai-Matchett & Abbott, 2021; Yokomitsu, Irie, Shinkawa, & Tanaka, 2021).

Cerulli-Harms and colleagues (2020) concluded that the reward structures and design features of loot boxes, especially those similar to monetary gambling activities, encourage users to continue playing and purchasing, leading to the development of gambling problems and risk-taking behaviour. Other authors noted that directionality of this relationship remains unclear (e.g. Delfabbro & King, 2020; Kolandai-Matchett & Abbott, 2021).

Two high value meta-analyses were also reviewed and reported similar associations. Spicer and colleagues (2021) found that loot box engagement – including spend, participation and



frequency – was moderately associated with problem gambling, and Garea, Drummond, Sauer, Hall, & Williams (2021) found a low-medium association between loot box expenditure and gambling problems.

Most research exploring the association between loot box engagement and gambling problems was based on cross-sectional surveys. A total of 18 studies, rated as medium strength/value of evidence and medium-high generalisability reported a relationship between loot box engagement and gambling problems. There was less evidence for an association between loot box consumption and other gambling harms (Carey, Delfabbro, & King, 2021; Rockloff et al., 2021). Some of the literature reviews and meta-analyses (above) included these cross-sectional studies within their scope.

Opening and purchasing loot boxes

Opening for free and purchasing loot boxes have been found to be associated with a higher risk of gambling problems in samples of Australian adolescents aged 12–17 years (Hing et al., 2020; Rockloff et al., 2020, 2021) and young adults aged 18–24 years (Rockloff et al., 2020, 2021; Russell et al., 2020), and 25–29 years (Russell et al., 2020). Russell and colleagues (2020) found that young adults who reported opening or purchasing of loot boxes more frequently were more likely to have experienced gambling problems at some point in their lifetime, but purchasing loot boxes for the first time prior to 18 years was not associated with increased risk. In addition, Rockloff and colleagues (2020, 2021) found that the association between loot box engagement and gambling problems increased as engagement increased; playing, opening and purchasing were related to gambling problems with low, low-medium and medium-high strength respectively.

International studies also reported an association between purchasing loot boxes and gambling problems in samples of British adults (aged 16–24 years and 18+) (Wardle & Zendle, 2021; Zendle, 2020), Spanish adolescents and young adults (González-Cabrera et al., 2022), Danish adolescents (Kristiansen & Severin, 2020b), adolescent gamers (Zendle, Meyer, & Over, 2019), German adult internet users (von Meduna et al., 2020), US adult video-gamers (Li et al., 2019), an international sample of video gamers (Macey & Hamari, 2018), and a sample of video gamers who had recently opened a loot box (Zendle, Cairns, Barrett, & McCall, 2019).

Wardle & Zendle (2021) found that, among pay-to-win video game players, those who had purchased loot boxes in the past 12 months were around 12 times more likely to be classified as experiencing problem gambling than those who had not.

Loot box expenditure

Several studies found an association between higher loot box expenditure and increased levels of problem gambling in samples from Australia, New Zealand, the United States (Drummond, Sauer, Ferguson, & Hall, 2020; Hall, Drummond, Sauer, & Ferguson, 2021; King, Wong-Padoongpatt, Barrita, Phung, & Tong, 2020) and other international samples (Brooks & Clark, 2019; Drummond, Sauer, & Hall, 2019; Zendle & Cairns, 2018; 2019; Zendle, Meyer et al., 2019; Zendle, Cairns et al., 2019). In a secondary analysis of data using six aggregated datasets, Close and colleagues (2021) found a moderate positive relationship between loot box expenditure and at-risk problem gambling. The frequency of purchasing was also found to be a significant factor associated with increased risk of gambling problems (Zendle, 2020).

Two pre-registered and peer-reviewed studies of high value examined how endorsement of different loot box features moderated the relationship between loot box spending and problem gambling severity (Zendle, Meyer, & Over, 2019; Zendle, Cairns, et al., 2019). The authors



observed that regardless of the presence or absence of specific features, loot box purchasing (using real-world money/fiat currency) predicted greater risk of problem gambling (Zendle, Cairns, et al., 2019). The first study recruited a multinational sample of adolescent gamers and found two features of loot boxes significantly strengthened links between loot box spending and problem gambling: loot box contents being available for a limited time and games giving away free loot boxes (Zendle, Meyer, & Over, 2019). The second study of adult past-month loot box openers found that being able to cash out, showing near misses, and letting players use in-game currency to buy loot boxes strengthened the relationship between loot box spending and problem gambling (Zendle, Cairns, et al., 2019).

Selling items from loot boxes

Items obtained from loot boxes can be sold for real money on third-party online platforms (e.g. a 'skin' exchange). Adolescents and adults who sell loot box items have been found to have a higher risk of problem gambling, both in Australia (Rockloff et al., 2020, 2021; Russell et al., 2020), and in Denmark (Kristiansen & Severin, 2020b). In an Australian study, the association with gambling risk was not as strong for selling as it was for purchasing loot boxes (Rockloff et al., 2020).

Evidence of causal link between loot boxes and gambling problems

As mentioned, the reviewed studies employed mostly cross-sectional designs and it was not possible to determine whether loot box engagement *caused* gambling problems. Further investigation – such as via longitudinal studies – would be required to determine whether: (i) loot box consumption causes gambling problems directly, (ii) those who already experience gambling problems are predisposed to higher loot box consumption, (iii) if there is a bidirectional relationship, or (iv) if any other factor/s are wholly explaining this relationship (mediation).

Internet gaming disorder

A total of nine Australian and international studies – with an average strength and value rating of **medium** – found an association between loot box engagement and internet gaming disorder. One study found an association with gaming harm. Gaming disorder was typically measured using DSM-V classification criteria (Internet Gaming Disorder; IGD). There was broad cross-sectional evidence demonstrating an association between loot box purchasing and higher levels of gaming disorder symptomology. The average strength of this relationship was **medium-high**, though it ranged from low-medium to high (higher among adolescents).

Loot box engagement

Three evidence reviews provided the highest value evidence of a relationship between loot box engagement (mainly measured by spend) and internet gaming disorder (Kolandai-Matchett & Abbott, 2021; Spicer et al., 2021; Yokomitsu et al., 2021). This association was medium-high strength. Findings from Spicer and colleagues' (2021) meta-analysis suggest that while the relationship with gaming disorder was stronger in magnitude than the relationship with problem gambling, the association was less reliable as it was based on fewer samples.

While a number of the in-scope articles examining internet gaming disorder were captured by the three evidence reviews (above), other more recent studies were not. Our assessment of the cross-sectional studies supports the conclusions from the literature reviews of medium evidence that loot box *purchasing* is associated with internet gaming disorder, with less evidence of an



association between opening loot boxes for free or selling items from loot boxes and internet gaming disorder.

Opening and purchasing loot boxes

The only study to measure the association between opening loot boxes (free) and internet gaming disorder was an experiment by Brady and Prentice (2021) that measured physiological response (heart rate, skin conductance) to loot box opening among young adult male video-gamers. The authors found decreases in physiological response to loot boxes being opened, the prize displayed, and the entire loot box experience for participants with higher scores for gaming disorder (as measured by the Gaming Addiction Scale). The authors' finding that participants with higher gaming addiction scores experienced less of an increase in physiological arousal from their loot box experience was in line with research on people who experience problem gambling – who get less of a response to wins and losses than non-problem gamblers.

Several studies found purchasing loot boxes was associated with greater risk of internet gaming disorder, or meeting criteria for problematic gaming, in samples of Australian adolescents (Hing et al., 2020), Japanese adolescents (Ide et al., 2021), Spanish adolescents and young adults (González-Cabrera et al., 2022), US young adults (King, Wong-Padoongpatt et al., 2020), US video gamers aged 18–25 years (Tham & Perreault, 2020) and US adult video-gamers (Li et al., 2019). More frequent loot box purchasing was associated with increased risk of gaming disorder (Zendle, 2020).

Loot box expenditure

Greater expenditure on loot boxes (often measured as monthly expenditure) was found to be associated with higher internet gaming disorder scores in international studies with medium-high generalisability to Australia (Brooks & Clark, 2019; González-Cabrera et al., 2022; Hall et al., 2021; King et al., 2020a). An Australian study with regular video gamers found loot box expenditure was positively associated with experiencing any and moderate gaming harm (Carey et al., 2021), although the measure used for 'gaming harm' was not a validated measure such as the IGD.

Other harms

A total of 12 Australian and international studies found an association between loot box engagement and other types of harm. These articles were **low-medium** strength and value on average, with the strength of relationship between loot boxes and other harms varying by type of harm.

Psychological harm and mental distress

One medium value study involving a narrative literature review, semi-structured interviews with key experts (academics, gaming industry, regulatory bodies, consumer organisations) and desk research examined the behavioural effects of loot boxes and other in-game purchase systems (Cerulli-Harms et al., 2020). Cerulli-Harms and colleagues suggested that loot boxes used problematic design features that could lead to negative psychological outcomes for users, such as addictive behaviours (Cerulli-Harms et al., 2020).

A recent systematic literature review (Yokomitsu et al., 2021) found that loot box purchasing may lead to mental distress or psychological harm, but the degree to which spending translates into psychological harm remains unknown and findings were interpreted with caution by the



author. Another three cross-sectional studies generalisable to Australia found an association between loot box (monthly) expenditure and higher levels of psychological distress (Drummond et al., 2020; Hall et al., 2021; Li et al., 2019), but loot box spending showed an association with both negative and positive moods.

Financial harm

There is little cross-sectional research available on the association between loot box engagement and financial harm. The narrative literature review by Cerulli-Harms and colleagues (2020) found that – in addition to psychological harms – loot box design features may be related to financial harms, such as excessive spending (Cerulli-Harms et al., 2020). Supporting this, one quantitative study found a weak association between loot box expenditure and moderate financial gaming harm (Carey et al., 2021).

Another qualitative study explored children's (aged 10-16 years) experiences of spending money within games and found that some children believed that loot boxes (with unknown rewards) were like gambling and that loot box purchasing was associated with financial harm for some young people, with reports of wasted money, not being in control of their spending and sometimes trying to 'chase losses' (Children's Commissioner for England, 2019).

Problematic loot box use

Problematic loot box use, as measured by the Risky Loot Box Index (RLI), has also been associated with both gambling and gaming harm. The RLI is a five-item measure of problematic loot box use, designed by Brooks and Clark (2019). Higher RLI scores indicate riskier loot box use (i.e., more likely to cause harm). Brooks and Clark's (2019) survey found that among samples of Canadian adult video-gamers and undergraduate students, the RLI was associated with higher scores on several other harm measures: problem gambling, internet gaming disorder, gambling-related cognitive distortions and risk taking.

These findings were replicated in a study of young adults (18–25 years) in the US that found the RLI (referred to as microtransaction engagement) positively correlated with gambling disorder, internet gaming disorder and risk taking (King, Wong-Padoongpatt et al., 2020). Drummond and colleagues (2020) also found that among US adults higher RLI scores were associated with greater monthly loot box spending.

A recent study by González-Cabrera and colleagues (2022) designed and tested a different measure called the Problematic Use of Loot Boxes Questionnaire (PU-LB). This measure consisted of 18 items around the problematic use of loot boxes, gaming-related problems concerning loot boxes, and gambling-related problems. Higher problematic use of loot boxes scores (PU-LB) correlated positively with online gambling disorder, internet gaming disorder, higher monthly spend on loot boxes, and a greater number of loot boxes purchased in the last week.

Problem pay-to-win gaming

Pay-to-win gaming refers when a consumer makes in-game purchases to increase their chances of winning, gaining time or keeping the game going (Steinmetz et al., 2021). A 'pay-to-win' gaming problem measure has also been adapted from the PGSI, using the same scoring and categorisation (no risk, low-risk, moderate-risk and high-risk pay-to-win problem gamers; Steinmetz et al., 2021; von Meduna et al., 2020). Studies of adult internet users have found that higher pay-to-win spending was related to a higher risk of pay-to-win gaming problems (Steinmetz et al., 2021). Purchasing loot boxes and daily loot box purchasing were also



associated with problem pay-to-win gaming classification (von Meduna et al., 2020). von Meduna and colleagues (2020) found that the observed relationship between loot box purchasing and pay-to-win gaming problems persisted even when accounting for demographic factors, monetary gambling and other gaming behaviours.

Perceived harmful features of loot boxes

Hing and colleagues (2021) conducted qualitative interviews with Australian adult loot box purchasers. While participants reported no serious harm from loot box purchasing, they expressed concerns that loot boxes may be attractive and harmful to a younger (underage) market. Participants also described risky features of loot boxes, including continual availability, unknown cost of chasing desired items, addictive potential, prolific in-game promotions, low cost per transaction facilitating continued purchasing, easy access to minors, and lack of consumer protection features (i.e. age restrictions, odds information, responsible gambling tools) (Hing et al., 2021).

Which groups are most at risk or vulnerable to harm from loot boxes?

Assessment of strength and value of evidence for which groups are most at risk of harm related to loot box engagement

Medium – Some high strength evidence of demographic differences affecting problem gambling risk (e.g. age, gender). Limited information about other types of harm.

Demographic characteristics

While an association between loot box spending and gambling problems has been found for both children/adolescents (aged 12–17 years) and adults aged 18 and over (e.g. Hing et al., 2020; Rockloff et al., 2021; Zendle & Cairns, 2018; Zendle, Cairns et al., 2019;; Zendle, Meyer et al., 2019), some research suggests this relationship is stronger for (older) adolescents than adults (Hing et al., 2021; Kristiansen & Severin, 2020b; Wardle & Zendle, 2021). In other recent Australian research, frequency of buying loot boxes was more strongly associated with problem gambling among the older cohort (25–29 years), compared to those aged 18–24 years (Russell et al., 2020).

Loot box engagement has been found to be more common among males than females but the association between loot box engagement and problem gambling risk has been found to be stronger for females who engage with loot boxes than males in Australia (Rockloff et al., 2021) and internationally (Ide et al., 2021; Kristiansen & Severin, 2020b).

Gambling behaviours

In a UK sample of adolescents and young adults (aged 16–24), individuals with higher gambling engagement (frequency, number of activities, past-week participation) were at increased risk of gambling problems associated with having purchased loot boxes in the previous year (Wardle & Zendle, 2021). In another representative sample of Australian adults who gamble, interactive (online) gamblers were more likely than non-interactive gamblers to report that loot boxes were the most harmful gambling activity (Hing et al., 2021).



A pre-post design longitudinal study conducted by Zendle (2019) surveyed video gamers about their loot box consumption. The second survey, roughly 12 months after the first, occurred after loot boxes had been removed from the game. The study found past month in-game expenditure decreased for problem gamblers, but not lower risk gamblers, after loot boxes had been removed from the game. This suggests that people experiencing problem gambling may be a particularly vulnerable cohort to loot box spending and associated harms.

Other factors

Other factors can affect which groups may be most at risk or vulnerable to harm. For example, a recent international study explored the effects of self-isolation and quarantine during the COVID-19 pandemic on people who played video games in Australia, New Zealand and the United States (Hall et al., 2021). Hall and colleagues (2021) found that the association between higher loot box spending and problem gambling symptomology was stronger among participants who reported being quarantined or self-isolating, compared to those not isolated during this time.

What other factors influence harm from loot boxes?

Other factors that may influence the relationship between loot boxes and harm fall into three broad categories – **mediators**, **moderators** and **predictors**. **Mediators** – in this review – are factors that help to explain some or all of the relationship observed between a product and harm (e.g. participation in monetary gambling). **Moderators** can increase or decrease the strength of a relationship (e.g. impulsivity). **Predictors** are other variables included in a model that also contribute to changes in the outcome (i.e. other factors that contribute to harm). See Appendix E for more detail.

Assessment of strength and value of evidence for key predictors, mediators and moderators of harm from loot boxes

Low-medium – Some evidence of behavioural (e.g. monetary gambling) and product features (e.g. time limits on purchasing) of mixed strength and value. Limited evidence assessing mediators and moderators of harm specifically.

A total of 11 studies examined key predictors, mediators or moderators of harm relating to loot boxes. Evidence available to address this research question was of **low-medium** strength and value. Across studies, a range of variables were found that may affect the relationship between loot box engagement and gambling problems.

Gambling problems and harm

Mediators

Several articles 'controlled for' potential mediators, that is, factors which may have explained or 'caused' the observed changes in harm.

For example, among young adults 18–29 years, Russell and colleagues (2020) found that lifetime use and frequency of opening and buying loot boxes were associated with greater problem gambling and lifetime gambling problems before and after controlling for:

- age
- impulsivity



- traditional gambling participation.

Other studies have controlled for traditional monetary gambling participation. A survey of British young adults (aged 16–24 years) by Wardle & Zendle, (2021) found that purchasing loot boxes (versus not purchasing loot boxes) significantly predicted the odds of experiencing problem gambling after controlling for:

- socio demographic factors
- impulsivity
- gambling participation.

Zendle (2020) found that loot box spending frequency was still associated with greater risk of problem gambling, but not gaming disorder, after controlling for:

- age
- gender.

However, in a nationally representative sample of Australian interactive gamblers, Hing and colleagues (2021) found that purchasing loot boxes was *not* associated with greater problem gambling severity after accounting for demographics, engagement in monetary gambling activities, and health and wellbeing.

Predictors

Several articles identified other predictors of harm alongside loot box engagement.

A recent Australian study (Rockloff et al., 2020) of adolescents (aged 12–17) and young adults (aged 18–24) found that after controlling for age, the following behaviours were all independently associated with gambling problems (PGSI) and gambling-related harms (SGHS), especially among female participants:

- ever opened a loot box, ever bought a loot box (the strongest predictor)
- playing games with loot boxes in last 12 months
- ever sold items gained from a loot box.

Additionally, the authors identified several other video-game related and online activities that were associated with problem gambling risk alongside loot box spending frequency, including:

- esports betting
- monetary video gaming
- token wagering
- watching loot box opening or other gambling online.

Internet gaming disorder

Mediators

A US survey of adults who played video games by Li and colleagues (2019) found that loot box purchasing was directly associated with greater risk of internet gaming disorder, even after controlling for:

- video gaming frequency
- extended video gaming sessions
- online gambling frequency
- extended online gambling sessions.



Further, findings from this study suggest that loot box purchasing may be indirectly associated with mental distress due to its association with problem video gaming and problem gambling behaviour (Li et al., 2019). In a representative sample of adults from the UK (Zendle et al., 2020), engagement in all forms of gaming-related practices (including spending on loot boxes and simulated gambling) was significantly associated with both disordered gaming (internet gaming disorder) and at-risk/problem gambling (PGSI), after controlling for:

- other video gaming-related gambling behaviours
- age
- gender.



Simulated gambling: what does the evidence tell us?

Definition: simulated gambling

Games with features that resemble or function like commercial gambling activities (King, 2018). This includes social casino games, free demo (demonstration) games, and other games with gambling-like components. Some, but not all, simulated gambling activities have in-game purchases; however, these in-game purchases operate in a closed-loop economy where they cannot be redeemed for money or traded among players.

Key findings

- There was medium-strength and value evidence that simulated gambling was associated with gambling problems. The evidence for the relationship between problem gambling and social casino gaming was slightly stronger (medium-high) than for other simulated gambling activities (medium).
- Greater involvement in simulated gambling was associated with higher problem gambling even when accounting for demographic characteristics, impulsivity and monetary gambling.
- Australian researchers found people already at risk of gambling problems were more likely to report problems due to simulated gambling. There was insufficient evidence to identify which groups were at greater risk of problems related to simulated gambling.
- There was limited evidence that any simulated gambling products were associated with internet gaming disorder, with only one article reporting a low-medium strength relationship.
- There was limited research on other types of harms associated with simulated gambling. There was some evidence that making in-game purchases in social casino games was associated with higher psychological distress and other negative consequences among adolescents. Strength of evidence of a relationship between simulated gambling and other harms was low-medium.



What types of harm, if any, are associated with simulated gambling?

Table 4: Assessment of relationship between simulated gambling and harm

	Assessment of the strength and value of evidence	Assessment of the strength of relationship
<i>Description</i>	<i>Strength and value of evidence of an association simulated gambling and harm</i>	<i>Strength of the relationship between simulated gambling and harm</i>
Problem gambling	Medium	Medium-high
Internet gaming disorder	Medium	Low-medium
Other types of harm	Low-medium	Insufficient evidence

Problem gambling

A total of 20 Australian and international studies found an association between simulated gambling and gambling problems, with more evidence specifically for social casino games than other types of simulated gambling. An overall rating of **medium** strength and value of evidence for this research question was given. The average strength of relationship between simulated gambling and gambling problems is **medium-high**, depending on the product, engagement type and sample cohort.

Two medium- and two low-value narrative literature reviews concluded that simulated gambling engagement, including social casino games, is associated with gambling problems (Armstrong et al., 2018; Dickins & Thomas, 2016; Gainsbury, King, Abarbanel et al., 2015; Kolandai-Matchett & Abbott, 2021). Similar to the findings on loot boxes, the reviews found that directionality of the relationship remains unclear. A number of literature reviews noted that simulated gambling may normalise gambling behaviours and increase the likelihood of participation in monetary gambling and development of a gambling disorder. This suggests an indirect – or mediated – relationship to problems via monetary gambling (Armstrong et al., 2018; Dickins & Thomas, 2016; Kolandai-Matchett & Abbott, 2021).

Armstrong and colleagues (2018) identified several features of simulated gambling games that increase the risk of problematic gambling for youth. The authors found that simulated gambling:

- provides consumers with an opportunity to practice and experiment with gambling
- increases exposure to gambling themes and advertising
- misrepresents real gambling experiences
- provides early big wins
- may lead to dissociation with/insensitivity to money
- encourages real and excessive expenditure
- engagement among children may be influenced by parental factors (gambling participation, beliefs, attitudes).

Another medium-value narrative literature review by King (2018) focused on the impact of gambling-like activities in games on young people. While they concluded that problematic



simulated gambling may involve harmful levels of spending on microtransactions, they pointed to the limited Australian evidence of an association between youth simulated gambling and problem gambling, with mixed findings and no longitudinal research.

Key findings from the cross-sectional quantitative and qualitative research studies are summarised separately below for social casino games and other simulated gambling studies.

Social casino games

Medium-value evidence from 12 cross-sectional studies and one qualitative study (nine of these Australian) suggests that social casino game engagement is associated with problem gambling.

Cross-sectional studies with both adolescents and adults found that participants were more likely to be at risk for problem gambling and/or have higher levels of problem gambling if they:

- *played social casino games* (Gainsbury, Russell, & Hing, 2014; Gainsbury, King, Delfabbro et al., 2015; Hing et al., 2020; Hing et al., 2021; King et al., 2014; Rockloff, Browne, Greer, Armstrong, & Thorne, 2019; Russell et al., 2020; Stark, Reynolds, & Wiebe, 2020; Veselka, Wijesingha, Leatherdale, Turner, & Elton-Marshall, 2018).
- *played social casino games more frequently* (Hing et al., 2021; Russell et al., 2020)
- *made in-game purchases in social casino games* (Gainsbury, King, Delfabbro et al., 2015; Kim, Hollingshead, & Wohl, 2016; King et al., 2016)
- *made in-game purchases in social casino games more frequently* (Russell et al., 2020; Zendle, 2020)
- *had a higher number or duration of social casino gaming sessions* (Gainsbury, King, Delfabbro et al., 2015).

Other simulated gambling research

Research on other simulated gambling, separate to social casino games is more limited, but provides some evidence that adolescent and adult simulated gambling is associated with problem gambling.

Two recent Australian cross-sectional studies found that playing video games with gambling components was associated with at-risk/problem gambling among children/adolescents aged 12–17 years (Hing et al., 2020), and adults aged 18–29 years (Russell et al., 2020). Other international studies have reported similar associations. A study of Danish adolescents found that those more involved in simulated gambling had a higher likelihood of being classified as an at-risk or problem gambler (Kristiansen & Severin, 2020a). A longitudinal study of German adolescents found simulated gambling in video games predicted problem gambling one year later (Brosowski et al., 2020).

Internet gaming disorder

Only four studies of **medium** value found an association between simulated gambling and internet gaming disorder: two cross-sectional studies and two narrative literature reviews. Overall, simulated gambling was associated with greater gaming disorder symptomology, though only one article reported the strength of the association (**low-medium**).

Kolandai-Matchett and Abbott's (2021) literature review reported that engagement in simulated gambling was significantly associated with gaming disorder (and problem gambling). A discussion paper on simulated gambling by Dickins and Thomas (2016) suggested that excessive use of these games constitutes gaming addiction with symptomology such as the



inability to limit time. Further, people may be more at risk for gaming addiction from simulated gambling if they are motivated to play to escape from their problems or to relieve negative emotions, are lonely, bored or lack self-control.

Survey data from a study of Australian children/adolescents (12–17 years) found that playing three types of simulated gambling activities in the past 12 months (social casino games, demo or practice games, and gambling-themed apps) was associated with meeting criteria for problematic gaming as measured by the IGD (Hing et al., 2020). The same report found that playing games with gambling content was associated with higher risk of gaming disorder. Another survey with a representative sample of UK adults found more frequent spending on social casino games was associated with higher levels of disordered gaming (Zendle, 2020).

Other harms

A total of nine **low-medium** value Australian and international studies found an association between simulated gambling and other types of harm. There was limited information about the strength of these relationships when accounting for other factors, such as demographic characteristics or monetary gambling. The strength of relationship between in-game purchases and other harms varied depending on the type of harm.

Problematic social casino game use

A few studies have examined harm associated with social casino gaming using the Problematic Social Casino Game Use Scale (PSCGS: Gainsbury, King, Russell, Delfabbro, & Hing, 2017); a five-item unvalidated measure derived from the DSM-V Internet Gaming Disorder criteria. The items capture components of problematic gaming including preoccupation, withdrawal, loss of control, escape and negative consequences, and higher scores indicate greater problematic social casino game use. In a sample of Australian adult social casino gamers, Gainsbury and colleagues (2017) found that problematic social casino gaming increased with more frequent gaming, higher spending and playing more games. More frequent expenditure on social casino games was the strongest behavioural predictor of PSCGS. Another study of Danish adolescents found higher PSCGS scores among those who engaged in simulated gambling more frequently, spent more money and engaged in more types of simulated gambling activities (Kristiansen & Severin, 2020a).

Psychological and mental distress

Links between social casino game consumption and psychological and mental distress have been examined in samples of Australian adult gamblers (Gainsbury et al., 2014) and adolescents (King et al., 2014, 2016). Australian adolescents making in-game purchases in social casino games (versus non-purchasers) were more likely to report 'at least mild distress' on the K6 measure of psychological distress (King et al., 2016). Higher psychological distress scores were also found for Australian adults who gambled and who had played social casino games, compared to those who had not (Gainsbury et al., 2014).

Other Australian research found no difference in anxiety and depression scores among adolescents who participated in simulated gambling in the past 12 months, compared to those who did not (King et al., 2014).

Self-reported negative consequences/problems

An Australian study of adolescent and adult internet users asked participants about social casino gaming, including whether they had experienced any negative consequences from their



social casino game use (e.g. relationship problems, poor school or work performance, worse physical health) or had a problem with their social casino gaming (Gainsbury, King, Delfabbro et al., 2015). Younger adults were significantly more likely to endorse having had frequent thoughts or strong urges about social casino games, having experienced negative consequences due to social casino games, and believe that they had a problem with social casino games. Participants with higher levels of problem gambling were significantly more likely to report experiencing negative consequences associated with social casino gaming.

Which groups are most at risk or vulnerable to harm from simulated gambling?

Assessment of strength and value of evidence for which groups are most at risk of harm related to simulated gambling engagement

Low-medium – Some medium strength and value evidence of demographic differences (e.g. age) and behaviours on problem gambling risk. Limited information about other harms.

Australian research suggests that individuals who are already experiencing gambling problems may be at greater risk of harm from simulated gambling products (Gainsbury, King, Delfabbro et al., 2015; Gainsbury et al., 2017). Gainsbury and colleagues (2015) found that the risk of problem gambling symptoms *decreased* with age; that is, younger social casino gamers were typically at higher risk than older players.

Other international research (e.g. Kristiansen & Severin, 2020a; Steinmetz et al., 2021; Wardle & Zende, 2021) suggests that high engagement and problematic behaviour in one form (e.g. online gambling) affects (over)involvement in the other (e.g. simulated gambling or 'pay-to-win' games). Steinmetz and colleagues (2021) suggest that once a player or gambler has developed a problematic behavioural pattern, that habit is likely to migrate to other game forms.

What other factors influence harm from simulated gambling?

Assessment of strength and value of evidence for key predictors, mediators and moderators of harm from simulated gambling

Medium – Some high strength and value evidence of predictors of gambling problems (e.g. depth of monetary gambling). Some medium strength information available about other harms.

King and Delfabbro (2016) reviewed 19 empirical studies of youth participation in simulated gambling to develop a conceptual model of problem gambling risk and protective factors. They identified four *key risk factor* categories:

- 1) social (gambling subculture, peer pressure, parental modelling, covert activity)
- 2) behavioural (early big wins, migration to monetary forms, larger wagers)
- 3) cognitive (greater confidence of winning, dilution of currency value, misinterpret profitability, gambling as gaming)
- 4) emotional (excitement, escape/coping, desensitisation to losses, craving and urges).



Many of these problem gambling risk factors identified by King and Delfabbro (2016) have not been examined by subsequent research.

Mediators

Several articles 'controlled for' potential mediators, that is, factors which may have explained or 'caused' the observed changes in harm.

A longitudinal survey of German adolescents (12–17 years) found simulated gambling within video games directly predicted problem gambling behaviour one year later, independent of simulated gambling in apps, social networks or demo games (Brosowski et al., 2020). The relationship between simulated gambling and problem gambling symptoms was mediated by:

- monetary gambling frequency (strongly positive)
- irrational cognitions about gambling/control illusion (mildly positive)
- compulsive internet use (negative).

Australian research with adolescents by Hing and colleagues (2020) found that the association between playing games with gambling components and experiencing gambling problems or internet gaming disorder was no longer significant after controlling for other variables such as:

- demographics
- impulsiveness
- engagement in other simulated gambling activities and
- monetary gambling.

Predictors

Several articles identified other predictors of harm alongside simulated gambling engagement.

While most of the reviewed studies only examined bivariate (descriptive) associations between simulated gambling and gambling problems, some studies did examine independent predictors. For example, an Australian survey of adolescents (12–17 years) found three independent predictors of at-risk/problem gambling when controlling for age, gender and ethnicity (King et al., 2014):

- past involvement in simulated gambling
- current simulated gambling
- current monetary gambling.

Other research with young adults (18–29 years) in Australia found several predictors associated with greater problem gambling and lifetime gambling problems. These relationships persisted even after controlling for age, impulsivity and traditional gambling participation (Russell et al., 2020). These included:

- lifetime use of social casino games
- frequency of social casino game play (free and paid)
- frequency of playing video game with gambling components.

Zendle (2020) found several co-predictors of both problem gambling and internet gaming disorder, alongside social casino play, including:

- esports betting
- token wagering
- monetary video gaming gambling

- loot box engagement (e.g. watching, spending).

Social casino game play was a significant predictor of both harms even when accounting for the effects of age and gender.



Other in-game purchases: what does the evidence tell us?

Definition: in-game purchases

Financial purchases in games for digital goods or services, also referred to in the literature as 'microtransactions'. In-game purchases may be purely aesthetic (e.g. cosmetic items or 'skins'), confer gameplay advantages (e.g. pay-to-win), contain these items as randomised contents of uncertain value (e.g. loot boxes), or include any other in-game expenditure (Zendle, Meyer, & Ballou, 2020).

This section focuses on research related to harm associated with 'other' in-game purchases, separate to the evidence presented previously for purchasing loot boxes and making in-game purchases for simulated gambling.

Key findings

- There was medium evidence of an association between other in-game purchases and problem gambling, and the strength of the relationship was low-medium.
- The evidence of an association between other in-game purchasing and problem gambling was weaker than for loot box purchasing and problem gambling.
- Research on 'pay-to-win' gaming found an association between making other in-game purchases for gameplay advantages and gambling problems.
- There was low-medium evidence that other in-game purchases were associated with higher levels of internet gaming disorder.
- There was some evidence that in-game purchases, particularly when unplanned, may be associated with conduct problems, hyperactivity/inattention and peer problems.
- There were gaps in evidence regarding which groups were at greater risk for harm from making in-game purchases (i.e., demographic differences) and how in-game purchases (distinct to those made for loot boxes and simulated gambling) predict, mediate, or moderate harm.



What types of harm, if any, are associated with other in-game purchases?

Table 5: Assessment of relationship between other in-game purchases and harm

	Assessment of the strength and value of evidence	Assessment of the strength of relationship
<i>Description</i>	<i>Strength and value of evidence of an association between other in-game purchases and harm</i>	<i>Strength of the relationship between other in-game purchases and harm</i>
Problem gambling	Medium	Low-medium
Internet gaming disorder	Low-medium	Insufficient evidence
Other types of harm	Low-medium	Insufficient evidence

Problem gambling

A total of 17 out of 18 international and multinational studies found an association between other in-game purchases and gambling problems. The overall assessment of the strength and value of evidence was **medium**.

Other in-game purchases were associated with increased risk of gambling problems with a **low-medium** average strength of relationship. Studies that included loot box purchases in their measurement of in-game purchases (i.e. King, Wong-Padoongpatt, et al., 2020) showed a higher strength of relationship than those measuring 'other' in-game purchases to loot boxes (i.e. Zendle & Cairns, 2018, 2019).

A literature review by Australian authors examined the convergence of gambling and monetised gaming activities and concluded that while there is early evidence that involvement in monetised gaming may be associated with problem gambling, the evidence is cross-sectional in nature (i.e. not proving causality) and there are still gaps in knowledge (King & Delfabbro, 2020).

Two cross-sectional studies found an association between monthly expenditure on other in-game purchases and problem gambling among adult gamers, but this association was weaker compared to monthly loot box expenditure (Zendle & Cairns, 2018, 2019). Zendle and Cairns (2019) also found that people experiencing problem gambling reported higher in-game spending than those at lower risk of gambling problems.

Similar findings were observed among samples of adolescents and young adults. Among adolescent gamers, higher problem gambling scores were more strongly associated with loot box purchasing than other microtransaction spending (Zendle, Meyer et al., 2019). A US study with young adults (18–25 years) found that higher overall engagement with in-game purchases and higher monthly in-game purchasing expenditure (loot boxes/other) were associated with higher problem gambling scores (King, Wong-Padoongpatt et al., 2020), and a Canadian study with adolescents (12–17 years), young adults (18–24 years) and parents of children aged 8–17 years found that those who made in-game purchases were more likely to be classified as being at risk of or already experiencing gambling problems than those that did not make in-game purchases (Stark et al., 2020).



Associations with pay-to-win gaming were also reported. A study with German adult internet users found that participants who engaged daily in 'pay-to-win' gaming experienced higher problem gambling severity scores than those who occasionally engaged in pay-to-win gaming (Steinmetz et al., 2021), and that participants meeting criteria of problem gambling were more likely to engage in pay-to-win gaming, make more frequent pay-to-win payments, and have high problem pay-to-win gaming scores. A study with Polish esports bettors also found that engagement in pay-to-win gaming was associated with higher problem gambling severity (Lelonek-Kuleta & Bartczuk, 2021).

Internet gaming disorder

Three international studies found an association between other in-game purchases and internet gaming disorder. An overall assessment of the strength and value of evidence for this research question was **low-medium** and there was insufficient evidence to determine the strength of relationship between in-game purchases and gaming disorder.

The literature review by King and Delfabbro (2020), mentioned in the previous subsection, concluded that while there was early evidence that involvement in monetised gaming may be associated with problematic gaming, there are still gaps in knowledge and the evidence does not prove causality (i.e. is cross-sectional in nature).

Three of six low-medium value but generalisable international studies found a relationship between other in-game purchases and internet gaming disorder. In addition to an association between in-game purchases and problem gambling, a US study with young adults aged 18–25 years found a medium-high strength association between overall engagement with in-game purchases, along with higher monthly in-game purchase expenditure (loot boxes/other) and higher internet gaming disorder scores (King, Wong-Padoongpatt et al., 2020). Another study with predominantly male young adult gamers found significantly higher internet gaming disorder scores for both moderate and high spenders on in-game purchases (including loot boxes) compared to non-spenders (Tham & Perreault, 2020). A weak association between higher purchase intention and meeting criteria for internet gaming disorder was found in a study of adult players of *Fortnite* (a free-to-play battle-royale style shooting game with in-game purchases, popular among teenagers and young adults), but not for actual in-game purchasing (King, Russell et al., 2020).

A qualitative analysis of regular adult gamers' perspectives on problem gaming identified several problematic behaviours relating to in-game purchasing including: the inability to control money spent in games, financial loss, compulsive spending, paying for items and loot boxes they don't need, and other negative effects of money spent on games (Stevens, Delfabbro, & King, 2021).

Other harms

Four of eight **low-medium** value international studies found an association between in-game purchases and other harms. The strength of relationship between in-game purchases and other harms varied depending on the type of harm.

Financial harm

Two medium-value narrative literature reviews concluded that monetisation features in games and predatory strategies to encourage spending could result in gamers becoming more financially involved and experiencing negative financial consequences (Cerulli-Harms et al., 2020; King, 2018).



Problem pay-to-win gaming

A Polish study of gamers who made 'pay-to-win' in-game purchases (i.e. made payments in online games to gain an advantage) found that the most common symptoms of problem pay-to-win gaming were impaired control (time and/or money), feeling an inner urge to play, and lying to gain more time to play. The severity of the symptoms corresponded to the severity of involvement in the game (Lelonek-Kuleta, Bartczuk, & Wiechetek, 2021). Another study of German adults found daily pay-to-win gamers were more likely than occasional pay-to-win gamers to have higher problem pay-to-win gaming scores and of meeting criteria for problem pay-to-win gaming (as opposed to no, low, moderate-risk) (Steinmetz et al., 2021).

Psychosocial adjustment

A recent study with Japanese students (12–15 years) examined the participants' psychosocial adjustment via strengths (prosocial behaviour) and difficulties (emotional symptoms, conduct problems, hyperactivity/ inattention, peer problems) against their purchasing behaviours in games (Shinkawa et al., 2021). The authors found that more hyperactivity/inattention was observed among in-game purchasers compared to non-purchasers, and that gamers who made 'unplanned' purchases exhibited more behavioural problems and peer problems than participants who planned their in-games purchases, and had more overall difficulties compared to non-purchasers.

Which groups are most at risk or vulnerable to harm from other in-game purchases?

Assessment of strength and value of evidence for which groups are most at risk of harm related to other in-game purchases

Low-medium – Evidence available of varying strength and value of demographic factors affecting relationship with harm (e.g. age, gender, income). Limited evidence of other factors.

'Pay-to-win' gamers (in which players can pay to advance in the game) have been found to be a distinct consumer group with a considerable attraction to gambling (Steinmetz et al., 2021). German studies have reported a clear link between pay-to-win purchases and an increased risk of problem gaming (von Meduna et al., 2020) and problem gambling (Steinmetz et al., 2021; von Meduna et al., 2020). A recent study of 'pay-to-win' gamers in Poland found that participants who had made more regular and higher payments experienced greater 'pay-to-win problem gaming' than other gamers (Lelonek-Kuleta et al., 2021).

In one study, several risk factors for problem gambling risk among 'pay-to-win' gamers were identified. These included age (younger); sex (male); not pursuing an apprenticeship; and lower household income (Steinmetz et al., 2021). Lelonek-Kuleta and colleagues (2021) found that while men played pay-to-win games more frequently, women were more likely to make in-game purchases – potentially exposing them to greater risk of harm.



What other factors influence harm from other in-game purchases?

Assessment of strength and value of evidence for key predictors, mediators and moderators of harm from other in-game purchases

Medium – Some high strength and value evidence of behavioural (e.g. esports betting) and trait-based (e.g. impulsivity) predictors of gambling problems. Limited information available about other harms.

Mediators

None of the articles that we reviewed specifically examined mediation of other in-game purchases, although several articles ‘controlled for’ other factors which may have explained or ‘caused’ the observed changes in harm. If the inclusion of the additional factors weakened the relationship between other in-game purchases and harm it may have indicated partial mediation, though further investigation would be required.

A medium-value longitudinal survey of German adolescents (12–17 years) examined video gaming behaviours, including in-game purchases, as mediators between simulated gambling involvement and problem gambling (Brosowski et al., 2020). In-game purchases *were not* found to mediate the relationship between simulated gambling involvement (within video games, apps, social networks and demo games) and problem gambling one year later.

Another study of adult gamers by King and colleagues (2020) found that expenditure in *Fortnite* was not predictive of having a gaming disorder when controlling for demographics, other gaming behaviours, impulsivity and perceived values of gaming.

Predictors

In a model developed by Lelonek-Kuleta and Bartzcuk (2021) using data from esports bettors, the authors found that participating in pay-to-win gaming was a predictor of problem gambling. Other co-predictors of problem gambling were identified in this model, including esports betting (more expenditure and time) as well as coping and financial motivations.

Steinmetz and colleagues (2021) also identified several additional factors – alongside pay-to-win gaming frequency – that predicted the risk of problem gambling, including:

- more frequent pay-to-win transactions
- lower pay-to-win spending and
- higher risk pay-to win gaming.

It is unclear whether any of these factors mediate or moderate the presentation of harm.



Mitigation and regulation

Standard definitions and application

To facilitate effective harm minimisation, the authors of the reviewed papers (e.g. Dickins & Thomas, 2016; Gainsbury, King, Abarbanel et al., 2015a; King & Delfabbro, 2016; Kollandai-Matchett & Abbott, 2021) recommended the need for:

- consistent definitions for specific products and features (e.g. loot boxes, simulated gambling, in-game purchases)
- clear, objective criteria about what constitutes each product (e.g. features)
- consistency in application of product definitions for regulation, including classification
- flexibility built into the product definitions to be able to adapt quickly as new products emerge.

Key findings

Several key themes emerged for harm mitigation and regulatory approaches related to loot boxes, simulated gambling and other in-game purchases including:

- Age restrictions for young people under 18 years, especially for in-game purchasing (loot boxes, simulated gambling and other in-game purchases).
- Ability to set spending and/or time limits and/or restrictions on consumption of these products.
- Self-exclusion options to disable simulated gambling features in games for individuals vulnerable to harm.
- Clear labelling of gambling-like products and features in video games and messages on the potential risks associated with these products.
- Displaying the odds or chances of gaining rewards (winning) from loot boxes and simulated gambling games, ensuring they are displayed automatically and prominently to the consumer.
- Provision of support information in games with loot boxes and simulated gambling (e.g. helplines, resources for safer gambling practices) and targeted to groups most at risk for harm.
- Education and public awareness about these products and their potential for harm, directed at at-risk groups and those who can support them.
- Intervention and treatment for problematic social casino game use, recognising the interaction with financial gambling.
- Ethical game design and removing or reducing the 'predatory' features and techniques that encourage excessive expenditure, and video gaming industry sharing player data with researchers and health professionals.
- Regulation via gambling laws.

Recommendations for mitigating harm associated with loot boxes, simulated gambling and other in-game purchases in video games were included in most (40 of the 64) of the articles reviewed.



Consumer protection measures in video games

The need for stronger consumer protection measures in video games was recommended by several authors. Recommendations related to age restrictions, limit setting, self-exclusion, product labelling, displaying odds/chances of winning, warning labels/messages, provision of support information, and ethical game design.

Age restrictions

Age-based restrictions were frequently recommended as a strategy to reduce harm from loot boxes, simulated gambling and other in-game purchases. Generally, the review found that adolescents were exposed to greater risk from these products than adults. While the articles reviewed offered different opinions regarding age restrictions, an area of consensus was that spending money on loot boxes and simulated gambling in video games should be restricted to adults (18+), as many of these products have features and/or mechanics similar to commercial monetary gambling products. Age verification (as required for online gambling) was also recommended (Gainsbury, King, Abarbanel et al., 2015; King and Delfabbro, 2016; Shi, Colder Carras, Potenza, & Turner, 2021; Steinmetz et al., 2021).

Loot boxes

Several studies recommended that loot box engagement should align with monetary gambling and be restricted to adults (18+) (Brady & Prentice, 2021; Children's Commissioner for England, 2019; Hing et al., 2021; King & Delfabbro, 2016; Russell et al., 2020; Shi et al., 2021; Steinmetz et al., 2021; von Meduna et al., 2020; Wardle and Zendle, 2021; Zendle, Cairns, et al., 2019; Zendle, Meyer et al., 2019). Zendle (2019) suggested minimising the exposure of loot boxes for people who experience gambling problems.

Simulated gambling

Authors generally agreed that games with simulated gambling, especially those including in-game purchases, should be restricted to adults (18+) (Gainsbury, King, Delfabbro et al., 2015; Shi et al., 2021). Another study advocated for social casino game operators to voluntarily restrict access to these games to adults (Gainsbury, King, Delfabbro et al., 2015). Rockloff and colleagues (2018) recommended discouraging or restricting the availability of gambling-themed apps to adolescents, while prohibiting them for children.

In-game purchases

In line with suggestions for age restrictions for purchases made in relation to loot boxes and simulated gambling, researchers also recommend that in-game purchases in games have age restrictions to mitigate harm associated with expenditure (Children's Commissioner for England, 2019; King, 2018; King, Wong-Padoongpatt et al., 2020; Stevens et al., 2021).

Limit setting and restrictions on consumption (spend, time)

In addition to age restrictions, authors recommended several other limit-setting features in games. Limit setting could allow account holders, other individuals (e.g. parent/guardian) or organisations to place a cap on consumption of these products for a defined period (e.g. per month) to mitigate harm from excessive play and spending.

The most frequently mentioned strategy was for game developers to include options to limit spending on loot boxes (Brooks & Clark, 2019; Cerulli-Harms et al., 2020; Children's



Commissioner for England, 2019; Close et al., 2021; Drummond et al., 2019; Drummond et al., 2020; Gong & Rodda, 2020; Hing et al., 2021; Zendle, Meyer, et al., 2019), simulated gambling (Gainsbury, King, Abarbanel et al., 2015; Hing et al., 2020, 2021; King & Delfabbro, 2016), and in-game purchases in general (Hing et al., 2021; King, Wong-Padoongpatt et al., 2020; Russell et al., 2020; Steinmetz et al., 2021; Stevens et al., 2021).

Various types of spending limits were proposed, including voluntary self-limit options (Drummond et al., 2020; Gainsbury, King, Abarbanel et al., 2015; Hing et al., 2020), financial caps (Drummond et al., 2020; King, 2018), and parental-set limits (Cerulli-Harms et al., 2020). These limits could restrict various features of the products, such as the number of loot boxes available for purchase and the amount available to spend per month (Gong & Rodda, 2020), or spending frequency (Steinmetz et al., 2021). Other features were suggested to help limit spend, such as pre-commitment (Drummond et al., 2019; Kristiansen & Severin, 2020b), expense tracking such as via the provision of activity statements (Cerulli-Harms et al., 2020; Children's Commissioner for England, 2019; Gainsbury, King, Abarbanel et al., 2015; Gong & Rodda, 2020), and advice on setting spending limits (Gainsbury, King, Abarbanel et al., 2015). The Children's Commissioner for England (2019) recommended that for children (under 18 years), game developers should disable the ability to spend money on loot boxes to progress in the game and that maximum daily spending limits should be turned on automatically.

Limit setting or restrictions on time spent playing games with simulated gambling content were also suggested, including temporary time-outs and having pop-up messages alerting players when playing continuously (i.e. over an hour) (Gainsbury, King, Abarbanel et al., 2015).

Self-exclusion options

Like spending limits, in-game or online self-exclusion options are analogous to those available to people who gamble with real money; for example, online or at land-based venues. Several authors recommended mandating a self-exclusion option for purchasing loot boxes (Brooks & Clark, 2019; Gong & Rodda, 2020; Kristiansen & Severin, 2020b) and simulated gambling (Dickins & Thomas, 2016; Gainsbury, King, Abarbanel et al., 2015; Hing et al., 2020).

Displaying odds/chance of winning

A number of studies recommended that the odds or probabilities of winning should be clearly labelled and displayed to all players by default for loot boxes (Brooks & Clark, 2019; Cerulli-Harms et al., 2020; Gong & Rodda, 2020; Hing et al., 2021; von Meduna et al., 2020) and simulated gambling (Carran & Griffiths, 2015; Dickins & Thomas, 2016; Gainsbury et al., 2014; Gainsbury, King, Abarbanel et al., 2015; Gainsbury, King, Delfabbro, 2015; King, 2018). This includes all chance-based features or video game events that cost, risk or wager currencies (e.g. fiat, crypto, pseudo or virtual currencies; virtual tokens) or other in-game items (e.g. weapons, cosmetic upgrades, achievements; Gainsbury, King, Abarbanel et al., 2015). King and Delfabbro (2016) and Russell and colleagues (2020) extended this by recommending parity in payout rates/rewards with monetary gambling products so simulated gambling products do not mislead consumers.

While around 60% of the top-grossing games in Australia contain loot boxes (2019 estimate), disclosure of loot box reward probabilities is not currently mandatory (Rockloff et al., 2020). A recent study examining new regulation to mandate disclosure in the People's Republic of China (Xiao, Henderson, Yang, & Newall, 2021) found that while over 90% of top-grossing games containing loot boxes did disclose odds in-game, less than 10% of games displayed the odds without the user having to search through 'sludge' – a term used to describe deliberate



obfuscation of information by burying it in difficult-to-access recesses of a game/website. Xiao and colleagues (2021) suggested careful consideration and implementation of any regulation to ensure developers are required to display odds automatically and prominently.

Gainsbury and colleagues (2014) recommended that social casino games be clearly distinguishable from gambling to avoid misleading players, particularly where the outcomes of games do not realistically depict the odds of gambling. Products should also include information on the similarities and differences between simulated and monetary gambling (Gainsbury, King, Abarbanel et al., 2015). Carran and Griffiths (2015) recommended that simulated gambling products include clear information that in-game purchases only use non-transferable credits or non-fungible tokens, and not real money.

Warning labels and messages

There is a consensus in the literature that loot boxes and games that include simulated gambling should be consistently defined and labelled clearly and unambiguously (Cerulli-Harms et al., 2020; Children's Commissioner for England, 2019; Gainsbury et al., 2014, Gainsbury, King, Abarbanel et al., 2015; King & Delfabbro, 2016; Zendle, Cairns, et al., 2019). Hing and colleagues (2021) recommended labelling such as, 'game offers in-game purchases' or 'simulated gambling'.

Authors also recommended that games with loot boxes, simulated gambling, and microtransactions provide consumers with warning labels or messages on the potential risks associated with these products (Dickins & Thomas, 2016; Carran & Griffiths, 2015; Gainsbury, King, Abarbanel et al., 2015, Gainsbury, King, Delfabbro et al., 2015; Gong & Rodda, 2020; Shi et al., 2021; Stevens et al., 2021). Recommendations for specific types of warning labels/messages included:

- Simulated gambling and potential risks of excessive play (Dickins & Thomas, 2016; Gainsbury, King, Abarbanel et al., 2015)
- Simulated gambling may exacerbate gambling (Gainsbury, King, Abarbanel et al., 2015)
- Simulated gambling could contribute to gambling harms, especially for vulnerable populations such as youth (Gainsbury King, Delfabbro et al., 2015)
- In-game purchasing could lead to gaming disorder (Stevens et al., 2021).

Prominent information about support services

Several authors highlighted the limited information and services currently available to support individuals to reduce harm from loot box and simulated gambling engagement, and recommended the inclusion of gambling, gaming and/or mental health support information in games (Gainsbury, King, Abarbanel et al., 2015; Gainsbury, King, Delfabbro et al., 2015; Gong & Rodda, 2020; Hing et al., 2020, 2021). Specific recommendations included listing safe gaming and gambling practices (Gong & Rodda, 2020), links to apps and videos demonstrating responsible gambling practices (Hing et al., 2021), and links to external service providers and other resources (Hing et al., 2020).

Other authors recommended the development of processes to tailor support to individuals or cohorts that may be at increased risk of harm from simulated gambling. This could involve the development of programs that monitor, identify and target at-risk individuals to provide needs-based and age-appropriate prevention, education and support/treatment services, while balancing individuals' privacy and security (Kristiansen & Severin, 2020a; Steinmetz et al., 2021; Veselka et al., 2018; Yokomitsu et al., 2021). Gainsbury, King, Abarbanel and colleagues



(2015) recommended that game operators identify, contact and assist problematic simulated gamblers.

Education and public awareness

Another key recommendation was public health messaging and education campaigns directed at at-risk groups such as children, adolescents and young adults (Cerulli-Harms et al., 2020; Close et al., 2021; Gainsbury et al., 2014; Gainsbury, King, Abarbanel et al., 2015; Gainsbury, King, Delfabbro et al., 2015; Hing et al., 2020, 2021; King, 2018; King & Delfabbro, 2016; Spicer et al., 2021; Stark et al., 2020; Steinmetz et al., 2021), as well as people at-risk for gambling harm (Gainsbury King, Delfabbro et al., 2015; Kim et al., 2016). Authors recommended the provision of parental education and tools to effectively monitor, control and protect children from harm associated with these products (Cerulli-Harms et al., 2020; Children's Commissioner for England, 2019; Gainsbury, King, Delfabbro et al., 2015; Hing et al., 2021; King, 2018; Stevens et al., 2021). Others recommended raising awareness more generally about the potential for harm (King & Delfabbro, 2016; Rockloff et al., 2018; Shi et al., 2021), especially with making microtransactions (Kim et al., 2016).

Intervention and treatment

Gainsbury and colleagues (2017) developed a screening tool for problematic social casino game use that could be used to make risk assessments in a clinical setting. They suggested it may be worthwhile screening for problematic social casino gaming alongside financial gambling to assess whether problems could be associated with multiple forms of gambling (including those that do not involve direct financial return), and whether social casino gaming is an initiating factor for other gambling (e.g. does it trigger gambling with real money). They recommended that clinicians recognise and inform clients that social casino gaming can produce problems that resemble gambling problems, despite the relative lack of financial expenditure (Gainsbury et al., 2017).

Role of the gaming industry

Several authors recommended the need for more transparent and ethical design of games to reduce the features and techniques that may encourage excessive expenditure and gameplay (Brooks & Clark, 2019; Cerulli-Harms et al., 2020; Kristiansen & Severin, 2020b; Gainsbury, King, Delfabbro et al., 2015; Ide et al., 2021; King, 2018; King & Delfabbro, 2016; Stevens et al., 2021). Some advocated for the removal of loot boxes, microtransactions and pay-to-win features (Gainsbury, King, Delfabbro et al., 2015; Ide et al., 2021; King, 2018; King & Delfabbro, 2016; Stevens et al., 2021), while others suggested changes to in-game purchasing that limit the rarity of items in loot boxes (Brooks & Clark, 2019), restrict or prohibit the ability to trade or sell items from loot boxes (Brooks & Clark, 2019; Kristiansen & Severin, 2020b), increase the transparency of virtual currencies and price composition (Cerulli-Harms et al., 2020), and provide avenues for reimbursement of unspent virtual currency in simulated gambling (King & Delfabbro, 2016).

As a part of the gaming industry engaging in prevention and harm minimisation strategies, two Australian studies suggested player data be shared with researchers and health professionals (King, 2018; Stevens et al., 2021).



Regulation via gambling laws

Regulating loot boxes as a form of gambling was also suggested (e.g. Children's Commissioner for England, 2019; Hing et al., 2020, 2021; Zendle, Cairns et al., 2019). A report by the Children's Commissioner for England (2019) recommended that the legal definition of gambling be reviewed to reflect new forms of gambling, such as simulated gambling and gambling-like features in video games.

Authors also recommended that gambling policies should prohibit the advertising or marketing of monetary gambling within games, which are often present in simulated gambling products (Gainsbury, King, Abarbanel et al., 2015; King & Delfabbro, 2016; Shi et al., 2021).



Discussion

Loot boxes, simulated gambling, other in-game purchases and harm

The review found reliable evidence that:

- **Loot box** engagement, including viewing, opening, and especially purchasing, was associated with problem gambling and internet gaming disorder.
- **Simulated gambling** engagement, especially in-game purchasing in social casino games, was associated with problem gambling.
- **Other in-game purchasing** (not including expenditure on loot boxes or in simulated gambling games) was associated with problem gambling.

In addition, while there was limited research examining other types of harm associated with these products, there was some evidence of a relationship between:

- Loot box purchasing and increased psychological distress and financial harm.
- Simulated gambling involvement with internet gaming disorder, psychological/emotional harm, and other negative consequences.
- Other in-game purchasing and internet gaming disorder and financial harm, and emotional and behavioural problems among adolescents.

Table 6: Assessment of loot boxes, simulated gambling and other in-game purchases and harm

Harm type	Assessment of the strength and value of evidence	Assessment of the strength of relationship
	<i>Strength and value of evidence of an association between the product and harm</i>	<i>Strength of the relationship between the product and harm</i>
	Loot boxes	
Problem gambling	High	Medium
Internet gaming disorder	Medium	Medium-high
Other types of harm	Low-medium	Insufficient evidence
	Simulated gambling	
Problem gambling	Medium	Medium-high
Internet gaming disorder	Medium	Low-medium
Other types of harm	Low-medium	Insufficient evidence
	Other in-game purchases	
Problem gambling	Medium	Low-medium
Internet gaming disorder	Low-medium	Insufficient evidence
Other types of harm	Low-medium	Insufficient evidence



Direction of relationships between products and harm

Findings of an association between these products and harm were usually based on cross-sectional studies and directionality or causality of the relationship cannot be inferred. For example, while engagement with loot boxes could directly contribute to gambling problems, it could also be that people already experiencing gambling problems are more likely to purchase these products as the chance-based element of winning items approximates a common gambling experience. Likewise, people classified as experiencing problem gambling may be more likely to engage in simulated gambling due to its structural similarity to monetary gambling activities (e.g. EGMs/pokies, casino games). This is partially supported by evidence that people at risk of gambling problems reported greater experiences of harm associated with loot boxes and simulated gambling than those classified as lower-risk or non-problem gamblers (Gainsbury, King, Delfabbro et al., 2015; Hing et al., 2021; King et al., 2021).

This evidence review also highlighted the authors' concerns that involvement in simulated gambling could encourage young players to progress to, or intensify, their monetary gambling and lead to or exacerbate harmful gambling (Armstrong et al., 2018; Dickins & Thomas, 2016; Gainsbury, King, Abarbanel et al., 2015; Kolandai-Matchett & Abbott, 2021). Several factors could influence this, including simulated gambling increasing the exposure and normalisation of gambling, providing opportunities to practice for monetary gambling, or misrepresenting the real gambling experience (e.g. higher payouts, early big wins) so players overestimate their chance of winning (Armstrong et al., 2018; King & Delfabbro, 2016).

The relationship between engagement in loot boxes, simulated gambling, other in-game purchasing and harm could also be bidirectional in nature or, as some evidence suggests, influenced by other factors. These include, but are not limited to, demographic differences (gender, age, ethnicity), impulsivity, distorted cognitions, video gaming behaviours, 'pay-to-win' gaming or 'nudges' from the structural game design, and monetary gambling involvement (Brooks & Clark, 2019; Hing et al., 2021; King et al., 2014, 2019; Kristiansen & Severin, 2020b; Rockloff et al., 2020; Russell et al., 2020; Steinmetz et al., 2021; von Meduna et al., 2020; Wardle & Zendle, 2021; Zendle, 2020).

The review also found that gaps in evidence exist about which subpopulations are most at risk for experiencing harms associated with these products, but that children/adolescents, females (loot boxes), males (other in-game purchases), pay-to-win gamers, and people at-risk of gambling problems may be more likely to experience harm.

Mitigation and regulation

The review identified several areas for harm mitigation and regulation. One overarching recommendation was for stronger consumer protection measures in video gaming. Suggestions included restricting engagement in these activities, especially in-game purchasing, to adults aged 18 and above; limit setting or restrictions on spending and excessive play; self-exclusion options; clear and prominent display of the odds/chances of winning; clear labelling and messages of the risks associated with these products, and the provision of support information, especially for those who may be at risk or vulnerable to harm.

Public health messaging and educational campaigns on these products and their associated risks were also recommended, along with clinical intervention and treatment that acknowledges the interplay between simulated gambling, financial gambling and harm. Several studies discussed the role of the gaming industry in ensuring the transparent and ethical design of games that remove or reduce features and techniques that encourage excessive expenditure.



Some authors also suggested that player data should be shared with researchers and health professionals. Variations for regulation under current gambling legislation were also mentioned.

Other published opinion pieces and commentaries beyond the scope of the current review have made similar recommendations for mitigation and regulation of harm associated with these products (i.e. Derevensky & Gainsbury, 2016; Derevensky & Griffiths, 2019; Derrington, Star, & Kelly, 2021; Gainsbury, 2019; King & Delfabbro, 2018b). King & Delfabbro's (2018b) conceptual paper on a potential regulatory and consumer protection framework for video game monetisation made additional recommendations to those captured in this review, including a two-step purchasing process for all microtransactions; voluntary breaks in play or cooldowns; ensuring all loot box items are also obtainable via standard play; microtransactions do not confer gameplay advantages; loot box probability not be determined by player behaviour; microtransactions be located in a separate space to or outside of the game; removal of repeat or duplicate rewards; removal of audio-visual cues of loot box openings; a checklist for problematic gaming use; access to records of in-game spending; notification of changes to microtransaction systems; and tips to maintain healthy playing behaviour.

This review highlighted inconsistencies in how loot boxes, simulated gambling and other in-game purchases have previously been defined in the literature. While clarity and consistency in product definitions and measurement have improved in recent years, it will be important for researchers, policy makers, industry, peak bodies and other stakeholders to ensure consistency in definition and application of classification and regulation as new products emerge.

Limitations of the current evidence base

While this evidence review provides valuable insights to inform policy responses, there are several limitations that should be considered, including:

- While most of the evidence supports an association between loot boxes and social casino games and harm, specifically problem gambling risk and internet gaming disorder, findings were usually based on cross-sectional studies. Causality, or directionality, of the relationships can therefore not be inferred.
- Most studies were conducted with adolescents (12–17 years) or young adults (18–29), but there was limited research conducted with children under 12 years, older adults or nationally representative samples of Australians.
- There was a lack of consistency in how different products (especially simulated gambling products) were defined and measured, sometimes making direct comparisons between study results or an overall assessment of harm difficult.
- Most studies examined clinical associations with problem gambling (using the Problem Gambling Severity Index; PGSI) or internet gaming disorder (IGD). However, other studies used modified versions of these measures, or different measures of gambling participation or gaming harm. This inconsistency in measurements makes it difficult to directly compare study results, and any differences in results may be due to differences in measures used.
- Other specific types of harm directly related to loot boxes, simulated gambling or other in-game purchasing (e.g. financial, emotional, relationship, health or work/school harms) were rarely investigated in the reviewed literature.
- The strength of the relationship between these products and the harms measured varies based on sample, product and type of harm, and few studies accounted for other factors that could contribute to harm (e.g. participation in monetary gambling).



- The recommendations made in the literature for the regulation and mitigation of harm associated with these products were usually based on strategies employed for similar activities, such as gambling. Evidence-informed information about the feasibility, implementation, and effectiveness of these mitigation strategies for loot boxes, simulated gambling and other in-game purchases is required.

Gaps in evidence

This evidence review highlights the need to improve understanding of the harms associated with engagement with loot boxes, simulated gambling and other in-game purchases, including:

- Determining directionality/causality of observed relationships between loot boxes and simulated gambling products with harm.
- Understanding children and their parent's experiences of harms associated with loot boxes, simulated gambling and other in-game purchases.
- Understanding the different types of harm experienced by people who use these products, including financial, emotional/psychological, relationship, health, and work or study harm.
- Improving understanding of other factors that may contribute to, moderate or mediate harm related to these products, such as demographic characteristics, peer influences, marketing of these products and participation in monetary gambling.
- Exploration of which groups may be most at risk or vulnerable to experiencing harm due to engagement with these products.
- Prospective longitudinal research on how people's engagement in and experience of harm associated with these products changes over time (i.e. from childhood to adolescence, through to adulthood, and later in life).
- Understanding the effectiveness of different types of mitigation and regulatory responses in preventing and/or reducing harm associated with loot boxes, simulated gambling and other in-game purchasing.

Conclusions

This review aimed to evaluate the evidence on harms associated with loot boxes, simulated gambling and other in-game purchases, as well as identify recommendations for harm mitigation and regulation. The main findings suggest that loot boxes, simulated gambling and other in-game purchasing are all associated with gambling problems, with growing evidence of an association with internet gaming disorder and financial harm.

The review also identified gaps and limitations in the existing evidence. For example, an improved understanding of the direction of the relationships observed in this review is required. Specifically, do loot boxes, simulated gambling and gambling-like products *cause* gambling and gaming harm, or does the experience of harm predispose individuals to increase engagement with these products? Further research should also explore the harms associated with these products among children, young people and other potentially at-risk groups, the impact of engagement with these products over time, and the influence of other factors such as player characteristics, social factors, product features and monetary gambling on the relationship between these products and harm. In gathering this evidence, we recommend that where possible, the definition and measurement of these products and harms remain consistent.



Finally, this review highlighted several suggestions for harm mitigation and regulation regarding loot boxes, simulated gambling and other in-game purchasing that policy makers, practitioners, researchers, consumers, industry, and other key stakeholders may find useful.

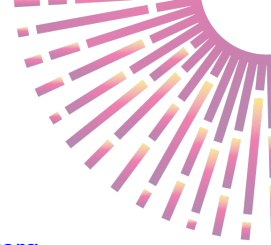


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Appendices

Appendix A. Glossary

Term	Description
Case study	An in-depth, detailed examination of a particular case (or cases) within the real-world context. Case studies cannot be generalised to the larger population and do not demonstrate causal relationships.
Cross-sectional study	A non-experimental research design in which the researcher collects data from a sample at a specified point in time. The variables are not manipulated by the researchers, nor can the results be used to assert causal relationships between variables.
DV	Dependent variable
Effect size	A numeric measure of the size or strength of a relationship between two variables. The larger the effect size, the stronger the relationship.
Electronic gaming machines (EGMs)	Also known as 'slots', 'pokies', 'poker machines' and 'fruit machines'. EGMs usually have three or more computer-simulated reels which 'spin' when a button is pushed. When winning symbols line up a prize is awarded.
Experimental study	A study in which the researcher manipulates an independent variable to determine its effect on an outcome, randomly assigns participants to certain conditions, or both. Experimental studies are used to determine causal relationships.
Gambling-related harms	The negative consequences of maladaptive gambling-related behaviour and cognitions (Browne et al., 2016). Browne and colleagues (2016) developed a conceptual framework for gambling-related harm that comprises seven main domains: financial, relationships, emotional/psychological, decrements to health, reduced performance at work/study, cultural harm and criminal activities.
Generalisability	The extent to which the results of a study can be applied to other contexts or circumstances. Also called external validity or applicability.
Interactive gambling	Gambling using the internet via a device. Excludes purely land-based gambling activities.
Internet Gaming Disorder (IGD)	A measure of disordered gaming based on the Diagnostic and Statistical Manual for Mental Disorders (DSM-V) criteria for gaming disorder (Petry et al., 2014). Various measures of IGD, also referred to as gaming disorder, are used in research (e.g. IGD-20, IGDS9-SF, IGD scale).
In-app purchases	In-game purchases (see below) made in device applications
In-game purchases	Financial purchases in games for digital goods or services, also referred to in the literature as 'microtransactions'. In-game purchases may be purely aesthetic (cosmetic), confer in-game advantages (pay to win), contain items as randomised contents of uncertain value (loot boxes), or any other in-game expenditure (Zendle, Meyer, & Ballou, 2020).
IV	Independent variable



Term	Description
Loot boxes (LB)	An in-game purchase of a virtual container (i.e. loot box, mystery box or chest) that randomly awards players with functional items or modifications (such as cosmetic items or weapons) based on chance or adjusted probabilities (King & Delfabbro, 2020). Loot boxes are also obtainable for free via gameplay (Rockloff et al., 2020).
Microtransaction (MT)	In-game purchases (see above)
Meta-analysis	The analysis of a group of individual study results with the aim of deriving conclusions about that body of research as a whole. Together with <i>systematic reviews</i> , meta-analyses are considered the strongest form of evidence on a topic.
Monetary gambling	Refers to gambling with real money on commercial gambling products (online or land-based)
Pay-to-win (P2W)	Making microtransactions in games for increasing chances of winning, gaining time or keeping the game ongoing (Steinmetz et al., 2021).
Pre-registration	The public specification of a researcher's research plan in advance of a study. Pre-registration aims to improve research integrity by preventing selective analysis and reporting of results that support the researcher's own biases.
Problem gambling (PG)	Behavioural addiction to gambling (problem gambling) is largely considered an individual issue requiring clinical treatment or individualised interventions. Risk of problem gambling (in the past 12 months) is commonly assessed via the Problem Gambling Severity Index (PGSI; Ferris & Wynne, 2001). Recent estimates suggest that around 7.2% of Australians (1.33 million people) would be classified as being 'at some risk' of experiencing gambling problems (Australian Institute of Health and Welfare [AIHW], 2021).
Problem Gambling Severity Index (PGSI)	A validated nine-item measure of problem gambling by Ferris & Wynne (2001). Total scores range from 0 to 27, with higher scores indicating higher problem gambling severity. The cut-off for categories for at-risk problem gambling: non-problem gambler (0), low-risk gambler (1–2), moderate-risk gambler (3–7), problem gambler (8+). Modified scoring of the PGSI categories by Currie, Hodgins, & Casey (2013) is as follows: non-problem gambler (0), low-risk gambler (1–4), moderate-risk gambler (5–7), problem gambler (8+).
Qualitative research	Data obtained by the researcher from first-hand observation, interviews, questionnaires, focus groups, participant observation, recordings made in natural settings, documents, and artefacts. The data are generally non-numerical.
Randomised controlled trial (RCT)	An <i>experimental</i> research design in which participants are randomly assigned to either receive the intervention that is being tested (the experimental or treatment group) or not (the control group). Members of each group are then followed up to see whether there are any differences in outcome. RCTs are considered the gold-standard method of determining whether there is a cause–effect relationship between the intervention and the outcome.



Term	Description
Replication	The ability of other researchers to repeat an experiment or observation under the same or similar conditions as the original research and obtain the same findings. Also called <i>reproducibility</i> .
Risky loot box index (RLI)	Problematic loot box use as a measure designed by Brooks and Clark (2019). The RLI is a five-item measure including: 1) <i>The thrill of opening Loot Boxes has encouraged me to buy more</i> ; 2) <i>I frequently play games longer than I intend to, so I can earn Loot Boxes</i> ; 3) <i>I have put off other activities, work, or chores to be able to earn or buy more Loot Boxes</i> ; 4) <i>Once I open a Loot Box, I often feel compelled to open another</i> ; and 5) <i>I have bought more Loot Boxes after failing to receive valuable items</i> . Higher scores indicate greater risky loot box use.
Simulated gambling (SG)	Games with features that resemble or function like commercial gambling activities (King, 2018). These include social casino games, free demo (demonstration) games, and other games with gambling-like components. Some, but not all, simulated gambling activities have in-game purchases; however, these in-game purchases operate in a closed-loop economy where they cannot be redeemed for money or traded among players.
Short Gambling Harm Screen (SGHS)	A validated 10-item measure of harms from gambling by Browne, Goodwin, & Rockloff (2017). Scores range from 0 to 10 with a higher score indicating experiencing a higher number of gambling-related harms.
Social casino game (SCG)	Gambling-themed games that are free-to-play, but payments can be made to unlock certain features or levels, or to buy in-game currency. No winnings can be withdrawn from these games. Categorised as 'monetised simulated gambling' (King, 2018). However, these in-game purchases operate in a closed-loop economy where they cannot be redeemed for money or traded among players.
Systematic review	A synthesis of the results from all available studies in a particular topic area that provides a thorough analysis of the studies' collective results, strengths and weaknesses. They seek to answer a clearly formulated question and use a pre-determined, explicitly defined search strategy to identify studies for inclusion. Together with <i>meta-analyses</i> , systematic reviews are considered the strongest form of evidence on a topic.



Appendix B. Literature sources

Literature sources

Australian Gambling Research Centre internal sources. Primarily a dedicated shared Endnote library with approximately 130 articles on loot boxes, simulated gambling, and in-game purchases

Databases: Via Catalogue Plus that includes databases such as PubMed, Business Source Complete, EconLit, Psychology and Behavioral Sciences Collection, SocINDEX, Cochrane CENTRAL (systematic reviews), and the Attorney-General's Information Service (AGIS).

Other online searches: Google Scholar was searched to identify any relevant literature not captured by the Catalogue Plus search.

Individual gambling and video/online gaming journal archives, such as: *Journal of Gambling Studies*, *Journal of Behavioral Addictions*, *International Gambling Studies*, *Computers in Human Behavior*, *Addictive Behaviors*, *Games and Culture*.

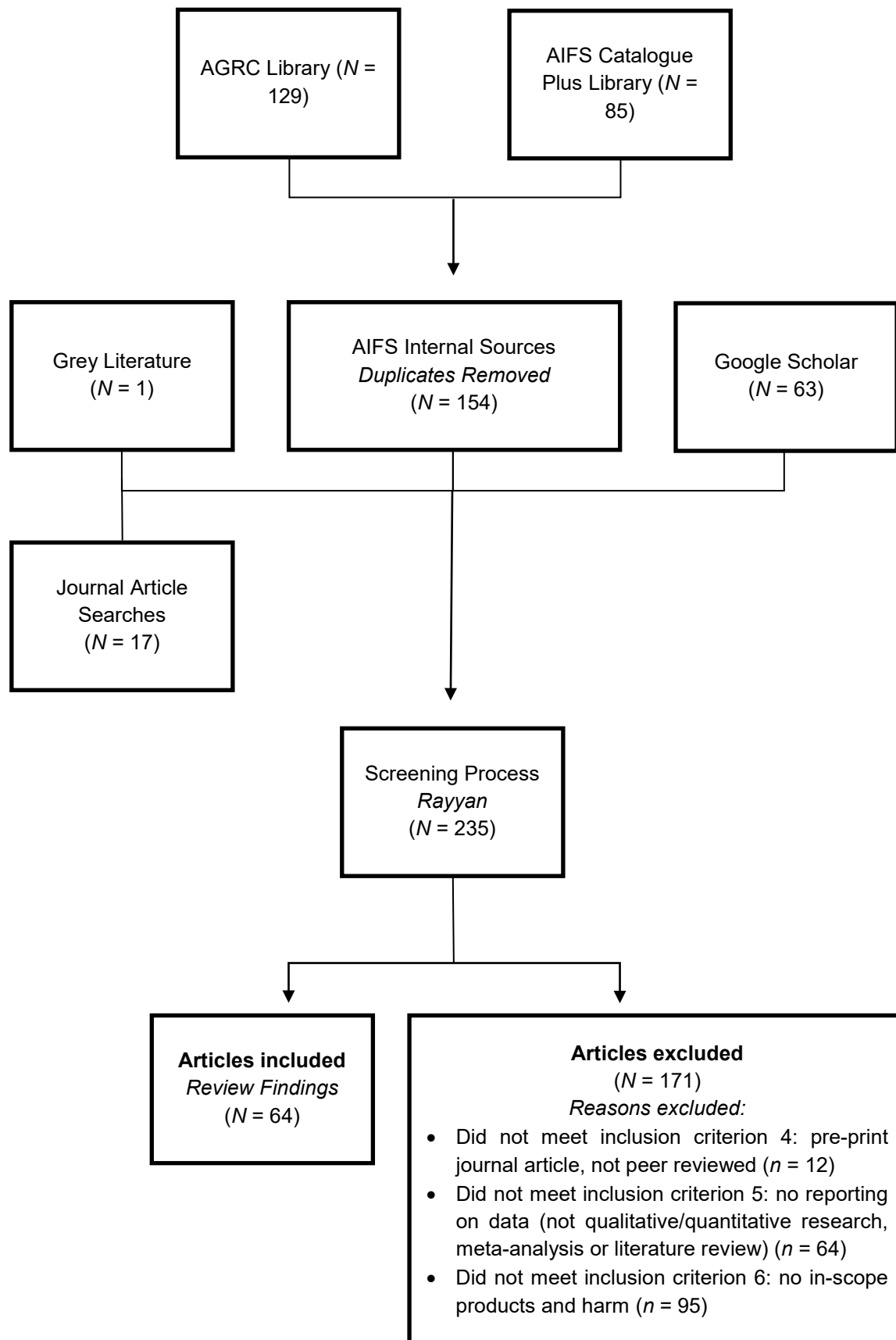
Australian and international grey literature for studies conducted for/by known government, research, industry, or other relevant agencies in this research area, such as: NSW Responsible Gambling Fund, Gambling Research Australia, Victorian Responsible Gambling Foundation, Office of the eSafety Commissioner, UK Gambling Commission, GREO (Canada), NZ Ministry of Health, and the Australasian Gaming Council.

Relevant literature cited in the 2018 Senate Inquiry into Gaming microtransactions for chance-based items.

Reference lists of identified relevant publications.



Appendix C. Review flowchart





Appendix D. Assessment of the strength and value of evidence, and generalisability to Australia

	Low	Medium	High
Strength of Evidence	Empirical study that is exploratory or cross-sectional (without comparison)	Empirical studies: pre-post design, quasi-experimental, cross-sectional comparisons, longitudinal	Empirical study with a randomised controlled trial (RCT) Pre-registered, peer-reviewed studies
	Narrative literature review with non-systematic search	Narrative literature reviews with systematic search (rapid, scoping)	Systematic literature reviews, with or without meta-analysis
	Qualitative research		
	Expert consensus, conceptual frameworks		
	Expert opinion		
	Case studies, series, reports		
	Low	Medium	High
Value of Evidence	Sample not appropriate/representative of target population(s), poorly sampled	Sample somewhat appropriate/representative of key population(s), fairly well sampled	Sample representative of key population(s), well-sampled
	Low relevance – mention harm though do not employ/assess literature with well-validated measures	Mild relevance – measure or assess literature related to harm using well-validated measures, though do so either indirectly or secondarily	High relevance – directly measure or assess literature related to harm using well-validated measures
	Analyses are inappropriate given available data, methodology and hypotheses	Analyses are appropriate given available data, methodology and hypotheses	Analyses are appropriate given available data, methodology and hypotheses, research is novel and/or particularly insightful
	Conclusions/recommendations are inappropriate given information in analyses/articles reviewed	Conclusions/recommendations are appropriate given information in analyses/articles reviewed	Conclusions/recommendations are insightful given information in analyses/articles reviewed
	Low	Medium	High
Generalisability	Only includes studies from international jurisdictions with different gaming/gambling characteristics and cultural/political/economic factors to Australia	Includes studies from jurisdictions (predominantly Eastern) that have similar socio-economic conditions to the Australian context, but different gaming/gambling characteristics	Studies from jurisdictions that have similar gaming/gambling characteristics and cultural/political/economic factors to Australia (primarily Western countries) Studies that include Australian or predominantly Australian samples



Appendix E. Harm measures

Problem gambling

'Problem gambling' or behavioural addiction to gambling (based on DSM-V criteria for gambling disorder; DSM-V, 2013) is largely considered an individual issue requiring clinical treatment or individualised interventions.

Problem Gambling Severity Index (PGSI)

A total of 28 included in this review assessed the risk of problem gambling (in the past 12 months) via the Problem Gambling Severity Index (PGSI; Ferris & Wynne, 2001).

The PGSI is a validated nine-item measure of problem gambling by Ferris & Wynne (2001). Total scores range from 0 to 27, with higher scores indicating higher problem gambling severity. The cut-off for categories for at-risk problem gambling: non-problem gambler (0), low-risk gambler (1–2), moderate-risk gambler (3–7), problem gambler (8+). Modified scoring of the PGSI categories by Currie, Hodgins, & Casey (2013) is as follows: non-problem gambler (0), low-risk gambler (1–4), moderate-risk gambler (5–7), problem gambler (8+).

Other measures of problem gambling

Other measures of 'problem gambling' applied in the reviewed papers included: DSM-IV-MR-J criteria for gambling disorder for adolescents (four studies), South Oaks Gambling Screen revised for Adolescents (SOGS-RA; four studies), Canadian Adolescent Gambling Inventory (CAGI; three studies), Online Gambling Disorder (OGD-Q; one study), gambling problems (NODS-CLiP; one study), the German validated questionnaire of gambling-related problems in adolescence (FPG-J; one study), and self-reported changes in problem gambling (one study). Eleven literature reviews and two meta-analyses included various measures.

Gambling-related harms

Gambling-related harm differs to 'problem gambling' in that it can be experienced at an individual or population-level. Browne and colleagues (2016) developed a conceptual framework for gambling-related harm that comprises seven main domains: financial, relationships, emotional/psychological, decrements to health, reduced performance at work/study, cultural harm and criminal activities.

Short Gambling Harm Screen (SGHS)

Four studies that evaluated gambling-related harm used the Short Gambling Harm Screen (SGHS). The SGHS is a validated shortened (10-item) measure derived from the work of Browne and colleagues (Browne, Goodwin, & Rockloff, 2017). Scores range from 0 to 10 with a higher score indicating experiencing more gambling-related harms.

Internet gaming disorder

Internet gaming disorder is a measure of disordered gaming based on the Diagnostic and Statistical Manual for Mental Disorders (DSM-V) (Petry et al., 2014). Various measures of IGD, also referred to as gaming disorder, are used in research. Of the 19 studies measuring gaming disorder in the current review, the following measures were used: Internet Gaming Disorder (IGD, Petry et al., 2014; four studies), Internet Gaming Disorder Scale (IGDS, Lemmens et al., 2015; two studies), DSM-V IGD criteria (two studies), C-VAT 2.0 IGD (van Rooij et al., 2017; one study), Internet Gaming Disorder Scale – Short Form (IGDS-SF9, Pontes & Griffiths, 2015;



one study), adapted IGD Checklist (Przybylski et al., 2017; one study), and four literature reviews and one meta-analysis with various measures. An additional study adapted the Short Gambling Harm Screen (SGHS) to a measure of gaming-related harm (financial, moderate: Carey, Delfabbro, & King, 2021).

Other harm measures

The other types of harms measured in 30 evaluated studies were: psychological distress (Kessler 6 or 10; 5 studies), self-reported or subjective harms associated with products (6 studies), substance use (alcohol, illicit drugs, tobacco) (3 studies), Problem Pay-to-Win (P2W) Gaming (2 studies), Risky Loot Box Index (Brooks & Clark, 2019: 2 studies), Gambling Related Cognition Scale (GRCS; 1 study), Problematic use of loot boxes (PU-LB; 1 study), problematic social casino game use screen (PSCGS; 1 study), positive and negative affect (PANAS-SF; 1 study), Revised-Children Anxiety Depression Scale (RCADS; 1 study), mental distress (BSI-18: 1 study; PHQ-A: 1 study), risk-taking scale (DOSPERT; 1 study), psychosocial adjustment (SDQ; 1 study), depression/anxiety (1 study), school grades (1 study), and three literature reviews with various measures.

Predictors, mediators and moderators

We examined potential predictors, mediators, or moderators of to observe other factors which may influence harm associated with the products reviewed. Studies were reviewed if they included advanced statistical techniques and examined relationships between sets of variables. We reviewed studies that examined how the variable(s) mediated or moderated the effect of a simulated gambling product on a harm outcome (e.g., structural equation modelling); or contributed significant variance to a harm outcome in a model which included a simulated gambling product (i.e., when controlling for additional factors, e.g., multivariate regression)