ORIGINAL ARTICLE

Gaming-Gambling Convergence: Trends, Emerging Risks, and Legislative Responses

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Abstract

A convergence of gaming and gambling products, services, and platforms is presently drawing considerable policy debate. This convergence may be giving rise to a critical area of consumer vulnerability given the addictive potential of gaming and gambling. While some convergence aspects are gaining research attention, the broader contexts of the phenomenon have not been adequately examined. In light of this, the present study aimed to inform four key enquiry areas pertaining to gaming-gambling convergence—contexts and drivers, definitions and framings, risk and harm, and legislative response. Using a narrative review method, 108 articles from the academic and grey literature were examined and thematically summarised to provide an overview of the convergence phenomenon. Findings indicate convergence in multiple over-lapping contexts (gaming elements in gambling, games incorporating gambling elements, gambling on games, free simulated online gambling, and social media games and gambling) driven by technological advances and commercial interests. Findings related to definitions and framing include the industry's strategic use of the term gaming to reduce negative connotations associated with gambling, and community perceptions of gaming as legitimate and harmless entertainment. Potential risks include transitions from games (without money) to real-money gambling, and problem co-existence. Legislative responses are beginning to emerge with the greatest focus being on loot boxes in games. However, the limited evidence of risk and harm has led to hesitancies in legislative actions to regulate gaming-gambling hybrids in some jurisdictions. Considering that convergence is supported by rapid advances in technology and is taking place largely on the Internet (accessible 24 h), harms for consumers could manifest quickly and spread broadly across societies before their existence and severity are established. Based on the *Precautionary Principle*, the present evidence base call for harm prevention policies and regulations in addition to changes in the definition of money (including digital currency and microtransaction) in gaming and gambling laws.

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This review examines what has come to be known as a convergence of gaming and gambling. Convergence includes crossovers in gaming and gambling networks resulting in hybrid products and services (e.g. game-like gambling, digital games with gambling elements) that are hosted on different media platforms (e.g. interactive television, social networking sites) and may contain persuasive content (Albarrán-Torres 2018; Gainsbury et al. 2015b; Griffiths 2007, 2008b; Griffiths et al. 2009; King and Delfabbro 2019). Protracted participation in gambling (Calado and Griffiths 2016) or gaming (Kuss and Griffiths 2012) can lead to addiction and harm. Both gaming disorder and gambling disorder are now included in the World Health Organization's International Classification of Diseases-11 (ICD-11). This suggests that gaming-gambling convergence may be an emerging area of consumer vulnerability, perhaps especially for millennials whose daily lives are highly intertwined with online technology (De Freitas and Griffiths 2008; Drennan et al. 2006; Griffiths 2008a, b, 2014; Martinelli 2017; Teichert et al. 2017; Torres and Goggin 2014), and for centennials born into the digital world.

Gaming-gambling convergence is only just beginning to receive significant research attention. To date, we have little understanding of associated risks and harm. Research related to convergence contexts (e.g. scope, promotional activities) is not well developed (Gainsbury et al. 2014a; King 2018; King et al. 2015) and we know little about how consumers perceive gaming-gambling hybrid products and services. This narrative review provides an overview of convergence contexts and drivers, considers how gaming and gambling are framed and understood, identifies potential risks and harm, and examines present legislative responses. To inform governments, policymakers, treatment providers, public health specialists, industry, and scholars, the review ends with a discussion on implications for diagnosis, harm prevention, and research.

Methods

Using a *narrative review* method (Ferrari 2015), a systematic search was carried out to identify relevant articles to inform four broad research areas (RA):

- RA1: What are the contexts and drivers of gaming-gambling convergence?
- RA2: How are gaming and gambling currently framed, defined, and understood? What implications do semantics have in terms of public perceptions?
- RA3: What is the evidence on impacts, risks, and harm resulting from participation in gambling-like games and gambling activities with gaming features?
- RA4: What are the current legislative responses to gaming-gambling convergence?

Searches were carried out in academic databases (Google Scholar, and the researchers' library catalogues which link to multiple academic databases) and in Google Search to include both academic papers and grey literature (Benzies et al. 2006; Mahood et al. 2014). In addition to the predefined search protocol (Fig. 1), we used an approach recommended for systematic reviews of complex and heterogeneous topics (Greenhalgh and Peacock 2005). This involves
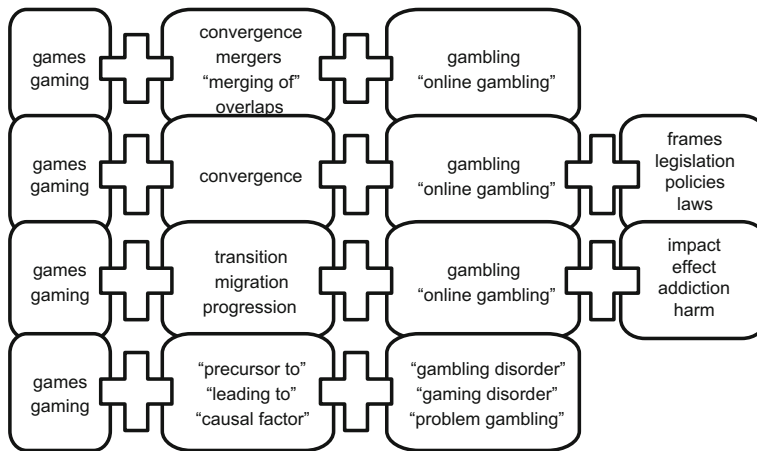
Fig. 1 Search terms

the inclusion of publications found incidentally and through researchers' knowledge of the field and citation mining.

To provide a broad overview of emerging developments, both empirical and conceptual articles (e.g. qualitative and quantitative research, reviews, scholarly commentaries, and viewpoints) published in English were included. Empirical studies were included regardless of locality, age group range, or sample size. To ensure recency, articles published between 2008 and 2020 were prioritised. Following a scan of titles, abstracts, and summaries, 174 articles were retrieved for text review. Sixty-six articles that did not directly inform the research areas were excluded, resulting in 108 articles that were consulted to address RA1 through to RA4 (see Appendix Table 1). It was not feasible to provide an exact count of the preliminary yield which included grey literature such as blogs, websites, and web-based news. These were scanned but not retrieved and stored.

Given the broad nature of the enquiry, this review is not exhaustive; nevertheless, it provides a thorough synthesis of relevant literature to familiarise the reader with the four mentioned enquiry areas.

Findings

Convergence Contexts

Gaming Elements in Gambling

Convergence of gaming and gambling in digital media includes an increase in gaming elements and themes in gambling products (Gainsbury et al. 2015b). For example, some electronic gaming machines (EGMs) now include an element of skill (Pickering et al. 2020) and others incorporate features that imply skill involvement. The featuring of themes from popular social games and television game shows in EGMs suggests a possible marketing strategy to make EGMs more attractive to younger gambling participants (Gainsbury et al. 2015b). In Las Vegas, slot machines incorporate video game mechanics through the addition of composite structures, manifold and variable goals, or games within games (Sahl 2015). Slot machines also contain the immersive

features of video games through the use of "sophisticated graphics", advanced "sound design", "complex themes", and "interactive animated characters" that are attractive to players (Sahl 2015, p. iii). This is an emerging risk from gaming-gambling convergence as EGMs are strongly associated with problem gambling development (see Abbott 2006; Binde et al. 2017; Breen and Zimmerman 2002). As the addition of skill elements to EGMs may elicit illusions of control and perceptions of higher return, the potential for harm arising from this convergence warrants investigation (for recent discussions see Delfabbro et al. 2020; Mantini 2016; Pickering et al. 2020).

Gambling Elements in Games

In addition to the incorporation of gaming elements in gambling activities, there is movement in the opposite direction. Skill gaming sites include many new forms of gambling and the inclusion of gambling elements in games is now commonplace (Gainsbury et al. 2015b; Griffiths et al. 2014; King et al. 2010a). These games are usually *free to play* and have no financial prizes. They may, however, include purchasing *virtual currencies* (see Appendix Table 2 for definition) where players can spend real money in return for an upgrade or reward, including random in-game rewards. Gambling elements may be secondary or peripheral to the games' focus. They may include card games, slot machines, or other gambling activities to win virtual currency to use within the game (Gainsbury et al. 2015b). Non-monetary rewards and payments in game-related currencies are often significant for players and may affect behaviour in similar ways to financial rewards. In Australia, there is a broad range of gambling simulations (including casino-style gambling activities) within commercial video games, many of which are classified as suitable for youth (King et al. 2012a). The gambling simulations are "often associated with incentives and rewards, such as virtual currency, rare in-game items, and other content of large contextual value in the game" (King et al. 2012a, p. 238). Many of the video games (e.g. Pokémon) displayed contents that were appealing to youth, suggesting that these may be a targeted form of advertising (King et al. 2012a).

The prospect of wining money within randomly generated games is a particularly difficult area to decipher in gaming-gambling hybrids. Griffiths (2011, p. 461) identified an arising *pay-per-kill* feature in video games where video game players get paid for each "kill" they make within the game (see Appendix Table 2). However, because these games are confined within a computer game environment, they are defined as skill-based (and not chance-based) activities and are thus exempt from gambling regulations in most jurisdictions. This leeway is likely to encourage gambling companies to incorporate video game technology into their products (Griffiths 2011).

Another development is gambling content (e.g. online poker, private lotteries) in the live streaming of video games on Twitch.tv which is monetised through subscription and other techniques (Johnson and Brock 2019). Twitch.tv streams over two million self-broadcasting gamers and is accessed by between 150 to 200 million viewers each year (Abarbanel and Johnson 2020; Johnson and Brock 2019; Johnson and Woodcock 2019a), suggesting the broad reach of gaming-gambling hybrids.

There has been intensifying debate regarding loot boxes, a type of in-game purchase (see Appendix Table 2). As loot box contents are unknown at the time of purchase, it implies an element of chance and randomness (akin to gambling). However, loot box purchases are not considered gambling by the video game industry (Griffiths 2018). Challenging this assumption, in an analysis of loot box features in 22 games rated as being appropriate for audiences aged 17 years or less, Drummond and Sauer (2018) found that 10 of the games met all five of Griffiths' (1995) criteria for defining gambling—(1) monetary or valuable goods transactions, (2) transaction

determined by an unknown future event, (3) outcomes at least partly determined by chance, (4) losses avoidable by non-participation, and (5) winners gaining at the expense of losers (Drummond and Sauer 2018).

The structural characteristics that cause addictiveness are quite similar in gambling and video gaming (see Griffiths and Nuyens 2017; King et al. 2010b; Wood et al. 2004). Reinforcers that either induce play or induce continuous play are an example of such structural characteristics (Griffiths and King 2015). It is also known that people participate in gambling activities for reasons additional to winning money; for instance, social rewards, entertainment, intellectual challenge, and mood state changes (Binde 2013; Walker et al. 2008). Many of these reasons are common to gaming and gambling. A survey testing six broad purchase motivations showed that player spending on in-game content was positively associated with the *unobstructed play*, *social interaction*, and *economic rationale* purchase motivations—implying that game designs that incorporate artificial limitations, obstacles, and social interaction can affect the amount players spend on in-game content (Hamari et al. 2017). The incorporation of gambling elements into games is, ostensibly, intended to make them more exciting and encourage greater intensity and duration of play. It may thus contribute to players transitioning to online and traditional forms of gambling for money (Gainsbury et al. 2015b).

Gambling on Games

Another convergence development is the practice of betting or gambling on games. For instance, betting on skill games that participants themselves take part in has become popular. While not legally considered to be gambling, as Gainsbury et al. (2015b) point out, there is a fine line between such activities and betting on game types where chance also plays a part. Within the Twitch.tv video game platform, some broadcasters host semi-private poker games and invite viewers to wager money alongside other fans of the broadcaster (Johnson and Brock 2019). Providing full-time income for some professional video gamers, Twitch uses a range of monetisation mechanisms including subscriptions, donations, competitions, chance-based prizes, and unpredictable rewards to encourage viewer spending (Johnson and Woodcock 2019a, 2019b).

Additionally, there is increased popularity of betting on Electronic Sports or eSports—events where professional video game players compete on multiplayer video gaming tournaments—converging professional gambling and professional video game playing (Griffiths 2017). Playing eSports can be done on a range of platforms including PCs, mobile phones, and gaming products (e.g. Xbox, PlayStation) (Igelman and Prizant 2017). Games include one-on-one types between individual players and types that are between teams or leagues of professional eSports athletes (Igelman and Prizant 2017). Betting on eSports has led to allegations of unregulated and underage gambling through connections to *skins betting* (Griffiths 2017) (defined in Appendix Table 2). While cash is a common currency in eSports gambling, the use of *virtual currencies* and *in-game items* is an increasing trend (Cleghorn and Griffiths 2015). The intersection between eSports and gambling is a relatively new niche in the gaming industry. While it remains to be seen if gamers are converted to gamblers, it is likely to encourage creative gaming-gambling partnerships (Schneider 2015).

Free Simulated Online Gambling

Many online gambling operators offer free simulated versions of their gambling products. For instance, "demo", "practice", or "free play" modes of online casinos and other Internet

gambling products are common non-monetary forms of gambling that players may try out (Frahn et al. 2015; Griffiths et al. 2009; King et al. 2010a). At the surface level, the purpose of these free-play versions is to help people become more familiar with the operation and rules of the game. However, they also serve as promotional tools to attract interest in these activities (Frahn et al. 2015). They thus offer gambling sites a way to advertise with fewer constraints and avoid age restrictions. Gambling researchers have argued that this area of gaming-gambling overlap provides a means to familiarise adolescents with gambling and instil a positive perception of gambling as simply a game (King et al. 2010a). A large representative youth survey in Canada found that substantial numbers of adolescents reported taking part in free simulated gambling—free Internet poker (9.1%), Facebook gambling games (9.0%), and free Internet slot games (4.9%) (Elton-Marshall et al. 2016).

Social Media Games and Gambling

Gaming-gambling convergence within social media has given rise to new gambling forms; for instance, online social casino games (Abarbanel and Rahman 2015; Gainsbury et al. 2014a; King et al. 2014; King et al. 2015) and other gambling games on Facebook such as Slotomania, and House of Fun (see GamblingSitesOnline.org 2019). Although no directionality was observed, in one study, online gamblers who engage in social casino games had a higher likelihood of spending more time in real-money online gambling (Abarbanel and Rahman 2015). An analysis of Facebook games found that 54% presented gambling content (Jacques et al. 2016). In the first quarter of 2013, Facebook profited $213 million from its social casino games (Martin 2014). Such profits are in part made possible via the *freemium* model used in such games (Wohl et al. 2017). Within freemium models, games may be downloaded at no cost, and players are offered free credits that can be periodically reloaded (Wohl et al. 2017). However, players are also offered the opportunity (and encouraged) to purchase additional credits to continue playing or to participate in higher stakes bets (Wohl et al. 2017).

Convergence Drivers

Technology Advances

Gaming-gambling convergence is largely driven by increasing interconnectedness between media channels and contents. Digital interconnection has become prominent, particularly following the advent of broadband Internet services, digital television, and smartphone technology (Griffiths et al. 2014). Content convergence has taken place simultaneously with media convergence, obnubilating previously distinct modes of information and communication (Griffiths et al. 2014; Jenkins 2006; King et al. 2010a; Lopez-Gonzalez and Griffiths 2018). Griffiths et al. (2014) identified four common technology-aided types of convergence: (1) one medium, for instance, the Internet, having the capacity to deliver content from other media (e.g. radio, television); (2) the possibility to engage in different activities (e.g. watching a sports match, playing a video game, producing a written document) on the same device; (3) the embedding of one digital activity (e.g. gambling) within another (e.g. video game); (4) activities such as game shows or video games having common features to gambling. A key implication of technology-driven convergence that relates to mobile technologies is that it enables gambling enterprises to offer mobile gambling around the clock, 365 days a year, in a vast global market (Drennan et al. 2006), thus increasing accessibility and risk. This raises the question of the vulnerability of "the

millennial consumer, whose lived experiences are imbued with new technology-based services"
(Drennan et al. 2006, p. 174).

Commercial Interests

Promotional materials of the 2013 Social Casino Summit in Las Vegas, aimed at game
developers and land-based casinos, included benefits to be gained from social and real money
gaming (Sapsted 2013). Gaming-gambling convergence is thus driven by commercial interests
(Cassidy 2013; Harwood 2010; Wohl et al. 2017). This is largely due to the broad reach,
relatively low cost, and digital compatibility of gaming, and the profitability of gambling
(Cassidy 2013). For instance, in 2012, International Game Technology, a designer and
manufacturer of slot machines, purchased a social casino gaming company called Double
Down Casino for $500 million (Wohl et al. 2017). The social games' customer base (approx-
imately 799 million) is three times greater than that of online gambling (Cassidy 2013). While
gambling has a smaller customer base, their customers spend (900 times) more than social
games customers (Cassidy 2013). The potential profitability of gaming-gambling convergence
thus becomes a significant driver. Market-driven convergence is also occurring in online sports
betting with integration with virtual and eSports, immersive reality, fantasy sports, sports
media, and in-venue betting (Lopez-Gonzalez and Griffiths 2018). A 2016 SuperData report
showed the rapid growth of professional eSports that was expected to increase to $10 billion in
2020 (Griffiths 2017). Since 2012, the social casino market has had a compound annual
growth rate of over 30%, generated an estimated global revenue of $976 million in 2016, and
was projected to reach $4.63 billion in 2020 (Krejcik 2017). Similarly, globally, 15% growth
in digital games revenue was observed, from $7.4 billion in October 2016 to $8.5 billion in
October 2017 (SuperData Research 2017b).

　　Numerous acquisitions, mergers, and partnerships between gaming and gambling operators
(Cassidy 2013; Gainsbury et al. 2015b; Schneider 2012) illustrate a convergence of two
previously distinct industries. These initiatives are not surprising from a business perspective.
In jurisdictions with mature gambling markets, participation in traditional forms of gambling
has declined especially among youth and young adults (Abbott et al. 2018; Abbott et al. 2014;
Abbott et al. 2016). In the UK, some gambling operators regard social gaming as a business
threat and see acquisitions of these products as a way of laying claim over the market (Cassidy
2013). Gainsbury et al. (2015b) argue that this also allows gambling operators to leverage their
brand and marketing capabilities to develop monetised gaming activities that appeal to non-
gamblers. It is also likely that this enables them to understand customer gameplay patterns and
preferences and maintain brand reinforcement and engagement when customers are not
gambling. They also note some overlaps between gamers and gamblers in terms of demo-
graphics and consumer interests—an overlap that might facilitate migration across markets
(Gainsbury et al. 2015b). Benefits of gaming product acquisition include a bigger consumer
base, strengthening of brands (Wohl et al. 2017), the possibility of bringing game mechanics
expertise into real-money gambling products, and shared business insights (Cassidy 2013).
Through these mergers and partnerships, social casino games and their casino counterparts
have begun to look identical—making it difficult to distinguish the two (Wohl et al. 2017).

　　Other commercially beneficial outcomes from these mergers include a boost in advertising
for online and land-based casinos within social casino games and social media platforms
(Wohl et al. 2017). The impact of advertising was among concerns expressed by participants in
a qualitative study in Australia (Gainsbury et al. 2015a). Social casino gamers reported

substantial exposure to social media advertising of gaming and gambling, with some describing the exposure to be "relentless". Social casino gaming and online gambling sites appear to use similar marketing strategies (Gainsbury et al. 2015a). Methods include pop-up advertisements on social media sites and email notices that use refer-a-friend incentives; "a variety of free credits, bonuses, and special offers to attract new recruits"; and even "likes" on Facebook being "connected to opportunities to engage in gambling and gaming activities" (Gainsbury et al. 2015a, p. 148).

Definitions, Framings, and Understandings

The above observations show that gambling elements in games and gaming mechanics in gambling activities obscure the line between gaming and gambling. This can cause vagueness in their definitions that could influence public perceptions and attitudes. In the literature, gambling is typically defined as an activity that involves the staking of money (or something of economic value) on an event with an uncertain outcome, and the offer of a prize of value that is largely or entirely achieved by chance (Bolen and Boyd 1968; McMillen 2005; Thomson 1997). This definition of gambling has gained some international consensus, although legal definitions vary between jurisdictions (see Rohsler 2019). However, in some contexts, gaming tends to be used as a synonym for gambling although the two can represent distinctly different activities (Derevensky and Griffiths 2019; Owens Jr 2012).

While scholars have proposed that gaming should be "principally defined by its interactivity," be "predominantly skill-based," with "contextual indicators of progression and success" (King et al. 2015, p. 216), the term is arbitrarily defined within society. Younger age groups, whose play experiences include video games as a pastime or for fun, may not associate gaming with gambling (Calado, Alexandre, & Griffiths 2014). In Germany, although consumers differentiated online gaming from gambling products, some placed action, strategy, and puzzle games alongside instant lotteries, sports bets, and casino gambling – suggesting a blurring of perceived boundaries between non-gambling and gambling products (Teichert et al. 2017).

The semantics of the terms gaming and gambling are also important because it can influence consumer perceptions of legitimacy. An analysis of "gambling" and "gaming" frames in US mainstream newspaper articles found that gambling positively correlated with criminalising frames (*crime* and *regulation*), but negatively with legitimising frames (*entertainment*) (Humphreys and Latour 2013). Gaming, on the other hand, positively correlated with *entertainment* frames but negatively with *crime* and *regulation* frames. Framing effects were evidenced in an experiment where non-gamblers associated "gaming" with legitimacy (Humphreys and Latour 2013). Framing effects, a well-researched phenomenon in public opinion, occur when changes in message frames cause changes in opinion (Chong and Druckman 2007). If framing causes more non-gamblers to perceive gaming as "normatively legitimate, it may come to seem more legitimate at the population level" (Humphreys and Latour 2013, p. 790) or achieve what Johnson et al. (2006) refer to as "general validation". This in turn could influence participation.

There has also been concern that pay-to-win features in popular online games such as Angry Birds, Candy Crush, and Pokémon Go may normalise gambling behaviours among children (Carter 2017). This is a potentially risky convergence development considering signs of addiction among youth to these games (see, for examples, Chen and Leung 2016; Mejia et al. 2019; Zafar et al. 2018). Normalisation may also occur when youth lack clarity in the

difference between gaming and gambling. For instance, adolescents in Portugal reported having engaged in online gambling and justified their behaviour because it was very similar to gaming (Calado et al. 2014).

There have been efforts to distinguish the definitions of gaming and gambling in addiction research (see King et al. 2015). Although the term gaming refers to activities with mathematically prescribed outcomes based on probability theory (Bewersdorff 2004), some scholars are of the view that it remains an industry-preferred term because it portrays an entertainment service that is regulated by responsible government agencies and deflects negative connotations associated with problem gambling (Australian Gambling n.d.; Brisman 2004; Campbell and Smith 2003; Drennan et al. 2006; King et al. 2015; Owens Jr 2012, 2013). People who engage in electronic "gaming" machines (EGMs), a type of gambling strongly associated with problem gambling (Abbott 2006; Abbott et al. 2018; Binde et al. 2017; Breen and Zimmerman 2002), are typically referred to as EGM "players". It is arguable that "gaming" and "players" are used by industry in place of "gambling" and "gamblers" to soften public perception of their image in the face of increased awareness of problem gambling rates and gambling harms (Campbell and Smith 2003; Drennan et al. 2006). The recent conflicts between the clinical and gaming professions in Korea, following the World Health Organization's (WHO) classification of gaming disorder as a disease in 2018 (alongside gambling disorder), highlight the significance of semantics and public perceptions (Kim and Jeon 2020). The European Games Developer Foundation's arguments against WHO's classification which included notions that "gaming is predominantly enjoyed 'safely and sensibly'" and that the term gaming disorder "would create moral panic" may be seen as deflecting attention from the harmful consequences of "problematic gaming (e.g. social isolation, displaced sleep, physical inactivity and dietary problems, decreased psychological wellbeing, academic or job interference and interpersonal conflicts)" (King et al. 2018, p. 2144). We believe that such industry arguments also reflect an attempt to safeguard the marketing advantage offered by the term gaming. For instance, according to Gamify (a game marketing company), "positive association" is a marketing strategy that can be used to help players acquire feelings of being engaged, being in control, and accomplishing (see, Denton 2021). Understandably, the negative connotations of disease, disorder, and addiction introduced through "gaming disorder" in ICD-11 can weaken such positive associations.

Inspections of industry advertising have revealed strategised use of the term gaming. In Malaysia, where gambling is associated with stigma due to bankruptcy, destruction of families, and crime, the term gaming was used by industry as a rebranding strategy to promote gambling activities in a positive manner and instil a false notion of high winning odds (Yoong et al. 2013). An analysis of 115 social casino gaming advertisements revealed that the visuals used were those known to be appealing to children and youth (e.g. bright colours, cute animals, cartoon-like characters of children, popular culture), and the themes in the messages included gambling glamorisation or normalisation, winning, and play encouragement (Abarbanel et al. 2017). Despite their gambling-like content, 90% of the advertisements did not have any responsible gambling messages (Abarbanel et al. 2017).

The overlaps between so-called games and actual gambling have prompted scholars to formulate new terminologies—gambling-like games, gambling-style games, games with gambling-like elements, simulated gambling games, games with gambling themes, real-money gambling, pseudo-gambling, gambling-play, gamble-play, and quasi-gambling (Albarrán-Torres 2018; Carter 2017; Dickins and Thomas 2016; Dussault et al. 2017; Griffiths et al. 2014; Hayer et al. 2018; Owens Jr 2013; SuperData Research 2017a). Scholarly interest

in gaming-gambling convergence has given rise to taxonomies and classifications to distinguish the two (Gainsbury et al. 2014a; Gainsbury et al. 2015b; King et al. 2015; Parke et al. 2012). To differentiate gaming from gambling, its outcomes, which may include prizes of value, should be entirely or primarily achieved by skill (see King et al. 2015); however, as noted in the preceding sections, this has not been the case within the context of gaming-gambling convergence.

Risks and Harm

Games to Gambling Transitions

While gambling and gaming disorders are considered to be separate problems, gaming-gambling convergence raises the question of transitions from games to real-money gambling and consequent gambling disorder development. An international online survey representing 61 different nationalities found that increased eSports spectating was strongly associated with increased gambling participation (Macey and Hamari 2019). Although this suggests some potential for a transition from gaming to gambling, further research is required to assess whether or not this is the case.

A qualitative study reported how engagement in social casino games led to paying for extra play time and then to real-money gambling (Gainsbury et al. 2015a). A recent review affirmed that simulated gambling generally did lead to monetary gambling (Lawn et al. 2020), and several cross-sectional studies have suggested transitions and risks. In a UK survey sample, close to half of social casino game players transitioned from these games or virtual item wagering to real-money gambling (SuperData Research 2017a). Engagement in Amateur eSports had the highest likelihood of transitioning to real-money gambling in both the UK (62%) and the Netherlands (53%) (SuperData Research 2017a). For 19%, in a non-representative sample of Australian adults, real-money gambling was a result of having previously engaged in social casino games (Gainsbury et al. 2016). The most common reasons for the transition included the excitement of risking money, prospect of winning real money, wide variety of real-money games, and use of games to practice for real-money gambling (Gainsbury et al. 2016; SuperData Research 2017a). Migration appears to be motivated by a perception of increased gambling skills as a result of gaming participation (Gainsbury et al. 2016).

An analysis of 463 popular *Steam* desktop games, accessed by over 4 million players, evidenced increase in exposure to loot boxes from 4.2% in 2010 to 71.2% in 2019 (Zendle et al. 2020b) which suggests that the popularity of these games have increased. Some "articles in the trade press have claimed that buying of loot boxes can be problematic and/or addictive because they are designed using reward schedules that are highly similar to those used in the design of slot machines" (Griffiths 2018, p. 54). This observation may help explain findings from recent studies that show associations between loot box spending and problem gambling symptoms (see Delfabbro and King 2020; Drummond et al. 2020; Garea et al. 2020). Others have demonstrated significant links between loot box spending and problem gambling severity, suggesting transitions and risk (see Garea et al. 2020; Macey and Hamari 2019; Zendle and Cairns 2019; Zendle et al. 2020a).

Gaming-gambling convergence also exposes children and adolescents to new types of gambling-like experiences through games (Griffiths et al. 2009). Among a representative sample of juveniles in the UK, 11% played online gambling-style games, 11% engaged in

skins-betting (i.e. betting using in-game items within computer games or apps), and 45% were aware of the possibility of betting with in-game items (Gambling Commission 2017b). An experimental examination of the psychological effects of inflated pay-out rates in slot-machine simulations on young Australian adults found that those subject to simulations with inflated return-to-player pay-outs placed significantly higher bets in monetary gambling than other groups (Frahn et al. 2015). The study indicated a risk of "misleading free play or demo modes" leading to "riskier gambling behaviour" (Frahn et al. 2015, p. 1539). In Canada, a significantly higher proportion of adolescents who engaged in paid-gambling reported having played free simulated gambling games suggesting that free games may be normalising gambling for youth (Elton-Marshall et al. 2016). Corroborating this finding, a survey of UK students noted correlations between playing on free or practice gambling games and gambling with real money and problem gambling (Forrest and McHale 2012). These risks for children and adolescents were confirmed in two reviews. One concluded that simulated gambling instils a positive perception about gambling profitability and increases the chances of future participation in real-money gambling (King 2018). The other noted how high exposure to simulated gambling games among youth led to a higher likelihood of participation in real-money gambling and gambling disorder development (Armstrong et al. 2018).

In qualitative studies, youth and university students in Portugal (Calado et al. 2014) and Canada (Kim et al. 2016) disclosed how they played online and social casino games to develop gambling skills before spending real money. While students held a feeling of immunity from effects themselves, they believed younger teenagers (between 12 and 14 years) were susceptible to transitioning from social casino games to online gambling as a result of early exposure and ease of access (Kim et al. 2016). Their perceptions are consistent with the findings of several cross-sectional studies. In a sample of Australian adolescents, two-thirds reported that real-money gambling was preceded by social casino gambling, suggesting a transition (King et al. 2016). An earlier survey of Australian secondary school students found a significant proportion engaged in simulated gambling activities (including in online gambling sites, social media, smartphone applications, and video-games) and had a higher risk of developing gambling problems than those not involved in simulated gambling (King et al. 2014). Likewise, the risk of transitioning from simulated gambling to problematic monetary gambling was evidenced among youth in Denmark (Kristiansen and Severin 2020a). A positive correlation between loot box engagement and problem gambling severity was also detected among Danish youth (Kristiansen and Severin 2020b).

More recently, a number of prospective studies suggest that gaming can often be a precursor to gambling participation. Participation in online simulated gambling activities was found to predict the development of problem and at-risk gambling across the four waves of the New Zealand National Gambling Study (Abbott et al. 2018). This finding held up when the effects of other predictors were controlled for in multivariate analyses (Abbott et al. 2018). A longitudinal study of social casino gamers in the USA who had never previously gambled online found that 26% transitioned to online gambling after 6 months (Kim et al. 2015). Use of virtual credits or microtransactions in social casino games was predictive of the transition. The odds of transitioning to online gambling were eight times higher among players who made micro-transactions while playing social casino games than those who did not (Kim et al. 2015). In Quebec, 29% of adolescents who had never played with real money engaged in real-money gambling for the first time within a 1-year interval (Dussault et al. 2017). Predictive links between playing simulated gambling games and real-money gambling were significant only for youth transitioning from simulated poker. Plausibly, this could be due to simulated poker

being used as a training platform to enhance skills, which in turn aids progression to real-money gambling (Dussault et al. 2017). More recently, in Norway, positive correlations between problematic gaming and problematic gambling were noted in a 2-year nationally representative longitudinal study (Molde et al. 2019). A prospective trial using an online panel sample reported how the use of gambling-themed EGM apps significantly predicted a greater frequency of engaging in real-money EGMs, and that players were more likely to admit problematic gambling (Rockloff et al. 2019).

However, findings from several studies suggest that the strength of transition from games to gambling is weakened when other factors such as gender and personality are taken into account (see Delfabbro and King 2020). Additionally, some studies show a lack of games to gambling transitional links. In Finland, social casino gaming was associated more strongly with digital games than with gambling (Macey and Kinnunen 2020). A study of video gamers in Australia demonstrated no association between video gaming and gambling—implying that participation in some game types may not necessarily lead to gambling and the "possibility that video gaming may be protective against uptake of gambling" (Forrest et al. 2016, p. 419). The researchers reasoned that the discrepancy could be due to differences in game types examined in earlier studies and the fact that theirs was a sample of regular video gamers (different to general population samples). Nevertheless, the study demonstrated significant associations between video gaming frequency and younger age, male gender, and higher problem gaming scores (Forrest et al. 2016). Likewise, no significant associations between video game playing and gambling participation or gambling disorder were noted among EGM players and regular video game players in Canada, (King et al. 2012b). However, for those who engaged in both activities, "video game playing was uniquely and significantly positively associated with the perception of direct control over chance-based gambling events" (p. 421).

Based on a literature review, Wohl et al. (2017) challenged the predominant presupposition that engagement in social casino gaming acts as a gateway to gambling and subsequent gambling disorders. They argued that some might in fact benefit from social casino games and cited a few studies that suggest "social casino game play may have prophylactic features that reduce the incidence, prevalence, and maintenance of disordered gambling" (p. 4) (see for examples, Hollingshead et al. 2016; LaPlante and Shaffer 2007). For instance, cases of gamblers who used social casino gaming as a way for reducing gambling cravings and participation suggest the potential of these games as a method for harm reduction (Hollingshead et al. 2016). However, in a discussion on the feasibility of this approach for adolescents, King and Delfabbro (2016) show how a substantial number of contextual features (e.g. parental monitoring, promotional messages that instil realistic knowledge about games, absence of indirect financial elements such as virtual currency) are required for simulated gambling to effectively encourage responsible gambling.

Problem Gaming and Problem Gambling Co-Existence

People who engage in games and gambling can develop problems in both areas. In Australia, a significant relationship between video gaming frequency and gambling disorder symptoms was observed among youth, with boys being more likely to engage in video-games and gambling, and present gambling disorder symptoms (Delfabbro et al. 2009)—suggesting the possibility of problem co-existence. Australian social casino gamers, relative to non-gamers, were more likely to have gambling problems and have a perception that gambling benefits outweigh harms (Gainsbury et al. 2014b).

Significant correlations between disordered gambling scores and Internet gaming addictions scores were observed among Hong Kong secondary school students (Fu and Yu 2015). A quarter of the Internet gaming addiction group met the DSM-5's diagnostic criteria for gambling disorder, indicating overlap between the two disorders (Fu and Yu 2015, p. 396). In Germany as well, small but significant positive correlations between problematic gambling and problematic computer gaming were observed among youth and young adults (Walther et al. 2012). Among Canadian youth, significantly more addicted gamers were identified as problem gamblers compared to social or non-gamers (McBride and Derevensky 2016).

Studies have reported problem co-existence among adults as well. For instance, a study testing the validity of a newly developed Problematic Social Casino Gaming Scale (PSCGS) for problem co-existence found that high severity social casino game players exhibited both greater problem gaming and problem gambling severity (Li et al. 2020). An examination of video gaming and gambling among a large Canadian sample noted problem co-existence among 10.5% of 466 problem gamblers, and 24.1% of 203 problem video gamers (Sanders and Williams 2019). Social casino game players in Australia with higher gambling severity scores had significantly higher problematic social casino gaming PSCGS scores—in other words, an association between gambling and gaming disorders (Gainsbury et al. 2017). In a UK-based study, adult engagement in gaming-like gambling or gambling-like games was significantly associated with problem gambling and gaming disorders (Zendle 2020). Likewise, associations between problem gambling and problem gaming were observed in a three-country study (Australia, New Zealand, and the USA) (Drummond et al. 2020), and in a cross-sectional population survey in Sweden (Karlsson et al. 2019). Among university and college students in Canada, a small subset of 2.2% was at risk for both problem gambling and problem video gaming (Mills et al. 2020).

In contrast to the foregoing studies, an international online survey of video gamers found video game addiction to be negatively associated with gambling and problem gambling (Macey and Hamari 2018). The study found only a weak positive association between video game use and video game-related gambling and concluded that contemporary video games were not, in themselves, associated with an increased problem gambling risk (Macey and Hamari 2018). A Canadian study aiming to validate the Problem Video Game Playing Test found that problem video gaming was associated with neither problem gambling nor its mental health correlates in a sample of undergraduate university students (Biegun et al. 2020).

Legislative Responses

At present, while gambling is regulated in most jurisdictions, gaming remains largely unregulated (Abarbanel 2018; Cassidy 2013). Typically, gambling classification is based on three key elements within an activity—(1) the risking of something of value, (2) an element of chance or uncertainty, and (3) a potential reward or outcome (Abarbanel 2018). The proportions of these elements are weighted differently in different jurisdictions and thus have varying impacts on related laws (Abarbanel 2018). Despite offering the same action, excitement, and even prizes as traditional gambling, a new subgenre of "quasi-gambling" games such as skin betting now appears to be benefiting from digital convergence in terms of their legal status (Martinelli 2017; Owens Jr 2013). In the USA, gaming-gambling hybrid games do not technically fall within statutory definitions of gambling (Owens Jr 2013). Likewise, these games tend to pass off as skill-based games and fall outside the Gambling Act 2005 in the UK (Griffiths 2008a).

Definitions of money within gambling laws were formed long before virtual currencies emerged. They "were never intended to capture Internet currency analogues"; hence "the status of virtual currency when used for the purposes of gambling has been unclear" within laws (Rutherford 2017, p. 367). These legal leeways, which offer exemption from administrative and licensing obstacles, and associated taxes, make gaming-gambling hybrid games very appealing to Internet gaming developers and gambling operators (Martinelli 2017; Owens Jr 2013). However, minor changes to the Isle of Man 2016 Online Gambling Regulations to include a deposit of anything with value in money's worth as a means for funding a player's online gambling account, has meant that it is now possible to license operators in this jurisdiction (Rutherford 2017).

Social casino games are currently unregulated in the majority of jurisdictions given the limited research associating social casino games to gambling and evidence of harm (see Abarbanel and Rahman 2015; Gainsbury et al. 2017; Li et al. 2020). However, the Interactive Gambling Act in Australia has proposed the need for public policy and regulation considering how gambling simulated sites tend to normalise gambling behaviour, feature unrealistic odds, and instil a delusive sense of winning (Derevensky and Gainsbury 2016).

Games with loot boxes, possibly due to their element of randomness, harm potential, and increased popularity, elicited a greater level of legislative response in some jurisdictions; however, responses are generally mixed (Liu 2019). Japan was the first region to regulate microtransactions associated with loot boxes (Liu 2019). In South Korea, loot boxes are subject to regulations that prevent approval of games that closely resemble gambling (Liu 2019). In China, loot boxes are classified as "lottery tickets" and treated as a type of gambling (Griffiths 2018; Hung 2017). China's regulations require transparencies about loot boxes' probabilities and random results, and safeguard measures to protect children (e.g. valid IDs for registration which triggers a two-step payment confirmation through email or text, spending limits) (Liu 2019). Loot boxes are also likely to be classed as gambling in Belgium (Abarbanel 2018). A magazine article reported that the Belgian Justice Minister called for a ban on loot boxes even while the issue was still undergoing investigation (Chalk 2017). The article also referred to a Belgian report on gambling and social gaming (Van Damme 2017) which noted the proliferation of loot boxes in videogames, the inadequacy of current laws for regulating them, and the aggressive methods used by game operators to target youth (Chalk 2017). A report examining four games containing paid loot boxes concluded that they violate the Belgian Gaming and Betting Act (Naessens 2018). The recommendations were for the removal of paid loot boxes from the games to comply with the Act or risk "a prison sentence of up to five years and fines of up to EUR 800,000 for a first violation" (Naessens 2018, p. 16). In 2018, Belgium, Denmark, and the Netherlands regarded monetary transactions associated with loot boxes to be in line with gambling definitions in their respective legislations—subjecting loot box gaming providers to similar prohibitions as gambling providers (Nettleton et al. 2020).

In New Zealand, however, since payment guarantees a loot box (and not just a chance of a loot box), it does not meet the country's Gambling Act's definition of gambling (Hung 2017; Liu 2019). Similar to New Zealand, loot boxes are not legally defined as gambling in the UK, Australia, and France (Liu 2019; Nettleton et al. 2020). Based on the UK's Gambling Act 2005 (Section 6), the British Gambling Commission declared that loot boxes are not regarded as "gambling" unless the prize has money's worth (Abarbanel 2018; Griffiths 2018). However, if loot box items can be exchanged for money, then they would typically be classified as gambling (Abarbanel 2018). Although legislative responses need to be evidence-based (e.g.

established causal links between loot boxes and problem gambling in children), some have argued that a lack of response is a failure on the part of the UK Gambling Act in protecting children and youth (Lui et al. 2020).

In Australia, the Senate Committee carried out a Loot Box Inquiry in 2018, to determine harms, and to gauge whether loot boxes met gambling's legal and psychological definitions (Nettleton et al. 2020). However, the Senate's recommendation for a comprehensive review of loot boxes was not accepted by the Government considering the lack of research evidencing gambling harms from loot boxes. The Senate's recommendations for age-restriction ratings (e.g. MA15+ and R18+) were also not accepted given the current lack of evidence (Nettleton et al. 2020). This rating scheme was similar to recommendations in the Department of Communication's 2020 review of Australia's classification regulation in response to gaming-gambling convergence (Browne 2020). Other recommendations related to the Loot Box Inquiry in Australia included clearer classification of microtransactions (Flew et al. 2020). However, the legislative response in Australia is yet to materialise (Liu 2019).

Concerns also triggered enquiries into loot boxes by the Federal Trade Commission in the USA (Zendle and Bowden-Jones 2019). Although some US federal statutes could be consulted when evaluating skin betting (i.e. among items made available in loot boxes), they appear to have loopholes and limitations, placing skin betting outside their range (Martinelli 2017). A global analysis of legislative responses to loot boxes evidenced four responses categories: "(1) outright banning loot boxes; (2) regulating loot boxes in various ways; (3) investigating loot boxes further; and (4) not recognizing loot boxes as gambling and taking no further action" (Liu 2019, p. 763).

Another legislative challenge concerns eSports which appear to involve a complex mix of chance and skill that is not easily deciphered. Deciphering is difficult because it requires a thorough examination of the activity to estimate its degree of luck or skill, and different countries have different scales to measure the degree of chance required for an activity to be defined as gambling (Igelman and Prizant 2017). Most eSports require skill while containing varying elements of chance—creating ambiguity for gaming law (Igelman and Prizant 2017). Whether eSports can be regarded as "gaming in the gambling sense, is therefore largely determined by an assessment of whether the underlying game is a game of skill" and if its element of chance is significant enough to matter (Gambling Commission 2017a, p. 9).

While eSports' features (chance or skill) are a challenge to its legal definition as a game or gambling, its relation to finances has provided a clearer push for legislative consideration. A 2017 UK Gambling Commission position paper (which assessed interactive entertainment crossovers into the boundaries of licensable gambling activities) highlighted the need to recognise and mitigate inherent integrity risks of eSports considering its commercial interests (Gambling Commission 2017a). The Commission's view was that "the ability to convert in-game items into cash, or to trade them (for other items of value)" indicates that these items acquire real-world value and "become articles of money or money's worth"—thus, warranting licences similar to other gambling facilities (Gambling Commission 2017a, p. 6).

According to a report by Gambling Research Exchange Ontario, "15 gambling regulators from Europe, including signatories from the UK, France, Ireland, Spain, and one from Washington State, USA," have declared a commitment to addressing the risks brought on by gaming-gambling convergence (Johnson and Brock 2019, p. 10). Overall, however, legislative responses to gaming-gambling convergence appear to be at a preliminary stage. For instance, in South Africa, although recognition of technology-aided convergence and risks for youth resulting from unregulated access to gambling platforms have prompted new

regulatory instruments, including the National Gambling Amendment Bill of 2018, these are yet to be implemented (Adams et al. 2020). In New Zealand, under the Classification Act, some games (akin to films) are classified with age-restricted labels (e.g. R13, R18) which make their sale or exposure to anyone under the specified age an illegal act (Office of Film and Literature Classification n.d.). However, the Film and Literature Classification Office, responsible for classifying games, has no authority to alter or create legislation (Hung 2017). Nevertheless, the issue of gaming-gambling convergence appears to remain on the Government's agenda, with a recent document seeking public feedback on online gambling in New Zealand (see Ministry of Internal Affairs 2019).

Recognising "the increasing intersection between social casino games and gambling, some operators and associations are now discussing self-regulation and responsible codes of conduct to exemplify their corporate social responsibility" (Derevensky and Gainsbury 2016, p. 4).

Discussion

Driven by both technological and commercial interests, gaming-gambling convergence is occurring in multiple overlapping contexts (gaming features in gambling products, gambling elements in games, gambling on games, free simulated gambling, and social media games and gambling) and accelerating. These developments have been accompanied by increases in the amount of time people (including children) engage with digital technologies in their various forms, e.g. mobile phones, the Internet, digital television, and social networking (Khang et al. 2013; Rideout et al. 2010). Gaming-gambling hybrid games and activities are thus ubiquitous and accessible around the clock 365 days a year.

In addition to terminologies and taxonomies in the academic literature defining and conceptualising gaming-gambling convergence, there are a plethora of associated terms such as digital currencies, freemium, free to play, and pay-to-win, to name a few, that researchers, legislators, and government bodies need to familiarise with to keep up with these developments (Appendix Table 2 provides a non-exhaustive list of these terms). How society defines and understands gaming appears somewhat different from scholarly, legal, and industry definitions—that are also variable. Legal definitions of previously distinct games and gambling raise many uncertainties within the context of gaming-gambling convergence—e.g. virtual transactions, and the degree of chance or skill. Because the term gaming implies entertainment and can reduce negative gambling-related connotations (Brisman 2004; Drennan et al. 2006; Owens Jr 2013), it is sometimes strategically used in advertising (Yoong et al. 2013). Related observations include community perceptions of gaming as harmless entertainment (Calado et al. 2014), and legitimate (Humphreys and Latour 2013). A normatively legitimate perception of these products can lead to increases in consumer uptake (Humphreys and Latour 2013) which, in turn, underlines the importance of assessing consumer perceptions about similarities and differences between games and gambling (Teichert et al. 2017). Definitions that clearly distinguish the two will be critical for formulating effective legislation and consumer protection measures that can prevent games to gambling transitions, particularly to protect youth and children (Adams et al. 2020; Teichert et al. 2017). The consensus around definitions could also aid shared understandings to effectively progress future research, regulation, and harm prevention.

Transitions from games to gambling are suggested in a considerable number of cross-sectional studies (e.g. Elton-Marshall et al. 2016; Gainsbury et al. 2016; Macey and Hamari

2019; Zendle and Cairns 2019), and evidenced in a small number of prospective studies (e.g. Molde et al. 2019; Rockloff et al. 2019). However, transition strengths may be weakened when demographic and personality factors are controlled for, and when maturation effects are considered (see Delfabbro and King 2020). Furthermore, some studies show no association between gaming and gambling participation (e.g. Forrest et al. 2016). Co-existence of gaming and gambling disorders (Fu and Yu 2015; Zendle 2020) has suggested the potential for risk and harm. However, the present evidence base is thought to be generally too weak to affirm relations between problem gaming and problem gambling (see, Delfabbro and King 2020). This, logically, suggests the need for additional research to better understand associations between gaming and gambling, and the co-existence of gaming and gambling disorders. In a recent bibliometric analysis of online gaming and online gambling research, Stehmann (2020) suggested the need for a merging of gaming and gambling research considering the similarities in players' psychological characteristics and play motivation, and the rate of gaming and gambling convergence occurring on the Internet.

Gaming-gambling convergence also has implications for the assessment and diagnosis of clinical and sub-clinical gambling and gaming disorders as treatment providers are likely to encounter increases in clients presenting with both conditions. Currently, most problem gamblers have problems in relation to gambling activities in the "real" rather than the virtual world, and gambling disorder is typically measured using instruments such as the *Problem Gambling Severity Index*, *Canadian Problem Gambling Index*, and *South Oaks Gambling Screen* (Abbott and Volberg 2006; Stinchfield et al. 2012). However, the situation may be more complex in the case of gaming-gambling hybrids. Here both gaming and gambling elements may be involved in sustaining high participation rates and generating addictive morbidities. There are approximately twenty different screens for measuring gaming disorder including the *Game Addiction Scale*, *Online Game Addiction Index*, and *Video Game Addiction Test* (Griffiths et al. 2016). It may be timely to review diagnostic measures and consider possible adaptations to capture co-existence of the two disorders. The *Problematic Social Casino Gaming Scale* assessing overlaps between problem video gaming and problem gambling (Li et al. 2020), and *GamCog* identifying gambling cognition among video game players (Macey and Hamari 2020) mark the beginning of this needed development in diagnostic tools.

Although gaming-gambling convergence is starting to raise debate in legislative and public policy arenas, legislative action appears slow and varied across jurisdictions. For example, while loot boxes within games have been either banned or regulated in some jurisdictions there has been no policy action in others (Liu 2019). While gambling advertising targeting children is typically prohibited, comparable restrictions on gaming advertising (e.g. ensuring games with gambling content are not appealing to children, age-related restriction labels on games) are presently not apparent. We identify several reasons for the general lack of legislative response. First, as most studies examining gaming-gambling convergence have been cross-sectional and/or based on non-representative samples, there is insufficient evidence at this time to justify legislative changes (see, Delfabbro and King 2020; Gainsbury 2019). Considering that loot boxes can intensify harm through increased spending, a recent review favoured the legislation of loot boxes over other convergence areas (Delfabbro and King 2020). Even so, the current evidence of harm associated with loot boxes seems insufficient to prompt legislative action in some jurisdictions (Liu 2019; Nettleton et al. 2020). Owens Jr (2013) reasoned that the slow pace in legislative response could be partly due to the relative lack of financial harm

resulting from addiction to games. While legislative inaction has been associated with limited evidence of harm arising from gaming-gambling convergence, plausibly, this lack of evidence could be partly due to the influence gaming regulations have on research. Gambling research appears to reflect the nature of gambling regulations of the jurisdictions from which they originate (Baxter et al. 2019). Researchers investigating gaming-gambling convergence should thus be conscious of this potential bias when formulating research aims, questions, and methods. Considering that harm from both gambling and gaming can be multifaceted, the evidence-base informing policy and legislative responses to gaming-gambling convergence should be comparably diverse.

Gaming and gambling may fall within different Acts and regulations within a jurisdiction—resulting in a lack of clarity around the authoritative body responsible for addressing legislative matters related to gaming-gambling convergence. This provides a second reason for legislative inaction. Thirdly, legislative responses may be constrained due to the difficulty of challenging pre-existing policies and legal frameworks on gambling and gaming. Different jurisdictions have different ways of determining gambling classification and games are typically not regarded as gambling. When gaming and gambling legislations were enacted, the features of games and gambling were more clearly distinct, and what constituted financial transactions then is different to present-day virtual transactions. Additionally, technological advances have resulted in unpredictable changes that make it difficult for legislators to distinguish the different types of gambling games (Rose 2015). Hence, the application of gambling legislation to games that contain varying types of gambling elements and involve ambiguous online transactions presents extraordinary complexity. Current legislative frameworks are likely to remain ineffective unless virtual goods and items in loot boxes are treated as being similar to casino chips—i.e. having intrinsic monetary value. The approach taken in redefining the meaning of money in the Isle of Man's 2016 Online Gambling Regulations (Rutherford 2017) and regulations governing microtransactions in Japan (Liu 2019) could serve as exemplary steps for overcoming the legislative challenge concerning the definition of money and its exchange.

By and large, legislative changes are driven by both evidence of harm and public concerns over those harms that are typically expressed in the news media (Brownson et al. 2009; Chapman 2001). Public perceptions of games as legitimate and harmless activities (see, Calado et al. 2014; Humphreys and Latour 2013) may mean limited public pressure to push legislative responses. This is a fourth plausible reason for response deficiency. Evidence of harm observed by clinical psychologists and treatment providers (Rumpf et al. 2018) could fill the proof-of-harm gap—which may in turn provide a stronger basis for legislative changes.

Finally, the border-transcending nature of gaming-gambling convergence on the Internet adds further complexities to legislative responses (see Rose 2015 for a discussion on legislative challenges associated with Internet-based gambling games). Gambling legislation is generally confined within national borders. For instance, a national policy governing the operations of gaming designers or providers is likely to be restricted to local companies only and cannot be imposed on games accessible via websites in other jurisdictions. While age restriction classifications offer a way to prevent the exposure of youth to gaming-gambling hybrids, such restriction even if imposed, would be difficult to implement and monitor for online games as minors are apt at using fake IDs to overcome legal barriers (Calado et al. 2014). This suggests the need for countries to collaborate to formulate standardised or universal features for inclusion in national laws and policies.

Industry self-regulation (McCaffrey 2019), social responsibility (King and Delfabbro 2019), and consumer protection measures (Cerulli-Harms et al. 2020) offer options in lieu of legislative changes. However, gaming providers are not legally required to implement harm minimisation or user protection measures to the same degree as required of gambling providers (see Derevensky and Griffiths 2019 for a discussion on gaming industry responsibility). Although a number of gambling sites include some measures, purportedly intended to reduce risk, there is limited empirical evidence of their effectiveness (Monaghan 2009; Tanner et al. 2017). Hence, we cannot be certain that reliance on industry to self-regulate would effectively prevent harms resulting from gaming-gambling convergence.

The quantitative and qualitative studies reviewed here, albeit limited, have demonstrated that engagement in games (not for money) can lead to real-money gambling and harm. Signs of gaming and gambling problem co-existence also alert to the possibility of amplified harms. This is considering the current body of literature that has demonstrated the diversity of harms associated with problem gambling which includes harms at individual, family and society levels (see, for examples, Abbott et al. 2015; Browne et al. 2017a; Browne et al. 2017b; Currie et al. 2009; Kolandai-Matchett et al. 2017; Langham et al. 2016; Tu et al. 2014; Walker et al. 2012). There is a need for similar investigation into the different types of harm arising from gaming disorder (King and Delfabbro 2018) and additional research to determine if (and how) harms are amplifying in populations experiencing both gambling and gaming addiction.

Based on the current evidence, we believe the *Precautionary Principle*, an approach for dealing with human activities in areas where there is plausible but insufficient scientific evidence of risk or harm (Raffensperger and Tickner 1999), should apply and that harm prevention regulations are needed. The basis of the *Precautionary Principle*, as a public policy tool for addressing gambling harm, is that uncertainty or limitations in evidence of harm does not deter anticipatory measures or preventive interventions (see Borrell 2003, 2008; Planzer 2014; Smith and Campbell 2007). While evidence of risk and harm are currently emerging, establishing scientific certainty about causality, estimating participation prevalence, and determining the nature and extent of resultant harm will require many years of research. The commercially driven developments in gaming and gambling technologies and rapidly evolving online and mobile technologies are already outpacing the speed of research. This may mean that harms could manifest at higher levels and spread broadly across societies before their existence and severity are established through methodical research. An effective regulatory response to gaming-gambling convergence would seek to not only prevent harm but also be subject to regular evaluation to ensure relevance in the face of altering environments and evolving technologies (Abarbanel 2018). As the "borderless" Internet is the predominant platform in which gaming-gambling convergence occurs, resulting harms are likely to be global in scope. As Griffiths (2008a) argues, given the ever-increasing integrations in the multi-media space, the law should not be seen as existing outside the virtual world, and the challenges arising from gaming-gambling convergence cannot be treated in legal isolation. Legislators need to re-examine exemptions presently granted to games. Close monitoring would be essential considering commercial operators' tendency to quickly "exploit new market opportunities in emerging media" and their capacity to always be "two steps ahead of current legislation" (Griffiths 2008a, p. 13). A collective response may thus be beneficial where international partnerships are established between national governments and other stakeholders (including gaming-gambling industries) for early detection of risks and formulation of appropriate harm prevention measures and policies.

Appendix 1

Table 1 List of researched references

Author	Year	Source type*	Methods	Sample size (age)	RA1	RA2	RA3	RA4
Abarbanel and Johnson	2020	JA	Content analysis	–	●			
Abarbanel and Rahman	2015	JA	Consumer data analysis	339	●			
Abarbanel et al.	2017	JA	Advertisement content analysis	–		●		
Abarbanel	2018	JA	Commentary	–				●
Abbott et al.	2018	R	Longitudinal	–		●		
Adams et al.	2020	R	–	–				●
Albarrán-Torres	2018	B	–	–		●		
Armstrong et al.	2018	JA	Review	–			●	
Australian Gambling	n.d.	W	–	–		●		
Browne	2020	R	–	–				●
Biegun et al.	2020	JA	Survey	651 (M=21)			●	
Bolen and Boyd	1968	JA	–	–		●		
Brisman	2004	B	–	–		●		
Calado et al.	2014	JA	Focus groups	37 (13–17)		●	●	
Campbell and Smith	2003	JA	Conceptual review	–		●		
Carter	2017	W	–	–		●		
Cassidy	2013	BC	–	–	●			●
Chalk	2017	OM	–	–				●
Delfabbro and King	2020	JA	Review	–			●	
Delfabbro et al.	2009	JA	Survey	2669 (13–17)			●	
Delfabbro et al.	2020	JA	Conceptual review	–		●		
Derevensky and Griffiths	2019	JA	Viewpoint	–		●		
Dickins and Thomas	2016	R	–	–		●		
Drennan et al.	2006	CP	–	–	●	●		
Drummond and Sauer	2018	JA	Content analysis	–	●			
Drummond et al.	2020	JA	Survey	AU=339, NZ= 323 US=387			●	
Dussault et al.	2017	JA	Longitudinal	1220 (14–18)		●	●	
Elton-Marshall et al.	2016	JA	Survey	10,035	●		●	
Forrest et al.	2016	JA	Survey	485 (16–68)			●	
Forrest and McHale	2012	JA	Survey	8958 (11–15)			●	
Frahn et al.	2015	JA	Experimental	128 (18–24)	●		●	
Fu and Yu	2015	JA	Survey	700 (M=17)			●	
Gainsbury et al.	2017	JA	Survey	176			●	
Gainsbury et al.	2016	JA	Survey	521			●	
Gainsbury et al.	2014a	JA	Review	–	●	●		
Gainsbury et al.	2015a	JA	Qualitative	10	●		●	
Gainsbury et al.	2015b	R	Review	–	●	●		
Gainsbury et al.	2014b	JA	Survey	2010 (18–65+)			●	
Gambling Commission	2017b	R	Survey	2881 (11–16)			●	
GamblingSitesOnline.org	2019	W	–	–			●	
Garea et al.	2020	PP	Meta-analysis	–			●	
Griffiths et al.	2014	BC	–	–	●	●		
Griffiths	2008a	JA	Commentary	–				●
Griffiths	2011	JA	Viewpoint	–		●		
Griffiths	2017	JA	Viewpoint	–		●		
Griffiths	2018	JA	Viewpoint	–		●		●

Table 1 (continued)

Author	Year	Source type*	Methods	Sample size (age)	RA1	RA2	RA3	RA4
Hamari et al.	2017	JA	Survey	519	●			
Harwood	2010	BC	–	–	●			
Hayer et al.	2018	JA	–	–		●		
Humphreys and Latour	2013	JA	Media content analysis + experiment	115		●		
Hung	2017	ON	–	–				●
Igelman and Prizant	2017	JA	Viewpoint	–		●		
Jacques et al.	2016	JA	Content analysis	–		●		
Jenkins	2006	B	–	–		●		
Johnson and Brock	2019	R	–	–		●		●
Johnson and Woodcock	2019a	JA	Interviews + ethnographic data	100		●		
Johnson and Woodcock	2019b	JA	Interviews	39	●			
Karlsson et al.	2019	JA	Survey	1593 (15+)			●	
Kim et al.	2015	JA	Longitudinal	409			●	
Kim et al.	2016	JA	Focus groups	30 (18–24)			●	
Kim and Jeon	2020	JA	Media content analysis	–		●		
King et al.	2010a	JA	Review	–		●		
King et al.	2014	JA	Survey	1287 (12–17)	●		●	
King et al.	2015	JA	Review	–	●	●		
King et al.	2016	JA	Online survey	555 (12–17)			●	
King	2018	R	Review	–			●	
King et al.	2012a	JA	Review	–		●		
King et al.	2012b	JA	Survey + laboratory data	115			●	
Kristiansen and Severin	2020a	JA	Survey	755 (12–16)			●	
Kristiansen and Severin	2020b	JA	Survey	1137 (12–16)			●	
Lawn et al.	2020	JA	Review	–			●	
Li et al.	2020	JA	Survey	436 (18–67)			●	
Liu	2019	JA	Review	–				●
Lopez-Gonzalez and Griffiths	2018	JA	Review	–		●		
Lui et al.	2020	JA	Review	–				●
Macey and Hamari	2018	JA	Survey	613			●	
Macey and Hamari	2019	JA	Survey	582 (14–50+)			●	
Macey and Kinnunen	2020	JA	Survey	946 (10–75)			●	
Mantini	2016	W	–	–		●		
Martinelli	2017	JA	Viewpoint	–				●
McBride and Derevensky	2016	JA	Survey	1229 (16–24)			●	
McMillen	2005	BC	–	–		●		
Mills et al.	2020	JA	Survey	1621 (18–27)			●	
Ministry of Internal Affairs	2019	R	–	–				●
Molde et al.	2019	JA	Longitudinal	4601 (16–74)			●	
Naessens	2018	R	–	–				●
Nettleton et al.	2020	JA	Viewpoint	–				●
Owens Jr	2012	JA	Viewpoint	–		●		
Owens Jr	2013	JA	Viewpoint	–		●		●
Parke et al.	2012	R	–	–		●		
Pickering et al.	2020	JA	Conceptual review	–		●		
Rockloff et al.	2019	JA	Prospective trial	566			●	

Table 1 (continued)

Author	Year	Source type*	Methods	Sample size (age)	RA1	RA2	RA3	RA4
Rohsler	2019	B	–	–		●		
Rutherford	2017	JA	Viewpoint	–				●
Sahl	2015	T	Mixed method	8	●			
Sanders and Williams	2019	JA	Online panel survey	3942 (M=44)			●	
Sapsted	2013	R	–	–	●			
Schneider	2012	JA	Viewpoint	–	●			
SuperData Research	2017a	OR	–	UK=1021 NL=1021		●	●	
Teichert et al.	2017	JA	Online panel survey	1000				
Thomson	1997	B	–	–		●		
Walther et al.	2012	JA	Survey	2553 (12–25)			●	
Wohl et al.	2017	JA	Review	–	●		●	
Yoong et al.	2013	JA	Media content analysis	–		●		
Zendle and Cairns	2019	JA	Survey	1172 (18–40+)			●	
Zendle	2020	JA	Survey	1081			●	
Zendle et al.	2020a	JA	Survey	1200 (18–40+)			●	
Zendle et al.	2020b	JA	–	–				●

*JA, journal article; R, report; OR, online report; CP, conference paper; B, book; BC, book chapter; PP, pre-print; W, website; OM, online magazine; ON, online news; T, thesis

Table 2 Terminologies related to gaming-gambling convergence

Term	Definition	Source
Digital currencies	"Established forms of crypto logically secured currencies that are traded, and recognised by institutions like the Financial Conduct Authority and HMRC. Bitcoin is a well-known example."	(Gambling Commission 2017a, p. 17)
Freemium	"A business model in which users of the service (in this context, game) usually play for free but are encouraged to pay: for extended game play; to compete with others/status; to express themselves; to give virtual gifts; and to obtain virtual goods which are valuable due to their scarcity."	(Parke et al. 2012, p. 16)
Free to play	Free to play is in fact a revenue model used in mobile game monetisation. Free to play models are popular because it captures more users with an initial free downloaded while providing flexible pricing for users with different willingness-to-pay levels for additional content.	(Alha et al. 2014)
In-game advertising	In-game advertising are advertisements displayed within a game that provides game developers additional revenue for their free to play games. Users who watch advertisements are awarded in-game goods.	(Fields 2014)
Loot boxes	These are "virtual boxes" containing random virtual items for use within a game. Some items are simply enhancive features, such as virtual attires that a character within a game wears. Other items are designed to affect gameplay; for instance, features that improve "weapons" used within games. While loot boxes can be earned (without spending) within most games, e.g. by winning	(Hung 2017)

Table 2 (continued)

Term	Definition	Source
	or performing well, players are also given the option to purchase them.	
Microtransaction	"Also referred to as in-app billing or in-app purchasing, a term used to describe the purchase of virtual goods via micropayments."	(Parke et al. 2012, p. 16)
Online-gambling-style games	Games that "look and play like gambling games such as roulette or poker but are free to play, do not offer any prizes and do not have any age restrictions. Such games are not considered as gambling by law but can have many similar characteristics to games that involve real money being lost/won…."	(Gambling Commission 2017b, p. 20)
Pay-per-kill	A feature in UK-based servers that pay players "for every kill they make, while putting a price on every death… No one knows who they are playing against and games are randomly generated to prevent elite teams having an advantage".	(Harper 2007)
Pay-to-win	An option introduced within some multiplayer free-to-play games, which gives players willing to pay for game enhancement features, in-game gear or in-game status a competitive edge over their non-paying opponents. Such features are sometimes colloquially referred to as pay-to-cheat as they offer unfair advantage within a skill-based game that supposedly has a level playing field.	(Alha et al. 2014; Bycer 2018; Zagal et al. 2013)
	Indicators that a game has a pay-to-win feature include ongoing/escalating requirements for real money purchases; the game becoming frustrating when money is not spent; inclusion of "punishments" that can be negated through spending money; and, an evidently better/improved play experience that only comes with spending.	(Bycer 2018)
Paywalls	A monetisation method (sometimes also included in supposedly free-to-play games) that prevents players from playing the game at some point unless payment is made.	(Konda 2013; Vankka 2014)
Simulated gambling games	Games that have "many of the core characteristics of gambling—such as the look, sound and actions—but do not provide an opportunity to win or lose real money. The most popular forms of simulated gambling are poker, "pokies", lotteries and casino-style games such as blackjack". "Simulated gambling can take place on many different platforms, from Facebook to smartphones and tablets, gaming consoles, websites and even interactive televisions."	(Dickins and Thomas 2016, p. 1)
Skins-betting / "Skin" gambling	Betting or gambling using skins, which "are in-game items, used within some of the most popular video game titles. They provide cosmetic alterations to a player's weapons, avatar or equipment used in the game."	(Gambling Commission 2017b, p. 22)
	Skins "are valued by reference to their rarity, aesthetics, utility and popularity. Prices are subject to constant fluctuation" and in the UK "typically range from under £10 to £300"; however, rare items may be "valued at over £1000".	(Gambling Commission 2017a, p. 7)
	Skins are virtual items "designed by video game companies, that change the appearance of in-game avatars, weapons, and equipment. In the real world, they would be akin to having a gun or knife that has a	(Martinelli 2017, p. 558)

Table 2 (continued)

Term	Definition	Source
	colourful design or camouflage finish. Skins are merely ornamental and have no effect on actual game play but have become a token of status and are immensely valuable. Game players can trade or bet their skins on the outcome of a video game match."	
Social casino games / gaming	Technically not considered to be "a form of gambling but they…enable players to spend money in a game that is gambling themed or structurally approximate to gambling."	(King et al. 2016, p. 401)
	"A sub-genre of social games which are based on casino style games such as slots, roulette and card based chance games. Examples include Zynga Poker and Slotomania."	(Gambling Commission 2017a, p. 17)
	"Social casino games are typically promoted via social media sites (e.g. Facebook) and involve structurally realistic simulated forms of gambling (e.g. poker, slot machines)."	(Gainsbury et al. 2015a, p. 136)
	"These games generally appear to replicate the basic structural design of gambling activities (i.e., betting mechanics, chance-determined outcomes), but are free to play and the prizes awarded are generally virtual currency that has no value outside of the game." Although they resemble gambling activities, they are neither classified nor regulated as gambling.	(Gainsbury et al. 2016, p. 59)
Social gaming	"Games accessed online invariably via mobile devices which have a social element often facilitated through social networks enabling players to compete against each other or interact with each other. Examples include Candy Crush or Farmville."	(Gambling Commission 2017a, p. 17)
Social network gaming / games	Games "that are connected to social networking services (SNS) directly, or through mobile applications (apps)…. Social network games (SNG) are generally free-to-play and do not award monetary prizes, but users can make in-game purchases to advance within the game, customise the game, give gifts to friends, and access other exclusive benefits and features, leading to these games being referred to as "freemium". Although SNG are connected to a SNS and encourage users to interact with their connections, most SNG can be played without any social interaction."	(Gainsbury et al. 2016, p. 59)
Virtual currencies	Currencies that are typically "unregulated and generally issued and controlled by developers, and used and accepted among the members of a specific virtual community for instance within a video game or social casino. Where they can be exchanged for cash or traded for items of value they are considered money or money's worth."	(Gambling Commission 2017a, p. 17)
Virtual gifts	"A virtual good given by one user of an online space to another user of that space. Can be given or shared as part of social game play."	(Parke et al. 2012, p. 16)
Virtual goods	"Commodities available for free or for sale that exist only online in digitised form. Can include virtual 'currencies' and virtual objects."	(Parke et al. 2012, p. 16)
Virtual items	Virtual items may be regarded as "the casino chips of the esports world, and skins have become one of the largest methods employed for gambling."	(Martinelli 2017, p. 558)
Whale	An industry term for high spenders in games.	(Cassidy 2013; Dreier et al. 2017)

Declarations

Conflict of Interest The authors declare no competing interests.

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