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FULL-LENGTH REPORT

Order of first-play in simulated versus monetary gambling

ALEX M. T. RUSSELL[1*], NERILEE HING[1], PHILIP NEWALL[1,2], NANCY GREER[1], CASSANDRA K. DITTMAN[1], HANNAH THORNE[1] and MATTHEW ROCKLOFF[1]

[1] Experimental Gambling Research Laboratory, CQUniversity, Australia

[2] University of Bristol, United Kingdom

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ABSTRACT

Background and aims: Simulated gambling products, like loot boxes and social casino games, contain gambling elements, but are not classified as gambling. They are available to minors, raising concerns about a "gateway effect" into gambling. This study examined the time course of young people's engagement in simulated and monetary gambling, and associations between simulated gambling and gambling problems and harm. A necessary, although not sufficient, condition for simulated games leading to real money gambling is that simulated play must come first. *Method:* Participants were 1,026 young adults (aged 18–25 years) who played video games in the last year. They reported the age at which they first took part in seven simulated and twelve monetary gambling products, and current gambling problems and harm. *Results:* First use of loot boxes and video games with gambling content tended to precede monetary gambling. Forms where gambling is a core gameplay element, such as social casino and demonstration games, tended to *follow* some monetary gambling forms. Engagement in most simulated gambling products was associated with greater harm from monetary gambling. *Discussion:* The findings leave open the possibility of a catalyst pathway from youth engagement in loot boxes and games with gambling content to later monetary gambling, but causal psychosocial mechanisms remain unclear. However, a pathway from social casino and demonstration games to monetary gambling appears less likely, which may instead reflect containment or substitution effects. Simulated gambling disproportionately attracts youth who are vulnerable to gambling problems and harm, indicating the need for consumer protection measures.

KEYWORDS

simulated gambling, gambling, migration, loot boxes, social casino games, demo games, gambling problems, gambling harm

INTRODUCTION

Simulated gambling games are software products that incorporate elements of gambling, but without monetary payouts. Researchers have raised concerns that simulated gambling products may normalise gambling among young people, and serve as a "gateway drug" to the subsequent use of monetary gambling, particularly because they are available to people under the legal gambling age and many appeal to adolescents (Armstrong, Rockloff, Browne, & Li, 2018; Hing, Browne, Rockloff, Lole, & Russell, 2022, Hing, Dittman et al., 2022, Hing, Rockloff et al., 2022; Kim, Wohl, Gupta, & Derevensky, 2017; Kristiansen, Camilla, Reventlov, & Malling, 2018; Kristiansen, Trabjerg, Lauth, & Malling, 2018). However, relatively little research has examined this gateway effect or even the time course of simulated and monetary gambling engagement amongst young people.

*Corresponding author.
E-mail: a.m.russell@cqu.edu.au

What is simulated gambling?

Gambling has been defined as risking something of value, to win something of value, with the outcome determined at least in part by chance (King, 2018). Simulated gambling refers to games that imitate many core characteristics of gambling (e.g., the look, sound and actions) but do not provide an opportunity for a cash payout (Hing, Russell, Browne, et al., 2021; Hing, Russell, King, et al., 2021). They therefore do not incorporate all definitional components of gambling. Several forms of simulated gambling exist. The main products are described below, including how they differ from monetary gambling products, as also highlighted in a taxonomy by King (2018).

Social casino games are apps or programs that replicate gambling products, such as slots, card or table games. Many are free to play, but players can pay for additional credits or to unlock levels within the game (Gainsbury, Hing, Delfabbro, & King, 2014; Gainsbury, Russell, & Hing, 2014; Gainsbury, Hing, Delfabbro, Dewar, & King, 2015; Gainsbury, King, et al., 2015; Gainsbury, Russell, Wood, Hing, & Blaszczynski, 2015; Hing, Lole et al., 2023; Hing, Rockloff, & Browne, 2023; Hing, Russell et al., 2023). *Demo games* have a similar concept, where players try a practice version of a real money gambling product, often on real online casino websites. In both social casino games and demo games, the core gameplay element is a gambling game; however, any credits won cannot be withdrawn for real money (Hing, Lole et al., 2023; Hing, Rockloff, & Browne, 2023; Hing, Russell et al., 2023; King, 2018; King & Delfabbro, 2020).

Some *video games incorporate gambling elements*, such as spinning wheels and slot games, as part of a broader gameplay experience, rather than gambling being the core element (King et al., 2018). For example, in Grand Theft Auto, players complete quests and explore a large online environment, but gambling is not involved in most of these quests. However, the game includes a virtual casino, where players can win virtual credits that are only valuable within the game (Hing, Russell, Browne, et al., 2021; Hing, Russell, King, et al., 2021; Hing, Lole et al., 2023; Hing, Rockloff, & Browne, 2023; Hing, Russell et al., 2023).

Loot boxes are digital containers that can be purchased or won within most popular video games, such as sports games, first-person shooter and strategy games (Rockloff, Browne, Greer, Armstrong, & Thorne, 2020; Rockloff, Russell, et al., 2020; Zendle, Cairns, Barnett, & McCall, 2020) and where gambling is not a core gameplay element. However, loot boxes involve gambling mechanics and some may meet the technical definition of gambling (Drummond, Sauer, Hall, Zendle, & Loudon, 2020; Drummond & Sauer, 2018; Liu, 2019). Some loot boxes can be earned through extensive gameplay ("grinding"), but players may also purchase loot boxes with real money. Players have a chance of winning rare items, which may be sold in online marketplaces or used as currency on skin gambling websites (Hing, Rockloff et al., 2022). Some loot boxes therefore meet definitions of gambling, as players can pay to play, can win something of real-world value, and the prize is based on chance. Nevertheless, loot boxes are not classified as gambling in most jurisdictions and are, therefore, available to people under the legal gambling age.

Real money can also be won in some free-to-enter *fantasy sports* competitions (Marchica, Zhao, Derevensky, & Ivoska, 2017; Tacon & Vainker, 2017). In fantasy sports, participants create and manage virtual teams of players, based on real players in real sporting competitions. Points are allocated based on how the relevant players perform in the real-world competition (King, 2018). These competitions are not classified as gambling because players do not stake something of value, although paid-entry competitions exist. However, prize money can often be won, and there is a degree of chance in how each player performs in real games each week.

Engagement in simulated gambling, and links to gambling behaviour and gambling problems

Gambling has become increasingly normalised among adolescents, partly through its frequent advertising (Hing, Lole et al., 2023; Hing, Rockloff et al., 2023; Hing, Russell et al., 2023; Pitt, Thomas, & Bestman, 2016), but also through gambling content in spaces that young people frequent, such as social media platforms (Gainsbury, King, et al., 2015) and video games (King, 2018; Rockloff, Russell, et al., 2020; Zendle et al., 2020). Simulated gambling is common amongst youth in many countries (Hayer, Rosenkranz, Meyer, & Brosowski, 2019; Hing, Dittman et al., 2022; Gambling Commission, 2019). For example, a recent study in Australia found that 36.5% of adolescents aged 12–17 years reported purchasing loot boxes in the past 12 months, 31.7% reported playing video games with gambling content, 14.2% played social casino game apps, 14.2% played demo games and 11.8% played gambling-style games on social media sites (Hing, Russell, King, et al., 2021). Another Australian study found evidence for a possible generational shift in interest amongst young people towards simulated gambling, including those under the legal gambling age (Russell et al., 2020).

Young people are overrepresented among people experiencing problems from monetary gambling (Australian Institute of Family Studies, 2016), and youth is a consistent risk factor for gambling-related harm (Gainsbury, Russell, et al., 2015; Hing, Russell, Tolchard, Nower, 2016; Hing, Russell, Vitartas, & Lamont, 2016; Johansson, Grant, Kim, Odlaug, & Götestam, 2009; Russell, Hing, Li, & Vitartas, 2019).

Several studies have found that engagement in simulated gambling is associated with monetary gambling (Dussault et al., 2017; Hayer, Kalke, Meyer, & Brosowski, 2018; Rockloff, Browne, et al., 2020), including amongst adolescents (Elton-Marshall, Leatherdale, & Turner, 2016; King, Delfabbro, Kaptsis, & Zwaans, 2014; Veselka, Wijesingha, Leatherdale, Turner, & Elton-Marshall, 2018). For example, in two Australian samples, past-month engagement in loot boxes, social casino games, demo games, and games with gambling content were each associated with past-month

participation in most forms of monetary gambling (Hing, Dittman et al., 2022; Hing, Rockloff et al., 2022). Further, research consistently links engagement in simulated gambling to a heightened risk of monetary gambling problems in youth (Gainsbury, Hing et al., 2015; King, Delfabbro, Katsis et al., 2014; Zendle, Meyer & Over, 2019), even when controlling for monetary gambling participation (Hing, Dittman, et al., 2022). However, these correlational studies do not provide evidence of migration over time from simulated gambling to monetary gambling.

Evidence of migration from simulated gambling to monetary gambling

Limited research has examined migration from simulated to monetary gambling among young people. Spicer et al. (2022) found that 19.9% of 1,102 individuals who had purchased both loot boxes and taken part in gambling self-reported a "gateway effect" from loot boxes to monetary gambling. Three longitudinal studies provide stronger evidence about the time course of simulated and monetary gambling amongst young people. In an Australian longitudinal study, young people who played simulated gambling games during adolescence (aged 16–17 years) were more likely to spend money on gambling in early adulthood (aged 18–19 years), including on race betting, sports betting and casino gambling (Sakata & Jenkinson, 2022). A Canadian study with 1,220 young people who had never gambled at Wave 1 (Dussault et al., 2017) found a migration over 3 waves from simulated poker to real money poker, but not to other gambling forms. Hayer et al. (2018) conducted a longitudinal study on 1,178 German school students and focussed on social casino games, games with gambling components, and demo games. Migration occurred over time from simulated to monetary gambling, but only for social casino games. Additional analysis revealed that simulated gambling impacted gambling problems mainly through the indirect effects of gambling frequency and erroneous cognitions (Brosowski, Turowski, & Hayer, 2020).

Potential causal mechanisms for migrating from simulated to monetary gambling

While there is evidence that some young people transition from simulated gambling to monetary gambling, it is unclear whether a causal mechanism exists. Nonetheless, researchers have identified several features of simulated gambling that might foster psychosocial processes and behaviours that lead to real-money gambling. These include play rewarded by in-game acquisition, even of non-financial rewards, inflated and more opaque odds of winning, randomised rewards, monetisation, and features that may train young people how to gamble, normalise it, and encourage erroneous cognitions, persistence and dependency (Armstrong et al., 2018; Hing, Browne et al., 2022; King & Delfabbro, 2016, 2020). In addition, Kim, Wohl, Salmon, Gupta, and Derevensky (2015) identified a plausible migration motivation whereby young people transition to monetary gambling when they tire of being able to win only virtual rewards in social casino games, demo games and loot boxes. Based on a literature review, King and Delfabbro (2016) modelled a "catalyst pathway" that integrates risk factors related to simulated gambling that can catalyse monetary gambling and gambling problems. This model includes risk factors across several domains: social (e.g., entry into a gambling subculture), behavioural (e.g., opportunities for early big wins, large bets, monetary expenditure and persistence), cognitive (e.g., can foster erroneous beliefs about gambling, such as the role of skill and strategy) and emotional (e.g., arousal, relief from negative mood states, desensitising to losses). However, as outlined in Table 1, simulated gambling activities have different structural characteristics and differ from monetary gambling in different ways. For example, in free fantasy sports with prizes, something of value cannot be staked, but something of value can be won. In contrast, in paid social casino games, money can be lost but not won. Therefore, migration from simulated gambling to monetary gambling may involve varying psychosocial and behavioural processes, depending on the activity.

The present study examined temporal evidence of plausible migration pathways from seven simulated gambling forms to each of 12 monetary gambling forms. A minimum, although not sufficient, condition for simulated gambling being a dominant factor in motivating a migration to monetary gambling is that it must come first in time. Consequently, this study examines which games are typically (on average) played first. Because the causal direction is not clear for different products, no hypotheses were developed and the study is exploratory. A secondary aim of the study was to determine which simulated gambling products were associated with gambling, gambling problems and gambling harm.

METHOD

Participants, inclusion criteria, exclusions and completion rate

Participants were recruited via Qualtrics, an online market research panel aggregator, in November 2020. Survey participants were residents of Australia (50% from Victoria, the location of the funding body), aged 18–25 years, and had played video games (not necessarily simulated gambling games) within the last 12 months. This sample therefore included people who took part in either simulated or monetary gambling forms, neither, or both. The inclusion of non-gamblers was crucial, as exploring transitions to gambling requires comparisons with people who have not transitioned. The video game inclusion criterion was a practical one, to ensure that the sample did not include a large proportion of people who take part in neither simulated nor monetary gambling. Quotas were set to ensure approximately equal numbers of males and females. The youthful age range was chosen due to the recency of products, and thus older adults would most likely have not been able to engage with many simulated gambling products first.

Table 1. How different simulated gambling products differ from monetary gambling products

Simulated gambling form	Something of real-world value placed at risk	The outcome is determined at least in part by chance	Something of real-world value can be won
Loot boxes (free) (opening a loot box that the person earned during the game, but did not pay for)	No	Yes	Yes, if loot box contents can be sold or traded
Social casino games (free) (gambling-like games, like simulated EGMs, poker, roulette, on an app or social network, played for free)	No	Yes	No
Playing video games that include gambling content (such as Grant Theft Auto's casino level)	No	Yes	No
Loot boxes (paid) paid loot boxes (buying a loot box with real money, or with virtual currency that was purchased with real money)	Yes	Yes	Yes, if loot box contents can be sold or traded
Demo games (free demonstration or practice games on real gambling websites or apps, generally designed to help players learn to play)	No	Yes	No
Fantasy sports (free) (fantasy sports or daily fantasy sports competitions that do not require an entry fee)	No	Yes	Yes, if a prize is offered
Social casino games (paid) (gambling-like games, like simulated EGMs, poker, roulette, on an app or social network, where they person has paid to play)	Yes	Yes	No

Note: The columns represent three typical components of monetary gambling products. "Some" means that at least some specific products in this category of simulated gambling may meet this definition. For example, some free loot boxes may contain rewards that can have real-world value.

A total of 2,619 participants started the survey, but 1,244 were excluded during the survey for being outside the age range (794), not providing consent (167), failing an attention check (110), not being video gamers (110), not providing their location (12), and being from Victoria after the quota was filled (51). After data collection, Qualtrics and the research team examined the data for poor quality responses, excluding a further 120 participants for one or more of the following reasons: duplicate responses (76), poor quality responses (36), straightlining (selecting the same answer, e.g., "agree", throughout multiple scales in the survey; 19), speeding (completing the survey in under one-third the median completion time from an initial soft launch; 7) and having an IP address outside of Australia (5). Of the remaining 1,255 eligible participants, 1,026 completed the survey, for a completion rate of 81.8%.

Procedure

Participants were recruited via Qualtrics, who recruited participants via online panel providers. Participants were reimbursed with a non cash-incentive in line with the usual practices of their online panel provider. A contact rate cannot be calculated as it is not known how many participants were contacted. Participants were shown an information page that outlined the purpose of the study, and conveyed that the survey was anonymous, voluntary and that they could withdraw at any time prior to survey submission. Participants were given the contact details of the lead investigator should they have questions or concerns, although no one contacted us. Survey participants were asked to provide consent before taking part. Median completion time was 18.3 min.

Measures

The measures below are shown in the order they appeared in the survey.

Screening and quota questions. Participants reported their age (in years), gender (male, female, other), postcode and how often they played video games, including games on

their smartphone, tablet, PC or console (seven-point Likert scale from 1 = never in the last 12 months, 2 = less than once a month, 3 = about once a month, 4 = 2–3 times a month, 5 = about once a week, 6 = 2–3 times a week and 7 = 4 or more times a week. This response scale is commonly used in Australian studies (e.g., Hing, Russell, Browne, et al., 2021; Russell et al., 2020).

Engagement with simulated and monetary gambling forms. Participants were asked whether they had taken part in each of the seven simulated gambling forms and 12 monetary gambling forms at any point in their life (see Table 2). The classification of simulated and monetary gambling is based on recent Australian studies, including amongst adolescents (Hing, Russell, King, et al., 2021) and young adults (Russell et al., 2020). The seven simulated forms were:

Table 2. Sample demographics, PGSI and NODS-CLiP (N = 1,026)

Variable	Level	N	%
Gender	Male	412	40.2
	Female	606	59.1
	Other	8	0.8
State of residence	Victoria	512	49.9
	Elsewhere in Australia	514	50.1
Marital status	Single/never married	664	64.7
	Living with partner/de facto	254	24.8
	Married	94	9.2
	Divorced or separated	12	1.2
	Widowed	2	0.2
Education	Did not complete year 12 or equivalent	63	6.1
	Completed year 12 or equivalent	400	39.0
	Completed trade or technical certificate or diploma	192	18.7
	Completed an undergraduate qualification	288	28.1
	Completed a postgraduate qualification	83	8.1
Country of birth	Australia	812	79.1
	Other	214	20.9
Aboriginal or Torres Strait Islander status	Neither Aboriginal nor Torres Strait Islander	957	93.3
	Yes, Aboriginal	49	4.8
	Yes, Torres Strait Islander	15	1.5
	Yes, both Aboriginal and Torres Strait Islander	5	0.5
Gambling problems last 12 months (PGSI)	Non-gambler (last 12 months)	624	60.8
	Non-problem	107	10.4
	Low-risk	54	5.3
	Moderate-risk	72	7.0
	Problem	169	16.5
Lifetime gambling problems (NODS-CLiP)	Non-gambler (lifetime)	143	13.9
	No lifetime problems	432	42.1
	Problems during lifetime	451	44.0

Note: PGSI = Problem Gambling Severity Index. GHS-10 = Gambling Harms Scale, 10 items. NODS-CLiP = National Opinion Research Centre Diagnostic and Statistical Manual of Mental Disorders version IV Screen for Gambling Problems, Control, Lying and Preoccupation.

- Loot boxes (free) (opening a loot box that the person earned during the game, but did not pay for),
- Social casino games (free) (gambling-like games, like simulated EGMs, poker, roulette, on an app or social network, played for free),
- Playing video games that include gambling content (such as Grant Theft Auto's casino level),
- Loot boxes (paid) (buying a loot box with real money, or with virtual currency that was purchased with real money),
- Social casino games (paid) (gambling-like games, like simulated EGMs, poker, roulette, on an app or social network, where they person has paid to play),
- Fantasy sports (free) (fantasy sports or daily fantasy sports competitions that do not require an entry fee), and
- Demon games (free demonstration or practice games on real gambling websites or apps, generally designed to help players learn to play).

The twelve monetary gambling forms were: scratch cards, lottery tickets, sports betting, race betting, betting on esports, betting on novelty events (e.g., elections), EGMs, bingo, casino games, Keno, skin gambling and betting on fantasy sports.

For every form that a participant endorsed, they were asked how frequently they had engaged in that form in the last 12 months, using the same seven-point Likert scale for video games. They were also asked the age at which they had first taken part and the age at which they had most recently taken part in each endorsed activity. Survey programming ensured that participants could not enter ages that were logically inconsistent, such as first taking part in an activity at an age older than their current age. Participants were also reminded that the survey was anonymous to reduce concerns that participants might not report taking part in monetary gambling activities under the age of 18, which is the legal gambling age in Australia.

Gambling problems. Gambling problems over the last 12 months were measured using the Problem Gambling Severity Index (PGSI; Ferris & Wynne, 2001). The PGSI consists of nine items, with response options from never (0) to almost always (3). Responses are summed for a total out of a possible 27 points. The PGSI was categorised based on the cut-offs developed by Ferris and Wynne: non-problem gambler (PGSI = 0), low-risk gambler (PGSI = 1–2), moderate-risk gambler (PGSI = 3–7), and "problem gambler" (PGSI = 8–27). Cronbach's alpha in the current sample was 0.94.

Gambling problems over the lifetime were assessed using the NODS-CLiP (Toce-Gerstein, Gerstein, & Volberg, 2009). The NODS-CLiP was asked of all participants who reported engaging with any monetary gambling activity during their lifetime, including outside of the last 12 months. This scale consists of three items, each with a no/yes response. Endorsement of any item indicates gambling problems in the lifetime. KR-20 in the current sample was 0.60. It is important to note that the NODS-CLiP consists of only three items, and short scales typically have lower internal consistency. This does not necessarily indicate poor reliability (Ziegler, Kemper, & Kruyen, 2014). Using the

Spearman-Brown prophecy formula, if the scale had nine items like the PGSI, reliability would be 0.82.

Gambling harm. The Gambling Harms Scale 10-item version (GHS-10, previously known as the Short Gambling Harms Screen or SGHS; Browne, Goodwin, & Rockloff, 2017) was used to measure gambling harm. The GHS-10 consists of 10 items, each with a no (0) or yes (1) response option. Endorsed items are summed for a total between 0 and 10. Cronbach's alpha in the current sample was 0.86.

Demographics. In addition to age, gender and postcode, participants were asked to report their marital status, highest level of education, country of birth, and Aboriginal and/or Torres Strait Islander status (Table 1).

Data analysis

Linear and logistic regressions were employed to determine associations between lifetime use of each simulated gambling form and monetary gambling outcomes (behaviour, problems, harm). The 'first age' response for each form was used to determine the mean difference between age of onset for each possible pairing of simulated and monetary forms, noting that sequencing was done separately for each pair. The mean difference variables were trimmed to range between −6 and 6. Wilcoxon signed-rank tests were conducted to determine whether the simulated or monetary form was significantly more likely to occur at a younger age for each possible pairing. There were no missing data because all survey questions were compulsory, unless questions were skipped by design (e.g., if participants did not bet on sports in their lifetime, they did not have answers for subsequent sports betting variables). Raw PGSI scores were positively skewed and therefore log-transformed (+1) for analysis. Data were analysed using a combination of SPSS v28 and R v4.3.0. An alpha of 0.05 was used throughout, but results are reported for $p < 0.01$ and $p < 0.001$ to allow for corrections for multiple comparisons.

Ethics

The study was assessed and approved by the CQUniversity Human Research Ethics Committee, approval 22,525. All participants were shown an initial description of the study, which outlined the nature of the questions obtained within the subsequent survey. This description also outlined that participation was voluntary and that they could withdraw at any time. Participants then indicated their consent before continuing with the survey. Participants who did not consent were thanked for their time before they exited the survey. Participants who did not complete the survey were deemed to have withdrawn and excluded from the final analyses.

RESULTS

Demographics

Full sample demographics are reported in Table 2. The sample included slightly more females than males (59.1% vs. 40.2%) and eight participants identified as a gender other than male or female. Participants were aged from 18 to 25 years, with a mean of 21.87 ($SD = 2.32$). Approximately half of the participants reported living in the state of Victoria and half elsewhere in Australia. In line with the sample participants' young ages, almost two-thirds were single/never married, and the most common educational qualifications were completing year 12 (high school), a trade or technical certificate or diploma, or an undergraduate degree. Close to 80% of participants were born in Australia, and 6.7% identified as Aboriginal and/or Torres Strait Islander. PGSI classifications showed that, amongst those who had gambled in the last 12 months, approximately three-quarters had experienced some degree of problems during this period (low-risk, moderate-risk and problem). Amongst those who gambled in their lifetime, approximately half had experienced problems during their lifetime (NODS-CLiP).

Engagement with simulated and monetary gambling forms

Engagement with simulated and monetary gambling forms is shown in Table 3. Importantly, because this is not a probability sample, these figures should not be interpreted as prevalence figures, but are reported for context. Around half of the participants had taken part in opening free loot boxes, playing video games with gambling content, and playing free social casino games in their lifetime. Around a quarter to a third had taken part in free fantasy sports, paid loot boxes, paid social casino games and demo games. The most popular monetary forms (lifetime) were scratch cards, lottery tickets, sports betting, EGMs, bingo, race betting and casino games. Newer forms, such as esports betting, fantasy sports betting and skin gambling were less popular. A similar pattern was observed with engagement in the last 12 months.

Associations between exposure and simulated forms, and subsequent traditional gambling behaviour and harm

Table 4 shows the relationship between each of the seven simulated gambling forms and monetary gambling outcomes. Engagement with any simulated gambling form during one's lifetime, apart from free loot boxes, was associated with monetary gambling during the lifetime, and all forms were associated with monetary gambling in the last 12 months. Most simulated forms, apart from free loot boxes, were associated with a higher (log+1) PGSI score (i.e., gambling problems in the last 12 months), and all forms were associated with being classified as experiencing gambling problems during their lifetime (NODS-CLiP). All forms, other than free loot boxes and playing video games with gambling content, were also associated with higher gambling harm scores (last 12 months). When controlling for multiple comparisons, free loot boxes were not associated with any gambling behaviour, problems or harm outcomes.

Table 3. Lifetime engagement, last 12 months engagement, mean first age of engagement and percentage first engaging in each simulated and monetary gambling form prior to age 18 (N = 1,026)

Category	Forms	Lifetime		Last 12 months		First age		Before age 18
		n	%	n	%	Mean	SD	%
Simulated	**Loot boxes (free)** (opening a loot box that the person earned during the game, but did not pay for)	579	56.4	486	47.4	17.2	3.9	47.5
	Social casino games (free) (gambling-like games, like simulated EGMs, poker, roulette, on an app or social network, played for free)	512	49.9	379	36.9	18.5	3.6	29.7
	Playing video games that include gambling content (such as Grant Theft Auto's casino level)	483	47.1	384	37.4	17.1	4.1	48.9
	Loot boxes (paid) paid loot boxes (buying a loot box with real money, or with virtual currency that was purchased with real money)	335	32.7	270	26.3	18.7	3.7	30.1
	Demo games (free demonstration or practice games on real gambling websites or apps, generally designed to help players learn to play)	335	32.7	263	25.6	19.4	3.4	16.7
	Fantasy sports (free) (fantasy sports or daily fantasy sports competitions that do not require an entry fee)	265	25.8	201	19.6	18.4	4.1	31.3
	Social casino games (paid) (gambling-like games, like simulated EGMs, poker, roulette, on an app or social network, where they person has paid to play)	226	22.0	181	17.6	19.8	3.3	8.8
Monetary	Scratch cards	557	54.3	394	38.4	17.9	3.2	21.7
	Lottery tickets	497	48.4	389	37.9	18.6	2.4	11.3
	Sports betting	464	45.2	380	37.0	19.2	3.0	11.6
	EGMs	426	41.5	316	30.8	18.9	2.2	6.1
	Bingo	416	40.5	253	24.7	18.0	3.8	28.1
	Race betting	395	38.5	309	30.1	19.1	3.1	14.2
	Casino games	335	32.7	231	22.5	19.4	2.4	5.4
	Novelty betting	233	22.7	189	18.4	20.1	2.9	7.7
	Keno	224	21.8	160	15.6	19.0	3.1	10.7
	Esports betting	197	19.2	164	16.0	19.7	3.5	13.2
	Skin gambling	141	13.7	117	11.4	19.3	3.3	17.0
	Fantasy sports betting	129	12.6	101	9.8	20.2	2.9	7.0

Note: Mean first age is based on people who took part in each form at any point during their lifetime. The before age 18 column shows the percentage of participants who had engaged in each form who reported engaging in each form in their lifetime prior to the age of 18. EGMs = electronic gaming machines.

Temporal sequence of taking part in simulated and monetary forms

Table 5 shows the temporal sequence of the age at which people reported first taking part in each possible pairing of simulated and monetary gambling forms. Each cell is based on people who took part in both forms. For example, the cell depicting the relationship between free loot boxes and scratch cards is based only on the people who took part in both free loot boxes and scratch cards at some point in their life. The figures in each cell are the mean difference of the age at which participants first took part in each form. For free loot boxes and scratch cards, this figure is −0.38, indicating that the age at which people first took part in loot boxes was 0.38 years (on average) before they took part in scratch cards. Red cells indicate that the simulated form was significantly more likely to occur at a younger age, while green cells indicate that the simulated form was significantly more likely to occur at an older age, compared to the monetary gambling form.

As can be seen in Table 5, free loot boxes and playing video games with gambling content were significantly more likely to occur before any monetary gambling activity, except for bingo in the case of video games with gambling content. Free fantasy sports were significantly more likely to occur before casino games, novelty betting and paid fantasy sports

Table 4. Associations between engagement with simulated gambling forms (lifetime) and engagement in monetary gambling, gambling problems and gambling harm

Dependent variables	Any monetary gambling forms (lifetime) (Ref = no)	Any monetary gambling form at least monthly (last 12 mths) (Ref = no)	Gambling problems score (last 12 mths) PGSI	Gambling harm score (last 12 mths) GHS-10	Gambling problems (lifetime) NODS-CLiP (Ref = no)
Regression type	*Logistic*	*Logistic*	*Linear*	*Linear*	*Logistic*
N	*1026*	*1026*	*402*	*402*	*883*
Loot boxes (free)	1.330	1.330*	0.128	0.172	1.372*
	(0.933; 1.894)	(1.038; 1.704)	(-0.071; 0.327)	(-0.026; 0.371)	(1.050; 1.793)
Social casino games (free)	3.335***	1.987***	0.296**	0.352***	1.746***
	(2.243; 4.961)	(1.550; 2.549)	(0.101; 0.490)	(0.158; 0.545)	(1.337; 2.281)
Play video games with gambling content	2.593***	2.183***	0.299**	0.185	1.752***
	(1.758; 3.822)	(1.700; 2.803)	(0.104; 0.493)	(-0.011; 0.380)	(1.342; 2.287)
Loot boxes (paid)	2.554***	2.706***	0.471***	0.396***	1.932***
	(1.623; 4.017)	(2.066; 3.544)	(0.274; 0.668)	(0.197; 0.594)	(1.458; 2.561)
Demo games	4.850***	4.628***	0.761***	0.611***	2.498***
	(2.792; 8.425)	(3.483; 6.149)	(0.576; 0.945)	(0.421; 0.800)	(1.879; 3.319)
Social casino games (paid)	7.577***	5.623***	0.898***	0.716***	2.875***
	(3.299; 17.403)	(3.983; 7.938)	(0.706; 1.089)	(0.517; 0.914)	(2.075; 3.985)
Fantasy sports (free)	2.362***	3.411***	0.666***	0.580***	2.357***
	(1.440; 3.874)	(2.531; 4.596)	(0.468; 0.865)	(0.379; 0.781)	(1.734; 3.204)

Note: Coefficients for logistic regressions are odds ratios (null value = 1), and for linear regressions are standardised coefficients (null value = 0). Values in brackets are 95% confidence intervals. $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$. Ref = reference. PGSI = Problem Gambling Severity Index. GHS-10 = Gambling Harms Scale, 10 items. NODS-CLiP = National Opinion Research Centre Diagnostic and Statistical Manual of Mental Disorders version IV Screen for Gambling Problems, Control, Lying and Preoccupation.

betting. Paid loot boxes were significantly more likely to occur before sports betting, casino games, novelty betting, esports betting, skin gambling and fantasy sports betting, but after scratch cards and lottery tickets. Free social casino games were significantly more likely to occur before novelty betting, but after scratch cards, lottery tickets and bingo. Paid social casino games and demo games were significantly more likely to occur after scratch cards, lottery tickets, sports betting, EGMs and bingo. In the case of paid social casino games, they were also more likely to occur after race betting and casino games. When controlling for multiple comparisons, the general pattern of results is similar, but some results were no longer statistically significant. Free social casino games were no longer more likely to occur after lottery tickets, paid social casino games were no longer more likely to occur after casino games, and demo games no longer more likely to occur after sports betting.

DISCUSSION

This study aimed to explore patterns of first use for simulated and monetary gambling, and links between simulated gambling and gambling problems and harm. Lifetime engagement in all simulated gambling forms (except free loot boxes) was associated with monetary gambling engagement during the lifetime and last 12 months, and gambling harms and problems. These findings add to the growing and consistent evidence that participating in simulated gambling statistically predicts monetary gambling, and more concerningly, harmful gambling, among young people (Baggio et al., 2016; Hing, Dittman, et al., 2022; Hing, Lole, et al., 2023; Hing, Rockloff, et al., 2023; Hing, Russell, et al., 2023; Hing, Rockloff, et al., 2022; King et al., 2014; Rockloff et al., 2021; Wardle, 2019). However, these

Table 5. Difference between mean age of first taking part in each simulated form, and each monetary gambling form

Forms	Loot boxes (free)	Play video games with gambling content	Fantasy sports (free)	Loot boxes (paid)	Social casino games (free)	Social casino games (paid)	Demo games
Scratch cards	-0.38*	-0.52**	0.41	0.93***	0.51**	1.56***	1.27***
Lottery tickets	-0.43*	-0.46*	0.46	0.79***	0.44*	1.69***	1.21***
Sports betting	-1.19***	-1.07***	-0.22	-0.42*	-0.24	0.76***	0.36*
EGMs	-0.87***	-0.97***	-0.12	0.03	0.11	0.95***	0.56**
Bingo	-0.54**	-0.22	0.04	0.22	0.54**	1.22***	1.16***
Race betting	-1.36***	-1.14***	-0.36	-0.35	-0.26	0.55**	0.16
Casino games	-1.38***	-1.37***	-0.66**	-0.57**	-0.30	0.46*	0.17
Novelty betting	-1.22***	-1.22***	-0.93**	-0.90***	-0.79***	0.07	-0.27
Keno	-0.92**	-0.93***	-0.16	-0.09	0.13	0.36	0.20
Esports betting	-0.87***	-0.78***	-0.41	-0.55**	-0.11	0.30	-0.01
Skin gambling	-0.69**	-0.62**	-0.19	-0.56*	-0.10	0.27	0.05
Fantasy sports betting	-0.76**	-0.96***	-0.67**	-0.68**	-0.25	0.07	-0.06

Note: Some cells have low cell counts, especially in the lower right of the table, and are therefore underpowered. Negative numbers (red cells) indicate that the age of first use of the simulated form was statistically significantly lower than that for the monetary form. Positive numbers (green cells) indicate that the monetary gambling form was statistically significantly more likely to come first. Tests are Wilcoxon signed-rank tests. Due to outliers, reported mean differences are trimmed at −6 and 6 years difference. $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$. EGMs = electronic gaming machines.

correlations cannot determine whether these associations are due to psychosocial and behavioural factors at play in a possible catalyst effect (King & Delfabbro, 2016) or to third-party variables (Hing, Dittman et al., 2022).

Importantly, therefore, examining the age of uptake of simulated and monetary gambling is a preliminary step towards untangling these pathways. This study found that young people commonly first engaged in free loot boxes and games with gambling content between the ages of 13 and 17. This likely reflects the incidental access that adolescents have to these activities because they are embedded and unavoidable within the digital games they frequently play (Hing, Lole, et al., 2023). However, engagement with simulated forms that they need to deliberately seek out and where gambling is the key element of gameplay (e.g., paid social casino games and demo games) was less common before the age of 18. Unsurprisingly, there was a large rise in the uptake of monetary gambling forms around the legal gambling age of 18, when young people are likely to have more disposable income and gambling is often seen as a "rite of passage" (Kristiansen, Trabjerg, & Reith, 2015; McCarthy, Thomas, Pitt, Daube, & Cassidy, 2020; Reith & Dobbie, 2011).

Untangling pathways between simulated and monetary gambling is further informed by information about their temporal sequencing. Free loot boxes and playing video games with gambling content were significantly more likely to precede every monetary gambling form (except bingo for video games with gambling content). Similarly, free fantasy sports and paid loot boxes preceded several monetary forms. These findings at least partly reflect that free fantasy sports, loot boxes and games with gambling content are more accessible to young people under the legal gambling age, compared to monetary gambling products. Nonetheless, this temporal sequence also leaves open the possibility of a migration pathway, where these simulated gambling games catalyse monetary gambling uptake through increasing social, behavioural, cognitive and emotional risk factors (King & Delfabbro, 2016). For example, engagement in these simulated activities can increase social influences on young people to gamble, through exposure to gambling subcultures and the social cache gained among peers from wins (Hing, Browne et al., 2022). These simulated games can also encourage behaviours such as persistence and real money expenditure to acquire prizes (Armstrong et al., 2018; Hing,

Lole, et al., 2023). Their cognitive effects can lead to a misperception of the role of chance in gambling and enhanced confidence in gambling "skill" (King & Delfabbro, 2016). In the emotional domain, these activities can foster arousal, reduced sensitivity to in-game losses, relief from negative mood states, and impulses to gamble with real money, especially among young people who are vulnerable to gambling problems (Armstrong et al., 2018; King & Delfabbro, 2016).

These results may also reflect that these particular simulated and monetary gambling products appeal to the same consumers. For example, gambling on lottery tickets typically preceded paying for loot boxes. These two activities are functionally similar and may therefore have a similar appeal to young people. Nonetheless, lottery products are often gifted to children from a young age (Hing, Russell, King, et al., 2021; Kristiansen et al., 2015), so this temporal sequence also reflects ease of access.

The forms of simulated gambling where gambling is the main gameplay element (social casino games and demo games) tended to first occur *after* engagement in many gambling forms, including some of the more harmful forms like EGMs and sports betting (Browne et al., 2023). These results raise doubts about the extent of migration for these products. Instead, this temporal sequence may reflect a "containment effect" where engaging in simulated gambling in a supportive and educative environment might be used to build resilience against excessive gambling (King & Delfabbro, 2016). Simulated gambling might also be used as a substitute for monetary gambling in order to curtail harmful gambling (Hing, Dittman et al., 2022), although few people appear to use this strategy (Gainsbury, Hing et al., 2015, Kristiansen, Camilla et al. 2018; Kristiansen, Trabjerg, et al., 2018; Rockloff, Browne et al., 2020; Rockloff, Russell et al., 2020). It is more likely that social casino and demo games appeal to people who already engage in monetary gambling due to their similar structural characteristics, which therefore enable their use as practice games, and because both activities appeal to particular types of young people (Armstrong et al., 2018; Hing, Dittman et al., 2022). It is well recognised that certain psychological characteristics, including poor social connectedness, higher impulsivity, emotional and attentional problems, social dysfunction, and maladaptive coping strategies, increase young people's vulnerability to gambling engagement and gambling problems (Riley, Oster, Rahamathulla, & Lawn, 2021).

Irrespective of the typical sequence of what games, simulated or monetary, are played first, simulated gambling games appeal to young people who are vulnerable to gambling harm. Policymakers should therefore consider improved consumer protection and harm minimisation measures for simulated gambling games, such as limit setting, age-gating, provision of help line details and other measures that providers of monetary gambling products must provide.

Limitations and suggestions for future research

The study relied on self-report, and there may be some recall bias, including in the age at which participants first took part in each activity. However, any biases were likely to be similar across forms for any individual, and key analyses were based on the sequence of activities per participant. Some participants may have been reluctant to report illegally taking part in some monetary forms when underage. We attempted to minimise this bias by reminding participants at this point that the survey was anonymous. Some forms are more prevalent than others, and therefore more people may take part in more prevalent forms earlier. For instance, a primary reason why people use free loot boxes before gambling on monetary forms is because loot boxes are present in the most popular games that young people play and they are therefore are more likely to encounter these products first. The study examined only the age of first participation in each simulated and monetary gambling activity and not the degree of engagement, such as frequency and time and money spent. Research that examines relationships between the level of engagement in simulated and monetary gambling activities, over time, is needed to clarify temporal and migration effects. Lastly, the research made use of a paid online research panel, so the sample may not be representative of the population of 18–25 year olds in Australia. However, paid online samples tend to support similar relationships between variables to those found in representative samples, and the current sample allows for better exploration of relatively rare activities (Russell, Browne, Hing, Rockloff, & Newall, 2022). As noted previously, our methodology does not allow for causal inference, but only suggests which games, simulated or monetary, are played first. It is a necessary (although not sufficient) condition for causation, however, that simulated gambling should be played before monetary gambling. The present results can provide evidence for future exploration of major causal pathways that might influence migration from simulated gambling to monetary gambling. Importantly, research is needed into pathways from simulated gambling to gambling addiction. Studying potential pathways, such as those seen in online addictive behaviours (Brand, 2022), can help to understand this pathway and how it might be disrupted. For example, the Pathways Model of problem and pathological gambling (Blaszczynski & Nower, 2002) has been applied to smartphone use (Canale et al., 2021) and might contribute to explaining migration from simulated gambling to gambling addiction. Broader public health models would also be informative to understand how contextual factors, such as products and environments, impact on this pathway.

Conclusion

While this study commenced with the ostensibly simple purpose of examining patterns of uptake of simulated and monetary gambling activities, it has instead revealed the complexity of these patterns and their possible explanations. In addition to the possible catalyst, containment and substitution effects of simulated gambling on monetary gambling, the relative access that young people have to these activities while growing up, may play important roles in how they engage with these activities. In alignment with a public

health perspective on gambling (Hilbrecht et al., 2020), other individual, social and contextual factors are also likely to influence the interplay between simulated and monetary gambling. Additional complexity is apparent because simulated gambling activities vary widely in their characteristics and their resemblance to monetary gambling products. These factors suggest that future research should be open to identifying several pathways amongst young people on the road from simulated gambling to monetary gambling, or vice versa.

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