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Skill gambling machines and electronic gaming machines: participation, erroneous beliefs, and understanding of outcomes

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ABSTRACT

Skill-based gaming machines (SGMs) include a skill-element within the random mechanisms of electronic gaming machines (EGMs). Concerns have been expressed that SGMs may increase erroneous beliefs among gamblers, which would exacerbate gambling problems. This paper presents the results of a survey of 184 Mechanical Turk workers with access to SGMs. Exploratory analyses were conducted on measures assessing understanding of the role of skill vs. chance in determining outcomes in SGMs, EGMs, and other gambling and gaming activities, gambling participation, problem gambling severity, and gambling-specific erroneous beliefs. SGM play was greater among participants who were younger, more frequently played mobile games or gambled on EGMs, and had higher problem gambling severity. Participants with prior SGM play experience did not have a greater understanding of SGMs, and had less accurate understanding of how EGMs operate, yet had a higher self-reported understanding. The results suggest that individuals with existing gambling problems may gamble on SGMs and that SGMs may also appeal to a new cohort who do not engage with existing gambling activities. Greater efforts are needed to enhance understanding of EGMs in addition to SGMs where these are available to enabled informed decision-making and reduce erroneous beliefs that may drive problematic play.

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Electronic gaming machines; erroneous beliefs; game; irrational beliefs; skill

Skill-based gaming machines (SGMs) are a novel gambling activity that combines traditionally popular and profitable electronic gaming machine (EGM) mechanics with skill and other gaming elements. Also referred to as skill-based gambling machines, video/hybrid/interactive gaming machines/slots, these gambling activities are emerging in various configurations. For example, some SGMs involve the addition of skill-based bonus rounds to traditional reel-driven EGMs, while others include the addition of chance-based prizes and underlying mechanics to machines that resemble video, mobile, or arcade games.

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SGMs are still early in their product life cycle. Their limited legal availability suggests that ongoing concerns are held by regulators, including the potential for the machines to increase gambling problems and impact vulnerable people such as young adults and individuals with gambling problems (Toscano, 2018). Recent review and commentary papers provide a good overview of the current styles of SGMs and potential impact for consumers (Delfabbro et al., 2020; Pickering et al., 2020). SGMs can incorporate skill in a variety of ways, and the extent to which players can impact outcomes varies between games; however, chance still determines the overall outcomes and all players have a chance of winning regardless of skill, and will occur losses over time. Two central issues for SGMs have received little academic study: 1) consumer understanding of SGM and the extent to which skill determines outcomes; 2) SGMs' potential impact on gambling-related harms.

By offering a new player experience that is distinct from traditional EGMs (slots, pokies, fixed odd betting terminals, fruit machines, video lottery terminals, etc.), SGMs present an opportunity for new customers and thus increased revenue. SGMs are described as being positioned to be adopted by younger generations who play many types of online games and create new streams of revenue for gambling venues (Parker, 2016). This rationale is based on indications that EGMs are less popular among millennials and Generation Z than previous generations (Suh et al., 2017). However, millennials are more likely to appreciate games such as Blackjack, which have an element of skill or strategy and some social elements (Un, 2013). Online game play, with a much higher skill and social component than most gambling is popular among younger generations. An estimated 67% of U.S. adults aged 18 to 29 years, and 75% of Australians aged 25–34 years, report having played video games at least once in their life (Brand et al., 2017; *U.S. Average Age of Video Gamers*, 2018).

The structural characteristics of EGMs, and their potential to encourage erroneous beliefs such as illusions of control, superstitions, and chasing losses (or wins), have been discussed (Delfabbro & Winefeld, 2000; Lund, 2011). Misconceptions about gambling are associated with increased consumption and problematic gambling behaviors (Ciccarelli et al., 2017), and erroneous beliefs are associated with persistent gambling to an unaffordable level (Goodie & Fortune, 2013; Myrseth et al., 2010; Toneatto et al., 1997; Xian et al., 2008). Miller and Currie (2008) demonstrated that erroneous beliefs moderate the relationship between risky gambling behaviors and gambling intensity. If the use of SGMs is related to increased levels of erroneous beliefs about gambling and lower accuracy of understanding of the role of skill and chance in determining outcomes, this may reduce the ability of consumers to make informed choices about play, and increase the risks of problematic gambling associated with these new (Blaszczynski et al., 2004; Blaszczynski & Nower, 2002).

Exposure effects (LaPlante & Shaffer, 2007) may be observed in the expansion of SGMs. When new gambling activities are introduced to a market, they are often engaged by individuals with high levels of gambling involvement and potentially existing problems. This is demonstrated by high rates of gambling problems among recent new gambling forms including Internet gambling (Gainsbury, 2015), esports betting (S. M. Gainsbury et al., 2017; Macey & Hamari, 2018), and Daily Fantasy Sports (Martin & Nelson, 2014). When controlling for overall gambling

involvement, participation in the new forms is generally not a predictor of gambling problems, however, they may exacerbate existing problems (Baggio et al., 2017; LaPlante et al., 2014; Philander & MacKay, 2014). Conversely, if SGMs do attract a new cohort this creates the potential for problems among a population that would not otherwise have been exposed to gambling, thus increasing overall gambling harms. If young adults are attracted to SGMs, this may be problematic as this group has a higher rate of gambling problems compared to other age cohorts (Abbott et al., 2018; S. Gainsbury et al., 2014; Welte et al., 2015).

There is limited evidence regarding the use of SGMs, which are currently only legally available in handful of North American jurisdictions. One SGM manufacturer, GameCo, reports that after two and a half years of operation, the average customer is approximately 25 years younger than most individuals that play EGMs (GameCo, 2019). They also report three to four times more play without a loyalty card than EGMs, suggesting individuals who play SGMs do not regularly play EGMs, and SGMs are thus creating incremental revenue (GameCo, 2019). The current study builds on a pilot study that explored consumer understanding of SGMs using an ecologically valid sample of casino customers (ref blinded). Following engagement with an SGM facilitated by the machine manufacturer, members of the US casino loyalty program were invited to complete a brief survey (N = 43, aged 31–74 years, 56% female, 58% novice SGM players). Responses to questions eliciting accuracy of understanding how SGMs outcomes are determined indicated a lack of subjectively strong understanding immediately following play. When asked to assess relative skill and chance, participants reported SGMs were higher in perceived skill than EGMs, lower than poker, but equivalent to blackjack. No differences in game understanding were observed between participants based on their previous SGM experience.

Research has not previously examined rates of gambling problems, game understanding, and erroneous beliefs amongst individuals who play SGMs. This research aimed to explore the extent to which individual's understand how outcomes are determined in SGMs and the characteristics of those likely to play these. The outcomes of this research have implications for gambling policy, including how to regulate SGMs based on individual's subjective experiences, informational strategies needed to ensure individuals make informed decisions about play, and harm minimization strategies. Understanding which individuals are likely to engage with SGMs is important for regulators, but also for industry and public health stakeholders to understand the likely impact on gambling adoption, revenue, and potential harms for individuals and the community.

This research was largely exploratory given the absence of related literature in the field. We predicted that in a community sample, those who had played SGMs would be younger than non-players, gamble more frequently, and have higher rates of gambling problems than those who had not played SGMs. We predicted that most individuals would not have a strong understanding of the role of skill vs. chance in determining SGMs outcomes. The research protocol was approved by the first author's University Human Research Ethics Committee (2017/890). The protocol was not pre-registered, the data and materials will be made available through [link].

Methods

Participants

The sample was recruited using Amazon Mechanical Turk, an online marketplace for sourcing tasks to workers. Participants reviewed a participant information sheet and completed a consent form prior to commencing the survey. To increase the probability of recruiting individuals who had previously played SGMs, participants had to meet the following inclusion criteria: a) be at least 21 years of age, b) speak fluent English, c) be North American, and d) live in or have visited a state where SGMs are legal (NV, NJ, CT, or CA) in the past 12 months. Mechanical Turk participants are more demographically diverse compared to convenience samples (Casler et al., 2013) and more representative of the US population (Berinsky et al., 2012; Buhrmester et al., 2011). To increase the likelihood of high-quality responses, participants were restricted to those with a Mechanical Turk approval rating of at least 95%, consistent with practices adopted in previous research (Goodman et al., 2013). Participants were paid USD2 for an estimated 30 minutes of their time, an amount consistent with similar studies and deemed to not represent a coercion to participate.

A total of 232 participants agreed to take the survey, 47 responses were removed due to failing one or more attention checks (e.g., asked to give a specific answer to indicate that they were paying attention, these questions were noted in the participant information sheet, Rouse, 2015), and one was removed due to completing the survey in an unreasonably fast time. To inform our initial power calculations, we used data on differences between online and non-online gamblers from the 2010 British Gambling Prevalence Study dataset – these data reflect differences between users and non-users of another emergent form of gambling. We examine the power to detect problem gambling severity index score differences (described in the measures section). The measure has a mean difference of 1.182 with an outcome standard deviation of 1.253 in the external data. We assume a power level of .8, an $\alpha = 0.05$, and apply a factor scale of two (*sd = 2.506)* to the standard deviation to allow for potentially higher variance in our sample. We calculate a required a sample size of 71 participants per group. After removing responses, there were 184 responses for analysis. Of these, 104 participants who report never playing SGMs in the past year, and 80 reported having played at least once, who were categorized as SGM players. Within this group, 23 reported typically playing SGMs at least once per week, 23 at least once per month, and 34 several times per year.

Measures

SGM game understanding

Participants were asked about their understanding of SGMs. They were instructed that items about 'winning' or 'losing' referred to outcomes overall their bets and that 'outcomes' refers to winning/losing money. Items were arranged on a five-point *Likert* scale (1 = *strongly disagree*, 5 = *strongly agree*) and used the term skill-based gambling machines. A summative score (SGMs understanding) from 4 to 20 was computed using the following items:

(1) A player of greater skill is more likely to win money on the skill-based gambling machines over 1 h of play, compared to a player of lesser skill.
(2) Over the long term, all players will lose money on the skill-based gambling machines.
(3) (Reverse scored) The outcomes of skill-based gambling machines are random no matter what a player does.
(4) With practice, a player can improve their outcomes on skill-based gambling machines over time.

Self-reported SGMs understanding was assessed using an additional question:

(1) I understand how a player's skill impacts the outcomes of skill-based gambling machines.

EGM game understanding

Participants were asked about their understanding of EGMs using similar items as with SGMs. The items were scored differently as a function of the differences between EGMs and SGMs. Items were arranged on a five-point *Likert* scale (1 = *strongly disagree*, 5 = *strongly agree*), and a summative score (EGM understanding) from 4 to 20 was computed using the following items:

(1) (Reverse scored) A player of greater skill is more likely to win money on EGM machines over 1 h of play, compared to a player of lesser skill.
(2) Over the long term, all players will lose money on EGM machines.
(3) The outcomes of EGM machines are random no matter what a player does.
(4) (Reverse scored) With practice a player can improve their outcomes on EGM machines over time.

Self-reported EGM understanding was assessed using an additional question:

(1) I understand how a player's skill impacts the outcomes of EGM machines.

Role of skill and chance

Participants were asked about the perceived skill and chance involved in various games. Items were arranged on a five-point *Likert* scale (1 = *all chance*, 5 = *all skill*). A measure of skill/chance understanding was computed using responses to items on five different games (EGMs, SGMs, poker, video games, and chess). Scores were computed such that '1' was added to participants' total if they identified EGM as 'all chance,' chess as 'all skill,' and each of SGMs, poker, and video games as a point between 'all chance' and 'all skill.' Possible scores thus provided an indication of the accuracy of understanding the role of skill and chance and range from 0 to 5.

Play frequency

Participants were asked about their frequency of play in several games of chance, skill, and mixed skill and chance. Games included SGMs, EGM machines, blackjack, poker, video games, mobile games, and chess. Participants were shown videos of SGMs and

EGM machines, and images of the other games with descriptions, to ensure they understood the differences in the games. Items were measured on a 6-point scale, including, 'not at all in the past year,' 'several times per year,' 'once per month,' 'several days per month,' 'at least once per week,' and 'daily.'

Problem gambling severity index (PGSI). The PGSI is a nine-item scale used for measuring the severity of gambling problems in the general population (Ferris & Wynne, 2001). Items are measured on a 4-point scale (0 = never, 1 = sometimes, 2 = often, 3 = almost always), which are summed. Scores vary from 0 to 27.

Gambler's Belief Questionnaire

The GBQ is a 20-item self-administered scale used to assess gambling-related cognitive distortions (Winfree et al., 2015). Items are measured on a 7-point *Likert* scale (1 = strongly agree, 7 = strongly disagree), which are reverse coded and summed. Higher scores indicate higher levels of cognitive distortions. There are two subscales: 1) An 8-item illusion of control construct (GBQ-IC); and 2) a 12-item luck/perseverance construct (GBQ-LP).

Demographics

Participants responded to demographic items, including their age, gender, highest degree (education), and household income band.

Summary statistics of variables used in are provided in Table 1.

Analysis plan

To explore the relationships of interest, we first estimated bivariate relationships between those variables and prior SGM participation. We then estimated an ordered logit model using past 12-month SGM play frequency as a dependent variable, and any statistically significant variables from our bivariate tests as explanatory variables. To produce the final model, non-significant variables are eliminated in backward stepwise fashion, using an $\alpha = 0.05$ criterion. We use a stepwise model as they can efficiently identify covariates from a large group of variables, but we note they can also produce frequent Type I errors (Mundry & Nunn, 2009).

Results

In Table 2, we report the results of our Welch-Satterthwaite's t-tests of differences in means between those with previous SGMs experience and those without SGM experience. In the demographic, psychographic, and behavioral variables, only education and household income fail to show a statistically significant difference in means. Individuals who had played SGMs were younger, more likely to be male, have higher gambling problems and erroneous beliefs, and were more likely to be involved in all gambling and game types measured, as compared to individuals who had not played SGMs. We observe individuals who had played SGMs to have less accurate skill/chance understanding, lower EGM understanding, higher self-reported EGM understanding but no difference in SGMs understanding or in self-reported SGMs understanding.

Table 1. Summary demographics of study participants.

	Mean	SD	Minimum	Maximum
Age	34.016	9.290	21	69
Female	0.321	0.468	0	1
Education	3.609	0.929	2	5
Household income	2.913	1.566	1	6
PGSI score	4.293	6.340	0	24
GBQ-IC	31.734	11.590	8	53
GBQ-LP	39.370	19.081	12	79
EGM frequency	2.435	1.333	1	6
SGM frequency	2.043	1.511	1	6
Poker frequency	2.120	1.350	1	6
Blackjack frequency	2.071	1.403	1	6
Video Game frequency	4.152	1.656	1	6
Mobile Game frequency	4.304	1.658	1	6
Chess frequency	2.261	1.695	1	6
Skill/chance understanding	3.739	1.001	1	5
SGM understanding	15.272	2.218	7	20
Self-reported SGM understanding	3.995	0.926	1	5
EGM understanding	16.038	3.435	9	20
Self-reported EGM understanding	2.913	1.423	1	5

Table 2. Independent samples t-tests of mean differences in past 12-month SGMs players and non-players.

	Mean for participants with no past SGM experience	Mean for participants with past SGM experience	*T*-statistic	*P*-value
Age	36.913	30.250	5.361	0.000
Female	0.385	0.237	2.171	0.031
Education	3.500	3.750	−1.842	0.067
Household income	2.875	2.962	−0.380	0.705
PGSI score	1.279	8.213	−7.876	0.000
GBQ-IC	27.096	37.763	−6.958	0.000
GBQ-LP	29.942	51.625	−8.913	0.000
EGM frequency	1.702	3.388	−10.067	0.000
Poker frequency	1.567	2.837	−6.789	0.000
Blackjack frequency	1.385	2.962	−8.271	0.000
Video game frequency	3.875	4.513	−2.697	0.008
Mobile game frequency	3.846	4.900	−4.607	0.000
Chess frequency	1.500	3.250	−7.427	0.000
Skill/chance understanding	4.144	3.212	6.829	0.000
SGMs understanding	15.423	15.075	1.049	0.296
Self-reported SGMs understanding	3.913	4.100	−1.397	0.164
EGM understanding	17.490	14.150	7.225	0.000
Self-reported EGM understanding	2.548	3.388	−4.267	0.000

We report the results of our stepwise logit regression model in Table 3. After the backward elimination method, four statistically significant variables are noted to be related to the frequency of SGMs play: age, EGM frequency, mobile game frequency, and PGSI score. The Pseudo R^2 = .428. Consistent with predicted relationships, the coefficients suggest that higher SGM involvement is associated with lower age, higher EGM, and mobile game involvement, and greater gambling problems.

To better understand the relationship between these variables and SGMs play frequency, we plot the marginal effects of each variable on each of the SGMs frequency categories in Figure 1. Most variables show a monotonic relationship, except for the 'several times per year,' 'once per month,' and 'several days per week' categories in relation to EGM frequency. Those estimated effects rise with initial involvement in EGMs, but then fall as SGMs continue to rise. The marginal effects plots also show that some participation in SGMs is increasing mobile game frequency and PGSI score and decreasing in age.

Discussion

Our predictions were supported and were consistent with the pilot study (ref blinded). SGMs were more likely to be played by a younger audience and those who regularly play EGMs and mobile games, suggesting that SGMs appeal to both existing regular EGM players and a new cohort of players. This is consistent with research on other newly introduced forms of gambling (S. M. Gainsbury et al., 2017; Macey & Hamari, 2018; Martin & Nelson, 2014), suggesting that individuals already involved in gambling will trial new gambling products where these are available. As predicted, SGMs use was greater among those with higher problem gambling severity index scores, suggesting that individuals with gambling problems are engaging with this new form of gambling. Previous SGM play experience did not increase the accuracy of understanding how outcomes are determined on these products or self-reported understanding. However, consistent with the greater engagement of SGMs among existing gambling cohorts with higher gambling problem scores, this cohort had a poorer understanding of EGMs and greater erroneous gambling beliefs in general.

Our results support previous findings that individuals who preferred skill games or both skill and chance games have higher levels of erroneous beliefs compared to individuals with a preference for chance gambling games only (Myrseth et al., 2010; Toneatto et al., 1997). Studies in cognitive biases indicate that the opportunity to make choices, maintain active involvement, and accumulate experience at a game increases perception of personal control and creates overconfidence in personal skills and subsequent expectations of winning (Langer, 1975, 1977; Langer & Roth, 1975). The nature of SGMs enables individuals to actively participate in the gambling experience and our results suggest that this is related to greater illusions of control in individuals, overconfidence in understanding how outcomes are determined, and greater gambling problem severity. However, our results are non-causal and it is possible that the greater problem gambling severity may account for higher erroneous beliefs in those who prefer SGMs.

The results from these studies need to be considered along with the limitations of the research. Our samples were non-probabilistic and represent those with potentially

Table 3. Final outcome of stepwise logistic regression model.

DV: SGMs frequency	Coefficient	Standard error
Age	0.935**	(0.022)
EGM machine frequency	5.918***	(1.557)
Mobile game frequency	1.404*	(0.195)
PGSI score	1.115**	(0.040

Exponentiated coefficients and standard errors shown; N = 184; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; cutoff 1: 41.380**; cutoff 2: 407.895***; cutoff 3: 1363.130***; cutoff 4: 9767.866***; cutoff 5: 216245.501***.

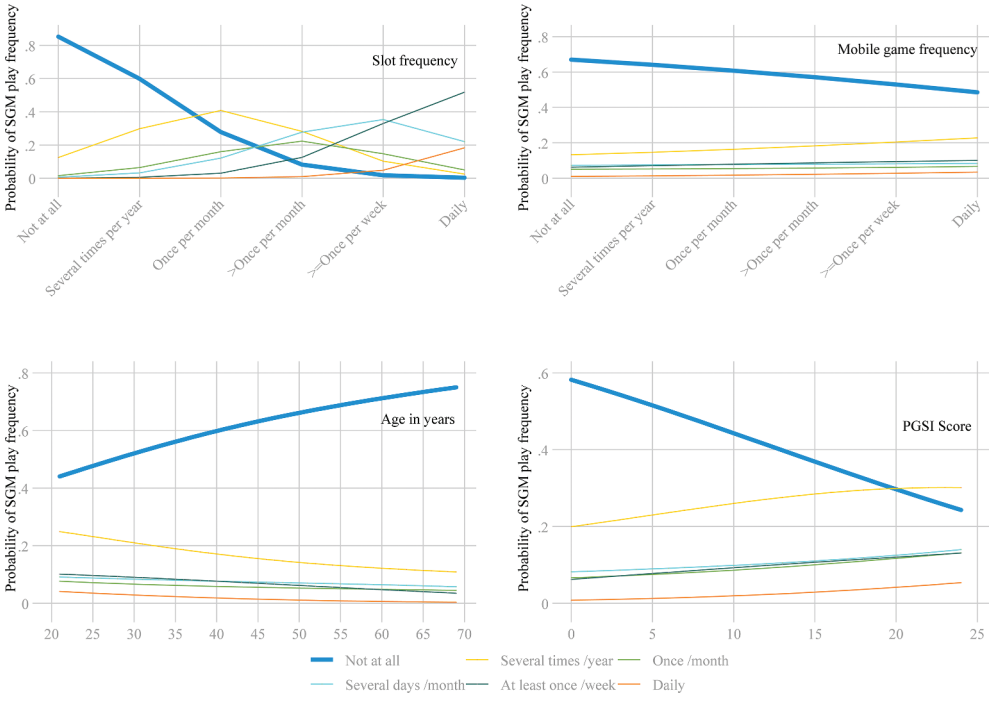

Figure 1. Plots of the estimated marginal effects of EGM frequency of play, mobile game frequency of play, age in years, and PGSI score. Lines describe the estimated probability of given SGM play frequency for levels of variables shown on x-axes.

limited experience with SGMs, so our results are preliminary in the sense that use and understanding of SGMs are likely to change over time as consumers adapt to the presence of these new gambling activities. Further research is needed with more representative populations, including those without previous gambling experience, and to assess the range of entertainment preferences of those attracted to SGMs. The current study was predominantly exploratory, so no aspects of causality are considered. Ongoing research, including experimental, longitudinal, or repeated measures studies, and ecologically valid field trials, is essential to examine the use of and understanding of SGMs over time. Early adopters of SGMs may also be quite different than the consumer base once the technology is more established (Mahajan et al., 1990).

Conclusions

This research suggests that SGMs are likely to appeal to both a new cohort of customers, including those who engage with mobile games, and existing gambling customers. SGM gambling does not appear to enhance understanding of how outcomes are determined for these devices, which could limit the ability for informed decision-making, which is held as a central tenant for responsible gambling (Blaszczynski et al., 2004). However, given that lower understanding of EGMs is related to erroneous beliefs and problem gambling severity, the findings indicate that efforts are needed not only to enhance understanding of the role of skill vs. chance for SGMs, but for existing EGMs in an effort

to reduce problematic gambling. The market for SGMs is evolving and it is likely that the trajectory of this new type of gambling will be influenced by regulatory decisions and consumer acceptance. This initial research is a first step in understanding who is likely to engage with SGMs and their relationship with gambling involvement, irrational cognitions, and gambling problems.

Disclosure statements

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Competing interests

Sally Gainsbury is the Editor of International Gambling Studies and were blinded from the review and editorial process. Her competing interests are declared on the IGS website.

Since 2016, Kahlil Philander has received research funds from the Washington State Gaming Commission, Manitoba Gambling Research Program, UNLV International Centre for Gaming Regulation, U.S.-Japan Business Council, Board of Regents of the Nevada System of Higher Education. He has received consulting payments from British Columbia Lottery Corporation, Responsible Gambling Council of Canada, Intralot, the Commonwealth of The Bahamas, West Virginia Lottery, Indiana Gaming Commission, and iDevelopment and Economic Association. He has received reimbursement for travel from the National Conference of State Legislators, National Council for Problem Gambling, International Association of Gaming Advisors, National Centre for Responsible Gambling, Responsible Gambling Council of Canada, North American State and Provincial Lottery Association, Evergreen Council on Problem Gambling, Global Gaming Expo Asia, and Alberta Gambling Research Institute. He is a member of the National Council for Problem Gambling, and formerly was the Director of Social Responsibility at the British Columbia Lottery Corporation.

Georgia Grattan has no competing interests to declare.

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Georgia Grattan was a student at the Gambling Treatment and Research Clinic at the University of Sydney. She is currently completing the final year of a Master of Clinical Psychology at Queensland University of Technology

Data availability statement

The data described in this article are openly available in the Open Science Framework at https://doi.org/10.17605/OSF.IO/TPA6U.

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This article has earned the Center for Open Science badges for Open Data and Open Materials through Open Practices Disclosure. The data and materials are openly accessible at https://doi.org/10.17605/OSF.IO/TPA6U.

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