Return Rates of Online Slot Machines in Trial Mode Influence Players' Errors of Estimation

Daniel Lalande,[1] Mathieu Emond,[1] & Emilie Bélanger[2]

[1] Department of Health Sciences, Université du Québec à Chicoutimi, PQ, Canada
[2] Department of Psychology, Université du Québec à Trois-Rivières, PQ, Canada

Abstract

In the present study, we aimed to evaluate the impact of an exaggerated return rate on players' errors of estimation and irrational beliefs. Conventional return rates for slot machines are set around 92%, whereas online gambling websites often use much higher return rates during demonstration (demo) play. Seventy college students were randomly assigned to play a virtual slot machine programmed to reflect a 92% return rate (control group) or a 180% return rate (experimental group). They completed self-reported measures of errors of estimation (e.g., chances of winning and losing) and irrational beliefs (e.g., having already won guarantees future wins) before and after playing a virtual slot machine for 10 min. Results from mixed 2 × 2 analyses of variance revealed statistically significant differences in errors of estimation (i.e., chances of winning, chances of winning the jackpot, chances of neither winning nor losing) between the experimental and control groups. Furthermore, participants estimated having less chance of losing during a slot machine session after exposure to the exaggerated return rate. Given the fact that many online gambling websites use similar exaggerated return rates during the demo period of their virtual slot machines, the present results suggest that this tactic may incite players to behave differently than they would otherwise during a gambling session. Implications for responsible gambling strategies are discussed.

Keywords: return rates, irrational beliefs, errors of estimation, virtual slot machines, responsible gambling

Résumé

La présente étude visait à évaluer l'impact d'un taux exagéré de retour sur les erreurs d'estimation et les croyances irrationnelles des joueurs. Les taux de retour conventionnels pour les machines à sous sont établis à environ 92%, tandis que les sites de jeux en ligne utilisent souvent des taux de retour beaucoup plus élevés dans

les démonstrations de jeux. Soixante-dix étudiants universitaires ont été assignés au hasard à une machine à sous virtuelle programmée qui reflète un taux de retour de 92 % (groupe témoin) ou une autre affichant un taux de retour de 180 % (groupe expérimental). Ils ont complété des mesures auto-déclarées des erreurs d'estimation (p. ex., les chances de gagner et de perdre) et des croyances irrationnelles (p. ex., avoir déjà gagné garantit des gains futurs) avant et après avoir joué à une machine à sous virtuelle pendant 10 minutes. Les résultats d'analyses de la variance (mixte 2 x 2) ont révélé des différences statistiquement significatives dans les erreurs d'estimation (c'est-à-dire les chances de gagner, les chances de gagner le jackpot, les chances de ne pas gagner ni de perdre) entre le groupe expérimental et le groupe témoin. De plus, les participants ont estimé avoir moins de chances de perdre pendant une séance de machine à sous après avoir été exposés au taux de retour exagéré. Étant donné que de nombreux sites de jeux en ligne utilisent des taux de retour exagérés similaires pendant la démonstration de leurs machines à sous virtuelles, les résultats actuels suggèrent que cette tactique peut inciter les joueurs à se comporter différemment que pendant une séance de jeu avec une machine affichant un taux de retour conventionnel. On y aborde les conséquences pour les stratégies de jeu responsable.

Introduction

Gambling is a popular activity in the province of Quebec, Canada. For instance, 75% of the adult population is estimated to take part in at least one form of gambling during the course of their lives (Kairouz et al., 2011). This popularity can be partly explained by the accessibility and diversity of available gambling activities (Dowling et al., 2005). New technologies enable the gambling sector to flourish and allow gamblers to engage in these activities from the comfort of their own homes (Productivity Commission, 2010). With online gambling, any person over 18 years of age can play at any moment of the day without having to spend time and money on transportation, which can raise concerns about the prevention of gambling problems. Research suggests that access to gambling and the intrinsic characteristics of online games place individuals at greater risk of developing gambling problems (Cole et al., 2011; Griffiths, 2003; Griffiths et al., 2009; MacLaren et al., 2011, 2015; Siemens & Kopp, 2011). A gambling disorder is defined as recurrent and persistent engagement in gambling activities that causes the individual significant distress (American Psychiatric Association [APA], 2013). The prevalence of gambling disorders in the general population is estimated to be between 0.4% and 1.0% among those who engage in traditional gambling activities (Dyke, 2009; Gerstein et al., 1999; Kairouz et al., 2011; Kessler et al., 2008; Welte et al., 2001) and is estimated to be between 5% and 18% among online gamblers (Griffiths & Barnes, 2008, Griffiths et al., 2009). Considering that gambling disorders occur more frequently in individuals who play online, it seems important to understand the different factors that contribute to this problem.

Machine Characteristics

A number of studies have examined the influence of machine characteristics on gambling behavior. For instance, video lottery terminals (VLTs) have been shown to attract more at-risk and disordered gamblers (54.8%) than occasional gamblers (12.4%), who prefer traditional lottery games such as scratch tickets or draws (Kairouz et al., 2011). VLTs are electronic slot machines that are considered to be continuous games because of the short lapse of time between the bet and the result (Diskin & Hodgins, 1999). Consequently, players can gamble continuously on these machines. This feature makes it necessary for the gambler to self-regulate his or her behavior and thus is more likely to be associated with gambling problems (Dowling et al., 2005; Kairouz et al., 2011). In addition, VLTs have stimulating audiovisual effects and allow the player to bet more than one credit on the same line or to bet on more than one line at a time (Kairouz et al., 2011). The amount time and money one can spend on these machines is virtually limitless.

Online VLTs

VLTs are now available online, and the websites on which it is possible to play these games often offer the player a free trial. The player receives fake credits to try out the game. The problem with these trials, however, is that the return rate changes when the demonstration (demo) mode is over and the player begins to use real money. The return rate is defined as the proportion of the bet that is returned to the player (Harrigan et al., 2012). For example, if the return rate is 92%, then, on average, for every dollar put into the machine, the player will receive 92 cents. To attract new players, the owners of online gambling websites often exaggerate the return rates in trial versions (Sévigny et al., 2005). Online hosts are not obligated to conform to any specific rules and therefore can use such a strategy to get people to bet money. In one study, Sévigny et al. (2005) selected 117 websites on which they played 100 games and found that 45 (39%) of them had a return rate of over 100% in their trial version. The return percentages of VLTs are normally between 85% and 98% (Harrigan & Dixon, 2010).

These trials reward the player with multiple gains, which can lead players to believe that online VLTs are a sure way of making money. In a recent study, Bednarz et al. (2013) examined the impact of being exposed to a free trial of roulette on players' behavior. They found that gamblers who participated in a trial bet significantly more money than did those who did not participate. Given the fact that players more easily remember their wins than their losses (inherent memory bias; Toneatto et al., 1997), they could end up overestimating their chances of winning or underestimating their chances of losing during the actual game when playing with real money. Some authors suggest that the demo versions of slot machines, either online or on a traditional VLT, entice players to think that they can make bigger and more frequent gains (Derevensky & Gupta, 2007; Griffiths, 2003; Griffiths & Parke, 2010; Griffiths & Wood, 2007; Sévigny et al., 2005). These beliefs are not based on reality and are therefore considered irrational.

Irrational Beliefs

It is well known that the majority of gamblers hold irrational beliefs towards gambling, regardless of their level of gambling experience (Fortune & Goodie, 2012; Goodie & Fortune, 2013; Joukhadour et al., 2004; Ladouceur et al., 1996; Ladouceur & Sévigny, 2005; Monaghan et al., 2009; Walker, 1992). These beliefs can lead players to spend more time and money gambling than they can afford (Lalande & Ladouceur, 2011). Irrational beliefs are therefore known to play a significant role in the development and maintenance of gambling disorders (Fortune & Goodie, 2012; Walker, 1992). Many irrational beliefs can be grouped under Tversky and Kahneman's (1973) heuristic and bias theory. Heuristics are cognitive shortcuts that allow an individual to make a judgement when he or she does not have sufficient information. These shortcuts can lead to errors of judgement because they do not represent a complete and precise evaluation of the situation (Fortune & Goodie, 2012). When an individual constantly uses the same heuristics, they make repeated errors of estimation, which, with time, become irrational beliefs.

Although most studies use a return rate similar to those in the casinos of between 85% and 98%, online slot machines in trial mode have a return rate of about 185% (Sévigny et al., 2005). This unrealistically high return rate may lead to erroneous estimates of the chances of winning and losing and may contribute to the development of irrational beliefs. Given the fact that irrational beliefs are a risk factor in the development of gambling disorders, it is important to determine whether the trial machines can modify the estimates and beliefs of the players.

The Present Study

The purpose of this study was to evaluate the impact of exaggerated return rates (comparable to those of online slot machines in trial mode) on young adults. We used a 2 × 2 (Condition × Time) experimental design to test the effect of return rates on participants' erroneous estimates and cognitive distortions. We expected to find an increase in errors of estimation and irrational beliefs only in the experimental group at the second measurement time.

Method

Participants

The sample size was determined by using G*Power (Faul et al., 2007). Anticipating a medium effect size and choosing a statistical power of 0.8 and a p-value of 0.05, we determined that 86 participants were needed to detect a statistically significant effect. After receiving ethical approval for this study, we advertised it to undergraduate students at our university via email and through brief classroom visits. All persons interested in the study were invited to send an e-mail to the research team. They were then contacted by phone to determine their eligibility. Participants had to be at least 18 years of age and could not present a gambling

problem as determined by the Problem Gambling Severity Index. Only one person was deemed ineligible because of symptoms of a gambling disorder. The final convenience sample included 70 participants, 32 men and 36 women (two people did not indicate their gender), all undergraduate students at BLINDED FOR REVIEW. The average age was 25.81 years (SD = 8.31). Although low participation rates allowed us to recruit only 70 participants, larger than expected effect sizes revealed some statistically significant group differences (see Results section). Most participants (n = 55; 78.6%) had already participated in some form of lottery and only 15 people (21.4%) had never participated in any form of lottery. Of the 55 people who had already gambled, 28 (40%) had played on slot machines. The experimental and control groups had similar sociodemographic profiles and gambling experience.

Procedure

Participants were randomly allocated to either the exaggerated return rate group (180%) or the conventional return rate group (92%). In both groups, participants used credits to gamble on a computer simulation of a slot machine. Before playing, each participant completed a series of self-reported questionnaires. Ten minutes into the game, a lapse of time sufficient to change the beliefs of players (Monaghan et al., 2009), they received a message asking them if they wanted to continue playing and how much money they would be willing to bet in a future gambling session. Regardless of their answers, the game ended. The participants were then asked to complete another series of questionnaires before being debriefed about the study's objectives and hypotheses.

Measures

A virtual slot machine was created by one of the authors of the study on Visual Basic 2005. It was a reproduction of a basic slot machine with 3 reels, with all possible winning combinations illustrated underneath the reels. Two versions of the virtual slot machine were created. The experimental group played with an exaggerated return rate of 180%, whereas the control group had a conventional return rate of 92%, the average return rate of Loto Québec's VLTs (Loto Québec, 2012). In order to provide the same sequence of events for each condition, we did not randomize the gains and losses.

The Canadian Problem Gambling Index (Ferris & Wynne, 2001) was used to measure a person's level of participation in gambling, the presence and severity of a gambling problem, and the consequences of the problem on the player's life. We used only the questions on participation in gambling (e.g., "In the past 12 months, how often did you bet or spend money on lottery tickets like the 649, Super 7, or POGO?") and on the severity of their problem (e.g., "Have you wanted to stop betting money or gambling, but didn't think you could?"). The index situated the participants as being non-problem gamblers, low-risk gamblers, moderate-risk gamblers, or problem gamblers. Cut-off points were used to determine group

membership, as suggested by Ferris and Wynne (2001), and only non-problem gamblers could participate in the study. The instrument shows good psychometric properties, including concurrent validity with the South Oaks Gambling Screen (SOGS) and with the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM-5*; 5th ed.; APA, 2013). Predictive validity is moderate (0.48), although Smith and Wynne (2002) revealed that it is higher than that for both the *DSM-5* and the SOGS. Cronbach's alpha in this sample was 0.84. Test-retest reliability was 0.78.

The Erroneous Estimates and Irrational Beliefs questionnaire (Monaghan et al., 2009) was used before and after exposure to the virtual slot machine. Four items measured erroneous estimates and five measured irrational beliefs. Erroneous estimates are defined by Monahan et al. (2009) as incorrect knowledge of the odds of winning, losing, winning the jackpot, and neither winning nor losing. Participants indicated the odds for each event in a single game from 0% to 100%. A sample item is, "What do you think is the chance you will come away with more money than you started with after one session of playing an electronic gaming machine?" The five irrational beliefs included the illusion of control, superstitious beliefs, independence of chance events, the gambler's fallacy, and misunderstanding of random outcomes. Participants indicated the extent to which they agreed, on a scale from 0% to 100%, with statements such as, "If the machine has not paid out for some time, what do you think are your chances of winning on the next few spins?". A mean score per group was calculated for each of the four erroneous estimates. A mean score for each irrational belief was also calculated. No psychometric results are available for this scale because it was created by Monaghan et al. (2009) for the purposes of their study. This questionnaire was chosen because it is the only one that covers irrational beliefs while also considering erroneous estimates under the heuristics and bias theory (Tversky & Kahneman, 1973).

In the sociodemographic questionnaire, participants were asked to report their age, gender, education level, and current program of study.

Analytical Strategy

To detect group differences on errors of estimation over time, we used a mixed ANOVA with each error (four ANOVAs in total). Paired student *t* tests were then used to verify whether the changes between T1 and T2 were statistically significant for both groups. The same analytical strategy was used for the five irrational belief variables. Finally, an independent *t* test was used to compare the amount of money that participants in each condition reported being ready to gamble on a real slot machine.

Preliminary Analyses

Before running the analyses, we checked the conditions for applying the two-factor mixed model ANOVA to the present data. Box and whisker analyses revealed 12 univariate outliers (which were dispersed equally in both groups). Because the

data represented valid answers, they were retained. Only one participant's results were removed because the responses were incongruent with the rest of the data. We evaluated the normality of the sample distributions by calculating asymmetry scores divided by their standard error (Field, 2009). Z scores smaller than 3 were considered to reflect approximately normally distributed data. In total, three distributions were slightly asymmetric (irrational beliefs at T1 for the control and experimental groups and irrational beliefs at T2 for the experimental group only). Considering that ANOVA is robust towards non-normality (Field, 2009) and to preserve the original units of measurement of the scales to facilitate their interpretation, we decided not to transform the data. Levene's test indicated homogeneous variance for the control and experimental groups concerning irrational beliefs and erroneous estimates at T1 ($p > .05$). However, at T2, the variances were heterogeneous ($p < .05$). For the reasons mentioned earlier, the data were not modified. Box's test of equality of covariance matrices was $p = .003$ for erroneous estimations and $p < .001$ for irrational beliefs.

Results

A summary of the results is presented in Table 1. These results are described in greater detail below.

Estimation of the Chances of Winning

A 2 × 2 mixed ANOVA revealed a significant main effect of condition on the estimation of the chances of winning, $F(1, 67) = 6.894$, $p = .011$, partial $\eta^2 = .093$. The experimental group reported more chances of winning than the control group did. There was no main effect of time, $F(1, 67) = 1.395$, $p = .242$, partial $\eta^2 = .020$, but there was a significant Condition × Time interaction effect on the estimation of the chances of winning, $F(1, 67) = 4.304$, $p = .042$, partial $\eta^2 = .060$ (see Figure 1). The increase in the experimental group's estimations of winning after having played on the software just failed to reach statistical significance, $t(34) = -1.932$, $p = .062$, $d = 0.33$, and the control group's estimation remained the same, $t(33) = 0.849$, $p = .402$, $d = 0.14$. There was a statistically significant difference between both groups at T2, $t(53.95) = -3.212$, $p = .002$, $d = 0.77$.

Estimation of the Chances of Winning the Jackpot

A 2 × 2 mixed ANOVA revealed a significant main effect of condition on the estimation of the chances of winning the jackpot, $F(1, 68) = 4.541$, $p = .037$, partial $\eta^2 = .063$. The participants in the experimental group thought they had more chances of winning the jackpot than the control group did. There was no main effect of time, $F(1, 68) = 1.683$, $p = .199$, partial $\eta^2 = .024$, and no Condition × Time interaction effect on the estimation of the chances of winning the jackpot, $F(1,68) = 0.34$, $p = .854$, partial $\eta^2 = .001$. Participants in both groups kept the same estimation of winning the jackpot after gambling on the software ($ps > .05$).

Table 1

*Mean Errors of Estimation and Irrational Beliefs Across Groups and Time*

Type of error/irrational belief	Group	Measure	T1	T2	Total
Estimation of the chances of winning	Control	*M*	14.71	13.53	14.12
		SD	8.96	9.50	8.30
	Experimental	*M*	19.43	23.71	21.57
		SD	15.13	16.47	14.38
Estimation of the chances of winning the jackpot	Control	*M*	3.43	4.29	3.86
		SD	5.91	5.58	5.16
	Experimental	*M*	6.29	7.43	6.86
		SD	5.47	9.19	6.54
Estimation of the chances of neither winning nor losing	Control	*M*	20.00	18.29	19.14
		SD	13.72	12.94	11.91
	Experimental	*M*	22.86	28.86	25.86
		SD	15.83	18.11	15.74
Estimation of the chances of losing	Control	*M*	75.14	78.00	76.57
		SD	23.44	16.41	19.13
	Experimental	*M*	79.71	71.71	75.71
		SD	13.17	20.51	15.10
Average of all irrational beliefs	Control	*M*	29.94	32.11	31.03
		SD	40.08	27.19	30.48
	Experimental	*M*	37.45	50.72	44.09
		SD	56.62	61.19	55.06
Irrational Belief 1	Control	*M*	0.86	0.29	0.58
		SD	2.84	1.69	1.61
	Experimental	*M*	2.06	4.71	3.39
		SD	8.80	9.61	6.71
Irrational Belief 2	Control	*M*	1.71	2.00	1.86
		SD	5.68	5.31	4.71
	Experimental	*M*	6.41	7.35	6.90
		SD	15.74	15.44	13.98
Irrational Belief 3	Control	*M*	7.14	9.71	8.43
		SD	16.37	14.85	12.65
	Experimental	*M*	8.57	12.29	10.43
		SD	16.83	19.72	17.46
Irrational Belief 4	Control	*M*	16.00	15.43	15.72
		SD	21.99	18.84	18.79
	Experimental	*M*	16.29	20.29	18.29
		SD	19.57	18.86	17.52
Irrational Belief 5	Control	*M*	78.86	76.57	77.72
		SD	27.95	31.33	26.85
	Experimental	*M*	75.71	76.57	76.14
		SD	30.61	28.49	26.08

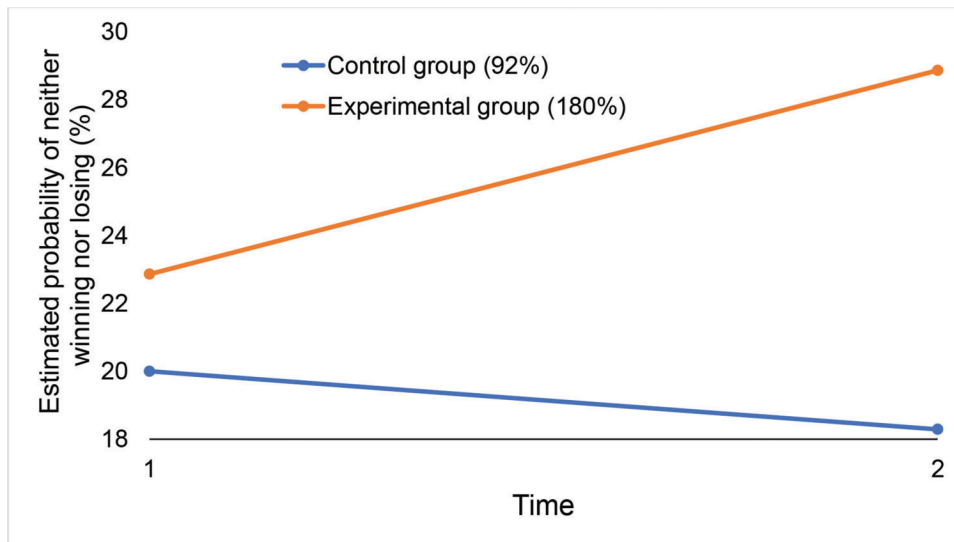## Estimation of the Chances of Neither Winning nor Losing

A 2 × 2 mixed ANOVA revealed a significant main effect of condition on the estimation of the chances of neither winning nor losing, $F(1,68) = 4.049$, $p = .048$, partial $\eta^2 = .056$. The experimental group estimated having more chances of neither

Figure 1
Estimation of the chances of winning as a function of group and time.
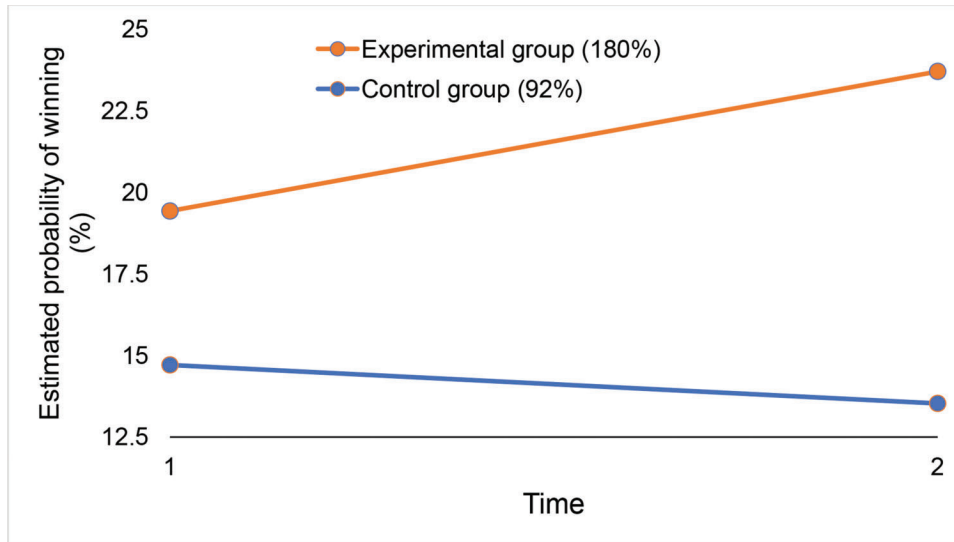

Figure 2
Estimation of the chances of neither winning nor losing as a function of group and time.

winning nor losing than the control group did. There was no main effect of time, $F(1, 68) = 2.074$, $p = .154$, partial $\eta^2 = .030$. There was, however, a significant Condition × Time interaction effect on the estimation of chances of neither winning nor losing, $F(1, 68) = 6.721$, $p = .012$, partial $\eta^2 = .090$, as shown in Figure 2. Only the participants in the experimental group significantly increased this error of estimation after playing their version of the software, $t(34) = -2.756$, $p = .009$, $d = 0.29$. The participants in the control group maintained the same level of this type of estimation error after playing their version, $t(34) = 0.845$, $p = .404$,

Figure 3
Estimation of the chances of losing as a function of group and time.
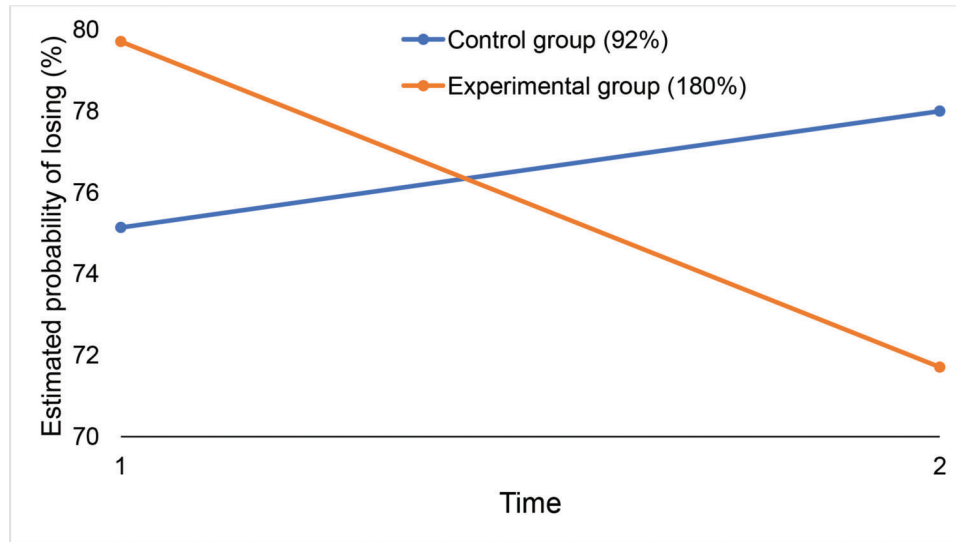
$d = 0.11$. There was a significant difference between groups at T2, $t(61,55) = -2.809$, $p = .007$, $d = 0.65$.

Estimation of the Chances of Losing

There was no main effect of condition regarding the estimations of the chances of losing, $F(1, 68) = 0.043$, $p = .836$, partial $\eta^2 = .001$, nor was there a main effect of time, $F(1, 68) = 2.061$, $p = .156$, partial $\eta^2 = .029$. However, there was a significant Condition $\times$ Time interaction effect on the estimation of the chances of losing $F(1, 68) = 9.184$, $p = .003$, partial $\eta^2 = 0.119$, as shown in Figure 3. Only the experimental group's estimations of their chances of losing significantly decreased from T1 to T2, $t(34) = 2.852$, $p = .007$, $d = 0.48$. The participants in the control group estimated having approximately the same chances of losing after having played, $t(34) = -1.282$, $p = .209$, $d = 0.11$. The difference between the two groups was not statistically significant at T2, $t(64,89) = 1.416$, $p = .162$, $d = 0.39$.

Irrational Beliefs

Mixed ANOVAs showed no statistically significant main effects or Condition $\times$ Time interactions for each of the five irrational beliefs ($ps > .05$).

Amount Willing to Bet and Desire to Play

On average, the players in the control group were ready to spend CAN$18.29 ($SD =$ 17.90) and those in the experimental group were willing to spend CAN$18.63 ($SD =$ 14.56) on a future episode of slot machine gambling. Regarding the desire to play, the results were identical for both groups: 94.3% ($n = 33$) of the participants did not

want to continue playing and only 5.7% (*n* = 2) wanted to continue. There was no statistically significant difference between the two groups regarding either variable (*p*s > .05).

Discussion

In the present study, we aimed to evaluate the impact of an exaggerated return rate on players' errors of estimation and irrational beliefs. We expected that the participants who were exposed to a return rate of 180% (similar to that of online slot machines in demo mode) would show an increase in their errors of estimation and in their irrational beliefs compared with those in participants who were exposed to the conventional rate of 92%, who we expected to maintain the same level of errors of estimation and irrational beliefs. The results partially confirm these hypotheses.

Our results show that the participants in the exaggerated return rate group (who finished with more credits than they started with) made more errors of estimation than the participants in the control group did. More specifically, participants in the experimental condition estimated that they had more chances of winning than did those who played the conventional return rate slot machine. Of particular interest are the pre-post changes in errors of estimation over the course of this brief experiment. The participants in the experimental condition estimated having less chances of losing after playing the 180% return rate version of the slot machine. Our results differ from those reported by Monaghan et al. (2009), where participants maintained the same level of errors of estimation when they finished with more credits than they had to start off with. This difference may be explained by the return rates used in the two studies. Whereas we used a much higher return rate than that used in the casinos (180%), Monaghan et al. used one that was similar to that in the casinos. The gains in the present study were, therefore, much higher.

The estimation of the chances of winning the jackpot was not affected by exposure to the virtual slot machine. This finding may be explained by the fact that our simulator did not offer jackpots, unlike the machines in the casinos. The maximum amount a player could win at any given time was 150 credits. Near misses could also have contributed to the results. They happen when all the symbols necessary for winning the jackpot except one are shown on the screen, giving players the impression that they almost won (or just missed) the jackpot (Dixon & Schreiber, 2004). Many slot machines online and in casinos are programmed this way. In the present study, the strategy of near misses was not used.

Although we observed a decrease in the estimation of the chances of losing among those who played the exaggerated return rate, we did not observe any significant change in their irrational beliefs. The way the simulator was programmed may have minimized the effect on the irrational beliefs of the participants. In fact, it was programmed in such a way that it did not induce the illusion of control. The majority of slot machines offer the option of betting on multiple lines at once and also offer bonus games in which the player must make choices, such as choosing numbers.

This set-up reinforces the player's illusion of control (Langer, 1975). In the present study, the only choice the participants could make was to bet one or three credits at a time. There were therefore not many occasions in which they could feel they were controlling the game in comparison to the situation with real slot machines.

We must also consider the fact that the participants were exposed to the simulation in a laboratory for a very short period (10 min). Tversky and Kahneman (1973)'s theory informs us that irrational beliefs are developed by using heuristics to make a judgement about a situation. Individuals constantly use the same heuristics, which brings them to make the same errors of estimation. With time, the repeated used of the estimation errors creates an irrational belief (Tversky & Kahneman, 1973). Irrational beliefs could also influence estimation errors, but longitudinal studies would be necessary to confirm this effect. Moreover, we measured only a few beliefs (the illusion of control, superstitious beliefs, independence of chance events, the gambler's fallacy, and misunderstanding of random outcomes). It is possible that the virtual slot machine influenced irrational beliefs that were different than those measured. Future studies would be necessary to test this hypothesis.

Our results highlight the importance of considering game characteristics when implementing responsible gaming strategies. According to Blaszczynski and colla-borators (2011), gambling providers must not make misleading claims related to their products or develop products that favor excessive gambling. When given accurate information, consumers of gambling products may decide whether or not to use them. Given inaccurate information, individuals may not be able to make an informed decision about their behavior and the risks involved. Because the return rates of slot machines in trial mode are much higher than usual, we believe this constitutes a misleading claim by the game provider, as players are shown unrealistic scenarios while *considering* playing the machine. The return rate then changes without warning when they begin to wager real money. Our results show that even a brief exposure to exaggerated return rates leads to minimizing the chances of losing. From a responsible gambling perspective, game providers should be enticed to modify the gaming characteristics that might promote false beliefs and contribute to excessive gambling (Blaszczynski et al., 2011). Exaggerated return rates of slot machines in trial mode may be one of these characteristics.

Strengths, Limitations, and Future Research

The principal strength of this study is that it used an experimental design with random assignment of the participants to the experimental and control groups. The controlled environment also allowed us to exclude many extraneous variables. For instance, participants in each group experienced gains and losses at the same moments, although the gains in the experimental group were greater. Generally, simulations use the same program as slot machines do in casinos. This approach causes participants to experience different outcomes; one person may finish with a gain and another with a loss, even if their return rates are similar. Because it is known that winning or losing will have an impact on the person's beliefs (Monaghan

et al., 2009), using the same sequence for each participant helped control this variable.

Certain limitations of the current study need to be acknowledged. It is important to remember that participants were undergraduate university students with little gambling experience, which limits the generalizability of the results to other populations. In the province of Quebec, Canada, gambling is more frequent in people between 35 and 74 years of age (Kairouz et al., 2011), older than the average undergraduate student. It thus seems relevant to continue to study the impacts of exaggerated return rates on younger populations because even minors can easily access online gambling and because problems related to gambling develop during adolescence or early adulthood (Blanco et al., 2000; Petry et al., 2005). It would also be pertinent to test the impact of exaggerated return rates on a population of experienced gamblers.

Although we observed a significant decrease in the estimation of the chances of losing after a short exposure to a virtual slot machine, the post-experimental data was collected right after the participants played on the gambling simulator. Therefore, the effect of this exaggerated return rate in the medium or long term is not known. Further research is necessary to measure the change in errors of estimation and erroneous beliefs over longer periods. It would also be interesting to determine the minimal return rates that influence players' estimations.

Furthermore, the study did not allow players to keep playing beyond the allotted 10-min period. Players were informed that the experiment lasted about 25 min. Knowing this, they may have planned other engagements afterwards. They may have been more tempted to keep playing if they had been in a real online gambling context.

Conclusion

A brief (10 min) exposure to the trial mode of a slot machine with an exaggerated return rate was enough to create a decrease in the estimation of the chances of losing. Because gamblers who believe they have more chances of winning on a slot machine will often play longer and bet more money (Bednarz et al., 2013), it is important to know whether the same is true for those who believe they have less chances of losing. Exposure to slot machines with return rates comparable to demo modes on gambling websites may potentially entice gamblers to spend more money than they can afford while gambling. Further research is necessary to better understand whether high return rates can be risk factors for problem gambling. Such research may inform policies that govern the online gambling industry in order to protect individuals from harm while participating in this kind of activity.

References

American Psychiatric Association. (2013). DSM-5: *Diagnostical and statistical manual of mental disorders* (5th ed.). Washington, DC: Author.

Bednarz, J., Delfabro, P., & King, D. (2013). Practice makes poorer: Practice gambling modes and their effect on real play in simulated roulette. *International Journal of Mental Health and Addiction*, *11*(3), 381–395.

Blanco, C., Ibáñez, A., Sáiz-Ruiz, J., Blanco-Jerez, C., & Nunes, E. V. (2000). Epidemiology, pathophysiology and treatment of pathological gambling. *CNS Drugs, 13*, 397–407.

Blaszczynski, A., Collins, P., Fong, D., Ladouceur, R., Nower, L., Shaffer, H. J., Tavares, H., & Venisse, J.-L. (2011). Responsible gambling: General principles and minimal requirements. *Journal of Gambling Studies, 27*(4), 565–573. https://doi.org/10.1007/s10899-010-9214-0

Cole, T., Barret, D. J., & Griffiths, M. (2011). Social facilitation in online and offline gambling: A pilot study. *International Journal of Mental Health and Addiction, 9*(3), 240–247.

Derevensky, J. L., & Gupta, R. (2007). Internet gambling amongst adolescents: A growing concern. *International Journal of Mental Health and Addiction, 5*(2), 93–101. https://doi.org/10.1007/s11469-007-9057-9

Diskin, K. M., & Hodgins, D. C. (1999). Narrowing of attention and dissociation in pathological video lottery gamblers. *Journal of Gambling Studies, 15*(1), 17–28. https://doi.org/10.1023/a:1023062912062

Dixon, M. R., & Schreiber, J. E. (2004). Near-miss effects on response latencies and win estimations of slot machine players. *The Psychological Record, 54*(3), 335–348.

Dowling, N., Smith, D., & Thomas, T. (2005). Electronic gaming machines: Are they the 'crack-cocaine' of gambling? *Addiction, 100*(1), 33–45. https://doi.org/10.1111/j.1360- 0443.2005.00962.x

Dyke, N. (2009). *Jeux et dépendances: colloque international 2009 : état sommaire des connaisances*. [Gambling and addictions : 2009 international colloquium : brief summary of the knowledge]. Montréal, Québec : Fonds québécois de la recherche sur la société et la culture, 37 p.

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, *39*(2), 175–191.

Ferris, J., & Wynne, H. (2001). *The Canadian Problem Gambling Index: Final report*. Canadian Centre on Substance Abuse.

Field, A. D. (2009). *Discovering statistics using SPSS (and sex and drugs and rock'n'roll)* (3rd ed.). Sage.

Fortune, E. E., & Goodie, A. S. (2012). Cognitive distortions as a component and treatment focus of pathological gambling: A review. *Psychology of Addictive Behaviors*, *26*(2), 298–310. https://doi.org/10.1037/a0026422

Gerstein, D., Hoffmann, J., & Larison, C. (1999). *Gambling impact and behavior study*. National Opinion Research Center, University of Chicago.

Goodie, A. S., & Fortune, E. E. (2013). Measuring cognitive distortions in pathological gambling: Review and meta-analyses. *Psychology of Addictive Behaviors, 27*(3), 730–743. https://doi.org/10.1037/a0031892

Griffiths, M. (2003). Internet gambling: Issues, concerns, and recommendations. *CyberPsychology & Behavior, 6*(6), 557–568. https://doi.org/10.1089/109493103322725333

Griffiths, M., & Barnes, A. (2008). Internet gambling: An online empirical study among student gamblers. *International Journal of Mental Health and Addiction, 6*(2), 194– 204. https://doi.org/10.1007/s11469-007-9083-7

Griffiths, M., & Parke, J. (2010). Adolescent gambling on the Internet: A review. *International Journal of Adolescent Medicine and Health, 22*(1), 59–75.

Griffiths, M., & Wood, R. T. (2007). Risk factors in adolescence: The case of gambling, videogame playing, and the Internet. *Journal of Gambling Studies, 16*(2), 199–225.

Griffiths, M., Wood, R. T., & Parke, J. (2009). Social responsibility tools in online gambling: A survey of attitudes and behavior among Internet gamblers. *CyberPsychology & Behavior, 12*(4), 413–421. https://doi.org/10.1089/cpb.2009.0062

Harrigan, K. A., & Dixon, M. (2010). Government sanctioned "tight" and "loose" slot machines: How having multiple versions of the same slot machine game may impact problem gambling. *Journal of Gambling Studies, 26*(1), 159–174. https://doi.org/10.1007/s10899-009-9154-8

Harrigan, K. A., Dixon, M., MacLaren, V., Collins, K., & Fugelsang, J. (2012). The maximum rewards at the minimum price: Reinforcement rates and payback percentages in multi-line slot machines. *Journal of Gambling Issues, 26*, 11–29. https://doi.org/10.4309/jgi.2011.26.3

Joukhador, J., Blaszczynski, A., & Maccallum, F. (2004). Superstitious beliefs in gambling among problem and non-problem gamblers: Preliminary data. *Journal of Gambling Studies, 20*(2), 171–180. https://doi.org/10.1023/B:JOGS.0000022308.27774.2b

Kairouz, S., Nadeau, L., & Paradis, C. (2011). *Portrait du jeu au Québec: prévalence, incidence et trajectoires sur quatre ans* [Portrait of gambling in Quebec : Prevalence, incidence and trajectories over four years]. Université Concordia.

Kessler, R. C., Hwang, I., & LaBrie, R. (2008). DSM-IV pathological gambling in the national comorbidity survey replication. *Psychological Medicine, 38*(9), 1351–1360.

Ladouceur, R., Paquet, C., & Dubé, D. (1996). Erroneous perceptions in generating sequences of random events. *Journal of Applied Social Psychology, 26*(24), 2157–2166. https://doi.org/10.1111/j.1559-1816.1996.tb01793.x

Ladouceur, R., & Sevigny, S. (2005). Structural characteristics of video lotteries: Effects of a stopping device on illusion of control and gambling persistence. *Journal of Gambling Studies, 21*(2), 117–131. https://doi.org/10.1007/s10899-005-3028-5

Lalande, D., & Ladouceur, R. (2011). Can cybernetics inspire gambling research? A limit-based conceptualization of self-control. *International Gambling Studies, 11*(2), 237–252. https://doi.org/10.1080/14459795.2011.598540

Langer, E. J. (1975). The illusion of control. *Journal of Personality and Social Psychology, 32*(2), 311–328. https://doi.org/10.1037/0022-3514.32.2.311

Loto Québec. (2012). *Les machines* [Brochure]. Loto-Québec.

MacLaren, V. V., Ellery, M., & Knoll, T. (2015). Personality, gambling motives and cognitive distortions in electronic gambling machine players. *Personality and Individual Differences, 73*, 24–28. https://doi.org/10.1016/j.paid.2014.09.019

MacLaren, V. V., Fugelsang, J. A., Harrigan, K. A., & Dixon, M. J. (2011). The personality of pathological gamblers: A meta-analysis. *Clinical Psychology Review, 31*(6), 1057–1067. https://doi.org/10.1016/j.cpr.2011.02.002

Monaghan, S., Blaszczynski, A., & Nower, L. (2009). Consequences of winning: The role of gambling outcomes in the development of irrational beliefs. *Behavioural and Cognitive Psychotherapy, 37*(1), 49–59. https://doi.org/10.1017/S135246580800502X

Petry, N. M., Stinson, F. S., & Grant, B. F. (2005). Comorbidity of DSM-IV pathological gambling and other psychiatric disorders: Results from the national epidemiologic survey on alcohol and related conditions. *Journal of Clinical Psychiatry*, *66*(5), 564–574.

Productivity Commission. (2010). *Gambling* (Report No. 50). Canberra.

Sévigny, S., Cloutier, M., Pelletier, M.-F., & Ladouceur, R. (2005). Internet gambling: Misleading payout rates during the "demo" period. *Computers in Human Behavior, 21*(1), 153–158. https://doi.org/10.1016/j.chb.2004.02.017

Siemens, J. C., & Kopp, S. W. (2011). The influence of online gambling environments on self-control. *Journal of Public Policy & Marketing, 30*(2), 279–293.

Smith, G. J., & Wynne, H. J. (2002). *Measuring gambling and problem gambling in Alberta using the Canadian Problem Gambling Index (C.P.G.I.)*. University of Calgary.

Toneatto, T., Blitz-Miller, T., Calderwood, K., Dragonetti, R., & Tsanos, A. (1997). Cognitive distortions in heavy gambling. *Journal of Gambling Studies, 13*(3), 253–266. https://doi.org/10.1023/a:1024983300428

Tversky, A., & Kahneman, D. (1973). Availability: A heuristic for judging frequency and probability. *Cognitive Psychology, 5*(2), 207–232. https://doi.org/10.1016/0010-0285(73)90033-9

Walker, M. B. (1992). Irrational thinking among slot machine players. *Journal of Gambling Studies, 8*(3), 245–261. https://doi.org/10.1007/bf01014652

Welte, J., Barnes, G., & Wieczorek, W. (2001). Alcohol and gambling pathology among U.S. adults: Prevalence, demographic patterns and comorbidity. *Journal of Studies on Alcohol and Drugs Alcohol, 62*(5), 706–712.

****

For correspondence: Daniel Lalande, Ph.D., Université du Québec à Chicoutimi, 555 Boulevard de l'Université, Room V2-1100, Chicoutimi, Québec, Canada G7H 2B1.E-mail: daniel_lalande@uqac.ca