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Heart Rate Arousal and Excitement in Gambling: Winners Versus Losers

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People sometimes claim they gamble for excitement rather than money. The authors examined in a laboratory analog whether excitement is generated by the expectancy of winning money. Eighty male undergraduate students watched a videotaped horse race with an exciting neck-to-neck finish. Half bet $1 for a chance of winning $7 if they picked the winning horse; the other half predicted the winning horse without wagering. Winning and losing were experimentally manipulated. Participants with a chance to win money showed greater heart rate (HR) elevations and reported more subjective excitement while watching the race compared with those who did not wager. Of students who wagered, the winners showed higher HRs after the end of the race than did those who lost, even though differences in subjective excitement were not statistically significant. The findings suggest that the expectancy of winning money is an important contributing factor to the excitement associated with gambling.

Keywords: Gambling, physiological arousal, heart rate, horse race betting

Over 80% of American adults have gambled at least once during their lifetime. Although the overwhelming majority gamble for recreational and social purposes, approximately 5% of individuals at some point in their lifetime develop a gambling problem (National Research Council, 1999). As gambling opportunities continue to rise, it is important to understand why so many people find gambling attractive and what factors contribute to excessive gambling.

The most obvious reason for gambling is the desire to win money (Blaszczynski & McConoghy, 1989; Roby & Lumley, 1995). However, regular gamblers, and in particular, problem gamblers, often claim that gambling is not about money, but about *action*, an aroused euphoric state that has been called the "gambler's drug" (Boyd, 1976) and likened to the high resulting from cocaine use (Rosenthal & Lesieur, 1992). Thus, the thrill and excitement of gambling may serve as a major, if not the major, reinforcement (Anderson & Brown, 1984; Dickerson, 1984) that not only promotes recreational involvement but also perhaps contributes to the development of problem gambling. A careful analysis of the role of excitement is therefore needed.

A number of studies have attempted to identify factors associated with the experience of excitement during gambling. Some of these studies have focused on subjective reports (e.g., Dickerson & Adcock, 1987; Dickerson, Hinchy, & Fabre, 1987; Griffiths, 1991), whereas others have focused on objective measures, such as heart rate (HR) as an indicator of emotional activation (Obrist, 1981). At the most fundamental level, these studies have shown that gamblers manifest HR increases across a variety of gaming situations, including when playing video poker (Coulombe, Ladouceur, Desharnais, & Jobin, 1992; Dickerson, Hinchy, England, Fabre, & Cunningham, 1992; Leary & Dickerson, 1985), slot machines (Carroll & Huxley, 1994; Coventry & Constable, 1999; Coventry & Hudson, 2001; Griffiths, 1993), and casino blackjack (Anderson & Brown, 1984; Meyer et al., 2000); when betting on horses (Coventry & Norman, 1997); or even when just imagining an exciting gambling experience (Blanchard, Wulfert, Freidenberg, & Malta, 2000). Thus, HR increases during gambling are a rather robust finding, although it is not clear exactly what factors are responsible for the arousal. It is also unclear how HR and subjective excitement are related. In a study of female slot machine players (Coventry & Constable, 1999), HR was not significantly associated with subjective excitement measured with a four-item subscale (calm, tensed, quiet, overexcited) of the State–Trait Anxiety Inventory (Spielberger, 1983). In another study that used the same measures, the HRs of male and female slot machine players were significantly correlated with subjective excitement (Coventry & Hudson, 2001); however, in a third study (Coulombe et al., 1992), this relationship held only among frequent video poker players, and not among occasional video poker players. Together, these findings indicate that more studies are needed to clarify what generates the arousal and how physiological and subjective responses are related.

There are at least three potential factors that might moderate gamblers' experience of excitement. One is prior involvement with gambling. Perhaps individuals with more experience—that is, a stronger conditioning history—might become more aroused. However, comparisons of high- and low-frequency gamblers have not yielded uniform results. One study reported greater HR increases in high- than low-frequency gamblers (Leary & Dickerson, 1985), but several others have failed to confirm this finding (Coulombe et al., 1992; Coventry & Norman, 1997; Dickerson et al., 1992; Griffiths, 1993). To confuse the picture further, Griffiths (1993)

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found no differences between high- and low-frequency gamblers during gambling, but the HRs of high-frequency gamblers remained elevated longer after gambling. Thus, prior involvement alone does not seem to account adequately for the excitement of gambling.

A second potentially important factor is the possibility of winning money. Individuals may become aroused by the expectancy of winning (e.g., Coulombe et al., 1992) and by the emotional reactions elicited during contact with a generalized reinforcer such as money (Delfabbro & Winefield, 1999) or a conditioned reinforcer such as a near miss (Griffiths, 1993). The significance of money is underscored by findings that horse race bettors (Coventry & Norman, 1997) and slot machine players (Coventry & Constable, 1999; Coventry & Hudson, 2001) who win tend to show significantly higher HRs than those who lose their bets. Thus, the prospects of winning money seem to play a major role in the excitement of gambling.

A third possibility is that gambling is an intrinsically exciting activity and that gamblers play mainly for fun or entertainment (Mississippi State University Gambling Group, 1995), with money playing a secondary role. Only one study to date has examined this possibility by attempting to tease apart the fun of playing a game from the effects of winning money. Ladouceur, Sevigny, Blaszczynski, O'Connor, and Lavoie (2003) measured the pulse rates of 17 high- and 17 low-frequency video lottery players while they played either for worthless points or for money. Participants who expected to win money showed significantly higher pulse rates than those who played for fun. At the end of the experiment, they were also more likely to say the game was exciting versus not exciting. Because of the dichotomous questions about subjective excitement, no fine-grained analysis of the relationship between self-reported excitement and HR could be ascertained.

Ladouceur et al.'s (2003) study was a clever attempt to shed light on the differential effects of playing for fun versus playing for money. However, although it makes intuitive sense that monetary expectancies are the driving force behind gambling, this study cannot rule out that variables other than money may play a role in arousal. For example, it could be argued that pushing a button on a video lottery terminal is not intrinsically exciting or fun, whereas certain action games might indeed be inherently arousing. If this were the case, events such as watching an exciting horse race or a sports game could lead to HR increases, even without wagering.

In a related vein, it is conceivable that HR increases with the degree of personal involvement in an outcome. As gamblers are thought to be highly competitive (e.g., Rosenthal, 1992), if they correctly predicted the winner of a game, the mere thrill of being right might be as exciting and physiologically arousing as winning money.

The examples just described illustrate that more research is needed to understand the possible contributing factors, other than money, to the excitement of gambling. The present study was designed to tease apart the effects of correctly predicting the outcome of an inherently exhilarating event with or without monetary expectancies. For this purpose, college students who in their majority were light social gamblers watched a videotaped horse race with an exciting neck-to-neck finish and either wagered on the outcome or simply predicted the winning horse. Through experimental manipulations, one half of the students in each condition chose the winning horse, and the other half chose the losing horse. We hypothesized that, if the expectancy of winning money is the driving force behind the excitement of gambling, then students who wagered money would become more aroused and rate the horse race as more exciting than those who simply predicted its outcome. Furthermore, in regard to the wagering condition, we hypothesized that students who won money would be more aroused and feel more excited than those who lost their wagers.

Method

Participants

Eighty male college students, recruited from introductory psychology classes, completed the study for extra course credit. The majority of the students were freshmen (65%) and sophomores (26%), their mean age was 18.7 years ($SD = 1.1$), and 77% were Caucasian (9% identified themselves as Latino, 5% as African American, and 9% stated "other" or did not provide information).

Design

The study followed a 2 (wagering or not wagering) × 2 (winning or losing) between-groups design, with 20 research participants randomly assigned to each condition.

Materials

Heart rate monitoring device. Heart rate was measured continuously in 5-s intervals with a portable HR monitor (Accurex Plus; Sark Products, Waltham, MA). The signals were transmitted from a chest strap to a receiver that was placed on an adjacent table 2 ft (61 cm) from the participant. Data were transferred from the receiver to a computer by means of Polar Interface Plus software (n.d.).

Gambling involvement. We used the South Oaks Gambling Screen (SOGS; Lesieur & Blume, 1987) to obtain information on gambling involvement. The SOGS is the most widely used instrument to assess gambling involvement in both clinical and nonclinical populations (Ladouceur, 1996; Volberg & Steadman, 1988). Because the participants were mainly light social gamblers, we not only examined SOGS scores but also assessed gambling involvement also by summing across SOGS items 1a through 1k, which measure the frequency with which individuals have engaged in different modes of gambling (e.g., betting on horses, card games, lotteries).

Subjective measure of arousal. Analogous to the commonly used method for assessing subjective units of distress, participants provided subjective ratings of excitement. In response to the question "How excited are you at this moment?" they provided ratings on a subjective scale that ranged from 1 (*not at all*) to 10 (*extremely*) twice during the race (in the second turn and in the final stretch) and again after the race was over.

Procedure

The study was approved by the university's institutional review board. Experimental sessions were conducted individually. The experimenter explained the study and asked for written informed consent. The research participants then completed the SOGS and received a $1 payment for completing this task. Then one half of them were asked if they would wager the $1 for a chance of winning $7. (Two research participants who refused were dismissed and replaced.) The other half of the participants were not asked to wager. The participants were then instructed on how to fit the HR monitor and were seated in front of a TV monitor to watch a horse race. For the purpose of watching the race, participants were randomly assigned to one of four conditions: picking a horse without wagering, which would either win (Condition 1) or lose the race (Condition 2),

or wagering $1 on a horse that would either win and pay $7 on the wager (Condition 3) or lose and pay nothing (Condition 4). Thus, Conditions 1 and 2 mimicked real life situations in which people simply predict the outcome of an event without wagering, whereas Conditions 3 and 4 mimicked situations where money is at stake. To exert experimental control over winning and losing, the research participants did not handicap the race; instead, they were asked to draw a chip from a bag containing seven chips. Participants in Conditions 1 and 2 were instructed as follows:

> There are 7 horses in the upcoming race and there are 7 chips in this bag. Each chip has a number corresponding to one of the 7 horses. Please reach in the bag for a chip. Whichever number you draw, this will be the horse you picked to win the race. There is no money involved; it is just to see whether you picked the right horse to win the race.

Participants in Conditions 3 and 4 received the following instructions:

> You earned $1 for participating in the study. Now I'm going to give you an opportunity to bet your $1 on the upcoming horse race for a chance of winning $7. Here is what you will have to do. There are 7 horses in the upcoming race and there are 7 chips in this bag. Each chip has a number corresponding to one of the 7 horses. I will ask you to draw a chip and whichever number you draw, this will be the horse you picked to win the race. If your horse wins, you'll win $7; if it loses, you'll forfeit your $1. Do you want to bet?

Unbeknownst to participants, the bag contained identical chips, which for one half of the research participants was the number of the winning horse and for the other half was the number of the horse that finished second to the winner in a neck-to-neck race.

After participants had made their choice, they were instructed to sit quietly for a 10-min HR baseline, with the experimenter seated behind the participant to remain inconspicuous. After the baseline, participants gave a subjective rating of excitement on a 1–10 scale. Then the videotaped horse race was started, which lasted 1 min, 40 s, from start to finish. Participants were asked to give ratings of subjective excitement on a 1–10 scale when the horses reached the second turn, when they were in the final stretch, and when the race was over.

At the end of the experiment, all participants were debriefed, and those with winning wagers received $7.

Results

Preliminary Analyses

Results of evaluation of assumptions of normality, homogeneity of variance, linearity, and multicollinearity were satisfactory for HR, subjective excitement, and gambling frequency; SOGS scores were non-normally distributed and were evaluated with nonparametric analyses. The equivalency of the four experimental conditions prior to manipulations was also established. One-way analyses of variance showed no significant differences among conditions in age, $F(3, 76) = 0.71$, $p = .66$; year in college, $F(3, 76) = 1.25$, $p = .30$; and prior experience with gambling (i.e., frequency of gambling), $F(3, 76) = 1.57$, $p = .21$. A Kruskal–Wallis test revealed no differences among conditions on SOGS scores, $\chi^2(3, N = 80) = -65.67$, $p = .13$.

On the basis of the SOGS, the majority of the students were light social gamblers: 77.5% scored between 0 and 2, 11.3% scored in the range for problem gamblers (SOGS score of 3 or 4), and 11.3% were probable pathological gamblers (SOGS score of 5 or higher). The students reported betting on card games (82.5%), lotteries (56.2%), sports (58.7%), casino games (33.7%), and horse races (25.0%).

Relationship Among Prior Gambling Experience, HR Arousal, and Excitement

We conducted correlational analyses (using Pearson's r and Spearman's ρ) to examine the relationship between objective (HR) and subjective excitement, and the association of these measures with prior gambling involvement. Heart rate and subjective excitement during the race were correlated ($r = .29$, $p = .01$); gambling frequency and SOGS scores also were correlated ($\rho = .48$, $p < .001$). Subjective excitement during the race was significantly correlated with frequency of gambling ($r = .29$, $p = .01$) and SOGS scores ($\rho = 28$, $p = .01$); in contrast, HR was correlated with neither gambling frequency ($r = -.02$, $p = .90$) nor SOGS scores ($\rho = -.03$, $p = .80$). For the period after the end of the race, no further significant correlations were found among any of these variables. To summarize, students with greater gambling involvement (as evidenced by SOGS scores and gambling frequency) expressed greater subjective excitement, but only during the horse race; HR was unrelated to these variables.

Excitement of Wagering

The remaining analyses focused on elucidating factors affecting HR arousal and subjective excitement. To control for individual variations in HR, we used difference scores (mean HR for a given interval minus mean baseline HR) in all analyses.

Participants' reactions before the end of the race. First, we examined whether physiological arousal and subjective excitement were affected by simply watching a race and predicting its outcome without wagering versus betting on the outcome for a chance of winning money. Following Coventry and Norman (1997), we focused our analysis on the last 30 s before the race was decided, as this phase is the most exciting one, especially in a neck-to-neck finish.

A correlational analysis showed that the participants' HRs and their subjective ratings of excitement were significantly related ($r = .26$, $p = .02$). We conducted a multivariate analysis of variance (MANOVA) with condition (predicting vs. wagering) as fixed factor and physiological arousal and subjective excitement as the dependent variables. (The win/lose factor was not considered here as the participants could not anticipate whether they had chosen the winning or losing horse, given that the race was decided during the last 2 s in a neck-to-neck finish). A MANOVA comparing HRs and subjective excitement yielded a significant effect of condition, Wilks's $\Lambda = 0.671$, $F(2, 77) = 18.85$, $p < .001$, effect size $R^2 = .33$. Follow-up analyses of variance (ANOVAs) showed that participants who wagered had HR increases (measured in beats/minute) that were significantly greater ($M = 12.02$, $SD = 11.17$) than those of participants who simply predicted the outcome of the race without wagering ($M = 2.01$, $SD = 5.82$), $F(1, 78) = 25.24$, $p < .001$, effect size $R^2 = .24$. They also reported greater subjective excitement ($M = 3.38$, $SD = 1.80$ vs. $M = 1.98$, $SD = 1.34$), $F(1, 78) = 15.75$, $p < .001$, effect size $R^2 = .17$.

Participants' reactions after the end of the race. The next set of analyses was focused on the first 30 s immediately following the end of the race. Given that the participants were now aware of the

outcome of the race, in addition to condition (predicting vs. wagering) the outcome factor (winning vs. losing) was taken into account.

The correlation between HR and subjective excitement was no longer statistically significant ($r = .15$, $p = .18$). A MANOVA with condition (predicting vs. wagering) and outcome (winning vs. losing) as fixed factors and HR and subjective excitement as dependent variables yielded a main effect of condition, Wilks's $\Lambda = 0.787$, $F(2, 75) = 10.18$, $p < .001$, effect size $R^2 = .21$. The main effect of outcome approached significance, Wilks's $\Lambda = 0.941$, $F(2, 75) = 2.37$, $p = .10$, effect size $R^2 = .06$. The interaction between condition and outcome was not statistically significant, Wilks's $\Lambda = 0.964$, $F(2, 75) = 1.39$, $p = .26$. A follow-up ANOVA on the main effect of condition showed that students who had wagered money continued with significantly higher HRs ($M = 12.44$, $SD = 10.23$) during the first 30 s after the race than those who had simply predicted without wagering ($M = 4.20$, $SD = 6.00$), $F(1, 76) = 20.60$, $p < .001$, effect size $R^2 = .27$, but there was no difference in self-reported excitement ($M = 2.28$, $SD = 2.45$ vs. $M = 2.03$, $SD = 2.96$), $F(1, 76) = 0.17$, $p = .68$.

Winning Versus Losing Money

The final analysis focused on those 40 research participants who had wagered money and either won \$7 ($n = 20$) or lost their \$1 wagers ($n = 20$). We conducted a MANOVA with outcome (winning vs. losing) as a fixed factor and arousal and excitement during the first 30 s after the end of the race as the dependent variables. The overall test was significant, Wilks's $\Lambda = 0.877$, $F(2, 37) = 3.28$, $p = .05$. A follow-up ANOVA on physiological arousal was statistically significant, $F(1, 38) = 5.01$, $p = .03$, indicating that students who won \$7 remained physiologically more aroused ($M = 15.88$, $SD = 9.56$) than those who lost their wagers ($M = 8.99$, $SD = 9.92$), effect size $R^2 = .12$. In contrast, an ANOVA on subjective excitement was nonsignificant, $F(1, 38) = 0.70$, $p = .41$, indicating that winners ($M = 2.60$, $SD = 2.68$) and losers ($M = 1.95$, $SD = 2.21$) reported similar degrees of excitement.

Summary of Results

The experiment yielded evidence that the participants became significantly more physiologically aroused during a horse race when they expected to win money than when they simply predicted the outcome of the race without wagering. Their HRs continued to remain elevated for a short period after the race, particularly when they won money as opposed to losing their wagers (see Figure 1). During the race, the participants also reported significantly greater subjective excitement when they had wagered rather than just predicted the outcome. However, the difference in subjective excitement for the two conditions was no longer statistically significant after the race (see Figure 2). Consistent with this finding, subjective excitement and physiological arousal were correlated for the 30-s period preceding the end of the race but not for the 30-s period following the end of the race. Finally, prior involvement with gambling, while apparently facilitating subjective excitement during, although not after, the race, was not significantly correlated with physiological arousal.

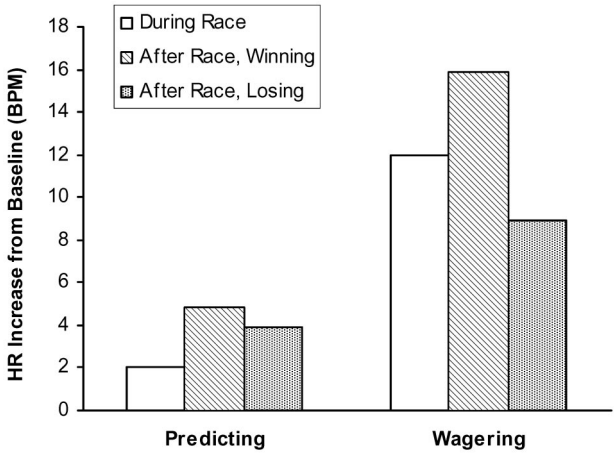

Figure 1. Heart rate (HR) increases from baseline of participants who predicted the outcome of a horse race without wagering versus those who wagered \$1 for a chance of winning \$7.

Discussion

Physiological Arousal

The present study yielded two pieces of information supporting the assumption that gambling is exciting because people expect to win money. First, students who had placed wagers showed significantly greater arousal and reported more excitement than those who had simply predicted the winning horse. This result is consistent with Ladouceur et al.'s (2003) finding that video lottery players have higher HRs when they play for money than just for fun.

Second, the HRs of students who won money stayed elevated longer than the HRs of those who lost their wagers. This finding is noteworthy, considering that the \$7 payoff was relatively small. This finding also provides additional evidence for the arousing quality of money based on a controlled laboratory preparation. It thus replicates, under more stringent conditions, the results of previous studies conducted in natural gambling environments showing that slot machine gamblers who win are more excited than those who lose (e.g., Coventry & Constable, 1999; Conventry & Hudson, 2001).

HR Arousal and Subjective Excitement

An interesting finding was the significant correlation between physiological arousal and subjective excitement. As the research participants were watching the race, those who wagered not only responded with higher HRs but also reported greater subjective excitement compared with those who merely predicted the outcome without wagering. This suggests that both objective arousal and subjective excitement are driven by the expectancy of winning. Although the present results differ from those of other studies that have not found a relationship between HR and subjective excitement (e.g., Coulombe et al., 1992; Coventry & Constable, 1999; Coventry & Hudson, 2001), the discrepancy most likely is due to differences in measurement. In other studies, participants responded *after* a gambling session to a four-item subscale of the State–Trait Anxiety Inventory how "calm, tensed, quiet and over-

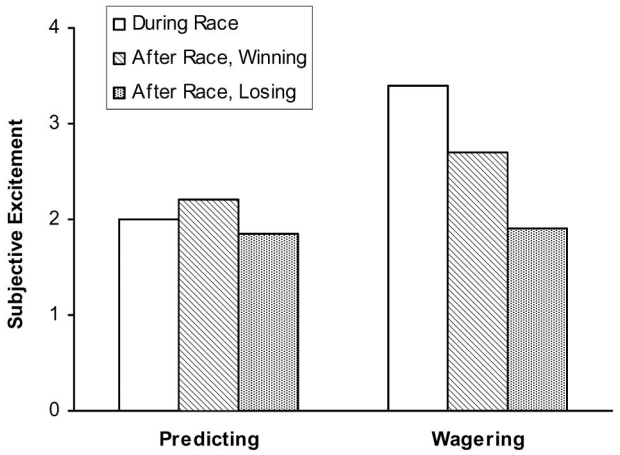

Figure 2. Subjective excitement of participants who predicted the outcome of a horse race without wagering versus those who wagered $1 for a chance of winning $7.

excited" they felt (e.g., Coventry & Hudson, 2001). In contrast, our participants gave ratings on a 1–10 scale *during* the race of how excited they felt *at that moment*. This method provided a more direct assessment of subjective excitement, which may explain the correlation with HR.

During the period immediately after the race, the correlation between objective and subjective excitement was no longer significant. Surprisingly, research participants who had just won $7 were physiologically more aroused but did not report more excitement than those who lost their $1 wager. A closer inspection of the data revealed mean differences in subjective excitement in the expected direction, but because of low power this comparison may not have achieved statistical significance. The relationship between objective and subjective excitement should therefore be investigated further in future studies. Perhaps an enhanced subjective rating scale with endpoints from 0 to 100 rather than 1 to 10 would be more suitable and eliminate the possibility of a floor effect. One might also vary the amounts of wagers and wins and examine whether excitement and arousal increase as risks and potential payoffs increase.

Limitations

The present findings should be considered in light of several limitations. The research participants were college students who, in their majority, were light social gamblers and relatively inexperienced in horse race gambling. It has yet to be determined whether high-frequency or problem horse race bettors have similar physiological reactions and whether they occur to the same aspects of the gambling process. The students responded mainly to the prospects of winning money, and although high-frequency gamblers might respond similarly, it is possible that they also react to other aspects of the gambling process. To illustrate, if high-frequency horse race bettors were more competitive than students, for them, being right (i.e., correctly predicting the winning horse, even without wagering) might also be arousing. A replication of the present study with high-frequency or problem gamblers might shed light on this issue and could perhaps identify factors involved in excessive gambling.

It also deserves mention that in the present study some degree of ecological validity was sacrificed for the sake of experimental control. The research participants were not allowed to handicap the race but picked the number of a horse from a bag, which is equivalent to selecting the winning horse by chance. This manipulation may not have engaged the participants' sense of self-efficacy to the degree real-life conditions would have done, because students who lost their wagers did not have to take personal responsibility for their choices. Yet it is noteworthy that the experimental manipulations produced significant HR increases and excitement in the wagering condition despite the relatively sterile laboratory setting. Nevertheless, it would be interesting to conduct future research under more naturalistic conditions. This could be done by allowing research participants to handicap races in a controlled laboratory setting or by studying gamblers in real world settings where they wager and often risk considerable sums of money on their self-perceived skills in handicapping.

Future Directions

The present study has yielded preliminary evidence that physiological arousal and excitement during horse race gambling result from people's expectancy to win money rather than from anything intrinsically exciting about gambling per se—at least, this is true for college students, who in their majority are not high-frequency horse race gamblers. Future studies should be conducted with more experienced or frequent gamblers and a more heterogeneous population, including men and women with a wider range of age, education, and income. These demographic characteristics might well be differentially correlated with factors such as competitiveness or the perceived value of money, which in turn might be related to arousal. Conducting such studies under controlled laboratory conditions and in real life settings might eventually yield a better understanding of recreational as well as disordered gambling.

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