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Do Cognitive Fallacies Predict Behavior When NonPathological Gamblers Play Slot Machines and Video Poker?

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DO COGNITIVE FALLACIES PREDICT BEHAVIOR WHEN NON-PATHOLOGICAL GAMBLERS PLAY SLOT MACHINES AND VIDEO POKER?

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A popular notion found in the research literature is that gambling, and gambling problems, are associated with illogical beliefs. The present study investigated whether peoples' subscription to cognitive fallacies related to gambling would be significant predictors of their actual gambling behavior. Twenty participants completed several questionnaires designed to assess cognitive fallacies related to gambling and then had the opportunity to gamble money on video poker and a slot machine. Results showed that faulty beliefs were seldom significant predictors of actual gambling behavior. In the lone instance in which such beliefs predicted gambling, the predictive relationship was in the opposite direction as suggested by the literature (i.e., fallacious beliefs were associated with *less* gambling). The present results therefore question the idea that cognitive fallacies lead to problem and/or pathological gambling.

Keywords: Cognitive fallacies, Gambling, Video poker, Slot machine

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Gambling is a serious societal problem, with approximately 1 – 3% of the general population suffering from pathological gambling (Petry, 2005). Although this percentage is small, it represents millions of individuals. As a result, a large literature has emerged on gambling behavior, the factors that influence or lead to problem gambling, and potential treatments for individuals who display pathological gambling (see Petry, 2005, for a review).

One of the popular explanations for problem gambling is that certain individuals subscribe to faulty beliefs about games of chance and their ability to play them. Ladouceur, Sylvain, Boutin, and Doucet (2002), for instance, outline several such fallacies. One is the illusion of control (Langer, 1975); the idea that because one actively participates in the game of chance, one's chances of winning have somehow been influenced. Another is the independence of turns; the failure to understand that the outcome of one gamble is often completely independent of the outcome of previous or subsequent gambles. Still another is that of diminishing returns; the failure to understand that games of chance pay back at a rate lower than 100% and thus continuing to gamble increases one's chances of losing, not winning.

Although the idea that faulty reasoning or beliefs underlies problem gambling is a popular one, it is not without its critics. For instance, Petry (2005) points out that such beliefs are not sufficient for understanding problem gambling. That is, pathological gamblers do tend to subscribe to such erroneous beliefs, but so too do a large percentage of individuals who *are not* pathological gam-

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blers. With that said, Petry does not rule out the possibility that these beliefs somehow contribute to problem gambling and even incorporates a cognitive component in her suggested treatment for problem gamblers. Some research (e.g., Joukhador, Blaszczynski, & Maccallum, 2004) has also suggested that problem gamblers may endorse erroneous beliefs to a greater degree than non-problem gamblers.

There is evidence to suggest that fallacies contribute to gambling behavior. For instance, Dixon, Jackson, Delaney, Holten, and Crothers (2007) had participants play two concurrently available video poker games. The games were identical with the exception that, on one, the computer identified the optimal cards to hold and discard while, on the other, no such information was provided. Twelve of the 13 participants demonstrated the illusion of control, showing a preference for playing the game in which they freely choose the cards to play. Other research (e.g., Dixon, Hayes, & Ebbs, 1998) has demonstrated similar results when participants play roulette in that they prefer to choose their own numbers rather than having the experimenter choose the numbers for them.

However, not all research has demonstrated the illusion of control when people gamble. Dannewitz and Weatherly (2007) had participants play video poker across three separate sessions. In one, participants could freely choose the cards that were played. In another, the program identified the optimal cards to hold and discard, but participants were free to play the hand as they saw fit. In the final condition, the program identified the optimal play and participants were required to play the hand as the program identified. Results showed that participants gambled the most money when they had the *least* amount of control over the cards that were played.

Similarly, mixed results also exist in the investigation of the fallacies of the independence of turns and diminishing returns. Weatherly and Meier (2008) had participants play a slot machine for money in two separate baseline sessions. Prior to the third session, participants were provided with accurate information pertaining to the independence of returns, to diminishing returns, or both. Participants then gambled in two separate sessions. Results demonstrated that providing participants accurate information regarding these fallacies significantly reduced gambling and that this decrease was sustained across both treatment sessions (i.e., the information was provided prior to the third session, but not the fourth), a finding that is consistent with the idea that these fallacies may influence gambling behavior. However, information on the independence of turns and on diminishing returns had a similar effect on participants' gambling. Furthermore, participants who received information on both fallacies did not show larger decreases in gambling than did the groups who only received information regarding one fallacy. Thus, it is not possible to determine whether the information directly influenced participants' subscription to these fallacies or whether the information simply served to successfully convey the message "you shouldn't gamble."

The present study took a different tack than previous ones. In the present study, non-pathological participants completed a series of questionnaires designed to determine how strongly they subscribed to certain cognitive fallacies. Specifically, participants completed the Informational Biases Scale (IBS: Jefferson & Nicki, 2003), which was designed to assess erroneous beliefs such as the illusion of control, illusory correlations, and the gambler's fallacy, the Superstitious Beliefs Scale (SBS; Joukhador et al., 2004), which was designed to assess erroneous beliefs about cause-and-effect relationships between independent gambling outcomes, and the Gambling Related Cognitions Scale (GRCS; Raylu & Oei, 2004), which purports to measure five cogni-

tions related to gambling (interpretative control, predictive control, the illusion of control, perceived inability to cease/stop gambling, and expectancies). Participants then gambled money on a slot machine and on video poker. If cognitive fallacies influence gambling behavior, then participants' subscription to these fallacies should be predictive of their gambling behavior. Thus, one would predict that the more participants subscribed to these fallacies (as measured by the above scales), the more they would gamble during the gambling sessions.

METHODS

Participants

Participants were 20 undergraduate students (10 female) recruited from the psychology department participant pool at the University of North Dakota. In order to participate, individuals had to be at least 21 years of age and score less than 5 on the South Oaks Gambling Screen (SOGS; Lesieur & Blume, 1987). The mean age of the participants was 23.15 years (SD = 2.70 years). None of the participants was married. Seventeen were Caucasian, one was American Indian, and two were African American. All participants reported an annual income of $15,000 per year or less.

Materials

Participants completed a number of paper-and-pencil measures. The first was an informed consent form as approved by the Institutional Review Board at the University of North Dakota. The second was a demographic survey that asked participants their age, sex, ethnicity, marital status, and annual income. This information was requested because these factors are potential risk factors for pathological gambling (Petry, 2005).

The next measure was the SOGS (Lesieur & Blume, 1987), which consists of 20 questions that are related to an individual's previous gambling experience and are based on the DSM-III criteria for pathological gambling. A score of 5 or more on the SOGS suggests the potential presence of pathology. The SOGS has been shown to have high internal reliability (Cronbach's alpha = 0.97) and good test-retest reliability (r = .71; Lesieur & Blume, 1987).

The next measure was the IBS (Jefferson & Nicki, 2003), which was designed to assess cognitive distortions related to gambling such as the illusion of control, illusory correlations, and the gambler's fallacy. Participants rate their agreement with each of 25 statements related to gambling on a Likert scale and scores are then summed across all responses, with higher scores indicating greater misconceptions related to the nature of randomness within a gambling scenario. Jefferson and Nicki (2003) report the IBS has good internal reliability (Cronbach's alpha = 0.92) and decent construct validity when correlated with other measures of gambling. The original IBS was slightly modified for use in the present study. The wording of the statements was altered so as to reflect gambling more generally, rather than specifically targeting use of video lottery terminals (VLTs) as was the case in the original measure. For example, the statement "I sometimes find myself trying to win back money that I have lost on VLTs" from the original IBS was changed to "I sometimes find myself trying to win back money that I have lost on gambling machines" for the present research.

The next measure was the SBS (Joukhador et al., 2004), which is an eight-item scale designed to measure superstitions related to cause-and-effect relationships in gambling. Participants are asked to rate how strongly they believe each item on a scale of zero to four, with higher scores indicating higher levels of superstition. Joukhador et al. (2004) showed that problem gamblers endorsed more superstitions on the scale than did non-problem gamblers. However, internal consis-

tency, test-retest reliability, and construct validity were not reported.

The final measure was the GRCS (Raylu & Oei, 2004), which consists of 23 items that assess a variety of cognitions related to problematic gambling. Participants respond to each statement on a Likert scale and a total score is calculated by summing the scores across all responses. Additionally, the GRCS contains 5 subscales. These subscales can be scored individually by summing the points associated with the set of statements related to each. The subscales assess the (1) inability to stop gambling, (2) interpretive bias, (3) gambling expectancies, (4) predictive control, and (5) illusion of control. Raylu and Oei (2004) reported high overall reliability (Cronbach's alpha = 0.93) and moderate to high reliability of each subscale (Cronbach's alphas ranged from 0.77 to 0.91).

Apparatus and Settings

When participants played a slot machine, they played a Triple Diamond machine (IGT Inc.) that was located with two other slot machines in a windowless room measuring approximately 1.5 m X 5 m. The machine allowed the player to bet one or two coins per play. Outcomes of individual spins were not preset (i.e., predetermined). The overall payback percentage for the machine was 87%, meaning that it was programmed to pay an average of 87 tokens for every 100 bet over an indefinite period of time. An internal counter measured the number of tokens inserted and the number of tokens dispensed when wins occurred. The visual displays on the machine indicated that it took 25-cent coins. However, the machine was reprogrammed to accept tokens that, in the present study, were worth five cents each. Thus, the "25¢" displays were covered with "5¢" displays. Two other slot machines were not used in the present study and were turned off.

When participants played video poker, they did so in a windowless room that measured approximately 2 m by 2 m. The room contained a table and two chairs, with a personal computer situated on the table. The video-poker software (Zamzow Software Solutions, 2003) on the computer allowed for a variety of five-card-draw poker games to be played. The present experiment utilized "Loose Deuces." In this five-card poker game, 2s were wild and the player's bet was returned for a hand of Three-of-a-Kind (three cards of the same face value, e.g., three Jacks). Increasing payoffs occurred for increasingly better poker hands. Loose Deuces was chosen relative to other possible games (e.g., Jacks or Better) because research (Weatherly, Austin, & Farwell, 2007) has demonstrated that players play this game less accurately than other games and thus this game allowed for a greater variation in participants' accuracy of play. Participants could bet one to five credits per hand. The software recorded number of hands played, number of credits bet, and accuracy of play (see Jackson, 2007).

Procedure

All data were collected in a single session. Upon the participant's arrival, the researcher checked the participant's driver's license to ensure that the participant was at least 21 years of age. Participants then went through the process of providing informed consent. Next, they completed the paper-and-pencil measures, beginning with the SOGS. While the participant was completing the other measures, the researcher scored the SOGS. The participant was dismissed if s/he scored 5 or more on the SOGS. One participant had to be dismissed for scoring 5 or more; that participant was replaced.

Upon completion of the questionnaires, the participant was given the opportunity to play the slot machine and video poker, with the order of these games counterbalanced across participants. Prior to gambling on each game, the researcher read the following instructions:

> You will now be given the opportunity to play on a slot machine (video

poker). You will be given 100 tokens (credits) worth five cents each. Thus, you are being given five dollars to gamble. You may bet as many tokens (credits) per play as the machine allows. Your goal should be to end the session with as many tokens (credits) as you can. You may end the session at anytime by informing the researcher that you would like to end the session. The session will end when a) you quit playing, b) you run out of tokens (credits), or c) 20 minutes has elapsed. At the end of the experiment you will be paid in cash for the number of tokens (credits) you have left or have accumulated. Do you have any questions?

Questions were answered by repeating the above instructions. When playing the slot machine, the researcher then gave the participant 100 tokens. When participants played video poker, 100 credits were already loaded into the game. The participant played the first game until one of the above criteria was met. The researcher then took the participant to the next room, read the above instructions, and the participant played the second game until one of the above criteria was met. After playing the second game, the researcher debriefed the participant, paid the participant for the number of credits s/he had accumulated or had remaining after playing both games, provided extra-course credit for participation (if applicable), and dismissed the participant.

RESULTS

Table 1 presents a summary of participants' scores on the questionnaires and their overall gambling behavior. In terms of gambling, all participants played at least one hand of video poker and all but one gambled on the slot machine. A series of related-samples *t* tests indicated that the average number of trials played ($t(19) = -1.92$), number of credits/tokens bet ($t(19) = 1.31$), and amount won ($t(19) = 1.40$) did not differ between video poker and the slot machine. The number credits won on video poker was significantly correlated with both the number of hands played ($r = .544$, $p = .016$) and total number of credits bet ($r = .726$, $p < .001$). The number of coins won on the slot machine was significantly correlated with both the number of spins played ($r = .785$, $p < .001$) and the number of tokens bet ($r = .826$, $p < .001$). These results, and all that follow, were considered significant at $p<.05$.

A series of linear regressions were conducted, using the various measures of cognitive fallacies (IBS, SBS, GRCS) as predictors of gambling behavior (e.g., tokens bet, hands played). None of the cognitive measures were significant predictors of the number of hands played during video poker, the accuracy of play on video poker, the number of spins played on the slot machine, or the number of tokens bet on the slot machine (all Fs < 1). The only significant predictor was found for the total number of credits bet on video poker, which was participants' score on the IBS ($F(1, 18) = 7.69$, $p = .013$, $R^2 = .299$). Greater misconceptions related to the nature of randomness within a gambling scenario predicted fewer coins played during the poker session ($\beta = -.547$).

Several significant correlations existed between the different paper-and-pencil measures. Specifically, participants' scores on the IBS was significantly correlated with their scores on the SOGS ($r = -.537$, $p = .018$), the gambling expectancies subscale of the GRCS ($r = .465$, $p = .045$), the predictive control subscale of the GRCS ($r = .483$, $p = .034$), the total score on the GRCS ($r = .483$, $p = .036$), and the SBS ($r = -.718$, $p = .001$).

DISCUSSION

The present study was designed to investigate the relationship found in the research literature between cognitive fallacies and gambling. Non-pathological participants completed a number of questionnaires designed to assess cognitive fallacies related to gambling and then had the opportunity to

Table 1. Descriptive statistics for the questionnaires and gambling measures.

	Mean	SD
Questionnaires		
SOGS	0.65	0.88
IBS	110.80	28.17
SBS	3.50	3.68
GRCS		
Inability to stop	34.45	1.40
Interpretive bias	24.90	2.97
Gambling expectancies	25.60	2.52
Predictive control	37.15	3.51
Illusion of control	27.05	1.61
Total	149.15	9.74
Video Poker		
Hands Played	45.05	30.42
Coins Played	152.16	128.13
Percent Correct	45.57	19.79
Coins paid (dollar amount)	92.32 ($4.62)	100.67 ($5.03)
Slot Machine		
Number of spins	66.16	51.31
Coins Played	102.05	92.78
Coins paid (dollar amount)	84.68 ($4.23)	63.27 ($3.16)

gamble money on video poker and a slot machine. In general, participants' subscription to cognitive fallacies was not a significant predictor of how they gambled, with one exception. Specifically, the greater the misconception participants had about the concept of randomness, the *less* money they gambled on video poker, a result that is in the opposite direction of that predicted by the research literature.

These results do not question the relationship between cognitive fallacies and gambling that is found in the research literature, but they do suggest that this relationship is not causal. That is, if cognitive fallacies lead to gambling problems, then you would expect that the degree to which people subscribe to these fallacies would predict how people gamble.

Despite broadly surveying a number of different potential beliefs pertaining to gambling, the present study found no such predictive relationship. In that respect, the present results are consistent with Petry's (2005) conclusion that such beliefs are not sufficient for problem gambling to occur given that many non-problem gamblers also hold such beliefs.

One could argue that the present results are silent to the issue of the relationship between cognitive fallacies and pathological gambling because the current study did not study pathological gamblers. While it is true that it remains possible that cognitive fallacies may predict actual gambling behavior in pathological gamblers, the present results still question that such fallacies lead to gambling problems. If they did, then their effect on gambling should be noticeable before, not after, one becomes a pathological gambler.

One could also argue that the present measures were not meant to be predictive in

nature, but rather were designed to assess pre-existing factors. On the other hand, one could argue that the measures are in fact predictive, but the present procedure lacked sufficient power to identify their predictive capabilities. The former argument cannot be refuted, but if these measures are not ultimately able to predict future behavior, then their overall utility is limited. In response to the latter argument, we can say that none of the present measures, even when tested alone, were significant predictors of more gambling on any of the present dependent measures. Furthermore, if extremely large numbers are required to demonstrate a significant effect, then again the utility of these measures to inform us about the behavior of individuals is limited.

With that said, the present design did have a number of limitations. Only 20 participants were tested, so it is indeed possible that statistically significant effects would have been observed if more participants had been employed. It is also the case that the present procedure did not prescreen for different populations pertaining to cognitive fallacies. That is, had we specifically targeted participants who varied widely in their beliefs pertaining to gambling, it is possible that such beliefs may have been significant predictors of gambling behavior. However, if the latter point was true, then the present results suggest that minor differences in beliefs toward gambling are not likely to predict differences in gambling. We also did not test for predictive relationships with individual items on the different scales. We did not do so because our intention was to use the measures as they had been originally intended.

One could also argue that the present results lack external validity because participants were not gambling their own money. The present results cannot address this argument. However, the research literature can. For example, research on the "endowment effect" has shown that, when people are gifted with something such as money, they take ownership of it and treat it as if it were their own (e.g., Kahneman, Knetsch, & Thaler, 1990). Furthermore, several studies from our laboratory (Weatherly & Brandt, 2004; Weatherly & Meier, 2007) have demonstrated that participants gambling with money that has been staked to them do so more conservatively than when what they are "gambling" has no value. These findings support the idea that participants valued the money that had been staked.

Despite the mostly null results of the present study, they join a host of recent experimental studies on gambling that help highlight the need for more experimentally based research on gambling. For instance, despite decades of reports of a "big win" early in a gambler's career leading to problem gambling later on (Custer, 1984; Custer & Milt, 1985), only one empirically based research study has reported an effect of a "big win" (Weatherly, Sauter, & King, 2004) and that effect was in the opposite direction as proposed in the literature. Likewise, the literature is rife with reports that distorted cognitive beliefs lead to gambling problems. The field would be wise to recognize that these reports are correlational in nature and have been found in pre-existing populations. Additional experimental research should be conducted before these relationships are raised to the levels of importance that many in the field wish to place them.

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