

## Development of the Drake Beliefs about Chance Inventory

W. Scott Wood, Maria M. Clapham

*Drake University*

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The present research describes the development and validation of a cognitive assessment instrument, the Drake Beliefs about Chance (DBC) inventory, designed to determine and quantify erroneous beliefs about games of chance. Principal components analyses showed that the DBC assesses two primary dimensions, Illusion of Control and Superstition. Correlation analyses showed that scores on these two dimensions are related to higher frequency of gambling behaviors in both adults from the general population and clients from gambling treatment centers. Of the two sets of erroneous beliefs, Illusion of Control was a better predictor of gambling than Superstition. This investigation provides additional evidence that participants in games of chance such as casino gamblers possess certain classes of erroneous beliefs regarding the games they play.

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**KEY WORDS:** gambling; cognitive errors; illusion of control; superstition.

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The rapid expansion of legalized gambling in the United States in the last three decades has produced concern about the extent and nature of the social impact such growth in gambling behavior might produce (National Opinion Research Center, 1999; National Research Council, 1999). Much of this concern is focused on the pathological gambling that is seen as the probable outcome of the increased opportunity for American citizens to gamble legally. The extent of this

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Please address correspondence to W. Scott Wood, Department of Psychology, Drake University, Des Moines, IA 50311, USA. Email: scott.wood@drake.edu.

problem currently is estimated by prevalence studies that have been conducted during the period of growth. Recent estimates range from 0.9% to 1.5% as life-time prevalence rates for adults in the United States (National Research Council, 1999) and derive from meta-analyses conducted by Shaffer, Hall, and Bilt, (1997) and survey research by the National Opinion Research Center (1999). If accurate, and there are questions regarding the validity of gambling prevalence measures, these figures would imply that nearly two million adult citizens can expect to experience pathological gambling sometime in their lives. However, this focus on excessive gambling almost cloaks an equally, if not more interesting phenomenon, the fact that many millions of citizens are routinely participating in an economic activity that is mathematically to their disadvantage. Survey research suggests that approximately 3/4 of the adult population of the United States gambled in any recent year (National Research Council, 1999). This overwhelming involvement in gambling occurs even though there is negative expectancy of winning for players in any legalized game of chance; the odds always favor the house. To engage and perhaps persist to the point of bankruptcy in playing a game with the odds set against you deserves careful analysis, and there are many theories that seek to account for such activity (National Research Council, 1999). Cognitive psychology provides one such approach.

Cognitive psychologists consider erroneous beliefs or cognitive errors to be important factors associated with gambling, excessive or not. Concepts such as the gambler's fallacy, illusion of control, cognitive biases, superstition and the failure to understand the concept of independent events have all been provided as examples of such cognitive errors (e.g., Ladouceur & Walker, 1996). Treatment counselors have developed gambling therapy procedures that focus on correcting such cognitive errors (Ladouceur, Sylvain, Boutim, & Doucet, 2002) and have provided empirical evidence regarding the success of this approach in reducing gambling behavior (e.g., Ladouceur, Sylvain, Letarte, Giroux, & Jacques, 1998). A valid measurement instrument that assesses such cognitive errors could be useful, both clinically and for theoretical purposes. Scores might predict the amount or type of gambling, or measure the degree to which such beliefs are corrected by therapy and the extent to which excessive gambling decreases. An instrument that assesses cognitive errors also could be used in research directed at clarifying the

theoretical links between cognitive distortions and gambling behaviors, identifying the direction of any causality of the correlation.

Because of these practical and theoretical interests, we initiated a series of studies to determine the nature of erroneous beliefs about games of chance and the degree to which such beliefs are associated with several measures of gambling behavior. We constructed a survey instrument, the Drake Beliefs about Chance inventory (DBC), to assess the presence of several patterns of beliefs and misunderstandings related to games of chance as cognitive psychologists have theorized. This was accomplished in several steps: First, survey items were developed that seemed logically to represent a number of possible erroneous interpretations of the nature of games of chance. Second, the dimensionality of these items was tested through principal components and internal consistency analyses. Third, the relationship of scores on the DBC to gambling behaviors was examined.

Other researchers recently have developed inventories to assess cognitive distortions associated with gambling as well. Jefferson and Nicki (2003) developed the Informational Bias Scale (IBS) to measure cognitive misconceptions of video lottery terminal (VLT) users. This 25 item scale was found to assess one dimension, and its scores were positively correlated with VLT user scores on the South Oaks Gambling Screen (SOGS) and the National Opinion Research Center DSM-IV Screen for Gambling Problems (NODS). Joukhador, Blaszczynski, and Maccallum (2004) developed an eight item superstition scale that showed an association with problem electronic gaming machine gambling. Steenbergh, Meyers, May, and Whelan (2002) developed the Gambler's Beliefs Questionnaire (GBQ), a 21 item instrument that assesses two dimensions, Luck/Perseverance and Illusion of Control. These researchers found that non-problem gamblers scored significantly lower on both dimensions of the GBQ than problem or pathological gamblers identified with the SOGS and than pathological gamblers identified with the Massachusetts Gambling Screen DSM-IV Questionnaire (MAGS). In addition, these researchers found that length of gambling sessions correlated positively with Luck/Perseverance scores but not with Illusion of Control scores in problem and pathological gamblers. Our research adds to the findings reported in these studies by combining several distinct elements into one study. First, we developed an inventory that assesses a different set of dimensions than any single inventory examined in the previous studies.

Second, we used criteria different from diagnostic measures of gambling pathology to validate the inventory. We were interested in assessing the validity of the DBC across a wider range of gambling behaviors than these clinical measures provide, and for individuals for whom the assumption of pathology is not implied by the measurement instrument. Third, we tested the validity of the DBC in two sample populations, in a survey sample of the general population and a sample of gamblers seeking counseling or already in treatment for the gambling behavior. This research is described in Study 1 and Study 2.

## STUDY 1

### *Purpose*

The purpose of this study was to develop an inventory to assess erroneous beliefs about chance, then examine the criterion-related validity of the inventory in a general population of adults.

## METHOD

### *Questionnaire Development*

Two questionnaires were developed. The first inventory was devised to assess erroneous beliefs about chance events. We originally developed 45 items to assess several hypothesized categories of erroneous beliefs about the games of chance, including the illusion of control, superstition, attribution error, biased and irrational thinking, the gambler's fallacy, and (lack of) knowledge of probability (Ladouceur & Walker, 1996). After a series of studies, primarily involving college students, the questionnaire items were distilled and revised to a list of 26. The response format for each item was a five-point Likert scale anchored as follows: 5-Strongly Agree, 4-Agree, 3-Neutral, 2-Disagree, 1-Strongly Disagree.

A second questionnaire called the Gambling Behavior Survey was developed to assess several measures of gambling behavior (see Appendix). It contained 15 questions related to gambling. Ten of these asked respondents to indicate the frequency with which they

played specific games of chance (dice, casino, lottery tickets, slot machines, scratch-off tickets, internet, sports, blackjack, poker and roulette) using a four-point scale: Never-0, Rarely-1, Occasionally-2, and Often-3. A Gambling Total score was obtained by summing the ratings on these ten questions. The possible score range for Gambling Total was 0–30. The other Gambling Behavior Survey items asked respondents how often they gambled in general, how long gambling sessions tended to be, how much money they gambled in an average session, the largest amount of money gambled in any one day, and the largest amount of money lost in any single day. The possible score range for these items was from 0-Never to 6 or 7 (depending upon the question). In total, 6 gambling scores were obtained from the Gambling Behavior Survey.

### *Participants*

A mail survey including the 26 beliefs about chance items, the Gambling Behavior Survey, a cover letter explaining the general purpose of the study, and a stamped return envelope was sent to 1000 randomly sampled local residents. A total of 265 surveys were returned with some portion completed. Respondents who did not complete all of the DBC items were not included in the analyses. This reduced the sample to 239 respondents. Because all of these respondents did not complete all of the questions on the Gambling Behavior Survey, the sample sizes vary by question. Respondents were 124 women, 110 men, and 5 of unknown gender. The age distribution of the respondents was as follows: below 21: .42%; 21–35: 24.37%; 36–55: 36.97%; 56–70: 23.11%; over 70: 15.13%.

## **RESULTS**

Prior to performing a principal components analysis to determine the dimensionality of the 26 erroneous beliefs items, a parallel analysis was conducted as indicated by Thompson and Daniel (1996) to determine the number of factors that could be retained. Based on the results, three factors were extracted and rotated using the varimax procedure. The three rotated factors accounted for 46.12% of the variance in item responses. Factors I and II respectively accounted for

19.96% and 19.44% of the variance, while Factor III only accounted for 6.72% of the variance. A factor loading cutoff of .40 was used to interpret an item as loading on a factor. All 26 items loaded on at least one factor, and most loaded on only one factor. Factor I showed high loadings for 11 items that primarily involved superstitious beliefs, and was thus called Superstition. Factor II showed high loadings for 11 items primarily involving beliefs about skills and techniques that can control the outcome of the game, and was called Illusion of Control. Four items loaded on Factor III, but these were dropped from further analyses and interpretation because they reflected a methodological artifact rather than an identifiable construct and because Factor III accounted for a much smaller percent of variance than Factors I and II. The 22 remaining items that comprise the Drake Beliefs about Chance (DBC) inventory and the rotated factor structure for Factors I and II are presented in Table 1.

Dimension scores were calculated for Superstition and Illusion of Control by summing the 11 item ratings corresponding to each dimension. Each dimension had a possible score range of 11–55. A Total Beliefs about Chance score was computed by summing Superstition and Illusion of Control scores, and had a possible score range of 22–110. The internal consistency reliabilities for the dimensions and total score of the DBC were good (Superstition:  $\alpha = .85$ ; Illusion of Control:  $\alpha = .88$ ; Total Beliefs:  $\alpha = .91$ ). The internal consistency of the 10 Gambling Total items from the Gambling Behavior Survey was also good,  $\alpha = .81$ .

Means and standard deviations for the community sample questionnaire scores are reported in Table 2. Because Shapiro-Wilk tests showed that all of the DBC and Gambling Behavior scores of the survey respondents were distributed non-normally, nonparametric analyses were conducted. Wilcoxon two-sample tests conducted to examine gender differences showed no significant differences between men and women in the three DBC scores or the six gambling behavior scores.

Spearman rank correlations between Beliefs about Chance scores and gambling behaviors of the community sample are presented in Table 3. The uncorrected correlation coefficients showed that all six of the Gambling Behavior scores were significantly related to Illusion of Control and Total Beliefs about Chance scores. Five of the Gambling Behavior scores were significantly associated with Superstition. The

**Table 1**  
**Rotated Factor Structure of DBC Items**

<i>Items</i>	<i>I</i>	<i>II</i>
<i>Superstition</i>		
- I like to carry a lucky coin, charm or token when I'm doing something important	<b>.764</b>	.153
- I can improve my chances of winning by performing special rituals.	<b>.761</b>	.079
- There may be magic in certain numbers.	<b>.664</b>	.352
- When I take a test (or took them in the past) I use a lucky pen or pencil.	<b>.651</b>	.377
- I have a special system for picking lottery numbers.	<b>.577</b>	.187
- There is useful information in my daily horoscope.	<b>.550</b>	.166
- When I need a little luck I wear lucky clothes or jewelry.	<b>.545</b>	.162
- A game of chance is a contest of wills between the game and the player.	<b>.536</b>	.267
- I believe that fate is against me when I lose.	<b>.517</b>	.356
- Playing slot machines is a form of competition between the player and the machine.	<b>.493</b>	.163
- I do not consider myself to be a superstitious person. (reverse scored)	<b>.488</b>	.055
<i>Illusion of Control</i>		
- A good casino gambler is like a quarterback who knows winning plays and when to use them..	135	<b>.801</b>
- There are secrets to successful casino gambling that can be learned.	.008	<b>.758</b>
- Wins are more likely to occur on a hot machine.	.251	<b>.757</b>
- Show me a gambler with a well-planned system and I'll show you a winner.	.276	<b>.682</b>

**Table 1** (*Continued*)

<i>Items</i>	<i>I</i>	<i>II</i>
– The more familiar I am with a casino game, the more likely I am to win.	.184	<b>.612</b>
– It is good advice to stay with the same pair of dice on a winning streak.	<b>.435</b>	<b>.585</b>
– One should pay attention to lottery numbers that often win.	<b>.424</b>	<b>.570</b>
– If a coin is tossed and comes up heads ten times in a row, the next toss is more likely to be tails.	.070	<b>.526</b>
– I will be more successful if I have a system to play the slot machines.	.353	<b>.508</b>
– Some gamblers are just born lucky.	.347	<b>.503</b>
– The longer I've been losing, the more likely I am to win.	<b>.445</b>	<b>.468</b>

*N* = 239.

*Note:* Factor structure coefficients equal to or greater than .400 are bolded.

highest validity coefficients were of Illusion of Control with total gambling frequency ( $r_s = .325$ ,  $p < .01$ ), largest \$ gambled on any one day ( $r_s = .307$ ,  $p < .01$ ) and largest \$ lost in any one gambling session ( $r_s = .303$ ,  $p < .01$ ). Illusion of Control accounted for 10.56% of the variance in total gambling frequency, 9.42% of the variance in largest \$ gambled in one day, and 9.18% of the variance in largest \$ lost in any one gambling session. In summary, gambling frequency, time and money were all significantly associated with DBC scores.

The validity coefficients were then corrected for unreliability in the DBC scores and, in the case of correlations between Beliefs about Chance and Gambling Total, corrected for unreliability in both the belief scores and the gambling behavior scores. No corrections were made for range restriction because of lack of recent data showing the standard deviations for gambling behavior in the general population. No significance levels are indicated for the corrected coefficients because they are estimated values (Muchinsky, 1996). The highest corrected validity coefficients were those of Illusion of Control with total gambling frequency ( $r_s = .384$ ), and of Total Beliefs about Chance



**Table 2**  
**Mean DBC and Gambling Behavior Scores by Sample**

	<i>Community (N = 239)<sub>a</sub></i>		<i>Treatment (N = 68)<sub>a</sub></i>		
	<i>Mean</i>	<i>S<sub>x</sub></i>	<i>Mean</i>	<i>S<sub>x</sub></i>	<i>Z</i>
<i>DBC</i>					
Illusion	24.57	8.40	25.38	9.06	.32
Superstition	20.30	7.16	23.03	8.16	2.42*
Belief Total	44.87	14.08	48.41	15.84	1.46
<i>Gambling</i>					
Often	.75	.61	1.89 (66)	1.37	6.57*
Gamble Tot	3.89 (235)	3.76	8.64 (58)	6.17	5.55**
Largest \$ Gam	1.22	1.04	2.53 (55)	1.03	7.59**
Average \$ Gam	1.07 (238)	.93	1.94 (54)	.63	6.74**
Average Time	1.23 (238)	1.01	3.13 (53)	1.32	8.96**
Largest \$ Lost	1.15 (238)	.99	2.63 (54)	1.10	8.19**
Total Debt	–	–	4.63 (59)	1.89	–
Gamble Debt	–	–	3.83 (59)	1.89	–

\* $p < .05$ ; \*\* $p < .01$ .

a: sample sizes that vary from these are indicated in parentheses within the table.

Illusion: Illusion of Control; Superstition; Belief Total: Total score on Beliefs about Chance Inventory, Often: How often one gambles; Gamble Tot: Sum of gambling behavior frequency ratings; Largest \$ Gam: Largest amount of money gambled on any one day; Average \$ Gam: Average amount of money gambled per visit; Average Time: Average length of gambling sessions; Largest \$ Lost: Most money lost in one gambling session; Total Debt: Total amount of debt; Gamble Debt: Amount of debt due to gambling.

with total gambling frequency ( $r_s = .337$ ). These results indicate that, with increased reliability in the measures, 14.75% of the variance in total gambling frequency could be explained by Illusion of Control, 6.5% could be explained by Superstition, and 11.36% could be explained by the Total Beliefs about Chance score.

The DBC dimensions were highly intercorrelated with each other. The correlation between Superstition and Illusion of Control was  $r_s = .646$  ( $p < .01$ ). Illusion of Control correlated  $r_s = .92$  ( $p < .01$ ) with Total Beliefs about Chance and Superstition correlated  $r_s = .89$  ( $p < .01$ ) with Total Beliefs about Chance. In addition, the gambling behaviors were intercorrelated. Of particular note are the high

**Table 3**  
**Correlations between Beliefs and Gambling Behaviors**

<i>Gambling Variables</i>	<i>Uncorrected</i>			<i>Corrected<sup>a</sup></i>		
	<i>Ill</i>	<i>Sup</i>	<i>Belief</i>	<i>Ill</i>	<i>Sup</i>	<i>Belief</i>
<i>Community Sample</i>						
Often ( <i>N</i> = 239)	.244**	.120	.203**	.260	.130	.213
Gamble Tot ( <i>N</i> = 235)	.325**	.212**	.290**	<b>.384</b>	<b>.255</b>	<b>.337</b>
Largest \$ Gam ( <i>N</i> = 239)	.307**	.172**	.260**	.327	.187	.272
Average \$ Gam ( <i>N</i> = 238)	.278**	.153*	.234**	.296	.166	.245
Average Time ( <i>N</i> = 238)	.258**	.162*	.225**	.275	.176	.236
Largest \$ Lost ( <i>N</i> = 238)	.303**	.184**	.266**	.323	.200	.278
<i>Treatment Sample</i>						
Often ( <i>N</i> = 66).	.067	.044	.063	.072	.048	.066
Gamble Tot ( <i>N</i> = 58)	.397**	.247	.363**	<b>.457</b>	<b>.288</b>	<b>.409</b>
Largest \$ Gam ( <i>N</i> = 55)	-.162	-.082	-.158	-.173	-.089	-.165
Average \$ Gam ( <i>N</i> = 54)	.050	-.066	-.015	-.053	-.072	-.016
Average Time ( <i>N</i> = 53)	-.015	-.118	-.111	-.016	-.128	-.116
Largest \$ Lost ( <i>N</i> = 54)	-.156	-.156	-.188	-.139	-.169	-.197
Total Debt ( <i>N</i> = 59)	-.107	-.104	-.128	-.114	-.113	-.134
Gamble Debt ( <i>N</i> = 59)	.019	.078	.039	.020	.085	.041

\* $p < .05$ ; \*\* $p < .01$ .

a: Bolded coefficients are corrected for unreliability in both predictor and criterion, non-bolded coefficients are corrected for unreliability in the predictor only. No significance levels are indicated for corrected coefficients.

Ill: Illusion of Control; Sup: Superstition; Belief: Total score on Beliefs about Chance Inventory; Often: How often one gambles; Gamble Tot: Sum of gambling behavior frequency ratings, Largest \$ Gam: Largest amount of money gambled on any one day; Average \$ Gam: Average amount of money gambled per visit; Average Time: Average length of gambling sessions; Largest \$ Lost: Most money lost in one gambling session; Total Debt: Total amount of debt; Gamble Debt: Amount of debt due to gambling.

associations between frequency of gambling and amount of money gambled and lost. As expected, higher Gambling Total scores were positively associated with more money gambled on average ( $r_s = .798$ ,  $p < .01$ ), higher largest amount of money gambled ( $r_s = .783$ ,  $p < .01$ ), and higher largest amount of money lost ( $r_s = .766$ ,  $p < .01$ ). They were also associated with longer gambling sessions ( $r_s = .780$ ,  $p < .01$ ).

## DISCUSSION

This study resulted in a 22 item questionnaire that assesses two dimensions of erroneous beliefs about chance events, Superstition and Illusion of Control. In addition, this study showed that higher scores on both of these dimensions were associated with greater frequency of playing games of chance in a sample from a general population of adults. The results suggest that up to almost 15% of the variance in frequency of playing games of chance could be explained by DBC scores. DBC scores also accounted for variance in measures of the largest amount of money gambled in one session, average amount gambled per session, average length of gambling session, and largest amount of money lost. Thus, in the community participants, DBC scores were associated with playing games of chance more frequently, playing for longer sessions, and playing more money. Of the two dimensions, Illusion of Control was more strongly associated with gambling behavior in this sample than was Superstition.

## STUDY 2

### *Purpose*

The purpose of Study 2 was to examine the extent to which DBC scores are associated with gambling behaviors in a population of gamblers self-identified as having difficulty controlling their gambling by their status in treatment or seeking treatment for their gambling behavior. This sample population will be referred to as “treatment gamblers” in this research.

## METHOD

### *Participants*

Participants consisted of individuals in voluntary treatment or seeking treatment for gambling problems at the Central Iowa Gambling Treatment Center. The Drake researchers were given access to this population on the condition of complete anonymity of participants and precluded any access to the Treatment Center’s diagnostic data on the participants or any information regarding their

treatment duration or status. The Drake Beliefs about Chance inventory and the Gambling Behavior survey were included in a packet that contained a cover letter requesting participation and assuring anonymity and confidentiality, and were administered at the gambling treatment center to gamblers in treatment and applying for treatment for a period of about three months. After completing the survey instruments, the respondent resealed the packet, which was later retrieved by a Drake research assistant. This process produced 68 surveys with complete DBC scores. Of these, 35 were men (51.47%) and 33 were women (48.53%). The age distribution was as follows: 21–35: 19.12%; 36–55: 41.18%; 56–70: 32.35%; over 70: 7.35%. Compared to the community sample, a higher percentage of participants in the treatment sample were in the 56–70 year old group.

### *Questionnaires*

The DBC inventory was distributed to these individuals together with the Gambling Behavior Survey as described above. Two additional items were incorporated into the later questionnaire regarding total debt and gambling debt. These new items, which are listed at the end of the Appendix, had a possible score range of 1–7.

## **RESULTS**

Internal consistency analyses for the DBC scores were conducted. They were as follows: Superstition,  $\alpha = .85$ ; Illusion of Control,  $\alpha = .87$ ; Total Beliefs about Chance,  $\alpha = .92$ . The internal consistency of the Gambling Total score was  $\alpha = .86$ . Thus, the internal consistency reliabilities of the measures in the treatment sample were good and comparable to those found in the community sample.

Means and standard deviations for the treatment sample scores on the DBC and the Gambling Behavior Survey are presented in Table 2. Similarly to scores from the community sample, Shapiro-Wilk test results, which showed that DBC and Gambling Behavior scores from this sample were non-normal, lead to the use of nonparametric statistical procedures. Wilcoxon rank sum analyses also showed no significant gender differences in the Beliefs about Chance scores or the Gambling Behavior scores in the treatment sample. It is important to

note that the mean for “often”, item 3 in the Gambling Behavior Survey, appears rather low for gamblers who are seeking or in treatment. This, we believe, is a result of the wording used in the question. It asked participants “How frequently do you gamble?” Some of the in-treatment gamblers responded that they “never” gamble, but proceeded to indicate playing specific games of chance within the past year. Thus, while they indicated no current gambling activity, they presumably had gambled within the past year.

The associations between DBC scores and gambling behaviors in the treatment sample were examined using Spearman Rank correlations, and are presented in Table 3. The uncorrected correlation coefficients showed a significant relationship between Illusion of Control and total gambling frequency ( $r_s = .397, p < .01$ ). Superstition showed no significant associations with gambling behavior scores. The Belief Total score was significantly associated with gambling frequency ( $r_s = .363, p < .01$ ). These correlations indicate that Illusion of Control accounted for 15.76% of the variance in total gambling frequency. Total Beliefs about Chance accounted for 13.18% of the variance in total gambling frequency.

As in the community sample, the validity coefficients were corrected for unreliability in the DBC scores and, in the case of correlations between Beliefs about Chance and Gambling Total, corrected for unreliability in both the beliefs scores and the gambling behavior scores. No corrections were made for range restriction because of lack of current data showing the standard deviations for gambling behavior in treatment populations, and no significance levels are indicated for the corrected coefficients because they are estimated values (Muchinsky, 1996). The corrected correlation coefficients showed particularly high associations between Illusion of Control and total gambling frequency ( $r_s = .457$ ), and between Belief Total and total gambling frequency ( $r_s = .409$ ). These corrected validity coefficients, which reflect potential associations if the reliability of the measures was increased, show that, of the variance of total gambling frequency in the treatment sample, Illusion of Control could account for 20.88%, Superstition could account for 8.29%, and Belief Total could account for 16.73%.

In comparing these results to those of the community sample, it is important to note several differences. Fewer relationships show statistical significance in the treatment sample than in the community sample. In the case of Superstition and Gambling Total, the lack of

significant association was due to sample size differences, not a weaker relationship. Contrary to the community sample, the treatment sample showed no associations between DBC scores and amount of money gambled or length of gambling sessions. Thus in the treatment sample, misbeliefs were associated with frequency of playing games of chance but not with the length of sessions or the amount of money gambled per session. Amount of total debt and gambling debt were also not significantly associated with DBC scores.

The belief dimensions were highly intercorrelated with each other. The correlation between Superstition and Illusion of Control was  $r_s = .641$  ( $p < .01$ ). Illusion of Control correlated  $r_s = .89$  ( $p < .01$ ) with Beliefs about Chance and Superstition correlated  $r_s = .90$  ( $p < .01$ ) with Beliefs about Chance. In addition, as expected, the gambling behaviors generally showed moderate to high intercorrelations. As in the community sample, the Gambling Total score was positively associated with average and largest amount of money gambled ( $r_s = .520$ ,  $p < .01$ ;  $r_s = .470$ ,  $p < .01$  respectively), length of gambling sessions ( $r_s = .400$ ,  $p < .01$ ) and amount of money lost ( $r_s = .441$ ,  $p < .01$ ), but these associations were weaker than those in the community sample. Contrary to expectation, debt items showed poor associations with other gambling behavior items. The Gambling Total score showed weak and non-significant associations with gambling debt ( $r_s = .235$ ,  $p > .05$ ) and total debt ( $r_s = .183$ ,  $p > .05$ ).

Comparisons of the treatment and the community sample scores on the DBC and on Gambling Behaviors were conducted and are presented in Table 2. Wilcoxon rank sum tests showed that the treatment and the community samples were not significantly different in Illusion of Control or Belief Total scores. The treatment sample did score significantly higher on Superstition than the community sample. In gambling behaviors, the treatment sample had significantly higher scores on all variables. Gamblers seeking or in treatment played games of chance more frequently, for longer periods of time, gambled more money, and consequently lost more money than did members of the community sample.

## DISCUSSION

This study extended Study 1 by examining the usefulness of DBC scores for predicting gambling behavior in a sample of gamblers

seeking or in treatment. Results show that DBC scores predicted frequency of playing games of chance in these individuals as well if not better than in the community sample. The Illusion of Control dimension was, as in the community sample, a better predictor of gambling behaviors than Superstition or both scores combined. Indeed, up to 20% of the variance in frequency of playing games of chance could be explained by a more reliable Illusion of Control measure. The DBC scores did not, however, predict money spent and length of gambling sessions in the treatment sample as they did in the community sample, nor did they predict debt scores. A comparison of scores across both samples showed no differences between the community sample and the treatment sample in Illusion of Control or Total Belief about Chance scores, although the treatment sample scored significantly higher in Superstition scores. The treatment sample did score significantly higher than the community sample in frequency of play and amount of money and time spent gambling, as would be expected.

In summary, higher cognitive error scores in the treatment sample were associated with going to play games of chance more frequently but not with the length of time spent gambling, as in the community sample, or the amount of money gambled once there. In addition, the dimension of cognitive error that predicted gambling behavior most effectively across both samples, Illusion of Control, did not distinguish members of the two samples. That is to say, treatment gamblers and gamblers from the community sample scored similarly on the Illusion of Control dimension but the two population samples gambled at different levels. The reasons for these findings are unclear. Perhaps in some gamblers factors beyond cognitive errors lead them to continue to play for longer periods of time and spend more money once they have started a gambling session. This, in turn, leads them to accumulate more debt and, perhaps as a result, seek treatment.

### **SUMMARY DISCUSSION**

The purpose of this study was to identify the principal cognitive errors and misunderstandings held by individuals who participate in games of chance and determine their correlations with various measures of gambling behavior. While preliminary in nature, the

studies provided considerable evidence of both the existence and nature of such cognitive errors. Principal components analysis disclosed 2 dimensions of erroneous thinking about games of chance that were categorized as the Illusion of Control and Superstition. Each of these dimensions had strong internal consistency. These dimensions were intercorrelated, not independent of one another.

There was further evidence that these 2 dimensions, both independently and combined in a total score, are correlated with gambling behavior; the stronger the erroneous beliefs and misunderstandings about chance events, the greater the amount of gambling. Specifically, in a random sample of the adult population, Beliefs about Chance scores were found to predict up to almost 11% of the variance in gambling behaviors. In a sample of adults who sought treatment for gambling problems, Beliefs about Chance scores predicted up to over 15% of the variance in gambling behaviors. Of the two dimensions, Illusion of Control was consistently a stronger predictor of gambling behavior than Superstition, suggesting that further research should be devoted to developing a more thorough and reliable measure of Illusion of Control to predict gambling behavior. Such a measure could predict substantially more variance in gambling behavior, as indicated by the corrected validity coefficients. It is important to note that in the community sample, the majority of subjects indicated that they never or rarely gambled. This reduced range of responses in the Gambling Behaviors probably limited the validity coefficients for the community sample.

Future research should address additional limitations. The validity coefficients in this study were corrected for unreliability, but could not be corrected for range restriction because no recent information was available showing standard deviations of frequency of gambling behavior in the general population or in treatment populations. While data on mean levels exist (e.g., Welte, Barnes, Wieczorek, Tidwell, & Parker, 2002), it is important that researchers also report the variability in gambling.

The cognitive error dimensions assessed by the DBC are distinct from those found in any other single gambling cognitive error measure to date. Joukhador et al.'s (2004) measure only assesses superstition. Jefferson and Nicki's (2003) IBS scale, which resulted in one dimension, contains items that have content relating to VDT users' illusion of control, understanding of probability and affective responses. Steenbergh et al.'s (2002) GBQ scale assesses two dimensions as does



the DBC. The first dimension, Illusion of Control, appears similar to the DBC dimension of Illusion of Control. The second dimension of the GBQ, however, is a bit different. It was called Luck/Perseverance because it contains items about the extent to which luck is perceived to play a part in winning and the belief that continued playing will result in more wins, with a larger number of items of the later type. Not surprisingly then, the Luck/Perseverance dimension of the GBQ showed a stronger association to time spent gambling than the GBQ Illusion of Control dimension. The second dimension of the DBC, in contrast, emphasized superstitious beliefs and practices, and did not show as strong an association to gambling behaviors, including length of gambling sessions and frequency of gambling, as the Illusion of Control dimension. Given the different measures that have recently been developed to assess cognitive errors in gamblers, and the different criteria used to examine their validity, it would be useful to conduct studies comparing these measures more directly. It would also be interesting to combine the items from the various measures to more accurately identify the nature and types of erroneous beliefs about games of chance.

It is also critical that future research examine the relationship of cognitive errors to the gambling behavior of gamblers who seek treatment and those who do not. The results of this study suggested that, while in both populations cognitive errors are associated with more gambling, there is something distinct about gamblers who seek treatment for their gambling problems. It would be useful to compare three groups, non-gamblers, gamblers, and gamblers who seek treatment on their level of cognitive errors. If there are no differences in cognitive errors between non-problem gamblers and problem gamblers, then some other factor or factors must distinguish these two groups, and it would be of critical interest to identify such factors.

Further research should also examine whether certain patterns of cognitive errors are associated with specific patterns of gambling behavior. Identifying whether these types of associations exist could have important benefits. If there are systematic patterns of erroneous thinking about games of chance that vary by individuals, then it should be possible not only to measure these belief patterns in a given individual but also determine the specific gambling behaviors related to such beliefs. Certain kinds of gambling might be associated with certain kinds of belief patterns. If this is the case, then an instrument that assessed such patterns of beliefs could become a useful predictor of patterns of play.

This investigation provides additional empirical support to the theory that participants in games of chance, such as casino gamblers, harbor certain kinds of erroneous beliefs regarding the games they play. Specifically, these studies reveal that there is a general misunderstanding about the probabilistic nature of games of chance and the player's ability to predict or control outcomes, and they are superstitious about their chances in play. This information, albeit restricted in the populations sampled, is an empirical foundation upon which further investigations may be based.

**APPENDIX**

*Gambling Behavior Survey*

1. Age: \_\_\_\_\_ 21-35 \_\_\_\_\_ 36-55 \_\_\_\_\_ 56-70 \_\_\_\_\_ 71 or older

2. Gender: \_\_\_\_\_ Male \_\_\_\_\_ Female

3. How often do you gamble?

- \_\_\_\_\_ never
- \_\_\_\_\_ less than once per week
- \_\_\_\_\_ 1-2 times per week
- \_\_\_\_\_ 3-6 times per week
- \_\_\_\_\_ daily
- \_\_\_\_\_ 2-3 times per day
- \_\_\_\_\_ more than 3 times per day

4. Please indicate how often you have played each of the following games of chance within the past year. Using the following scale, mark one answer for each type:

- Never
- Rarely: a few times a year
- Occasionally: once a month or more
- Often: once a week or more

	Never	Rarely	Occasionally	Often
a. Played dice games for money	_____	_____	_____	_____
b. Gambled in a casino	_____	_____	_____	_____
c. Bought a lottery or Powerball ticket	_____	_____	_____	_____
d. Played slot machines, video poker or other gambling machines	_____	_____	_____	_____

- e. Bought lottery scratch-off tickets or played a video lottery terminal \_\_\_\_\_
- f. Gambled over the Internet \_\_\_\_\_
- g. Placed bets on a sporting event for money \_\_\_\_\_
- h. Played blackjack for money \_\_\_\_\_
- i. Played poker for money \_\_\_\_\_
- j. Played roulette for money \_\_\_\_\_

**Please answer the following questions with respect to the last year:**

- 5. What is the largest amount of money you have gambled with on any one day?
  - \_\_\_\_\_ never gamble
  - \_\_\_\_\_ from \$1 up to \$25
  - \_\_\_\_\_ more than \$25 up to \$100
  - \_\_\_\_\_ more than \$100 up to \$1000
  - \_\_\_\_\_ more than \$1000 up to \$2500
  - \_\_\_\_\_ more than \$2500 up to \$5000
  - \_\_\_\_\_ more than \$5000
- 6. What is the average amount of money you gamble with per visit?
  - \_\_\_\_\_ never gamble
  - \_\_\_\_\_ from \$1 up to \$25
  - \_\_\_\_\_ more than \$25 up to \$100
  - \_\_\_\_\_ more than \$100 up to \$1000
  - \_\_\_\_\_ more than \$1000 up to \$2500
  - \_\_\_\_\_ more than \$2500 up to \$5000
  - \_\_\_\_\_ more than \$5000
- 7. On average, how long are your gambling sessions?
  - \_\_\_\_\_ never gamble
  - \_\_\_\_\_ less than 1 h
  - \_\_\_\_\_ more than 1 h up to 3 h
  - \_\_\_\_\_ more than 3 h up to 6 h
  - \_\_\_\_\_ more than 6 h up to 9 h
  - \_\_\_\_\_ more than 9 h up to 12 h
  - \_\_\_\_\_ more than 12 h up to 15 h
  - \_\_\_\_\_ more than 15 h
- 8. What is the most money you have lost in one gambling session?
  - \_\_\_\_\_ never gamble
  - \_\_\_\_\_ from \$1 up to \$25
  - \_\_\_\_\_ more than \$25 up to \$100
  - \_\_\_\_\_ more than \$100 up to \$1000
  - \_\_\_\_\_ more than \$1000 up to \$2500
  - \_\_\_\_\_ more than \$2500 up to \$5000
  - \_\_\_\_\_ more than \$5000

*Additional Gambling Behavior Survey Items – Treatment Sample Only*

- 9. What is your total debt?
  - \_\_\_\_\_ from \$1 up to \$100
  - \_\_\_\_\_ more than \$10 000 up to \$25,000

- more than \$100 up to \$1000       more than \$25,000 up to \$50,000  
 more than \$1000 up to \$5000       more than \$50,000  
 more than \$5000 up to \$10,000
10. How much of your total debt is a result of gambling?
- from \$1 up to \$100       more than \$10,000 up to \$25,000  
 more than \$100 up to \$50,000       more than \$25,000 up to \$1000  
 more than \$1000 up to \$5000       more than \$50,000  
 more than \$5000 up to \$10,000

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