JOURNAL OF APPLIED BEHAVIOR ANALYSIS 2009, **42,** 73–81 NUMBER 1 (SPRING 2009)

INFLUENCING CHILDREN'S PREGAMBLING GAME PLAYING VIA CONDITIONAL DISCRIMINATION TRAINING

TAYLOR E. JOHNSON AND MARK R. DIXON

SOUTHERN ILLINOIS UNIVERSITY

Past research has demonstrated a transformation of stimulus functions under similar conditions using gambling tasks and adults (e.g., Zlomke & Dixon, 2006), and the present study attempted to extend this research. Experimenters exposed 7 children (ages 7 to 10 years) to a simulated board game with concurrently available dice differing only by color. Following initial exposure to the game, participants were trained to discriminate between two contextual cues representing the relational frames of more than and less than. Following the training procedure, experimenters reexposed participants to the simulated board game. Six of the 7 participants demonstrated an increased preference toward the die with the color that had been paired with more than during the conditional discrimination training.

DESCRIPTORS: addiction, children, gambling, prevention, relational frame theory, risk taking

---

According to the National Gambling Impact Study Commission (1999), people who begin gambling as youth or adolescents are more likely to meet criteria for pathological gambling at some point in their lifetime than those who do not begin gambling at such an early age. Nearly one third of the pathological gamblers interviewed in a study by Dell, Ruzicka, and Palisi (1981) reported gambling prior to the age of 10 years, and nearly half of the pathological gamblers in a study by Petry (2005) reported gambling before the age of 18 years.

Of concern is that the percentage of youth and adolescents who already meet criteria for pathological gambling (11.2%, with a range of 7.7% to 34.9%; National Research Council, 1999) is almost twice as high as the reported prevalence among adults. The reported prevalence of adolescents who have gambled on occasion during their lifetime ranges from 39% to 92% with a median of 85%. Elementary students also have been found to gamble at alarming rates. For example, Ladouceur, Dube, and Bujold (1994) found that over 85% of the fourth, fifth, and sixth graders interviewed admitted to gambling, defined as betting money. Unlike adults, who are more likely to buy lottery tickets or gamble in casinos, youth tend to bet on sports, simple card games, games of skill (e.g., marbles), and less formal games of chance such as flipping coins or rolling dice (Knapp & Crossman, 2006; Petry, 2005; Stinchfield, 2000).

Smith and Abt (1984) noted that "a number of childhood and adolescent games bear a strong resemblance to gambling behavior and in some cases are actually gambling experiences" (p. 127). For example, marbles, card games, and video games share characteristics of gambling games because they require both luck and skill, and there is an emphasis on winning that leads to the potential of gain (the reinforcement of beating the other players) and loss (the aversiveness of losing the competition; Smith & Abt). However, there have been relatively few experimental studies of children's gambling behavior (for notable exceptions, see studies by Kearny & Drabman, 1992, and Hardoon & Derevensky, 2001). This paucity of research has led to large gaps in our knowledge of how gambling develops and what factors may contribute to gambling in childhood.

Address correspondence to Mark R. Dixon, Behavior Analysis and Therapy Program, Rehabilitation Institute, Southern Illinois University, Carbondale, Illinois 62901 (e-mail: mdixon@siu.edu).

doi: 10.1901/jaba.2009.42-73

Assessment of the effects of conditional discrimination training on gambling behavior may help to explain why some gambling behavior persists independent of the contingencies associated with the behavior (i.e., wins, losses) and may help us to understand ways in which gambling behavior can be altered. For example, Zlomke and Dixon (2006) assessed the preferences of 9 recreational gamblers for two concurrently available slot machines (one yellow and one blue) that were identical in terms of payout during a pretraining phase. Experimenters then trained the participants via a conditional discrimination matching-to-sample procedure to apply the arbitrary relations of more than and less than, depending on the contextual cues of blue (less) and yellow (more). Following the training procedure, the participants were reexposed to the two slot machines. Although none of the participants had a preferred slot machine prior to training, 8 of the 9 participants preferred the yellow slot machine following training; the function of the more than contextual stimulus transferred to the color of the slot machine. This finding is important because it demonstrates that arbitrary relations may exert control over gambling behavior, and this control may occur independent of the actual contingencies of the gambling behavior (e.g., an individual may continue to gamble on the yellow slot machine because yellow was associated with more than, even though the individual is not winning on the yellow slot machine).

The emergence of these arbitrary relations may be even more likely in children because the outcomes of childhood games are largely hypothetical. That is, winning a childhood game comes with little more than "bragging rights," and losing may have no detrimental tangible effect on the child. The child's risk-taking and choice-making behaviors during game playing (or pregambling activities) may be experienced without the significant negative consequences that are experienced by adult gamblers. Thus, these risk-taking and choice-making behaviors may be strengthened due to the absence of significant negative consequences for the behaviors and may set the occasion for arbitrary relations such as the ones described by Zlomke and Dixon (2006) to develop.

The purpose of the present study was to extend Zlomke and Dixon's (2006) findings by altering children's preferences for concurrently available dice via conditional discrimination training involving the relational frames of more than and less than. The goal of the replication was to determine if a transformation of function would occur in young children who had no experience with gambling, yet regularly played games of chance where gambling-like responses were emitted (e.g., dice roll). The present study incorporated a non-matching-to-sample training protocol to teach the relational frames to show that Zlomke and Dixon's findings were not an artifact of their training procedure.

METHOD

Participants and Setting

Seven typically developing children (5 boys and 2 girls) between the ages of 7 and 10 years participated. Five of the participants were in second grade, 1 was in first grade, and 1 was in fourth grade. The study was conducted with Participants 1, 3, 4, and 5 in Illinois and Participants 2, 6, and 7 in Utah. All participants had prior experience using computers either at school or at home, and all participants except Participant 5 reported prior experience with playing video games and board games that involved the use of dice. The parents of each participant signed an approved permission form, and each child signed an approved assent form as well.

The children were recruited through personal acquaintances of the investigators, and participation in the study required about 45 min of each child's time. Both to compensate the children for this time and to increase the importance of the simulated board game, each child was given $0.01 per point they earned (with a maximum earnings of $5.00).

For the convenience of the parents, the study was conducted at a location suggested by the participant's parent that met the following criteria. To minimize distractions, each participant was required to complete the experiment in a room with only the experimenter, the participant, and the parent (if the parent so desired) present. For this study, none of the parents elected to observe. Parents of Participants 1, 3, and 4 elected to have the study completed at their homes, and parents of Participants 2, 5, 6, and 7 elected to have the study completed at the home of the experimenter.

The entire experiment was programmed using Visual Basic Studio.Net 2003. The participants completed the experiment on a computer with the Windows XP operating system and an external mouse for ease of responding.

Data Collection and Interobserver Agreement

All dependent measures were recorded via the computer interface. The accuracy of the data collection by the computer program was verified manually prior to the start of the study by having two independent observers compare paper-and-pencil recorded responses to the data collected by the computer program. No errors in recording were found. Also, a program debugger was run prior to each participant to check the computer program for any errors in procedure or data collection. The debugger never reported an error. Data were obtained on every trial of the experiment. The computer program recorded the participants' choices of available stimuli, if the response was correct or incorrect if relevant, and the trial or condition number of the procedure. These individual trial data were then summarized by the computer to provide overall percentages of responding by phase and 10-trial block.

Procedure

Simulated board game pretest. The initial pretest consisted of a board game involving race vehicles and a serpentine track. To make the game appear more competitive and increase the children's motivation to complete the race quickly, there was a simulated computer opponent competing as well that appeared on the screen as a picture of a computer. The computer opponent was programmed to roll a 1 if it was ever four or more spaces ahead of the child so that the child would win more often than the computer.

At the bottom of the screen, there were two concurrently available dice (one red and one blue). The children were directed to click on one die at a time to move the game piece around the track. After reaching the finish line, the participant earned a medal. Each medal earned was accompanied by a congratulatory "ta da" sound effect from the Windows media sound files and corresponded to 25 points. The number of trials completed by each participant varied between 40 and 60 and was determined randomly. If the participant or computer completed the serpentine track prior to reaching the predetermined number of trials, a new serpentine track appeared on the screen, and the child had a chance to win another medal.

Prior to beginning the game, the experimenter read aloud the following instructions (these instructions also appeared on the computer screen so that the child could read along):

> You are going to play a game where you are racing against the computer. First, you will select what you want your game piece to look like. Then, you will see a race track with your chosen piece and the computer. In order to move your piece, you need to click on either square at the bottom of the screen to roll the dice. Your piece will move according to what you roll. If you car reaches the finish line first, you will get a medal. Each medal is worth 25 points, and you will earn one penny per point, so try to get to the finish line before the computer does as many times as you can.

After reading the instructions, the participant was allowed to select one of five game pieces (a car, a girl running, a rocket, a tank, or a unicorn). Once the participant selected a piece, he or she was able to begin the simulated board game (contact the second author for a visual representation of the board game).

The purpose of the simulated board game was to establish a baseline of responding between the two concurrently available dice. The concurrently available dice randomly appeared in either the left or the right button position to avoid any position bias. The dice were also programmed so that only one could be clicked at any given moment. Finally, an observing response of clicking an additional button was required to begin the next trial to ensure the attention of the participant. The observing response button was simply a button labeled ''click to roll'' that appeared on the screen instead of the two dice prior to each roll. The two dice were programmed to cycle through 10 random numbers before stopping on a final random number between 1 and 6. The initial 10 cycles were included to approximate animation of the dice being rolled.

Conditional discrimination training. Following the simulated board game trials, participants were trained in the arbitrary relations of more than and less than with the same colors used during the board game. The program default was to train blue as the contextual cue signaling the relation of less than and to train red as the contextual cue signaling the relation of more than. However, to control for the possibility that a participant could show a strong initial preference for red during the simulated board game pretest, the computer was programmed to train red as the more than color if the participant did not have an initial preference or if the participant had an initial preference to blue. If the participant showed an initial preference to red, the experimenter programmed the computer to train blue as the more than color. This initial preference was defined as selecting red for 60% or more of the pretest trials. No participant demonstrated a bias for the red die; therefore, for all participants, blue signaled less than and red signaled more than.

Prior to conditional discrimination training, the experimenter read aloud the following instructions (the instructions also were presented on the screen):

> You are going to see two pictures on the screen surrounded by a border. Your job is to choose one of the two pictures by clicking on the picture. If you get it right, you will hear a chime, and you will get 1 point. A smiley face will appear on the screen. If you get it wrong, you will hear an incorrect ding, and you will not get any points. A frowning face will appear on the screen. Remember you are earning one penny for every point. Please try your best and go slowly. At one point, you will not hear any sounds or see your point total. The computer is still keeping track so continue to do your best.

During conditional discrimination training, six sets of five stimuli were used. These sets of stimuli all ranged from a continuum of least to most. Stimuli were chosen to reflect monetary amounts as well as pictures depicting a range of objects, similar to those used by Zlomke and Dixon (2006).

These sets of stimuli were presented to each participant using a conditional discrimination training procedure. Sets A, B, and C were used during training, and Sets D, E, and F were used to test for generalization. During each trial of both training and testing, two stimuli were presented in the center of the screen surrounded by a contextual cue of either a blue rectangle (the contextual cue to apply the relational frame of blue) or a red rectangle (the contextual cue to apply the relational frame of red). Contact the author for a sample screen configuration.

During each training phase, a point counter was visible to each participant. The participant earned one point for every correct response. Correct responses were also accompanied by a 1-s chime and a picture of a smiley face. Incorrect responses were accompanied by a 1-s ding and a picture of a frowning face. No points were given for incorrect responses. There was a 1-s intertrial interval between each trial.

Less than. During this phase, the blue contextual cue enclosed the two comparison stimuli. The computer delivered reinforcement when the participant selected the stimulus that was less than the other comparison. For example, if the two stimuli were three slices of pizza and six slices of pizza, the computer delivered reinforcement if the participant selected three slices of pizza.

Stimuli from Sets A, B, and C were randomly presented in an 18-trial block. The criterion for moving on to the next phase was selecting the correct response in 16 of the 18 trials (89%). If the participant did not reach criterion, he or she repeated the phase.

More than. During this phase, the red contextual cue enclosed the two stimuli. The computer delivered reinforcement when the participant selected the stimulus that was more than the other stimuli. For example, if the two presented stimuli were three slices of pizza and four slices of pizza, the computer delivered reinforcement if the participant selected four slices of pizza.

Stimuli from Sets A, B, and C were randomly presented in an 18-trial block. The criterion for moving on to the next phase was selecting the correct response in 16 of the 18 trials (89%). If the participant did not reach criterion, he or she repeated the phase.

Mixed less than/more than. During this phase, each participant was presented with a mix of presentations from both more than and less than conditions. Thus, the participant had to pay special attention to the color of the contextual cue. The contextual cue presentations were randomized, and the training block consisted of 30 trials, with 15 trials with the red contextual cue (more than) and 15 trials with the blue contextual cue (less than). There were 10 trials from each of the sets. The criterion for moving to the next phase was 26 of 30 correct (87% accurate responding). If the participant did not reach criterion, he or she repeated the phase. Programmed contingencies were identical to the procedures described in more than and less than conditions.

Test for transfer of function. This phase consisted of 30-trial blocks composed of five trials each of the stimuli from Sets A, B, and C as well as five trials each of the stimuli from Sets D, E, and F. These novel sets assessed for transfer of functions of the established contextual cues. During the test for transfer of function, the point counter was not visible, and there were no sounds or faces associated with correct or incorrect responding.

If a participant did not meet the criterion of 26 of 30 trials correct (87%), he or she completed mixed less than/more than training again. After successful completion of the mixed training, the participant was reexposed to the test for transfer of function. If the participant successfully met the criterion on the test for transfer of function, he or she continued on with the study. If the participant still was not able to meet the criterion, he or she was reexposed to the mixed more than/less than condition one final time. If the participant was still unable to complete the test for transfer of function after three exposures to the mixed condition, his or her participation in the study was terminated.

Sorting task. During these 18-trial blocks, two comparisons appeared at the top of the screen, and a red die and a blue die appeared at the bottom (contact the author for a sample screen configuration). Experimenters gave the participants the instruction to "put each picture where it goes by clicking and dragging the picture to either the red die or the blue die." During this phase, no feedback (i.e., smiley face, pennies, or social praise) was given regarding accuracy of responding. Also, the participant did not need to meet a certain criterion to continue on in the experiment. The purpose of the sorting task was to explore potential transfer of stimulus functions of the contextual cues to novel stimulus sets.

The 18-trial blocks were composed of randomly selected stimuli from Sets A through F. Novel stimulus sets (i.e., sets that were not used during the previous phases) were included in the sorting task as well. These sets (G, H, I, and J) included stimuli that were slightly different than the previous stimuli in that the more than/less than relations depicted in the sets were not as clearly related to the mathematic definitions of more and less (i.e., number of objects or monetary value). Rather, these stimuli were designed to expand the transformation of stimulus function to novel sets and included the following images: thumbs up versus thumbs down, short versus tall, and a full ice cream cone versus an empty ice cream cone.

Simulated board game posttest. After completion of conditional discrimination training, each participant was reexposed to the simulated board game task. The experimenter did not give any additional instructions to the participant regarding this phase; the experimenter simply told the participant to "play the game again." The number of trials in the final condition also was determined by random selection of a number between 40 and 60. During the final exposure to the simulated board game, the outcome of rolling either of the concurrently available dice was still random.

RESULTS

During the simulated board game pretest, 4 of the 7 participants had no clear preference for either color. However, Participants 3, 4, and 5 showed a slight overall preference for the blue die. Thus, because none of the participants showed an initial preference for the red die, conditional discrimination training for all participants used red as the contextual cue for more than and blue as the contextual cue for less than.

All participants reached the criterion level of correct responding during the conditional discrimination training procedures as well as during the testing phase. Participants reached the criterion (89%) for the less than, more than, and mixed more than/less than conditions in a mean of 6.6 (range, 1 to 18), 2.7 (range, 1 to 8), and 6.4 (range, 1 to 27) training blocks, respectively (the mean for the mixed more than/less than condition was inflated due to an outlying score of 27).

Four of the 7 participants passed the test for transfer of function on their first exposure to the task with an accuracy of at least 93%. In fact, 3 of the 4 who met criterion on their first exposure had 100% accuracy for both the trained and the novel stimulus sets. Of the 3 participants who required additional training, 2 required one additional exposure to mixed training prior to meeting criterion on the test phase and 1 required a third and final exposure to mixed training to meet the criterion of 89% accuracy. However, all of these participants had at least 80% correct responding on their first exposure to the test phase. Also, it is worthwhile to note that 2 of the 3 participants responded with at least 90% accuracy on the trained sets but had initial trouble responding to the novel stimuli.

Participants responded with a mean of 95% (range, 83% to 100%) accuracy on the sorting task. The mean percentage correct responding for the trained sets was 97% (range, 89% to 100%), and the mean percentage correct for the novel sets was 94% (range, 67% to 100%). Thus, most participants performed similarly on the novel and the trained sets. This indicates that generalization to novel sets did occur for most participants. However, Participant 5 responded with 100% accuracy to the trained stimuli but with only 67% accuracy to the novel sets.

Response allocation to the red die for pre- and posttraining on the simulated board game task is displayed in Figure 1. Six of the 7 participants showed an increase in preference to the red die following the conditional discrimination training (depicted in Figure 1 as changes in the mean percentage allocation to

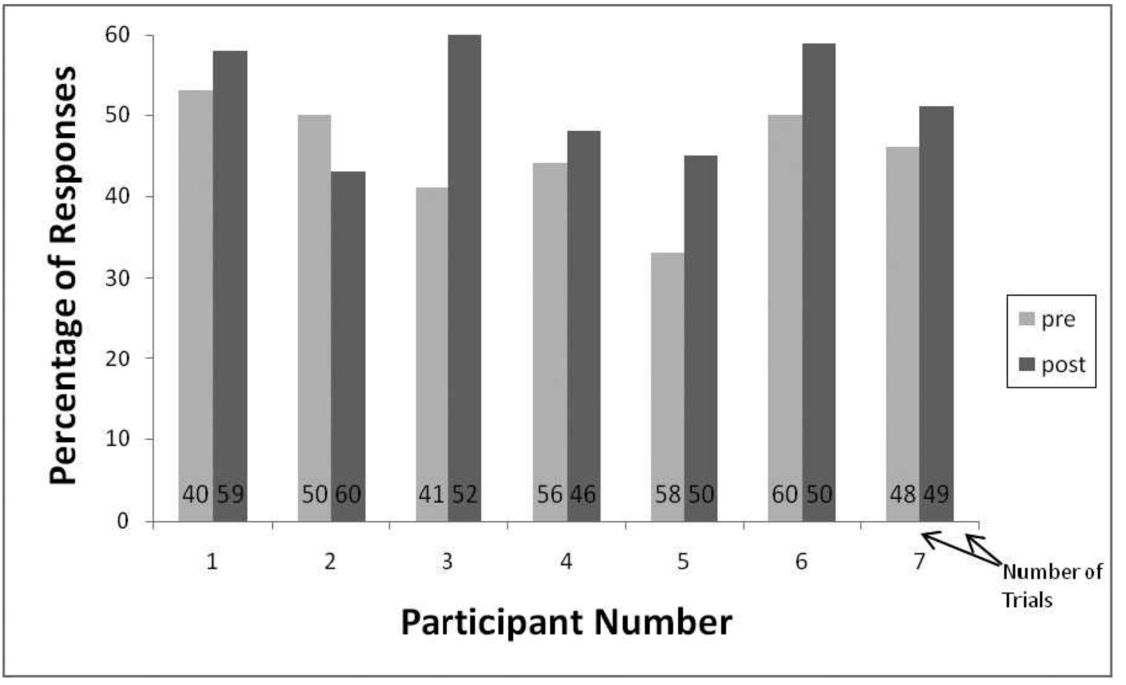

Figure 1. Percentage of responses to the red die during the initial exposure and the final exposure to the simulated board game.

the red die across all pretest to posttest trials for each participant). The participant who did not shift preference (Participant 2) was also the participant who took significantly longer to meet criterion during the testing phase.

DISCUSSION

The current study replicated previous studies with similar procedures that showed a transformation of stimulus functions of the contextual cues used in training (e.g., Dymond & Barnes, 1995; Zlomke & Dixon, 2006). Initially, none of the participants showed a preference for the red die when they were exposed to the simulated board game task with concurrently available dice whose probability of outcomes was random. Then, during conditional discrimination training, the experimenter delivered differential reinforcement for selecting the stimulus that was less than the other stimuli given the contextual cue of blue and for selecting the stimulus that was more than the other stimuli given the contextual cue of red. When the participants were reexposed to the simulated board game task with the same concurrently available dice, 6 of the 7 participants showed an increased preference for the red die. That is, they showed a shift in response allocation toward the die with the color that had served as the contextual cue for selecting more than. This indicates that a transformation of the stimulus functions of more than and less than may have occurred for these participants. The participant (Participant 2) who did not shift preference after reexposure to the simulated board game task was the participant who required a significantly greater number of training blocks to meet criterion during the mixed training phase. It is possible that his greater exposure to trials in which the colors did not serve as contextual cues may have weakened the established relational frames and may explain the lack of observed transformation of stimulus function.

The current study suggests that preference for irrelevant game characteristics (e.g., die color) can be brought under experimental control in children during their engagement in gambling-like choices (Frank & Smith, 1989; Ladouceur et al., 2003; Smith & Abt, 1984). Knapp and Crossman (2006) have suggested that such games are precursors to adult gambling, and the present findings suggest that transformations of functions can bias the responding of a child who engages in gambling-like behaviors. In addition, the child may engage in choice making and risk taking during game playing and not experience any significant negative consequences. Therefore, the child's choice-making and risk-taking behaviors may be more likely to come under the control of the conditional discriminations because the actual consequences associated with pregambling behavior are not potent. However, this hypothesis is somewhat speculative and should be examined in future research.

Although the present study replicates the findings of Zlomke and Dixon (2006) and extends the research on the development of transformation of stimulus functions in children, the limitations of the pretest–posttest design should be noted. However, this potential weakness in design was somewhat ameliorated by the random assignment of pre- and posttest trials, and the experiment still provides an initial exploration of the transformation of stimulus functions in children and how such transformations may affect children's preferences during a game of chance.

The present study also was perhaps most importantly an initial attempt to understand how risk taking and what seem like harmless choices in childhood may be related to gambling. As noted by previous researchers (Knapp & Crossman, 2006; Smith & Abt, 1984), childhood games of chance (e.g., board games or rolling dice) may serve as an early form of gambling behavior. Thus, a better understanding of children's behavior while engaging in games of chance may lead to a means of preventing gambling addiction. The scientific community has far too long relied on assumptions and assertions about why someone develops into a pathological gambler. Retroactively asking adult pathological gamblers if they gambled in childhood may provide insight into the history of the gambler, but it does not prevent the problem. Researchers need to explore means of understanding the basic mechanisms of learning that produce responding in children that mirrors such responding in adults with gambling problems. Perhaps then we will be closer to preventing the problem of gambling disorders rather than attempting to eliminate an already present addiction.

REFERENCES

Dell, L. J., Ruzicka, M. F., & Palisi, A. T. (1981). Personality and other factors associated with the gambling addiction. *Substance Use & Misuse*, *16*, 149–156.

Dymond, S., & Barnes, D. (1995). A transformation of self-discrimination response functions in accordance with the arbitrarily applicable relations of sameness, more than, and less than. *Journal of the Experimental Analysis of Behavior*, *64*, 163–184.

Frank, M. L., & Smith, C. (1989). Illusion of control and gambling in children. *Journal of Gambling Behavior*, *5*, 127–136.

Hardoon, K. K., & Derevensky, J. L. (2001). Social influences involved in children's gambling behavior. *Journal of Gambling Studies*, *17*, 191–215.

Kearny, C. A., & Drabman, R. S. (1992). Risk taking/gambling-like behavior in preschool children. *Journal of Gambling Studies*, *8*, 287–297.

Knapp, T. J., & Crossman, E. W. (2006). Pathways to betting: Childhood, adolescent, and underage gambling. In P. M. Ghezzi, C. A. Lyons, M. R. Dixon, & G. R. Wilson (Eds.), *Gambling: Behavior theory, research, and application* (pp. 207–230). Reno, NV: Context Press.

Ladouceur, R., Dube, D., & Bujold, A. (1994). Gambling among primary school students. *Journal of Gambling Studies*, *10*, 363–371.

Ladouceur, R., Sylvain, C., Boutin, C., Lachance, S., Doucet, C., & Leblond, J. (2003). Group therapy for pathological gamblers: A cognitive approach. *Behavior Research and Therapy*, *41*, 587–596.

National Gambling Impact Study Commission. (1999). *National Gambling Impact Study Commission final report*. Retrieved January 20, 2007, from http://www.ncfpc.org/NGISC%20Final%20Report/4.pdf

National Research Council. (1999). *Pathological gambling: A critical review*. Washington, DC: National Academy Press.

Petry, N. M. (2005). *Prevalence, assessment, and treatment of pathological gambling: Etiology, comorbidity, and treatment*. Washington, DC: American Psychological Association Press.

Smith, J. F., & Abt, V. (1984). Gambling as play. *Annals of the American Academy of Political and Social Sciences*, *474*, 122–132.

Stinchfield, R. D. (2000). Gambling and correlates of gambling among Minnesota public school students. *Journal of Gambling Studies*, *16*, 153–173.

Zlomke, K. R., & Dixon, M. R. (2006). Modification of slot-machine preferences through the use of a conditional discrimination paradigm. *Journal of Applied Behavior Analysis*, *39*, 351–361.

Received April 6, 2007
Final acceptance December 6, 2007
Action Editor, Chris Ninness