ISSN: 1942-6453

Analysis of Gambling Behavior

Volume 5
Number 1
Summer 2011

The Analysis of Gambling Behavior (AGB) is a peer-reviewed publication that contains original general interest and discipline specific articles related to the scientific study of gambling

Content of the Analysis of Gambling Behavior

The Analysis of Gambling Behavior (AGB) contains general interest and discipline specific articles related to the scientific study of gambling. Articles appropriate for the journal include a) full-length research articles, b) research reports, c) clinical demonstrations, d) technical articles, and e) book reviews. Each category is detailed below along with submission guidelines:

Research Articles – a manuscript of full length (20-30 double-spaced pages approximately), which may contain multiple experiments, and are original contributions to the published literature on gambling.

Research Reports – a manuscript of reduced length (no more than 10 double-spaced pages and a single figure or table page), which may be less experimentally rigorous than a Research Article, a replication of or failure to replicate a prior published article, or pilot data that demonstrates a clear relationship between independent and dependent variable(s). The Results and Discussion sections of Reports should be combined.

Clinical Demonstrations – a manuscript of reduced length (no more than 8 double-spaced pages and a single figure or table page) which lack the rigor of a true experimental design, yet do demonstrate behavior change of persons with gambling disorders under clinical care. This manuscript should contain an Introduction, Methods/Treatments, Results, and Discussion sections. The Results and Discussion sections of Clinical Demonstrations should be combined.

Technical Article – a manuscript of either full or reduced length, depending on necessity, that describes either a new technology available that would be of interest to researchers or a task-analysis style description of how to utilize existing technology for the conducting of research. Examples of appropriate topics may include, but are not limited to, the rewiring of a slot machine for the collection of data or controlling of win/losses, how to use computer software to simulate a casino game, or the way in which neuroimaging devices may interfaced with an experimental apparatus.

Book Review – a review of a contemporary book related to gambling not more than three years after the publication data of the book to be reviewed. The review should be no more than 15 doubled-spaced pages in length.

ANALYSIS OF GAMBLING BEHAVIOR

Volume 5, Number 1, Summer 2011

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Contents

EDITORIAL COMMENT: TURNING THE CORNER AT *ANALYSIS OF GAMBLING BEHAVIOR*

Jeffrey N. Weatherly
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Although it may not be apparent by the current issue, *Analysis of Gambling Behavior* has turned a corner of sorts. In the past, we have received a sufficient number of submissions from a small group of researchers and laboratories to support a high-quality journal. We are fortunate that we are still receiving quality submissions from those same researchers and laboratories. What has changed, however, is that the journal is now receiving unsolicited submissions from researchers and laboratories from across the country and world that represent new contributors to the journal.

The journal has been graced by the fact that the submissions that it has received to date have generally been good quality, behavior-analytic studies of gambling behavior. We have also benefitted from the skills of a large number of reviewers, who have helped ensure that the submissions that were ultimately accepted for publication met high standards of scientific quality. My compliments go out to both previous authors in the journal and the reviewers who helped make those contributions as strong as they could be.

That is not to say, however, that the journal has published all the papers that have been submitted. It has not. Admittedly, the acceptance rate at *Analysis of Gambling Behavior* has been higher than one might find at long-standing, highly respected journals that receive far more submissions than they could possibly publish. We have not had that luxury. However, we also have not had to deal with a large number of submissions that were clearly below the standards and mission of journal.

By my calculations, the majority of the research papers that have been submitted to *Analysis of Gambling Behavior* and have ultimately been published were initially reviewed as "revise and resubmit." Nearly 15% of the research papers that have been submitted to the journal have not been accepted for publication and have not been published. Again, that percentage is likely not high enough for researchers in the field to consider *Analysis of Gambling Behavior* a highly competitive journal, at least when it comes to acceptance rates. On the other hand, it does indicate that we do not simply publish manuscripts because they are submitted to the journal.

The impetus for penning this editorial comment is to inform readers and potential contributors to *Analysis of Gambling Behavior* that the acceptance rates will most likely be decreasing in the future. As noted before, the journal continues to receive research papers from laboratories that have been consistent contributors to the journal since its inception. It is now also receiving a solid number of submissions from different laboratories that represent novel submitters to the journal. For the first time in the journal's history, we now stand at the point at which accepted articles are queued for upcoming issues rather than being immediately published in the next issue.

As the number of submissions increases, and I am certainly hopeful that the recent rise in submissions will continue, the editorial board will have the opportunity to become more discriminating in the papers that get accepted. That does not necessarily mean that they will, or that they should. Rather, it represents the opportunity for the board to reevaluate the mission of the journal and to make future decisions on submitted manuscripts based solely on that mission. The peripheral contingencies of making sure that the journal had enough articles to publish a legitimate issue are (hopefully) no longer in play. And that is a good thing.

I know a good number of the past contributors to the journal on a personal basis. I certainly want to thank them for their efforts as well as their willingness to have their work represented on the pages of *Analysis of Gambling Behavior*. I also sincerely hope that now, as the journal appears to have turned the corner, they continue to see the journal as a viable outlet for their research and that the journal continues to see submissions from their research programs.

On the flip side, I also certainly do not want to see the journal become exclusive. That is, where one can find journals that are the private publishing ground of the editorial board of that journal, I would like to encourage people from outside the editorial board to submit their work when that work fits within the scope of the journal. At present, the number of submissions from this group seems to be growing. I think I speak on behalf of the entire editorial board when I say that is a good thing and we hope that it continues.

Which, in conclusion, brings me to the present issue of the journal. As I noted at the beginning of this editorial comment, one might not be able to discern the truth of my comments given that a large proportion of the articles in the present issue come from my laboratory. That will hopefully not be the case in future issues. With that said, however, I plan to continue an active research program on the behavior-analytic study of gambling behavior and I certainly view *Analysis of Gambling Behavior* as an excellent outlet for that work. So, do not be surprised to see the work from my laboratory and students in future issues of the journal! And consistent with the above comments, should the board become increasingly discriminating in what articles get accepted for publication in the journal, I certainly expect that my work will be subjected to the same standards as every other work that gets submitted to *Analysis of Gambling Behavior*.

Jeffrey N. Weatherly
Executive Editor
Analysis of Gambling Behavior

A RAT MODEL OF GAMBLING BEHAVIOR AND ITS EXTINCTION: EFFECTS OF "WIN" PROBABILITY ON CHOICE IN A CONCURRENT-CHAINS PROCEDURE

David N. Kearns and Maria A. Gomez-Serrano
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Two experiments examined the effects of varying the probability of "wins" within a rat model of gambling. On a concurrent-chains procedure, rats could choose between a "work" lever on which a fixed 20 responses produced a food pellet or a "gamble" lever, where on some trials ("wins") only one response was required for reinforcement while on other trials 40 responses were required. Despite the fact that the work lever was always associated with the higher overall reinforcement rate, rats frequently chose to respond on the gamble lever. The frequency with which rats chose the gamble lever varied as a function of win probability. Extinction of the gamble choice (i.e., gamble-lever choices no longer resulted in wins) resulted in consistent choice of the work lever. The behavioral baselines reported in the present study may prove useful for investigators interested in employing a rat model of gambling.

Keywords: gambling, choice, concurrent chains, impulsivity, rats

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There has been growing interest in the development of animal models that capture essential features of human pathological gambling (Johnson, Madden, Brewer, Pinkston, & Fowler, 2011; Madden, Ewan, & Lagorio, 2007; Peters, Hunt, & Harper, 2010; Weatherly & Derenne, 2007; Winstanley, Cocker, & Rogers, 2011; Zeeb, Robbins, & Winstanley, 2009; Zeeb & Winstanley, 2011). As Madden et al. (2007) note, there are a number of practical difficulties with human models of gambling and animal models can permit investigators to manipulate neuropharmacological variables and to take measures of brain functioning. Animal models might also be used in the development of a treatment for pathological gambling, which is estimated to occur in 1-3% of the population (Petry, 2005; Welte, Barnes, Tidwell, & Hoffman, 2008).

An early effort to develop an animal model of gambling used a concurrent-chains schedule in pigeons. Boeving and Randolph (1975) trained pigeons on a procedure where two white keys were simultaneously illuminated during the initial link. Once a pigeon made 10 responses on a particular key, the second (terminal) link of that chain was entered (and

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Supported in part by the National Institute on Drug Abuse, grant number R01DA008651, and American University's faculty Mellon Fund.
The content is solely the responsibility of the authors and does not necessarily represent the official view of the National Institute on Drug Abuse or the National institutes of Health. The authors thank Brendan Tunstall for his helpful comments on this manuscript.

the other key went dark). For one key, the second-link schedule was fixed-ratio (FR) 30, while for the other key it was multiple FR-5 FR-80. On the multiple schedule key, the ratio in effect was either FR-5 or FR-80 and each ratio was associated with a different stimulus (a triangle or parallel lines) projected on the key. Food was delivered when the second-link ratio requirement was completed. Then, a new trial commenced.

Initially, FR-5 and FR-80 were equally likely to be the effective ratio when the multiple schedule alternative was chosen. Pigeons chose this "gamble" key 100% of the time under these conditions, even though they had to make 42.5 responses per reinforcer on average (the mean of 5 and 80) as opposed to only 30 responses on the FR-30 key. Boeving and Randolph then decreased the probability of a "win" (an FR-5) occurring on the gamble key in steps from 0.5 to 0.4 to 0.25 to 0.05 and finally to 0. All pigeons continued to exclusively choose the gamble key when the probability of a small ratio (win) was 0.25 and two of three pigeons continued to exclusively choose the gamble key when this probability was as low as 0.05. Such choice is remarkable because at a 0.05 probability of the small ratio, pigeons would have to make on average 76 responses per reinforcer on the gamble key as compared to only 30 on the FR-30 key. Thus, by choosing to gamble, pigeons risked the opportunity to earn reinforcement at an overall much higher rate. Only when there was no chance of a "win" (i.e., when the probability of FR 5 was 0) did pigeons prefer the FR-30 key.

The goal of the present study was to further explore the concurrent-chains model of gambling in rat subjects. A method similar to that used by Boeving and Randolph (1975) was used to investigate the effects of varying the probability of "wins" on choice of the gambling-like option in rats. The effects of extinction of the choice to gamble (i.e., removing the consequence maintaining gambling) were also investigated. Adapting the concurrent-chains model of gambling for use with rats would expand its usefulness to a species that has been used in much recent behavioral neuroscience research. Though rats and pigeons perform similarly on many learning tasks, previous research using the delay discounting procedure has demonstrated species differences in impulsive choice (Green, Myerson, Holt, Slevin, & Estle, 2004). Experiment 1 used a within-subjects design and Experiment 2 used a between-groups design.

EXPERIMENT 1

In Experiment 1, rats chose between two retractable levers that were inserted into the chamber. The initial-link schedule was FR-1 for both alternatives. When a lever-touch response was made on one lever, the other lever retracted and the rat was required to complete the terminal-link schedule requirement associated with the chosen lever (that remained inserted) to receive a food pellet. The terminal links were FR-20 on one alternative (the "work" lever) and multiple FR-1 FR-40 on the other alternative (the "gamble" lever). Initially, the FR-1 ("win") and FR-40 ratios were equiprobable on the gamble lever. That is, if a rat chose this alternative, there was a 50% chance that it would only have to emit one response (FR-1) to earn food on that trial (i.e., on a win trial). A tone signaled when these FR-1 trials occurred. On the remaining 50% of trials, 40 responses (FR-40) were required for reinforcement. On the work lever, 20 responses (FR-20) were always required for reinforcement on every trial that it was chosen. Over phases, the probability of an FR-1 (i.e., a win) occurring on the gamble lever was changed in steps from 0.5 to 0 and then back to 0.5.

These contingencies were arranged so that the gamble lever was always associated with the lower overall rate of reinforcement throughout all phases of the experiment. That is, choosing to gamble was never the rational choice in terms of maximizing reinforcement rate. In some phases, the difference in overall reinforcement rates between the alternatives was relatively small. For example, when the probability of a win was 0.5, on average 20.5 responses (the mean of 1 and 40) were required for reinforcement on the gamble lever as compared to 20 on the work lever. With the 0.5 win probability, the difference in reinforcement rates between levers may not have been discriminable. However, in other phases, the difference in reinforcement rates was much greater. For example, when the probability of a win was 0.125 (1 out of 8 ratios were FR-1), on average 35 responses were required for reinforcement on the gamble lever as compared to only 20 responses on the work lever. Under these circumstances, rats risked having to make many more responses per reinforcer by choosing to gamble.

METHOD

Subjects

Subjects were 4 adult male Long-Evans rats maintained at approximately 80% of their free-feeding bodyweights (~350-450 g). Rats were individually housed in stainless-steel hanging cages where they had unlimited access to water and were fed approximately 12–15 g of laboratory rat chow following training sessions. The colony room where subjects were housed was on a 12:12 h light:dark cycle, with lights on at 08:00 h. Throughout the experiment, rats were treated in accordance with the Guide for the Care and Use of Laboratory Animals (National Academy of Sciences, 1996) as well as the guidelines of the Institutional Animal Care and Use Committee (IACUC) of American University.

Apparatus

Training took place in a Coulbourn Instruments test chamber (28.5 cm×25.5 cm×39.5 cm) enclosed in a Coulbourn Instruments sound attenuation shell that was equipped with an exhaust fan. The two sidewalls of the chamber were made of Plexiglas and the front and rear walls were made of aluminum. The grid floor consisted of 0.7-cm diameter steel rods spaced 1.3 cm apart. The chamber was continuously illuminated by a 100-mA houselight mounted on the rear wall of the sound attenuation shell. Two retractable levers (Scientific Prototype; 3.2 cm×1.0 cm) were located on the front wall approximately 2 cm from the left or the right side walls and approximately 2.5 cm from the floor. When fully inserted, each lever extended 1.2 cm into the chamber. When retracted, a guillotine door descended to cover the aperture through which the lever moved. Each lever, as well as the grid floor, was connected to a Med-Associates lickometer circuit so that lever contacts (touches) could be measured. The lever-contact response was the operant used in this study. The food trough was located on the front wall directly between the levers. Food pellets (P.J. Noyes Co., 45-mg Formula 1-A pellets) were delivered by a Coulbourn Instruments Model E14-12 food dispenser. All experimental events were controlled by a computer located in an adjacent room that was running Med-PC (Med-Associates) software.

Procedure

Lever-touch response acquisition. Rats were first trained to respond on both levers with the same schedule in effect on both. On the first session, one of the levers (randomly selected) was inserted into the chamber for 10 seconds and a food pellet was delivered upon retraction. In addition to this contingency of response-independent food pellet presentation, an FR-1 contingency operated such that the lever immediately retracted and the food pellet was delivered if the subject touched the inserted lever. Only one lever was inserted at a time. After an inter-trial interval lasting 60 seconds on average (range: 40-105 s), the next trial commenced with the insertion of one of the levers, selected at random with the restriction that no more than 2 consecutive trials were of the same lever. There were 50 trials per session (25 of each lever). Rats were trained on this procedure until a lever-contact response was made on at least 80% of trials. On subsequent sessions, the response-independent contingency of food delivery/lever retraction was discontinued. The response requirement was gradually increased over sessions until rats regularly responded on both levers on an FR-40 schedule of lever-touching.

Forced-choice sessions. Rats were then exposed to both levers on an alternating, forced-choice procedure to ensure that they had equivalent exposure to the reinforcement schedules associated with each lever prior to the start of free-choice (concurrent chains) training. For half the rats, the left lever was designated the work lever and the right lever was the gamble lever. For the other half of the subjects, these designations were reversed. The position of the work and gamble lever remained constant for each rat throughout the experiment. Rats did not choose which lever to respond on during these sessions. Each lever was presented 50 times over the course of a session in a random order with the restriction that no more than 2 consecutive trials were of the same type. There was an inter-trial interval lasting 7 s on average (range: 5-12 s) between lever insertions. For both levers, the initial-link schedule was an FR-1. Touching the lever once advanced the subject to the terminal-link schedule. For the work lever, this was FR-20. Completion of 20 lever touches resulted in delivery of a food pellet and lever retraction. For the gamble lever, the terminal link was multiple FR-1 FR-40. On half of the gamble-lever trials, an FR-1 (one lever touch) had to be completed for food pellet delivery (and lever retraction). These trials were signaled by the tone stimulus, which was activated when the initial-link FR-1 response was made and was turned off when the terminal-link FR-1 response was made. On the other half of the gamble-lever trials, the subject was required to make 40 lever touches to complete the trial and earn a food pellet. The sequence of FR-1 and FR-40 ratios on the gamble lever was randomized with the restriction that the same ratio did not occur on more than 2 consecutive gamble-lever trials. Rats were trained on this procedure for 4 sessions.

Free-choice sessions. Each free-choice session began with 32 forced-choice trials (16 of each lever) just like those described above. This was done to ensure that subjects remained familiar with the terminal-link contingencies available on both of the levers. Then there were 100 free-choice trials. On these trials, both levers inserted simultaneously. A lever-touch response on one of the levers resulted in retraction of the opposite lever. The subject was then required to complete the terminal-link schedule requirement associated with that lever in order to obtain a food pellet. For example, if the work lever was chosen, the gamble lever immediately retracted and the rat was required to emit 20 lever touches on the work lever. Then, a food pellet was delivered, the work lever retracted, and the inter-trial interval (mean: 6 s; range: 4-9 s) began. This interval was not an adjusting inter-trial interval, but instead its length was randomly selected from a list of values independently of how long it took the rat to complete the previous trial. If the gamble lever was chosen, the work lever retracted and then either an FR-1 (signaled by the tone) or FR-40 schedule was in effect on the gamble lever. Completion of the ratio resulted in food pellet delivery, lever retraction, and initiation of the next inter-trial interval.

The probability of the FR-1 ratio (i.e., a win) occurring when subjects chose the gamble lever was manipulated over phases lasting generally 8 sessions each. (This win probability also applied to the 16 forced-choice gamble-lever trials at the start of each session.) The win probabilities were varied over phases in the following order: 0.5, 0.25, 0.125, 0, 0.125, 0.25, 0.5. The sequence of wins and losses that occurred on gamble-lever trials was randomized within blocks of 16 trials. For example, when the probability of a win was 0.25, each block of 16 gamble trials included 4 wins and 12 losses, with the order of wins and losses randomized within this sequence of 16 trials. The same process was used with the other probabilities, adjusting the number of wins and losses per block of 16 to achieve the desired win probability.

Data Analysis

The primary measure of interest was percentage of free-choice trials on which the gamble lever was chosen. For all statistical tests, α was set to 0.05. To determine if there was an effect of win probability on choice, the non-parametric Page's L test for ordered alternatives (Page, 1963) was performed on percentage of free choices on the gamble lever averaged over the last 3 sessions of each phase. Separate Page's tests were performed on the first 4 phases (where win probability decreased from 0.5 to 0) and on the last 4 phases (where win probability increased from 0 to 0.5).

RESULTS AND DISCUSSION

Rats required a mean of 8.8 (± 0.8 SEM) sessions to learn to regularly respond on both levers on an FR-40 schedule. Thus, including the 4 forced-choice sessions that followed response acquisition, rats had a mean of 12.8 (± 0.8) total sessions prior to the start of free-choice training. Figure 1 presents for individual subjects the percentage of free-choice trials on which the gamble lever was chosen during each free-choice session. Figure 2 presents the mean (± SEM) gamble-lever choice percentage averaged over the final 3 sessions of each phase.

As Figure 1 illustrates, 3 out of 4 subjects displayed near exclusive choice of the gamble lever by the end of the first phase where the probability of a win was 0.5. The fourth subject chose the gamble lever on approximately 40% of the trials. When the probability of a win on the gamble lever was reduced to 0.25, 3 out of 4 subjects continued to choose the gamble lever, despite the fact that 50% more responses on average (FR-20 vs. the mean of 1, 40, 40, 40 = 30.3 responses) were required to earn a food pellet on that lever. When the probability of a win was reduced to 0.125, 2 out of 4 rats continued to regularly choose the gamble lever and the group mean percentage of trials where the gamble lever was chosen remained above 50% (see Figure 2). This result occurred despite the fact that on average rats had to make 35 responses per food pellet (mean of seven FR-40 ratios and one FR-1

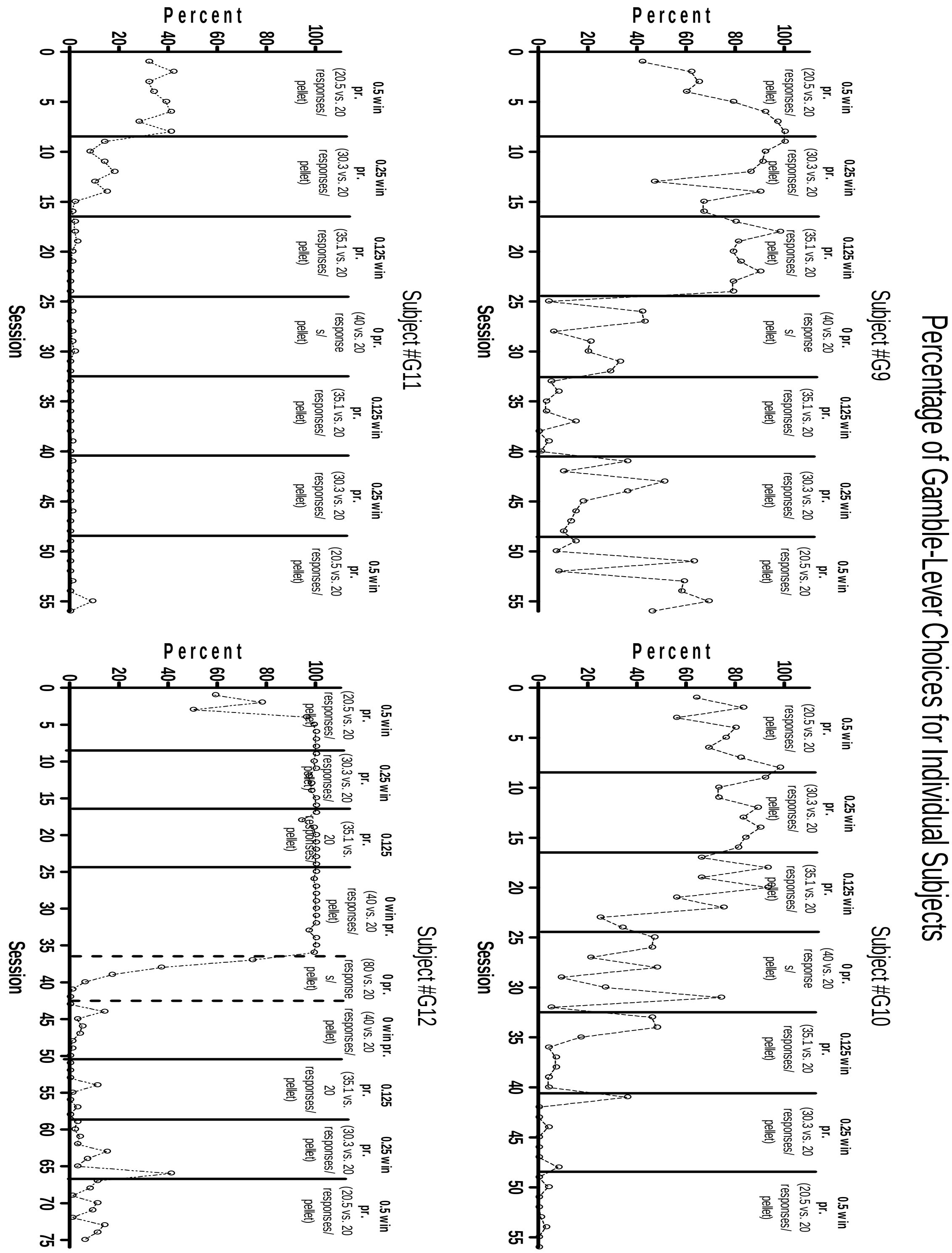

Figure 1. Individual subjects' data from Experiment 1. Data presented are the percentage of free-choice trials made on the gamble lever in each session. Phases are demarcated by solid vertical lines. The win probability (i.e., probability of an FR-1 on the gamble lever) operative in each phase is indicated above the data points. The numbers in parentheses represent the mean number of responses required per reinforcer on the gamble lever vs. the work lever.

ratio) on the gamble lever versus only 20 responses on the work lever. It should be noted that the pigeons trained by Boeving and Randolph (1975) on a similar procedure generally chose the gamble alternative more frequently than the rats did in the present experiment. This result is consistent with the finding by Green et al. (2004) that pigeons respond more impulsively than rats on choice tasks.

When the probability of a win was 0 (i.e., when the choice was simply between FR-20 and FR-40 terminal links), 3 out of 4 rats now more frequently chose the work lever. The fourth subject – G12 – continued to exclusively choose the gamble lever even after 4 extra sessions (12 total) on this choice contingency. Therefore, this subject was trained for 6 additional sessions where the FR associated with the gamble lever was increased from FR-40 to FR-80 (see Figure 1, lower right panel). On this contingency, the subject finally came to choose the work lever. Subject G12 was then run for 8 sessions with win probability 0 and FR-40 on the work lever so that this subject's training experience was similar to that of the other subjects before progressing to the next phase. (For subject G10, there were 4 occasions between sessions 31 and 45 where the gamble lever was found to have malfunctioned and was stuck in the inserted position at the end of the session. Data were discarded from each of these sessions and a replacement session was run in its place the following training day.)

A Page's L test performed on the choice percentages averaged over the final 3 sessions (see Figure 2) of each of the first 4 phases (where the win probability was deceased from 0.5 to 0) confirmed that choice of the gamble lever significantly decreased over phases ($L[4] = 115$, $p < 0.01$).

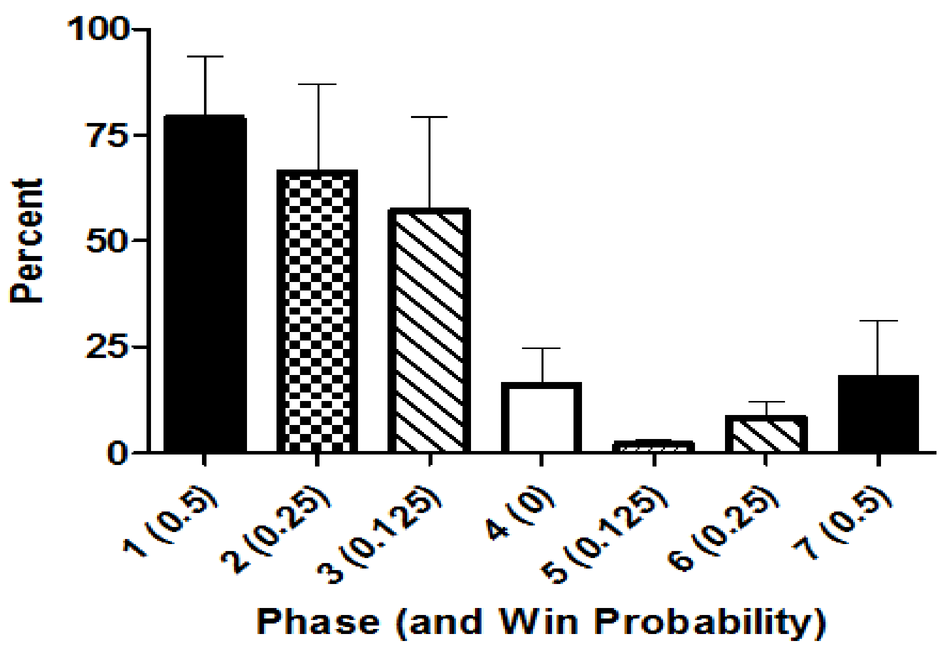

Figure 2. Mean (± SEM) percentage of free-choice trial choices on the gamble lever averaged over the last 3 sessions of each phase in Experiment 1. The numbers in parentheses on the X-axis indicate the win probability that was in effect on the gamble lever during each phase.

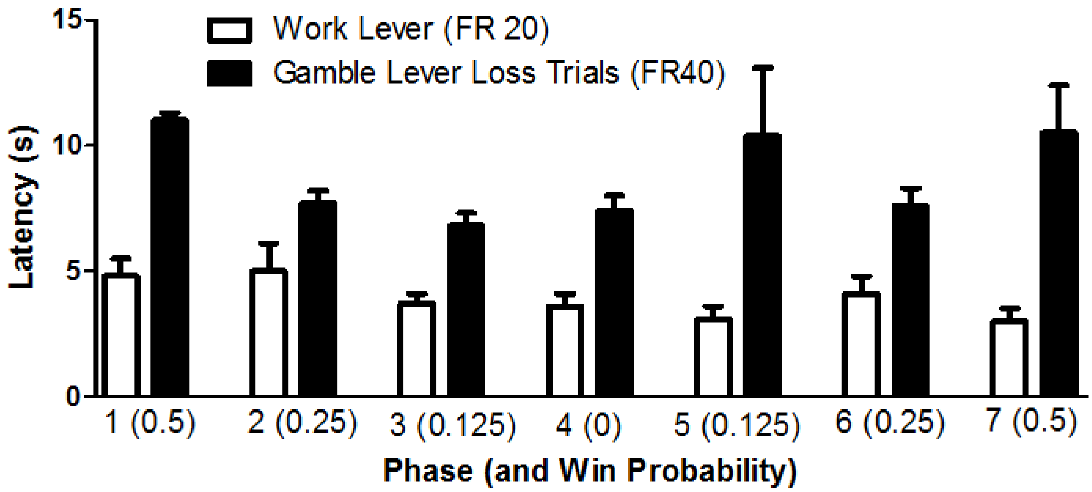

Figure 3. Mean (± SEM) latencies (in seconds) to complete the FR-20 and FR-40 ratios on the work and gamble levers, respectively, averaged over the final 3 sessions of each phase in Experiment 1.

After the 0 win probability phase, subjects were trained for 8-session phases with the 0.125, 0.25, and 0.5 win probabilities (now in ascending order). As Figure 1 shows, the effects of the 0 win probability contingency were persistent. Animals continued to generally choose the work lever, even when the probability of a win on the gamble lever was increased to 0.5. Even subject G12, who previously displayed exclusive choice of the gamble lever during the initial 3 phases and only came to choose the work lever when the FR-40 ratio was increased to FR-80, now showed near exclusive choice of the work lever even as the win probability was increased to 0.5.

A Page's L test performed on the percent choices for the gamble lever averaged over the last 3 sessions (see Figure 2) of the final 4 phases (where win probability increased from 0 to 0.5) indicated that there was no significant effect of phase ($L[4] = 103$, $p > 0.05$).

Rats' behavior after the 0 win probability phase suggests that the effects of extinction of gambling behavior (i.e., removal of the outcome maintaining the choice to gamble) persist even in situations that previously engendered high rates of gambling behavior. It is unlikely that this effect was due to rats not learning that FR-1 ratios were again available on the gamble lever because each free-choice session began with 32 forced-choice trials where the subject was made to experience the contingencies operating on each lever.

Figure 3 presents mean (± SEM) latencies to complete the terminal-link ratio on free-choice work-lever (FR-20) trials and on gamble-lever loss (FR-40) trials averaged over the final 3 sessions of each phase. If, due to exclusive choice of one or the other lever, there were no work-lever or gamble-lever loss trials during the last 3 sessions, then earlier session(s) from the phase were used in calculating the average. As Figure 3 illustrates, work-lever FR-20 ratios were generally completed in 3-5 s and gamble-lever FR-40 ratios were generally completed in 7-11 s. Latencies are not presented for the gamble win (FR-

1) trials because the computer program resolution was set to 1 s. This caused most of the gamble-lever win trial latencies to be recorded as 0 since these FR-1 ratios were usually completed in less than 1 s. Extrapolating from the approximate 4-s latency to complete the FR-20 ratios it may be estimated that gamble-lever win FR-1 ratios were completed in approximately 0.2 s (4 s/20 = 0.2 s).

EXPERIMENT 2

Experiment 1 used a within-subjects design with multiple phases to investigate the effect of various win probabilities on choice of the gamble lever. As was especially evident after the 0 win probability phase, results suggested that exposure to one probability influenced choice behavior in subsequent phases. To investigate the effect of different win probabilities without the influence of potential order effects, Experiment 2 used a between-groups design. Separate groups of rats (different from those used in Experiment 1) were trained on only one of the win probabilities used in Experiment 1.

METHOD

Subjects & Apparatus

Subjects were 20 adult Long-Evans rats maintained at approximately 80% of their free-feeding bodyweights (~350-450 g). Rats were housed under the same conditions described in Experiment 1. Throughout the experiment, rats were treated in accordance with the Guide for the Care and Use of Laboratory Animals (National Academy of Sciences, 1996) as well as the guidelines of American University's IACUC. The apparatus was the same as that described in Experiment 1.

Procedure

Lever-touch response acquisition. Rats were first trained on the same lever-touch acquisition procedure as that described in Experiment 1 until they responded on an FR-40 schedule on both levers.

Forced-choice sessions. Rats were then assigned to one of four groups, based on the win probability that they would experience: 0 probability (n=4), 0.125 probability (n=6), 0.25 probability (n=6), and 0.5 probability (n=4). The gamble-lever and work-lever designations were counterbalanced over left and right levers within each group. The position of the gamble and work levers remained constant for individual subjects throughout the experiment. Forced-choice training proceeded just as described in Experiment 1, except the probability of a win on gamble-lever trials was 0.5 only for the 0.5 group. For the 0, 0.125, and 0.25 groups, the probability of a win on gamble-lever trials was 0, 0.125, and 0.25, respectively. There were 5 forced-choice sessions (instead of 4 sessions as in Experiment 1). All other aspects of the procedure were the same as those described in Experiment 1.

Free-choice sessions. Rats were then trained for 8 sessions on the same free-choice training procedure as that described in Experiment 1. The probabilities of a win on trials when the gamble lever was chosen remained at 0, 0.125, 0.25, and 0.5 for the 0, 0.125, 0.25, and 0.5 groups, respectively, throughout this experiment.

Data Analysis

The primary measure of interest was percentage of free-choice trials on which the gamble lever was chosen. For all statistical tests, α was set to 0.05. A Kruskal-Wallis test, followed by the associated multiple comparison procedure (Siegel & Castellan, 1988), was performed on the percentage of gamble-lever choices averaged over the last 3 sessions.

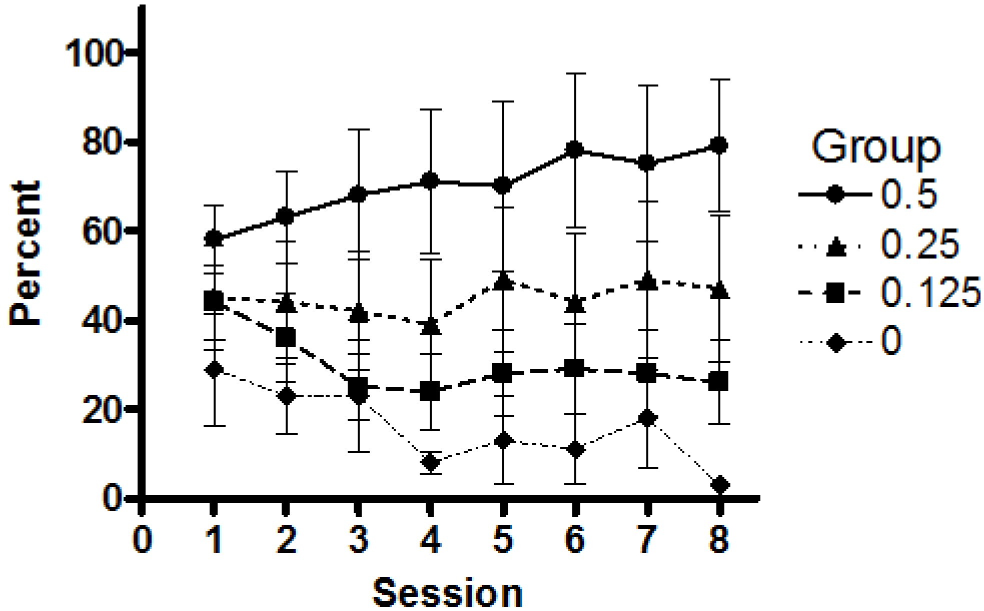

Figure 4. Mean (± SEM) percentage of free-choice trials on which the gamble lever was chosen over sessions for each of the 4 groups in Experiment 2.

RESULTS AND DISCUSSION

Rats required a mean of 7.1 (± 0.1 SEM) sessions to learn to respond on the FR-40 schedule on both levers. With the 5 forced-choice sessions that followed acquisition, rats had a mean of 12.1 (± 0.1 SEM) total sessions prior to the start of free-choice training.

Figure 4 presents for each group the mean (± SEM) percentage of trials on which the gamble lever was chosen on each of the 8 free-choice sessions. By the end of training, rats in the 0.5 win probability group chose the gamble lever on almost 80% of trials. This outcome replicates the result of the first phase of Experiment 1, where the mean percentage of gamble-lever choices was also approximately 80% at the end of the first phase where the win probability was 0.5. Rats in the 0.125 and 0.25 win probability groups chose the gamble lever on approximately 25% and 45% of trials, respectively, by the end of training. By the end of training, rats in the 0 win probability group of Experiment 2 almost never chose to gamble, which is not surprising since for this group the choice was simply between FR-20 vs. FR-40 terminal links.

A Kruskal-Wallis test performed on the percentage of gamble-lever choices averaged over the last 3 sessions indicated that the groups significantly differed ($\chi2[3] = 7.93$, $p < 0.05$). Subsequent group comparisons, using the Kruskal-Wallis post-hoc procedure described by Siegel and Castellan (1988), indicated that the 0.5 and 0 groups significantly differed from each other ($p < 0.05$), while the 0.25 and 0.125 groups were intermediate to and did not significantly differ from either of these extremes ($p > 0.05$).

Figure 5 presents mean latencies to complete the free-choice work-lever FR-20 ratios and the gamble-lever FR-40 ratios averaged over the final 3 sessions

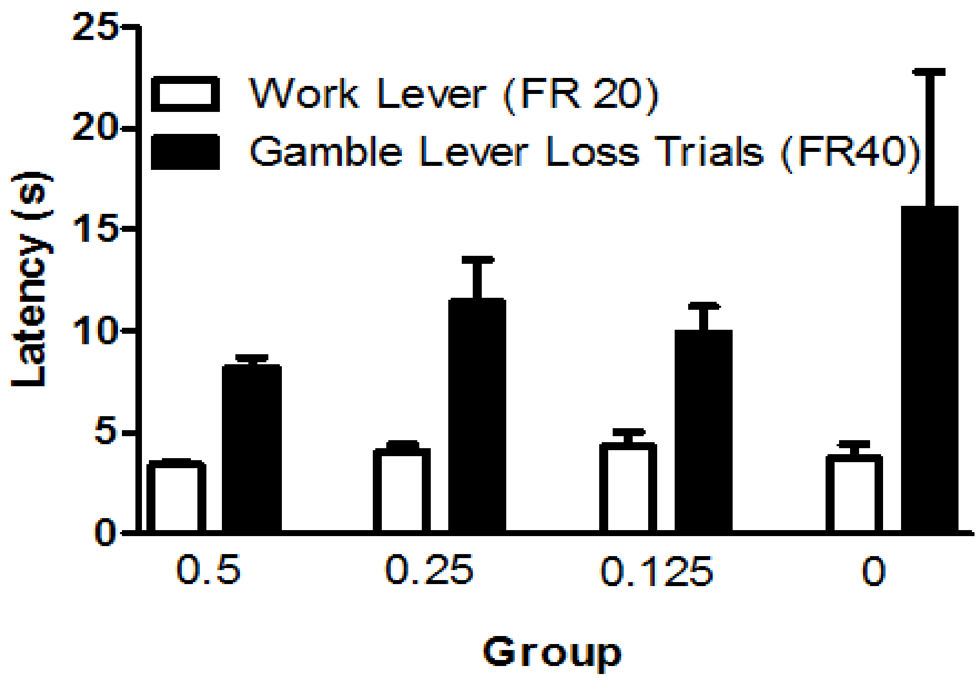

Figure 5. Mean (± SEM) latencies (in seconds) to complete the FR-20 and FR-40 ratios on the work and gamble levers, respectively, averaged over the final 3 sessions for each group in Experiment 2.

(again, data from earlier sessions were used if there was exclusive choice for one lever during the final 3 sessions). Similar to the results from Experiment 1 presented in Figure 3, rats generally required approximately 4 s to complete the FR-20 ratio and slightly more than double that to complete the FR-40 ratios.

GENERAL DISCUSSION

Experiments 1 and 2 demonstrated that rats would frequently choose an alternative associated with a lower overall reinforcement rate over one associated with a higher rate if the former provided occasional and unpredictable opportunities to receive food on an FR-1 schedule. The work lever was the rational (overall reinforcement rate maximizing) choice throughout both experiments (even when the win probability was 0.5), yet rats frequently (and sometimes exclusively) chose the gamble lever. By choosing the gamble lever, rats risked the opportunity to receive food for a fixed and relatively modest amount of work (FR-20) for the chance to collect a food pellet for very little effort (FR-1). Rats continued to frequently take this risk when the cost in the long run was having to make almost double the number of responses per reinforcer (i.e., on the 0.125 win probability contingency). These results fit with much previous research showing that animals often prefer probabilistic schedules of reinforcement over fixed schedules, even when the probabilistic schedule is associated with a lower reinforcement rate (e.g., Davison, 1969; Fantino, 1967; Herrnstein, 1964; Kendall, 1987, 1989; Rider, 1979, 1983; Sherman & Thomas, 1968)

Results of Experiment 1 also suggest that removal of the consequence (i.e., wins) that maintains gambling behavior has an effect that persists even in situations that previously engendered high rates of gambling behavior. After exposure to the 0 win probability contingency for a number of sessions, rats only infrequently chose the gamble lever even when the frequency of wins was increased to 0.5, a win rate that normally results consistent choice of the gamble lever (see Figure 2, first 0.5 probability phase and Figure 3, 0.5 group). This outcome suggests that an extinction-based treatment where gambling behavior never results in wins may decrease the likelihood of future gambling behavior. This outcome also suggests that very long losing streaks that sometimes naturally occur in human gambling activities may have persistent suppressive effects on subsequent gambling behavior.

An application of delay discounting to gambling behavior (Madden et al., 2007; Rachlin, 1990) appears to account well for the apparently irrational gambling behavior of rats in the current study. According to a hyperbolic delay discounting model (e.g., Mazur, 1987), the subjective value of the FR-1 reinforcers, delivered essentially immediately, would have been substantially higher than that of either FR-20 or FR-40 reinforcers, which were discounted in value since they were delivered after delays of several seconds. This model helps explain why rats frequently chose the gamble lever despite the fact that it was always associated the lower (sometimes substantially lower) overall reinforcement rate. Similar delay discounting dynamics may explain the apparently irrational behavior of human compulsive gamblers. A number of studies have shown that compulsive gamblers discount delayed rewards to a greater extent than do control subjects (Dixon, Marley, & Jacobs, 2003; Petry, 2001; Petry & Casarella, 1999).

The present study endeavored to further develop an animal model of gambling using a concurrent-chains procedure. Use of this model may permit many potential avenues of research that may provide important insights into factors related to pathological gambling. For example, Johnson et al. (2011) recently showed, using a procedure similar to that used here, that administration of a D2/D3 dopamine agonist increases percent gambling choices under conditions where there is a low baseline of gambling choice. Future animal studies might investigate the association between substance abuse and gambling (Hodgins, Peden, & Cassidy, 2005). Due to the limitations of research with human subjects, it would be difficult or impossible to determine whether substance abuse plays a causal role in pathological gambling or whether the correlation might be due to a third variable. A study employing the rat model used here could shed light on this question by investigating the effects of prolonged drug self-administration on the choice to gamble. Future studies might also investigate potential treatments for pathological gambling. Results of the present study suggest that extinction-based treatments might be effective in substantially decreasing the motivation to gamble.

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Action Editor: Jeffrey N. Weatherly

Analysis of Gambling Behavior 2011, **5**, 19-27 Number 1 (Summer, 2011)

DISCOUNTING BY PROBLEM AND NON-PROBLEM GAMBLERS WHEN THE HYPOTHETICAL CONTEXT IS MANIPULATED

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The majority of the previous research on delay discounting in pathological gamblers has found that these individuals discount monetary consequences more steeply than do non-gamblers. The present study attempted to replicate this effect, as well as determine whether changes in the context in which the discounting decision was made would differentially influence the discounting of non-gamblers and problem/pathological gamblers. Participants discounted $1,000 after being informed that their hypothetical annual salary was a certain amount. Participants then completed the discounting task a second time after being informed that their hypothetical annual salary remained the same, had been halved, or had been doubled. Manipulation of the participants' hypothetical salaries did not alter rates of delay discounting, but the problem/pathological gamblers discounted the $1,000 significantly less than did the non-gamblers. These results suggest that steeper rates of discounting will not always be observed in problem gamblers relative to non-problem gamblers. Potential reasons for the present results and their implications for understanding the relationship between discounting and pathological gambling are discussed.

Keywords: delay discounting, problem/pathological gambling, university students

Over the past several years, there has been an increasing amount of research conducted on the process of delay discounting as it pertains to gambling, particularly as it pertains to pathological gamblers (e.g., Dixon, Jacobs, & Sanders, 2006; Dixon, Marley, & Jacobs, 2003; Holt, Green, & Myerson, 2003; Petry & Madden, 2010; Weatherly & Derenne, 2010). Delay discounting is said to occur when the subjective value of a reinforcing outcome decreases because its delivery is delayed in time (see Madden & Bickel, 2010, for a recent review). Overall, research has indicated that, for pathological gamblers, the subjective value of outcomes decrease more steeply as the outcomes are delayed than they do for non-pathological gamblers (e.g., Dixon et al., 2003, 2006). However, such an outcome is not always reported (Holt et al., 2003). Likewise, although some researchers have suggested that there is an integral connection between the phenomenon of delay discounting and the disorder of pathological gambling (e.g., Petry & Madden, 2010; Weatherly & Dixon, 2007), others have questioned whether the relationship is as meaningful as some have supposed (Weatherly, 2010).

A recent report by Weatherly and Derenne (2010) both supported the general findings in the literature on the subject, as well as identifying aspects of the relationship between discounting and gambling that are not yet understood. In their study, university students completed the South Oaks Gambling Screen (SOGS; Lesieur & Blume, 1987), which is the most widely used diagnostic screen for pathological gambling. Participants then completed a delay-discounting task that involved five

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different outcomes. The results demonstrated that SOGS scores were directly correlated with the rates of discounting of the monetary outcomes studied, but not the non-monetary outcomes. Thus, consistent with the bulk of the previous literature, higher scores on a measure of gambling pathology were related with steeper rates of discounting. However, this finding was limited to only monetary outcomes. Finding that the measure of gambling pathology was not related to rates of discounting for non-monetary outcomes leaves open the possibility that differences in discounting in between pathological gamblers and non-gamblers is not a general one. Rather, the difference may be isolated to certain contexts.

Pursuing this latter possibility is potentially critical because determining how important understanding delay discounting will be for ultimately understanding pathological gambling depends on the exact relationship between the two. That is, if how steeply someone discounts delayed outcomes is a trait variable as some have argued (Odum, 2011; and see Odum & Baumann, 2010, for a discussion), then finding that rates of discounting are correlated with problem or pathological gambling suggests that problem or pathological gambling are likely also trait variables. However, if changes in rates of discounting contribute to the appearance of pathological gambling as some researchers have suggested (e.g., Weatherly & Dixon, 2007), then determining what factors alter rates of discounting could help identify prevention or treatment techniques for problem or pathological gambling. On the other hand, if the appearance of pathological gambling leads to an alteration in how the individual discounts delayed outcomes, then studying delay discounting is not going to be informative as how to prevent or treat the disorder. In such a situation, the reverse would be true; understanding pathological gambling would enhance our knowledge of the process of delay discounting.

One of the deficits of the current literature on delay discounting and problem/pathological gambling is that most of the studies to date have been correlational or pseudo experimental. Weatherly and Derenne (2010), for instance, reported correlations between rates of discounting and participants' score on the SOGS. The Dixon et al. (2003) study, on the other hand, was pseudo experimental in that participants' group assignment was determined prior to the study. That is, Dixon et al. (2003) compared rates of discounting of pathological and non-pathological gamblers, but because these groups were pre-existing, one cannot determine the direction of the relationship between discounting and pathological gambling prior to the disorder. The procedure employed by Dixon et al. (2006) did involve direct manipulation. That study demonstrated that pathological gamblers tended to display steeper rates of discounting when they completed the discounting task in a gambling environment (e.g., a racetrack) than they did in a non-gambling environment. Dixon et al. (2006), however, only studied gamblers. Thus, it is not possible to determine whether or not similar changes in discounting rates would have been observed if non-gamblers were tested in the same environments.

In terms of delay discounting, research has demonstrated that rates of discounting can be altered by how the discounting task is framed. For instance, Weatherly, Derenne, and Terrell (2010) had two groups of university students complete a discounting task involving hypothetical monetary outcomes. One group was told that the outcomes were money they had won. The second group was told that the outcomes were money that they were owed. Results showed that the participants who had supposedly won the money displayed steeper rates of delay discounting than did participants who were supposedly owed the money. Because rates of discounting vary inversely with the magnitude of the outcome being discounted, a finding called the magnitude effect (Chapman, 1996; Thaler, 1981), these results indicated that framing the money as "owed" increased its subjective value relative to if it had been "won." Weatherly and Terrell (2011) subsequently replicated the same finding, indicating that the effect of framing the discounting task reliably alters rates of discounting.[1]

The present study was designed to determine if the previously reported differences in discounting would be observed between non-gamblers and problem/pathological gamblers (as measured by the SOGS), whether altering how the discounting task was framed would alter the observed rates of discounting, and whether the effect of changing how the task was framed would differ for the non-gamblers relative to the problem/pathological gamblers.

University students were recruited to complete a delay-discounting task and were randomly assigned to one of four groups. Participants then completed the SOGS. They then completed a discounting task that involved discounting the hypothetical monetary amount of $1,000 on two separate occasions. Prior to completing the task the first time, participants were informed to complete the task under the assumption that they were earning a particular annual salary. Prior to completing the task the second time, they were informed (depending on the group) that their hypothetical salary was unchanged, had been halved, or had doubled.

Given the existing literature, the hypothesis was that participants who qualified as problem/pathological gamblers would display steeper rates of delay discounting than would non-gamblers. The current literature, however, does not point to a specific hypothesis in terms of the other manipulations. That is, one might predict that if one's annual salary was decreased, then the relative value of money would increase, which would result in a decrease in how steeply one discounts a delayed monetary outcome. Then again, if one was in greater need of money now than before, then one might behave more impulsively, which would result in an increase in how steeply one discounts a delayed monetary outcome. The reverse arguments could potentially be made when one's annual salary was increased. Lastly, if the difference in discounting rates between non-gamblers and problem/pathological gamblers is a trait variable, then one would predict a constant difference between these participants regardless of the context of one's hypothetical annual salary. However, if state factors contribute to the difference in discounting between non-gamblers and problem/pathological gamblers, then one might predict to observe an interaction between group affiliation and the rates of discounting observed in the different contexts.

METHOD

Participants

The original sample of participants consisted of 279 undergraduate students enrolled at the University of North Dakota. Participants were excluded from data analysis if they did not qualify as a non-gambler (operationally defined in the present study as scoring 0 on the SOGS) or a problem/pathological gambler (i.e., a SOGS score of ≥ 3). In other words, participants who scored one or two on the

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[1] It should be noted that Weatherly et al. (2010) and Weatherly and Terrell (2011) both employed the fill-in-the-blank method of measuring delay discounting (Chapman, 1996), which was also used in the present study. This method has shown to produce temporally reliable data (Weatherly, Derenne, & Terrell, 2011), although it has also been shown to potentially produce different rates of discounting relative to other methods of measuring delay discounting (e.g., see Smith & Hantula, 2008; Weatherly & Derenne, in press). With that said, research has not determined whether the rates of discounting measured using this particular method are less, or more, accurate than other methods. Variability across different methods of measuring delay discounting is another potential reason to be cautious when interpreting the relationship between gambling and delay discounting.

SOGS completed the procedures, but were excluded from all analyses.

Thus, the final sample employed in the present study consisted of 151 (109 females; 42 males) undergraduate students. The mean age of the participants was 20.7 years (SD = 4.8 years) and the self-reported grade point average was 3.27 out of 4.00 (SD = 0.50). The sample was racially homogenous, with 140 (92.7%) self-reporting as Caucasian. Ninety five participants scored 0 on the SOGS and 56 scored 3 or higher (Mean SOGS = 3.93; SD = 1.56; Range = 3 – 9). Participants received (extra) course credit in their psychology class for their participation.

Materials and Procedure

Participants completed the study using an online research administration program (SONA Systems, Ltd; Version 2.72; Tallinn, Estonia), which was accessible through their psychology class. This system tracked participation at the individual level. That is, the system ensured that any individual could participate in the study only one time even if s/he was enrolled in more than one psychology class. Participants could access the system wherever they could access the Internet. In other words, the researcher was not present when the participants completed the materials.

Participants were randomly placed into one of four groups. After the group assignment, the first item that was presented to each participant was the informed consent form that outlined the study as approved by the Institutional Review Board at the University of North Dakota. Continuation beyond this item constituted the granting of informed consent. The next item was a demographic questionnaire, which asked the participant about his/her sex, age, grade point average, and ethnicity.

The next measure was the SOGS (Lesieur & Blume, 1987). The SOGS is a 20-item questionnaire that asks about the respondent's gambling history. A SOGS score of 5 or more suggests the potential presence of pathological gambling and scores of 3 or 4 suggest the potential of problem gambling. The SOGS was employed because it is the most commonly used diagnostic screening measure for pathological gambling (Petry, 2005). Research suggests that the SOGS has good internal consistency and test-retest reliability (Lesieur & Blume, 1987; Stinchfield, 2002).

The final measure that was identical for all participants was the Gambling Functional Assessment (GFA; Dixon & Johnson, 2007). The GFA is a 20-item self-report questionnaire that was designed to identify the contingencies that maintain the respondent's gambling behavior. The four contingencies tested are tangible (i.e., money), sensory experience, social attention, and escape. The GFA has been shown to have good internal consistency (Miller, Meier, & Weatherly, 2009) and adequate temporal reliability (Miller et al., 2009), although its construct validity is marginal (Miller, Meier, Muehlenkamp, & Weatherly, 2009).

The final task was a delay-discounting procedure that involved two phases. Participants assigned to the 50-50 group were initially presented with the statement: "For the following questions, please assume that you have recently signed a contract to start a new job that pays $50,000 per year[2]." They then completed the delay discounting task, which consisted of the following question:

[2] The hypothetical salary amounts in the present study were chosen with three criteria in mind. First, they needed to be realistic. That is, although the present participants were university students and most, if not all, had an annual income below those tested in the present study, the goal was to use salaries the participants would recognize as being earned in the "real world." Second, it needed to be possible to parametrically manipulate the salaries and still keep them realistic. Third, when they were manipulated, the goal was to maximize the manipulation (i.e., make the increase or decrease in salary "substantial").

> You have won a raffle in which the prize is $1,000 in cash. However, it will be X time before you receive the prize. What is the smallest amount of money you would accept today rather than having to wait X time for your prize?

This type of discounting task is called the fill-in-the-blank method (Chapman, 1996), with the participant supplying the indifference point at each delay. This method is potentially preferable to the typical binary-choice method because it greatly reduces the number of questions posed to, and answered by, the participant (see Smith & Hantula, 2008, for a discussion). Participants were tested at five different delays, meaning they answered the above question five times. The five delays that were used were 1 week, 1 month, 6 months, 1 year, and 5 years. The order of the five different delays varied randomly across participants.

After answering the initial five delay-discounting questions, phase 2 began with the participants being presented with the statement: "For the following questions, please assume that you are in the third year of that job and are still making $50,000 per year." The participants then completed the identical delay-discounting task a second time.

Participants in the 100-50 group were presented with the statement: "For the following questions, please assume that you have recently signed a contract to start a new job that pays $100,000 per year" at the beginning of phase 1 and the statement: "For the following questions, please assume that, after three years, you were laid off from your job that paid $100,000 per year and you have had to accept employment at a new job that pays only $50,000 per year" at the beginning of phase 2. Participants in the 200-200 group were presented with the statement: "For the following questions, please assume that you have recently signed a contract to start a new job that pays $200,000 per year" at the beginning of phase 1 and the statement: "For the following questions, please assume that you are in the third year of that job and are still making $200,000 per year" at the beginning of phase 2. Lastly, participants in the 100-200 group were presented with the statement: "For the following questions, please assume that you have recently signed a contract to start a new job that pays $100,000 per year" at the beginning of phase 1 and the statement: "For the following questions, please assume that, after three years at your job, you have been promoted to a position that pays $200,000 per year" at the beginning of phase 2.

Data Analysis

Rates of discounting were determined by calculating the area under the discounting curve (AUC) as proposed by Myerson, Green, and Warusawitharana (2001):

$$x_2 - x_1\ [(y_1 + y_2)/2] \quad \text{(Equation 1)}$$

AUC is calculated by summing the areas of the trapezoids formed by the indifference points (i.e., the participant's responses) across the different delays. AUC can vary between 0 and 1, with the value varying inversely with the rate of discounting (i.e., high AUC values indicate little or no discounting and low AUC values indicate steep discounting).

Although there are other methods for measuring rates of discounting (e.g., fitting the data to a hyperbolic equation; Mazur, 1987), Equation 1 was employed for several reasons. For one, it is does not presuppose the form discounting should take (i.e., a hyperbola). Secondly, AUC is a direct measure of the data rather than being estimated from the data. Thirdly, AUC values are typically parametric and therefore do not require data transformation prior to statistical analysis (see Myerson et al., 2001, for a discussion).

Participants' data were excluded from analysis if their SOGS score was either 1 or 2.

The remaining participants were divided into groups depending on their score on the SOGS. Participants scoring 0 were placed into one group (non-gamblers; NG) and participants scoring 3 or more were placed in the other group (problem/pathological gamblers; PG). Thus, the final design consisted of eight groups 50-50NG (n = 29), 50-50PG (n = 16), 100-50NG (n = 29), 100-50PG (n = 16), 200-200NG (n = 18), 200-200PG (n = 13), 100-200NG (n = 19), and 100-200PG (n = 11). The AUC values from each phase of the procedure were then analyzed by conducting a three-way (Group by Type of Gambler by Phase) mixed-model analysis of variance (ANOVA), with group and type of gambler serving as between-group measures and phase being a repeated measure. Results were considered significant at $p \leq .05$

RESULTS AND DISCUSSION

Results of the ANOVA indicated that the main effect of group was not significant, $F(3, 143) = 0.54$, $p = .658$, $\eta^2 = .011$, indicating that discounting did not vary systematically as a function of the contexts presented to the different groups. The main effect of type of gambler, however, was significant, $F(3, 143) = 4.39$, $p = .038$, $\eta^2 = .030$. Interestingly, participants in the PG groups (Mean AUC = 0.69; SD = 0.26) displayed significantly *less* discounting than did participants in the NG groups (Mean AUC = 0.60; SD = 0.26). The main effect of phase was not significant, $F(1, 143) = 0.81$, $p = .370$, $\eta^2 = .006$, indicating that overall rates of discounting did not differ between phases 1 and 2. The interaction between group and type of gambler, $F(3, 143) = 1.25$, $p = .295$, $\eta^2 = .025$, phase and group, $F(3, 143) = 1.10$, $p = .351$, $\eta^2 = .023$, phase and type of gambler, $F(1, 143) = 0.01$, $p = .919$, $\eta^2 = .000$, and all three factors, $F(3, 143) = 0.39$, $p = .760$, $\eta^2 = .008$, all failed to reach statistical significance.

Thus, the present results indicate that problem and pathological gamblers discounted the $1,000 prizes at a significantly different rate than the non-gamblers. However, the difference was perhaps not in the expected direction. Rather, the problem and pathological gamblers displayed significantly less discounting than the non-gamblers, which is contrary to some past reports (e.g., Dixon et al., 2003, 2006). Thus, one could entertain the idea that the present participant sample and/or data set were suspect.

However, there are numerous reasons to believe otherwise. For instance, although the differences across groups were not statistically significant, the rates of discounting in phase 1 of the discounting task were consistent and interpretable. That is, the mean AUC values of the participants hypothetically making $50,000, $100,000, or $200,000 per year were 0.606, 0.630, and 0.642, respectively. These results can be interpreted as, the lower the hypothetical annual income, the greater the tendency toward getting the prize money now rather than waiting. Likewise, again although the results were not statistically significant, the change in rates of discounting for the 100-50 and 100-200 groups between phases 1 to 2 were in the direction one might expect. That is, the mean AUC values for the 100-50 groups went from 0.636 in phase 1 to 0.693 in phase 2, indicating that the hypothetical decrease in annual income tended to increase the subjective value of the $1,000 in prize money. Likewise, the mean AUC values for the 100-200 groups went from 0.623 in phase 1 to 0.604 in phase 2, indicating that the hypothetical increase in annual income tended to decrease the subjective value of the $1,000 in prize money.

It is also the case that other aspects of the data were consistent with previous research. That is, participants' GFA scores for gambling for tangible outcomes ($r = .557$, $p < .001$), the sensory experience ($r = .568$, $p < .001$), social attention ($r = .343$, $p < .001$), and escape ($r = .599$, $p < .001$) all correlated significantly with SOGS scores (Miller, Dixon, Parker, Kulland, & Weatherly, 2010). Furthermore, escape scores correlated more strongly with SOGS scores than any of the other contingencies (Miller et al., 2010). In fact, when only the data from the 56 participants who scored 3 or more on the SOGS were analyzed, escape was the only contingency on the GFA that significantly correlated with SOGS scores ($r = .358$, $p = .007$)[3]. It was also the case that SOGS scores were significantly correlated with gender ($r = .229$, $p = .005$), with males tending to score higher on the SOGS than females. That result is consistent with the established idea that males are at higher risk for pathological gambling than females (see Petry, 2005).

Finally, not all previous research on discounting has found that gamblers discount delayed rewards more steeply than non-gamblers (see Holt et al., 2003). In fact, it is possible that aspects of the present procedure contributed t to the finding of less discounting in the problem/pathological gamblers than in the non-gamblers. Specifically, in the present procedure, the hypothetical outcome that was being discounted was a monetary sum that had been won through gambling. In contrast, the participants in Dixon et al. (2003, 2006), for instance, were asked to make choices between two different hypothetical sums of money without mention as to why those sums were available. By phrasing the outcome as money that had been won through gambling, the outcome may have held greater subjective value to the gamblers than to the non-gamblers. If that were the case, one would expect the gamblers to display less discounting of that outcome than the non-gamblers (i.e., the magnitude effect; Chapman, 1996; Thaler, 1981). Future research could potentially test this possibility by manipulating how the monetary outcome was framed to see if rates of discounting displayed by problem/pathological gamblers vary as a function of whether the money has been won gambling or gained by some other means. Future research might also pursue whether the present results were influenced by the procedure used to collect the discounting data. That is, the fill-in-the-blank method (Chapman, 1996) allows for the participant to generate the response rather than choosing from a set of researcher-determined responses. Doing so may have maximized any potential differences in interpretation of the source of the $1,000 between the gamblers and non-gamblers.

One goal of the present study was also to determine whether any differences in the rates of discounting between non-gamblers and problem/pathological gamblers would be differentially affected by similar changes in the context in which the discounting occurred. As no significant interactions were observed, the present results do not provide evidence to indicate that the process of discounting for non-gamblers and problem gamblers is differentially affected by such manipulations. Phrased differently, altering the participants' hypothetical annual income did not produce statistically significant changes in the rates of discounting in the present study for either the non-gamblers or the problem/pathological gamblers. Taken together with the finding that rates of discounting differed between the non-gamblers and the problem/pathological gamblers, these results suggest that difference between these populations in terms of discounting is one of absolute rate, at least when it comes to monetary outcomes (Weatherly & Derenne, 2010), and not how the process is influenced by other contextual factors such as changes in one's hypothetical salary. Finding a difference in rates of discounting between non-gamblers and problem gamblers, but not how discounting is influenced by contextual

[3] Scores on the GFA were not, however, significantly predictive of rates of discounting. That is, when regression analyses were conducted on discounting rates in phases 1 and 2 using the scores for the different contingencies on the GFA as predictors, no significant effects were observed.

manipulations, could also be seen as support of delay discounting being a trait, rather than a state, variable (Odum, 2011). However, the problem gamblers in the present study displayed *less* delay discounting than the non-gamblers. Thus, from a trait perspective, one would need to explain why in some situations gamblers discount more steeply than non-gamblers (e.g., Dixon et al., 2003, 2006), in some instances similar to non-gamblers (e.g., Holt et al., 2003), and in some instances less steeply than non-gamblers (e.g., present study).

It should also be noted that the present results do not indicate that rates of discounting by problem or pathological gamblers could never be altered by contextual changes. In fact, the idea that their rate of discounting might be influenced by whether or not the monetary sum being discounted had been won gambling is one potential example. Although the present results did not produce a change in discounting with changes in contexts, the idea may be worth pursuing in future research. That is, inasmuch as the process of delay discounting may contribute to the disorder of pathological gambling (e.g., see Petry & Madden, 2010), determining how to alter rates of discounting by pathological gamblers will be important in identifying successful treatment approaches for the disorder. Perhaps the most important contribution of the present data is the results indicate that rates of discounting by problem and/or pathological gamblers will not *always* be steeper than for non-problem gamblers.

In closing, aspects of the present procedure should be recognized as potentially limiting how broadly the results can be generalized. For one, the present participants were all university students attending a Midwestern university, they were relatively young, and the sample itself was racially homogenous. Any of these factors could have influenced the results. Non-gamblers and problem/pathological gamblers in the present study were identified by the SOGS, which may be important because, although the SOGS is the most widely used diagnostic screen for pathological gambling, it is not without its critics (e.g., see Gambino, 1997). Lastly, had more participants been employed the results, and thus the interpretation of the results, might have been different. Thus, as is the case with most research reports, the present results require replication before the conclusions drawn from them are roundly accepted.

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Action Editor: Alyssa N. Wilson

COMPARING THREE STRATEGIES OF MOTIVATING GAMBLING BEHAVIOR IN THE LABORATORY ENVIRONMENT

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The present study compared three methods of motivating participants' gambling behavior in a laboratory environment. Thirteen university students played in three sessions of video poker, which differed in whether participants were 1) asked to play "as if" gambling real money, 2) staked with real money, and 3) in competition with other participants for a gift card. Also measured was whether participants' reported annual income would influence their gambling behavior under these conditions. Results showed that the number of hands played and the accuracy of game play did not differ across the different sessions. The number of credits bet, which is a metric of risk, was significantly different across sessions. Participants bet the least credits when they were playing for actual money or competing for a gift card, but their betting did not differ between these two conditions. Results also showed that all dependent measures varied directly with annual income. The present results suggest that using competition for a prize may produce similar gambling behavior as having participants risk actual money, and may have the benefit of being more cost efficient. The results also suggest, however, that gambling researchers should measure their participants' financial status, as that may influence how participants behave in laboratory experiments on gambling.

Keywords: gambling, motivation, financial status, university students

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The opportunity to engage in gambling is greater than ever, with most states offering some form of gambling. A meta-analysis of gambling prevalence surveys has shown a positive correlation between increased gambling in the general population with increased pathological gambling (Shaffer, Hall & Vander Bilt, 1999). As of 2006, worldwide estimates of pathological gambling were 0.4 to 1.9% (Petry, 2006). Though this percentage may seem small, when considering that pathological gambling is associated with marital problems, financial crimes, and suicide, it is apparent that pathological gambling is a serious social concern (Petry & Armentano, 1999). A study conducted by the National Gambling Impact Study Commission (2000) concluded that pathological and problem gamblers cost society approximately $5 billion per year for productivity reductions, social services, and creditor losses.

For the treatment and prevention of pathological gambling to be most effective, the contingencies that maintain gambling behavior must be identified. However, very little of the research on gambling involves direct experimentation, partly due to legal and ethical constraints of simulating the consequences faced by actual gamblers. Participants gambling in the laboratory environment typically face lower personal risk than those in actual gambling situations. The task of researchers then is to create an environment which

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accurately simulates real gambling behavior while remaining within the boundaries of ethical research.

A common strategy used by gambling researchers to overcome this ethical barrier is to ask participants to treat laboratory credits as if they had actual value (e.g., Nastally, Dixon, & Jackson, 2010). In such studies, the amount of credits won or lost by the participant has no bearing on his or her compensation. This approach is based on the assumption that participants actually will treat the credits as they would their own money.

An alternative method, in which participants actually risk something of value, has also been used. A study conducted by Weatherly and Brandt (2004) using a slot-machine simulation, staked participants with amounts of money that varied between groups (Experiment 1) or across conditions (Experiment 2). Participants played with credits worth $0.00, $0.01, or $0.10. The results indicated that the monetary value of laboratory credits significantly affected participants' gambling behavior; when the monetary value of the credits was smaller, participants bet more and played more trials than when the credits had a higher value. These results were replicated by Weatherly and Meier (2007) in a study that had participants play video poker. The results of that study also showed that the value of laboratory credits did not influence how accurately participants played however, only how much they bet.

Another risk-simulating strategy used by some researchers that is both legal in most states and could potentially produce results similar to playing with real money is to create a competition among participants for something of value (e.g., a gift card). Dixon and Schreiber (2002), for instance, had participants play video poker and compete for a prize rather than staking each individual with actual money. The participant who completed the video-poker session with the most credits received a $50 gift card. Several other studies have used a similar "gift-card competition" model to motivate participants' gambling performance (Dixon & Jackson, 2008; Dixon, Nastally, Jackson, & Habib, 2009; Johnson & Dixon, 2009). It was seemingly assumed by these researchers that a competition among participants for the gift card would be sufficient to create risk; however, none of these studies measured the actual effectiveness of the gift card in this regard.

Though asking participants to play as if they were risking real money, playing with staked money, and competing for a gift card have been used to control participants' gambling behavior, there has not been research comparing these three strategies. Such a comparison would provide researchers with important information in regards to which risk-consequence strategy is most appropriate and could potentially reduce the cost of research. For example, if competing for a gift card is as effective in motivating participants' gambling behavior as staking them with real money, it may be more cost efficient for researchers to use a gift card, rather than cash, when studying large groups of participants.

Another factor that might influence participants' motivation to gamble in a laboratory environment is their own financial situation. Phrased differently, $5 in staked money or a $50 gift card may have different subjective values (i.e., be more or less reinforcing) to different participants depending on the participants' financial status. If that is the case, then one might expect that behavior in the laboratory situation would be associated with the participants' financial status. To our knowledge, no studies to date have attempted to empirically test this idea.

The present research was designed to compare the three popular strategies of simulating risk in gambling research: playing as if risking real money, gambling with real money, and competing for a gift card. The comparison was made by assessing differences in the number of trials played, number of coins bet, and accuracy of game play by participants playing video poker in each of these three scenarios.

Based on previous research (Weatherly & Brandt, 2004; Weatherly & Meier, 2007), it was predicted that asking participants to play "as if" risking real money would result in both a higher number of hands played and coins bet compared to gambling with staked money or competing for a gift card. It was also hypothesized that the influence of playing for actual money or a gift card would vary as a function of the participant's annual income such that the higher the participant's income, the more coins he or she would bet.

METHOD

Participants

Thirteen individuals (6 females, 7 males) enrolled at the University of North Dakota volunteered to participate in this Institutional-Review-Board-approved study. To participate, individuals needed to be at least 21 years of age and score below five on the South Oaks Gambling Screen (SOGS; Lesieur & Blume, 1987). One potential participant was dismissed from the study due to failing to meet the SOGS-score criterion. That participant was replaced. Participants ranged in age from 21 to 30 years of age (Mean = 23.62 years, SD = 3.40 years); SOGS scores ranged from zero to four (Mean = 1.08, SD = 1.44). One participant self-identified as American Indian, two as Asian, one as Asian/Caucasian, and nine as Caucasian. Participants received (extra) course credit for their participation, as well as whatever they earned or had remaining in the sessions that they played for something of value. One participant also won a $50 gift card. In terms of self-reported annual income, 6 participants reported making less than $10,000 per year, 5 reported making between $10,000 and $25,000 per year, one reported making between $25,000 and $50,000 per year, and one reported making more than $50,000 per year. No measure was taken of the participants' previous experience playing video poker.

Apparatus

The experiment was conducted in a 4-by-2-m room. The room contained a table, two chairs and a desktop computer. The video-poker software used was WinPoker 6.0 (see Jackson, 2007). The poker game used was "Jacks-or-Better," which is a variation of standard five-card-draw poker. The player is dealt five cards that s/he can choose to hold or discard, then draw new cards. The five cards remaining after the draw determine the outcome of the hand. Players were allowed to bet one to five credits per hand. Obtaining at least a pair of Jacks was necessary for returning the original bet, with increasing payouts for increasingly better hands (i.e., straights, flushes, full houses, etc.).

The software recorded a variety of dependent measures each session. Of particular interest was the number of hands played, number of coins bet, and number of errors made during play. These dependent measures were chosen because they reflect persistence of play, amount of risk taken, and accuracy, respectively. All plays that resulted in a potential reduction of the player's optimal rate of return were recorded as errors. Players were not notified of the best play for each hand nor whether they had made the optimal choice. The only information provided to the player was the potential return for each winning card combination given the number of coins bet.

Materials and Procedure

Participants were run individually. At the beginning of the session, the researcher verified the participant's age and initiated the informed-consent process, which included a form outlining the procedure as well as any potential risks of the present study. After the participant provided informed consent, the researcher asked him or her to complete the SOGS (Lesieur & Blume, 1987) and a demographic questionnaire. The SOGS is a survey designed to assess the individual's gambling history; it is also used as a measure for pathological gambling, with a score of five to more indicating potential pathology. While the participant was completing the demographic questionnaire, the researcher scored the SOGS. If the participant scored five or more on the SOGS, he or she was provided with (extra) course credit, if applicable, and dismissed. For participants who scored below five on the SOGS, the researcher read the following instructions:

> You will now be given the opportunity to play video poker. Specifically, you will be playing the game Jacks or Better, which is a 5-card-draw poker game that returns your bet for finishing the hand with at least a pair of Jacks and payouts increase for increasingly better hands. You have been staked with 100 credits.* Your goal should be to end the session with as many credits as you can. The game will end when you have lost all your credits, you choose to quit, or 15 min has elapsed. Do you have any questions?

Questions were answered by repeating the appropriate portion of the instructions.

Each participant completed three sessions of video poker, which were counterbalanced across participants. In one session, the 100 credits had no monetary value, in another each credit had a value of $0.05, and in the third the credits had no monetary value, but participants were told that the individual with the most credits remaining at the end of this particular session, compared to all other participants in the study, would receive a $50 gift card to a major retail store. Prior to the session in which the credits had no monetary value, "These credits have no monetary value, but we ask that you treat them as if they did" was read at the point where the asterisk appears in the instructions. Before the session in which the credits had monetary value, "These credits have a value of $0.05. In other words you have been given $5 with which to gamble. You will be paid in cash at the end of the experiment for the number of credits you have remaining at the end of this particular poker session" was read at the point where the asterisk appears in the instructions. Prior to the session in which the participant's credits were compared to all other participants, "These credits have no monetary value. However, at the end of this study, the participant who had the most credits at the end in this particular session will receive a $50 gift card to a major retailer" was read at the point where the asterisk appears in the instructions.

For each session, participants played video poker until one of the three criteria for ending the session was met. Upon completion of a session, the participant completed a filler survey while the researcher recorded the data generated from the session. After completing the third session, the participant was debriefed, paid in cash for the number of credits s/he had remaining in the session where credits held a monetary value, given credit in his or her psychology class (if applicable), and dismissed.

RESULTS AND DISCUSSION

Separate one-way repeated-measures analyses of covariance were used to analyze the number of trials played, total number of credits bet, and accuracy of individual participants in each of the type of sessions. The participants' self-reported annual income served as the covariate in these analyses[1]. The consequence of each gambling session (e.g., "as if", money, or gift card) did not significantly alter the number of hands played by participants, $F < 1$, partial eta2 = .072. The covariate of annual income was significantly related to the number of hands played by participants, $F(1, 11) = 7.68$, $p = .018$, partial $eta^2 = .411$. Specifically, the number of hands participants played increased as self-reported annual income increased. Results in these, and all following, analyses were considered significant at $p < .05$.

The consequence of the gambling sessions was significantly related to the total number of coins bet by participants, $F(2, 22) = 3.84$, $p = .037$, partial $eta^2 = .259$. The effect of annual income was also significant, $F(1, 11) = 5.25$, $p = .043$, partial $eta^2 = .322$. A visual analysis of the data suggested that participants bet more credits when they were asked to play "as if" the credits were worth money (Mean = 344.15 credits bet per session, SD = 306.39) than they did when the credits were actually worth money (Mean = 313.15 credits bet per session, SD = 307.43) or the participants were playing for a gift card (Mean = 311.92 credits bet per session, SD = 245.03), which was expected given previous research. Most germane to the present study, however, was whether differences in betting occurred when participants were playing for money or for a gift card. When the number of credits bet in these two sessions were compared using a one-way analysis of variance[2] , no significant difference was observed $F < 1$, partial $eta^2 = .000$. Thus, it can be concluded that participants did not bet differently when they were betting with real money vs. when they were playing for a gift card. In terms of annual income in the omnibus analysis, the number of credits bet per session varied directly with participants' self-reported annual income.

The different consequences did not significantly influence how accurately participants played video poker in the three sessions, $F(2, 22) = 1.92$, $p = .170$, partial $eta^2 = .149$. However, the covariate of annual income $F(1, 11) = 11.91$, $p = .005$, partial $eta^2 = .520$ was significant. Interestingly, accuracy of play increased as self-reported annual income increased.

The results of this study were in accordance with others like it (Weatherly & Brandt, 2004; Weatherly & Meier, 2007). Participants bet fewer coins when they played for something of value (e.g., gift card or money) compared to "as if" risking something valuable. Consistent with Weatherly and Meier (2007), the number of hands played and accuracy of game play did not significantly vary between sessions. Thus, it appears that the effect of adding a real consequence to the gambling session manifests itself in the risk that the participants take.

When comparing gift card and money sessions, the number of hands played,

[1] Research exists that suggests that participants who score 3 – 4 on the SOGS may differ from those who score 0 – 2 on certain measures of gambling (e.g., Chase & Clark, 2010). Statistical analyses were conducted with SOGS scores also serving as a covariate. However, the effect of SOGS score was never significant and therefore was excluded from the analyses presented here.

[2] An analysis of variance, rather than an analysis of covariance, was used in the analysis because the effect of the covariate was not significant in this follow-up analysis.

number of coins bet, and accuracy of play did not vary significantly. This result is potentially financially beneficial for future gambling researchers who are looking for realistic and economical ways to motivate their participants. The use of a gift card allows researchers to know exactly how much the study will cost no matter how large the group of participants. This finding would appear to validate comparisons between the results of studies that exclusively used a gift card or money as the consequence of gambling.

However, it is not yet known if the effect of having a chance to win a prize varies as a function of the size of the prize or the chances of winning it. For instance, there is no guarantee that the same results would have been observed had participants competed for a $25, rather than a $50, gift card. Likewise, had participants competed for a $100 gift card, they may gave gambled significantly less than participants staked with $5 in cash. Future research should pursue these possibilities.

The covariate of annual income was significantly related to all three dependent measures. Participants with a higher annual income did not play more conservatively when playing for something of value than when playing "as if" gambling something valuable; they played more hands and bet more coins than those of lower income. This result is somewhat intuitive. The relative value of $5 or a chance to win $50 is inversely related to one's income. Those with a higher income may have found the consequence of the gambling session to be less valuable, and therefore less reinforcing, than those with a lower income, resulting in less conservative game play (i.e., playing more hands and betting more coins). However, those with a higher income played more accurately. It is difficult to reconcile these results as it would stand to reason that less conservative game play would result in decreased accuracy (or no difference in accuracy). It is unclear what attributes of a high wage earner contribute to more accurate video-poker play.

Based on the effects of the covariate, one would expect that a person with high income would bet more money in a real gambling environment; however, this seems at odds with accepted demographics of pathological gamblers, in particular, that they are typically of a lower socioeconomic status (Welte, Barnes, Wieczorek, Tidwell & Parker, 2001). The disparity between the results of this research and gambling demographics could exist for several reasons. For example, those with a higher income may be better able to recover from gambling losses making it harder to detect them as potential pathological gamblers. Another explanation deals with the participants of this study; none of the participants were believed to be pathological gamblers as assessed by their score on the SOGS. It could be argued that the behaviors observed in this study and the behaviors of pathological gamblers are of two different populations.

The point above alludes to some of the limitations of this study. The many factors involved in gambling research are difficult to control and often vary between individual participants. Parke and Griffiths (2002) outlined some of these factors, one of which being observation of the participant. The participants in this study may have been influenced to gamble in ways they believed to be more socially appropriate due to the observation and recording of their behavior by the researcher. Other limitations related to the sample group include that participants consisted only of university students and pathological gamblers were not included, reducing the ability to generalize these results. For instance, because a university sample was employed in the study, the typical annual self-reported income was relatively low. It is not yet known whether the present results would be replicated if a community-based sample was employed.

A potential procedural shortcoming also exists. The $5 staked to participants was not physically presented to them until the end of all gambling sessions and prior to dismissal; this may have decreased the salience (i.e. subjective value) of the money. Weatherly, McDougall, and Gillis (2006), for instance, showed that participants' gambling was decreased if they were shown or got to hold the actual money. Future research should present participants with staked money prior to gambling to see if a similar comparison to a gift card can still be made. Also, the present study was conducted only using video poker. It is unknown if these results would be replicated with other forms of gambling such as blackjack or slot machines.

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Action Editor: Alyssa N. Wilson

Analysis of Gambling Behavior 2011, **5**, 35-41 Number 1 (Summer, 2011)

THE CONTINGENCIES CONTROLLING GAMBLING BEHAVIOR: A PRELIMINARY CULTURAL ANALYSIS IN AMERICAN INDIAN UNIVERSITY STUDENTS

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Research on pathological gambling has suggested that the disorder afflicts American Indians at a greater frequency than the majority population. The present study investigated whether potential pathology and/or contingencies maintaining gambling behavior differed between 29 American Indian undergraduate students and 29 Caucasian students who were matched to the American Indian students in terms of sex, age, and grade point average. The American Indian participants scored lower on all dependent measures of gambling than did the Caucasian students, although several of the differences approached, but did not reach, statistical significance. The present results suggest that the increased rates of pathological gambling that have been observed in the American Indian population are not the direct product of ethnicity or race.

Keywords: pathological gambling, functional assessment, American Indians, university students

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Pathological gambling is a significant societal problem. For instance, researchers have estimated that pathological gambling afflicts 1 – 2% of the adult population (see Petry, 2005, for a review). Not only does the disorder directly affect millions of individuals, researchers have also argued that there are serious social and economic repercussions that infiltrate different aspects of society and culture (e.g., see Mawhinney, 2006, for a review).

Pathological gambling does not afflict all groups at an equal frequency, however. Petry (2005) identified several known risk factors for pathological gambling, with one being age. Specifically, the older one gets, the less likely one is to be diagnosed as a pathological gambler (see Petry, 2005). For example, the prevalence of pathological gambling among college students has been shown to be well above that observed in the general population (Petry, Weinstock, Morasco, & Ledgerwood, 2009; Winters, Bengston, Dorr, & Stinchfield, 1998).

Another risk factor for pathological gambling is ethnicity (Petry, 2005) in that members of minority groups suffer from the disorder at a higher rate than members of the majority population. Research suggests that this problem is especially acute in the American Indian population. For instance, Wardman, el-Guebaly, and Hodgins (2001) estimated that the prevalence of pathological gambling among American Indians is up to 15 times that observed for the Caucasian majority.

One possible reason for the increased prevalence of pathological gambling among American Indians is that the disorder has a genetic component. However, that is not the only possibility. Another potential reason is that other factors correlated with ethnicity are contributing to the high rates of pathological gambling. For instance, research has indicated that preva-

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lence rates of drug and alcohol abuse are heightened in the American Indian population (e.g., Young, 1994). This fact is potentially important because the strongest risk factor for pathological gambling is substance abuse (Petry, 2005).

Research from our laboratory would seem to favor the latter explanation. Specifically, we have conducted several experiments in a laboratory environment that have attempted to identify differences in the gambling behavior of American Indians and non Indians. Differences have rarely been found. McDougall, McDonald, and Weatherly (2008) had American Indian and non-Indian participants play a simulated slot machine in the presence of a confederate who was either an American Indian or a non Indian. Results indicated that gambling behavior did not differ between the American Indian and non-Indian participants, nor was the influence exerted by the confederate related to the confederate's ethnicity. Gillis, McDonald, and Weatherly (2008) had American Indian and non Indians play a slot-machine simulation that varied across sessions in how well the simulation paid off. Gambling behavior sometimes varied as a function of the simulation's payback percentage, but no differences in gambling were observed between the American Indian and non-Indian participants. Whitton and Weatherly (2009) was the only study from our laboratory to demonstrate a difference in gambling between American Indian and non-Indian participants. In that study, American Indian participants played significantly fewer hands of video poker than did non-Indian participants.

Failing to find differences in gambling behavior of American Indians and non Indians in a controlled environment suggests that the differences observed in the natural setting are due to factors found in that setting. If that is the case, then it stands to reason that differences in pathological gambling between the American Indian and majority population may be related to differences in the contingencies that are maintaining the gambling. For instance, if gambling among American Indians is related to lowered socioeconomic status, which is another risk factor for pathological gambling (Petry, 2005), then American Indians may be more likely than non Indians to gamble for the purpose of winning money (versus for the entertainment or to escape from boredom). Although we know that rates of pathological gambling differ between the American Indian and majority population, we know little about potential differences in the contingencies controlling the behavior of individuals in these groups. The present study was a preliminary attempt to assess potential differences in this regard.

There are numerous diagnostic measures that have been created to study pathological gambling (see Petry, 2005), with the most commonly used measure being the South Oaks Gambling Screen (SOGS; Lesieur & Blume, 1987). Although identifying potential pathology is important, these tools do not measure why a person gambles. To determine why a person engages in a behavior, one should conduct a functional assessment. The first functional assessment tool for determining the contingencies maintaining gambling behavior, the Gambling Functional Assessment (GFA), was proposed by Dixon and Johnson (2007). The original GFA, however, had several psychometric inconsistencies (e.g., see Miller, Meier, Muehlenkamp, & Weatherly, 2009), which were addressed in the revised version of the GFA (GFA-R; Weatherly, Miller, & Terrell, in press). The GFA-R consists of 16 self-report items that together potentially identify whether the respondent gambles in order to obtain something (i.e., gambling is maintained by positive reinforcement) or in order to escape from something (i.e., gambling is maintained by negative reinforcement). Likewise, answers to individual questions potentially provide an indication as to the specific outcome or situation that maintains the person's gambling.

In the present study, American Indian and Caucasian university students completed the SOGS (Lesieur & Blume, 1987) and the GFA-R (Weatherly et al., in press). The participants in the different groups were matched in terms of sex, age, and grade point average. Given that the participants were university students, the hypothesis was that the rate of pathological gambling, as measured by the SOGS, would be above the 1 – 2% found in the overall population. Given that the prevalence of pathological gambling is reportedly higher among American Indians than among Caucasians, the hypothesis was that the SOGS scores of American Indians would be significantly higher than that of Caucasians. In terms of the GFA-R, the hypothesis was that a difference would exist between the American Indian and Caucasian students in terms of gambling to get something (e.g., money) inasmuch as the groups differed in socioeconomic status. Also, research has suggested that pathological gambling is associated with gambling as an escape rather than gambling as a means to get something (e.g., Miller, Dixon, Parker, Kulland, & Weatherly, 2010). Thus, given the prediction that rates of potential pathological gambling would be higher for the American Indian participants than the Caucasian participants, the hypothesis was that American Indian participants would score higher than Caucasian participants on the GFA-R in terms of gambling as an escape.

METHOD

Participants

Fifty eight undergraduate students enrolled at the University of North Dakota served as participants. Twenty nine participants self-identified American Indians. After data were collected from these participants, 29 self-identified Caucasian participants were individually matched to the American Indian participants. Participants were matched individually on the basis of sex, age, and grade point average. The 29 Caucasian participants were drawn from a pool of 974 potential respondents. Upon completion of the matching process, each group of 29 participants consisted of 19 females and 10 males. The mean age and grade point average were an identical 21.34 years and 3.16 out of 4.00, respectively.

For the American Indian participants, the modal self-reported annual income was less than $10,000 (72.4%), with seven participants indicating that their parents' annual income was less than $25,000. For the Caucasian participants, the modal self-reported annual income was also less than $10,000 (75.9%). However, only one participant reported that his/her parents' annual income was less than $25,000. One American Indian participant reported being married whereas four of the Caucasian participants reported being married. Three American Indian participants reported being a smoker whereas five of the Caucasian participants reported being a smoker. All participants received (extra) course credit for their participation in the study.

Materials and Procedure

Participants completed the packet of materials in their psychology course. The first item in each packet was an informed consent form that outlined the study as approved by the Institutional Review Board at the University of North Dakota. The second form in the packet was a demographics questionnaire that asked participants about their sex, age, grade point average, ethnicity, annual income, parents' annual income, marital status, and whether or not they smoked.

The next item in the packet was the SOGS (Lesieur & Blume, 1987). The SOGS is the most commonly used diagnostic screening measure for pathological gambling. It is a 20-item self-report measure pertaining to the respondent's gambling history. A score of five or more on the SOGS is indicative of the potential presence of pathological gambling. Research on the SOGS indicates that the measure is internally consistent (Lesieur & Blume, 1987; Stinchfield, 2002) and the scores are reliable across time (Lesieur & Blume, 1987; Poulin, 2002). It should also be noted that previous studies that have attempted to validate the SOGS have included American Indian participants (e.g., Stinchfield, 2002).

The final measure in the packet was the GFA-R (Weatherly et al., in press). The GFA-R is a 16-item self-report measure that assesses the potential reasons for why the respondent gambles. Eight items identify gambling for positive reinforcement and eight items identify gambling for negative reinforcement. Each item is endorsed on a scale of 0 – 6, with higher scores indicating greater endorsement for gambling for that particular outcome. Research on the GFA-R indicates that the measure is internally consistent (Weatherly et al., in press) and that scores are reliable across time (Weatherly, Miller, Montes, & Rost, in press).

RESULTS AND DISCUSSION

Participants' scores on the SOGS were analyzed by conducting an analysis of variance (ANOVA). The difference approached, but did not reach, statistical significance, $F(1, 56) = 3.88$, $p = .054$, $\eta^2 = .065$. Contrary to the hypothesis, the mean SOGS scores for the American Indian participants (Mean = 0.34, SD = 0.77) was below that of the Caucasian participants (Mean = 1.52, SD = 3.11). None of the American Indian participants scored five or more on the SOGS whereas two Caucasian participants scored five or more.

Participants' scores on the GFA-R were analyzed by conducting a two-way (Group by GFA-R category) mixed-model ANOVA. In this analysis, group served as the between-subjects factor and participants' sum scores on the eight separate questions on the GFA-R intended to identify gambling for positive or negative reinforcement served as the within-subjects measure. Results showed that the main effect of group was significant, $F(1, 56) = 10.53$, $p = .002$, $\eta^2 = .158$, with the American Indian participants displaying lower scores on the GFA-R than the Caucasian participants. The main effect of GFA-R category was also significant, $F(1, 56) = 96.21$, $p < .001$, $\eta^2 = .632$, with participants scoring higher on the questions pertaining to gambling for positive reinforcement relative to gambling for negative reinforcement. Lastly, the interaction between group and GFA-R category was significant, $F(1, 56) = 8.17$, $p = .006$, $\eta^2 = .127$.

Because the interaction was significant, tests for simple effects were conducted. The American Indians scored significantly lower than the Caucasian participants on the items assessing gambling for positive reinforcement, $F(1, 56) = 10.64$, $p = .002$, $\eta^2 = .160$ (American Indian: Mean = 11.28, SD = 10.68; Caucasian: Mean = 21.97, SD = 14.05). However, the groups did not differ significantly on the items assessing gambling for negative reinforcement, $F(1, 56) = 3.12$, $p = .083$, $\eta^2 = .053$ (American Indian: Mean = 0.97, SD = 2.86; Caucasian: Mean = 3.17, SD = 6.09). The American Indian participants scored significantly higher on gambling for positive reinforcement (Mean = 11.28, SD = 10.68) than for negative reinforcement (Mean = 0.97, SD = 2.86), $F(1, 28) = 32.33$, $p < .001$, $\eta^2 = .536$. The Caucasian participants also scored significantly higher on gambling for positive reinforcement (Mean = 21.97, SD = 14.05) than for negative reinforcement (Mean = 3.17, SD = 6.09), $F(1, 28) = 64.03$, $p < .001$, $\eta^2 = .696$.

The influence of the participants' annual income and their parents' annual income were tested by conducting separate linear regressions on participants' SOGS scores, as well as their GFA-R scores for gambling for positive and negative reinforcement. These factors were not significant predictors in any of the regression models.

In terms of responses to individual items on the GFA-R, the American Indian participants had the highest rating for the item "I enjoy the social aspects of gambling such as being with my friends or being around other people who are having a good time and cheering me on" (Mean = 1.93, SD = 2.03). In terms of gambling for negative reinforcement, the highest score was observed for the item "I gamble when I feel stressed or anxious" (Mean = 0.21, SD = 0.68). The most endorsed item for gambling for positive reinforcement by the Caucasian participants was the same as for the American Indian participants (Mean = 3.76, SD = 2.43). However, the most endorsed item for gambling for negative reinforcement was "I gamble to get a break from work or other difficult tasks" (Mean = 0.69, SD = 1.29).

The literature on gambling indicates that American Indians suffer from pathological gambling at a significantly higher rate than the majority population (Wardman et al., 2001). However, the exact reason for this difference is not known. One possibility is that this difference is one of ethnicity or race. Another possibility is that the difference is the outcome of other factors correlated with the American Indian population. The current results support this latter possibility. In the present study, American Indian and Caucasian participants were matched in terms of age, sex, and grade point average. The American Indian participants displayed lower levels of potential pathological gambling, as measured by the SOGS (Lesieur & Blume, 1987), than the Caucasian participants, although this result only approached statistical significance. The American Indian participants displayed a significantly lower proclivity to gamble for positive reinforcement relative the Caucasian participants. Their scores for gambling for negative reinforcement were also lower than that for the Caucasian participants, but the difference was not statistically significant.

Thus, none of the hypotheses were supported. However, one could argue that this lack of support represents good news about American Indians and pathological gambling. Not only was the rate of potential pathological gambling below that of the Caucasian participants, the number of American Indian participants scoring five or more on the SOGS was zero. Thus, in the current sample of American Indians, the rate of pathological gambling appears to be below that of the general population and well below the rate previously reported in the American Indian population (e.g., Wardman et al., 2001). The same cannot be said of the Caucasian participants. Two Caucasian participants scored five or more on the SOGS, suggesting that the rate of pathological gambling for this group was above that found in the general population.

The American Indian participants were also significantly less likely than the Caucasian participants to identify positive reinforcement as the contingency maintaining their gambling behavior. With that said, both the American Indian and Caucasian participants gave the highest rating to the same item (i.e., gambling for the social aspects). Together, these results suggest that the gambling behavior of American Indian participants was not differently governed relative to the gambling behavior of the Caucasian participants.

The differences in gambling maintained by negative reinforcement were not statistically significant. However, it is notable that the mean score for the American Indian participants was lower than that of the Caucasian participants, consistent with the trend observed for the SOGS and GFA-R positive reinforcement scores. Low scores on measures of gambling for escape are promising because, as noted above, gambling as a means of escape is a potentially strong predictor of pathological gambling (Miller et al., 2010). It may also be worth noting, however, that in terms of the most endorsed item on the GFA-R in terms of gambling as an escape, the American Indians most endorsed the item of gambling to escape stress or anxiety whereas the Caucasian participants most endorsed gambling to escape work or difficult tasks. Future research may be warranted to determine if such a difference is a reliable one because, if it is, attempts to prevent pathological gambling may need to differ between populations.

Before the current results are generalized broadly, there are a number of aspects of the present procedure that should be recognized. First, the sample sizes used in the present study were not large. Despite this potential deficit, not only were significant differences detected, but the effect sizes for the group effects were in the moderate range. Second, the sample was regionally isolated in the sense that all the participants were enrolled at the University of North Dakota. Third, it is possible that the present results represent an interaction between the instruments used and cultural differences. That is, one cannot assume that the American Indian and Caucasian participants interpreted the questions on either the SOGS or the GFA-R the identical way. Fourth, although no influence of socioeconomic status was found in the current study, it is quite possible that such a relationship would be observed had more sensitive measures of this status been used. One could also argue that the present results are limited because none of the American Indian participants were currently living on a reservation. Thus, inasmuch as pathological gambling is a problem on reservations, finding low rates of pathology in a sample of American Indians not living on the reservation may not be surprising. It is, however, important. Clearly, one would need to replicate the present procedure using a sample of American Indians residing on a reservation to determine whether the present results would be replicated in that setting. But finding different results in that setting would not negate the present results. Rather, such results would indicate that the factors contributing to pathological gambling are found in that setting. Researchers and mental-health professionals could then set about trying to determine what those factors might be and address them.

It may also be the case that there are individual differences between American Indian students who enroll in an off-reservation university and those who attend tribal colleges. Then again, it may also be the case that the environment at an off-reservation university may differ from that at tribal colleges and that this difference might contribute to differences in gambling problems observed among American Indians in the two settings. The present study cannot address which, if either, of these possibilities might be true. However, both possibilities would seem to be important areas for future studies.

Finally, the present results should promote the use of the GFA-R by researchers. Designed as a functional assessment tool, its original purpose was to identify the contingencies maintaining the respondent's gambling behavior so that behavior could be modified. However, as demonstrated in the present study, it also shows the promise of being able to identify differences that may exist across groups. Future research will be needed to determine whether the GFA-R is as, or even more, sensitive to such differences as measures of pathological gambling, such as the SOGS, that have been used in such research for decades.

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Action Editor: Alyssa N. Wilson

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Analysis of Gambling Behavior (AGB) is published twice per year (summer and winter). AGB is a print journal and back issues are available online.