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Gambling on a Simulated Slot Machine under Conditions of Repeated Play

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Three experiments using a parametric, single-subject design investigated gambling behavior in eight adult humans on a slot-machine simulation. Participants were staked with credits exchangeable for money prior to each session. Experiment 1a was a systematic replication of Weatherly and Brandt (2004), which investigated the effects of percentage payback (the amount of money gained as a proportion of the amount of money bet) on gambling. Percentage payback was varied from 50% to 110% across conditions. Consistent with Weatherly and Brandt, gambling did not vary systematically across percentage-payback conditions. Experiment 1b replicated Experiment 1a but also included forced-exposure sessions prior to experimental sessions to guarantee a minimal exposure to the percentage-payback conditions. The results were similar to Experiment 1a. In Experiment 2, win probability and size were manipulated across conditions. Only one of three participants showed sensitivity to this manipulation. In all experiments, most participants tended to place fewer bets as the experiment progressed. Most participants reported the use of a gambling strategy that was consistent with their performance on the gambling task. Overall, these results highlight the utility of studying gambling with procedures that give participants extensive experience with gambling conditions.

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Introduction

Since 1976, nearly all state governments in the United States have passed legislation allowing some form of legalized gambling (MacLin, Dixon, & Hayes, 1999). As forms of legalized gambling have become more common, interest within the scientific community to understand the variables that influence gambling has increased.

Gambling has been defined as, "an activity in which a person subjects something of value, usually money, to a risk involving a large amount of chance in hopes of winning something of greater value, which is usually money" (Thompson, 1997). That is, gambling is the behavior of risking a valued item to probabilistic loss, in exchange for the probabilistic gain of an item of higher value. For example, within a typical casino gaming environment, some monetary amount is risked to possible loss in exchange for the chance to win more money.

One approach to the analysis of gambling has been to conceptualize gambling as behavior maintained by a variable-ratio (VR) schedule of reinforcement (Skinner, 1953). Variable-ratio schedules deliver a reinforcer after an organism has emitted a variable number of responses. The VR schedule generates higher rates of responding and generates more responding in extinction conditions than the fixed-ratio (FR) schedule which delivers reinforces after a fixed number of responses (see Ferster & Skinner, 1957).

Other researchers have argued that delivery of reinforcers in games of chance may be better described as a random-ratio (RR) schedule of reinforcement. (see Hurlburt, Knapp, & Knowles, 1980; Schreiber & Dixon, 2001). The primary difference between VR and RR schedules is the probability of reinforcer delivery on any single trial. On a

RR schedule, the probability of reinforcer delivery is the same on each trial, and is therefore unpredictable. On a VR schedule, as unreinforced responses are made, the probability of a reinforced response increases, thereby allowing a degree of predictability. However, it appears this distinction may be of little importance when controlling behavior. Hurlburt et al. (1980) investigated human participant's response allocations to a computer-based slot machine operating on a VR or RR schedule of reinforcement. The authors report the participants did not respond differentially or employ any unique strategies on either schedule.

Recently, Weatherly and Brandt (2004) suggested that some games of chance might not operate under a simple RR or VR schedule because multiple winning combinations are possible. Such conditions are more accurately described as conjoint RR schedules. A conjoint schedule is a reinforcement schedule in which multiple contingencies are in effect simultaneously for the same behavioral operant (see Ferster & Skinner, 1957). In the case of the slot machine, for example, there are multiple winning outcomes and each may be viewed as a unique reinforcement contingency. Each reinforcement contingency is in effect at the same time, and each has a different probability of occurrence.

Gambling, however, involves more than simply responding on a probabilistic reinforcement schedule. A gambler must pay to play a game of chance, thus an element of loss or risk is present in all gambling scenarios. The loss component is best described as a response-cost punishment contingency. Response-cost punishment is defined as the response-contingent removal of an unconditioned or conditioned reinforcer (Miltenberger, 2001). Evidence that response-cost is an effective punishment procedure in humans and nonhumans has been well documented (see Miltenberger, 2001; Pietras and Hackenberg, 2005). Recently, Weatherly and Brandt (2004) provided evidence that the removal of money (actually tokens exchangeable for money) in a gambling situation serves as a punishing stimulus. In a simulated gambling task, Weatherly and Brandt manipulated the monetary value of the game's tokens across conditions. The results showed that as the monetary value of the tokens increased, participants placed fewer bets. The results suggest that the increased cost of placing a bet increased the effectiveness of the response-cost punishment contingency and reduced gambling behavior.

Although the contingencies determining the outcomes in games of chance may be analyzed in terms of reinforcement and punishment schedules, it is difficult to directly relate performance on reinforcement and punishment schedules to performance on gambling tasks. First, performance on reinforcement schedules is commonly studied under free-operant conditions, in which an organism can respond at any time to earn reinforcers. The strength of behavior can then be analyzed in terms of rate of responding. Games of chance, however, rarely operate on a free-operant basis, and therefore the gambler is only allowed to bet as fast as the game will allow (Kendall, 1987). For instance, when playing blackjack, the gambler can only place a bet at the beginning of a new hand. This characteristic restricts the rate at which bets may be placed. The typical gambling game more closely resembles a discrete-trials preparation, in which there are limited opportunities to respond. For example, a dealer asks for a player's bets, and the player has the opportunity to make a response or not (e.g., place a bet or not). This difference typically precludes gambling researchers from using the standard behavioral measure of rate to analyze behavior. Instead, investigations of gambling behavior are often limited to measuring the number tokens bet, the number of bets placed per session, or percentages of response allocation (Kassinove & Schare, 2001; Weatherly & Brandt, 2004). This discrepancy complicates comparisons of gambling research to basic schedule research, in that response rates under varying schedules of reinforcement and punishment under free-operant conditions are not easily comparable to the number of bets placed on a game of chance.

Secondly, the gambling tasks typically employed in gambling research (e.g., slot machines, roulette, blackjack, etc) do not closely resemble the simplified, highly controlled tasks that commonly appear in schedule research. For example, most schedule research tasks lack the variety of outcomes and visual stimuli that are present in games of chance. These unique characteristics of the gambling task may or may not be important for empirical investigations of gambling to simulate, however, they provide a degree of face validity that is absent in most basic operant tasks.

A final difference between typical schedule research and gambling research is that when playing many common gambling games (e.g., slot machines, blackjack, poker, etc), the player is required to emit a chain of behaviors during each discrete interval before a reinforcer can be obtained. For example, when playing blackjack the player must decide how much money (or how many chips) to bet before the cards are dealt. After the player gets two cards, the player must make at least one verbal response (i.e., hold or hit) or possibly many more, if additional cards are requested. Similarly, when playing a slot machine, a player must make a bet and then spin the reels to produce an outcome, which may be a win or loss. Thus, a challenge for gambling researchers has been to develop procedures for studying gambling that closely approximate the unique characteristics of real-world games of chance, while maintaining a high degree of experimental control.

The introduction of the personal microcomputer into laboratories has allowed researchers to employ simulated games of chance within experimental settings that are highly controlled, yet similar to casino-style gambling. Many games are now easily employed in a laboratory setting and are programmable by the researcher, thus numerous experimental manipulations are possible.

Recently, MacLin et al. (1999) created a computer software program that simulates many characteristics of an actual slot machine, but also provides the researcher with a great deal of experimental control. Specifically, the program allows the researcher to dictate the symbols that appear, the probability that those symbols will appear as a winning combination, the combinations of symbols considered a win, and the number of credits staked to the participant (i.e., the number of credits the participant starts with). Because modern slot machines are video based instead of having actual reels inside the machine, this software also captures many realistic qualities of a casino slot machine (see MacLin et al., 1999 for a complete description).

Researchers have investigated a number of variables thought to influence gambling behavior using the slot-machine simulation (Kassinove & Schare, 2001; Schreiber & Dixon, 2001; Weatherly & Brandt, 2004; Weatherly, Sauter, & King, 2004). Kassinove and Schare (2001), for example, have investigated the effects of the "near miss" phenomenon. The near miss is a losing outcome that appears similar to a winning outcome. A slot machine commonly consists of three reels, each of which has a certain sequence of symbols that must appear in a certain orientation to constitute a win. For example, if a cherry on each reel constitutes a win, then two cherries and another symbol in the same orientation would represent a near miss. Kassinove and Schare reported that an increased probability of near misses increased the number of bets a gambler was willing to place during a subsequent extinction condition. That is, it was more difficult to extinguish gambling behavior when near misses were present than when near misses were absent. This finding suggests that the probability of near misses may alter the willingness of a gambler to place bets.

Another variable investigated using a simulated slot machine is the big win phenomena (Weatherly, Sauter, and King, 2004). The "big win" is described as a large win (such as a month's salary or more) early in a person's gambling experience that increases the probability of gambling. Recently, Weatherly et al. (2004) argued that the ability of a gambling game to produce high levels of responding is due to the intermittent nature of the reinforcers (the VR or RR schedule), and not the absolute magnitude of those reinforcers. Moreover, they argued that a solitary early big win followed by many losses should decrease rather than increase responding because the gambler can easily discriminate the one large win from the many subsequent losses. Weatherly et al. found that participants who received just one big win on the first trial of a simulated gambling task gambled less during extinction than participants receiving big wins at other points or not at all. The data therefore supported the prediction that an early big win would reduce gambling persistence during subsequent losses.

Slot-machine simulations have also been used to study the effect percentage payback on gambling behavior. Percentage payback is calculated by dividing the total credits earned per session by total credits bet per session, and multiplied by 100%. For example, if a person places 100, $1.00 bets and wins back only $75, the person has experienced a percentage payback of 75%. Schreiber and Dixon (2001) used a between-subjects group design to investigate the effects percentage payback on total bets placed by 12 female participants on a slot-machine simulation. No differences were found between the number of total bets across three percentage-payback conditions (40%, 80%, and 120%). This finding is interesting because one might expect responding to increase as the net value of the gambling contingency increases.

Weatherly and Brandt (2004) also investigated the effects percentage payback and monetary value of credits (i.e., credit value) on gambling behavior of participants playing a slot-machine simulation. Three levels of percentage payback (75%, 83%, and 95%) and credit value ($0.00, $0.01, and $0.10) were investigated using both a 3 x 3 between-subjects and a 3 x 3 within-subjects factorial group design. In the between-subjects design (Experiment 1) each participant experienced one of nine combinations of percentage payback and credit value. Participants were staked with 100 credits (worth $0.00, $0.01, or $0.10 each, depending on the condition) and given the opportunity to play the slot machine up to 15 minutes. Participants were instructed that they could bet 1, 2, or 3 credits on any trial, that they could quit at any time, and that they would be paid for the credits they had remaining at the end of the experiment. Participants in the within-subjects group design (Experiment 2) experienced each of the nine conditions once. All other aspects of the procedure were the same as Experiment 1. Similar results were found using both designs. There was a significant main effect of credit value on total credits wagered. However, there was no significant main effect of percentage payback on total trials or total credits wagered. Similar to the results of Schreiber and Dixon (2001), the total trials played and total number of credits wagered were similar across percentage-payback conditions.

Weatherly and Brandt (2004) provided several potential reasons for the lack of differential responding across percentage-payback conditions. First, they argued that it is possible that humans are not sensitive to manipulations of percentage payback under gambling conditions. Although there is evidence for this possibility, additional research is needed before such a conclusion could be accepted.

Secondly, Weatherly and Brandt (2004) suggested that participants might not have shown sensitivity to percentage payback because participants did not have enough experience with the programmed contingencies. That is, the participants may have been sensitive to the percentage-payback manipulation if given more experience. When an organism's behavior is shaped and maintained by a reinforcement contingency, behavioral control by those contingencies is rarely immediate. Rather, control by reinforcement contingencies often requires repeated exposure to those contingencies (see Baron, Perone, & Galizo, 1991). One measure of contingency control is the acquisition of stable responding. Stable responding indicates that the behavior is maintained by the current reinforcement contingency, rather than by other variables. Because stability was not assessed in the Weatherly and Brandt experiments, the participants' responses may not have been stable and may have been too variable to observe differences between conditions.

The lack of behavioral sensitivity to percentage payback in the Weatherly and Brandt (2004) studies could have also been the result of a discrepancy between the programmed and experienced percentage payback, due to the fully random nature of the programmed outcomes. Weatherly and Brandt (2004) argued against this possibility, noting that participants in both experiments had, on average, more credits remaining at the end of the session in the highest percentage-payback condition than in the lower two percentage-payback conditions. However, the authors do not explain why the participants' average credits remaining per session in the lower two levels of percentage payback were, in the majority of cases, identical. This discrepancy suggests that the experienced percentage payback may have been similar across some conditions.

The goal of the present research was to investigate variables that may have contributed to the insensitivity to percentage payback reported in previous studies. Three experiments were conducted using a simulated slot machine task. To increase the total exposure to the experimental conditions, all three studies used a parametric single-subject design. In addition, trial outcomes were programmed to reduce the variability of outcomes within each condition.

Experiment 1a

Experiment 1a was a systematic replication of Weatherly and Brandt (2004). Experiment 1a investigated the effects of four levels of percentage payback (50%, 75%, 95%, and 110%) on gambling in 2 participants. The experiment used a single-subject design to ensure that the participants were given sufficient exposure to each level of percentage payback and to measure gambling at a steady state.

As noted above, Weatherly and Brandt (2004) randomized the slot machine outcomes at each level of percentage payback. This produced experimental conditions that closely resembled "real world" gambling conditions, however, the effects of percentage payback on gambling behavior may have been obscured due to the highly variable levels of programmed percentage payback. The current experiment addressed this concern by programming percentage payback to fall within preset limits (± 5% of the target percentage payback). The conditions therefore contained some variation in percentage payback, but were similar to the target percentage-payback levels (this programming also guaranteed no overlap in percentage payback across conditions). Limiting the variability of percentage payback within conditions was intended to increase the likelihood of observing an effect of percentage payback on gambling behavior, especially if the effect were small.

Even when variability in programmed percentage payback is controlled, both the random nature of the programmed outcomes and the fact that participants can quit a session at any time, may result in participants experiencing a percentage payback different from the programmed percentage payback. Therefore, experienced percentage payback was measured for each session. Experienced percentage payback was calculated by dividing the total number of credits earned on winning trials by the total number of credits bet in a session. Experienced percentage-payback calculations were used to assess the similarity between the programmed and experienced levels of percentage payback.

Weatherly and Brandt (2004) investigated three percentage-payback levels (75%, 83%, and 95%). Because this range of percentage payback (20%) may have been insufficient to generate differences in gambling, the range of percentage-payback levels used in the current experiments was increased to 60% (i.e., 50%-110%). Because the first three percentage-payback levels were losing conditions (i.e., they would result in a net loss of money), a winning percentage-payback condition (110%) was also included to investigate gambling behavior under a positive net outcome condition.

Method

Participants

Western Michigan University's Human Subjects Institutional Review Board approved all aspects of the procedure. Participants were two college students (1 female, 1 male) recruited from Western Michigan University (WMU). Participants were recruited via flyers posted on campus. The flyers invited males and females to participate in a gambling study for money. All participants were 21 years of age or older. After informed consent was obtained, all applicants were asked to complete the South Oaks Gambling Screen (SOGS; Leisure & Blume, 1987), which is a 20-point questionnaire used to assess pathological gambling. Applicants who scored four or below on the SOGS were recruited for participation. Those applicants who scored 5 or above on the SOGS were excluded from the study and were given a debriefing script and access to referral information for assistance with potential pathological gambling problems.

Over the course of the experiment, 23 people were screened on the SOGS. Their SOGS scores ranged from 0 to 10 ($M = 2.5$, $SD = 2.7$). Of the 23 applicants who were screened, three were excluded due to a SOGS score greater than four. The SOGS scores for the eight participants that completed the experiment are shown in Table 1. These eight participant's SOGS scores ranges from 0 to 4 ($M = 1.6$, $SD = 1.2$).

Participants were paid money contingent on their performance on the gambling task and attendance. Each participant was staked with money (in the form of credits) to gamble with each session. The amount of credits remaining at the end of each session was tallied and paid to the participant at the end of each day (participants were told how much money they had earned after each session). The participants were also paid a completion bonus of $1 per session, which was paid to them at the end of their participation, if they completed the study. This incentive was used to increase the likelihood that participants would attend each session and finish the experiment. Across participants 1 and 2, the average total earnings were $238.05 or $10.94 per hour.

Apparatus

Sessions took place in one of two identical cubicles measuring 1.7 m by 1.3 m. Both cubicles were contained in a 2.13 m by 3.51 m room. Each cubicle had a separate entrance, and heavy curtains covered each entrance. Inside each cubicle was a desk, a color computer monitor, an optical computer mouse, a computer camera (located in a top corner of the cubicle), and a white-noise generator. For additional noise reduction, participants were required to wear noise-deadening muffs over their ears.

All experimental events were controlled by a computer located in an adjacent room. The cameras, also connected to the computers in the adjacent room, were used only for real-time monitoring of the participants.

Slot-Machine Simulation

The gambling task was a modified version of a computerized slot-machine simulation created by MacLin et al. (1999). A payoff table (see Figure 1) that illustrated the winning combinations was attached directly to the computer monitor.

Procedure

Participants completed six sessions per day, 3-5 days per week. Sessions lasted a maximum of 20 min. Participants were provided a 5-min break between sessions. On the first day of participation, participants were told how many credits they were to be staked per session and were instructed that one credit was worth $0.10. Participants were instructed that the amount of credits remaining after each session would depend upon their performance on the gambling task, and that any remaining credits were exchangeable for money after the last daily session. In addition, participants were told that upon completion of the experiment they would be paid $1.00 per completed session, independent of their performance on the gambling task. Participants were told how much money they had accumulated towards their attendance bonus after each day of participation. The participants never lost any of their own money because they were only allowed to gamble with the credits that has been staked to them at the start of each session.

Upon arriving at the laboratory for the first experimental session, participants were asked to take a seat in the waiting area. While participants were in the waiting area, the researcher gave them a copy of the following instructions:

> You will be given the opportunity to play a computer-simulated slot machine. Three symbols will appear on the slot machine as you are playing: Bells, Cherries, and Blanks. The winning combination of these symbols, as well as the payoffs for those combinations, appear on the Payoff Table. To win, a winning combination must appear on the middle row. Each session, you will be staked with 50 credits, to bet as you chose. Each credit is worth $0.10. Thus, you are being staked $5.00 for each session. You will be paid in cash at the end of each day for the total credits you accumulate. <u>You may quit at any time by clicking the "exit" button at the bottom of the screen. The session will end when a) you click "exit," b) you reach 0 credits, or c) 20 minutes has elapsed.</u> Do you have any questions?

The researcher allowed the participant to read the instructions and answered any remaining questions by referring back to the relevant portion of the instructions. The participant was then escorted to the experimental chamber. Prior to entering the chamber, the researchers provided the following additional instructions: "You may play the slot machine as long as you want, up to 20 min."

It was impossible for a participant to lose any of their own money. It was possible for a participant to finish the session with fewer, more, or the same amount of credits than originally staked. Participants were not under any overt obligation to play the simulation. That is, when a session began a participant could immediately press the exit button without placing a bet and receive the money they were staked. If a participant chose to quit the session before 20 min had elapsed, they were asked to remain in the waiting area until the next scheduled session time. Thus, participants could not leave the laboratory early by quitting before the end of a session.

Prior to every session, participants were staked with 50 credits worth $0.10 each (i.e., $5.00). Both participants experienced seven conditions. Each participant was exposed to four levels of percentage payback (50%, 75%, 95%, & 110%). Participants were exposed to the PP50, PP75, and PP95 conditions in a varied sequence and each condition was replicated once. The PP110 condition was added after the experiment commenced, and was experienced only one time by each participant. Table 2 shows the condition order and number of sessions per condition. For each percentage-payback level, 20 unique sequences of 240 outcomes were created. In all, 240 outcomes were programmed per session because pilot work demonstrated that this amount exceeded the number of plays that could possibly occur in a 20 min period. To control the variability of percentage payback within each session, outcomes were first randomly generated at each percentage-payback level. Then six, 40-outcome blocks that had a percentage payback of $\pm$ 5% of the target percentage payback were selected to create a 240-outcome session. No block was used twice, and therefore all sessions within each level of percentage payback were unique.

Methods of Data Analysis

Visual analysis of graphical data was used to assess stability within each phase. A minimum of three stable sessions per condition were required for a condition change. Conditions were considered stable if session-to-session variability of total trials played was low and a trend in the direction of expected behavior change was absent. The experimenter also changed phase if stability was not achieved after 10 sessions.

Results

Figure 2 shows the number of credits remaining at the end of each session and the total number of trials (bets) per session across conditions for both participants. Neither participant responded differentially across percentage-payback conditions. The total trials for Participant 1 varied substantially across the first three conditions, ranging from 4-135 total trials. Total trials eventually stabilized around 15-20 per session following Session 23. Participant 2 responded at a high level (120 total trials) in the first session, but responded at a low level in nearly all subsequent sessions (total trials typically ranged from 15-40). This participant placed 50 or more bets in only 4 out of 43 sessions.

For both participants, when a high number of bets were placed in a session (relative to their typical levels of responding) and earnings were very low, fewer bets were placed on subsequent sessions. Participant 1 showed this pattern of responding following Sessions 3, 7, 17, 19, and 23. For these sessions, the credits remaining were low ($\leq$ 19 credits) and the number of bets during subsequent sessions decreased from prior levels, sometimes across several sessions. Participant 2 showed this pattern of responding following Sessions 9, 16, and 35. In each of these sessions the high number of bets resulted in a low number of credits remaining ($\leq$ 30) and the number of bets placed in subsequent sessions decreased.

Figure 3 shows average experienced percentage payback in the final three sessions of each condition. The black bars show the first exposure to the condition and the shaded bars show the second exposure to each condition (replication). The experienced percentage payback varied systematically across conditions, with lower percentage payback typically experienced in lower percentage-payback conditions. There were however, departures from the programmed percentage payback. As discussed above, these deviations were primarily due to the fact that participant's could quit a session at any time. If a participant quit a session after a large losing streak or after a large win, the experienced percentage payback for that session could be quite different from the programmed percentage payback. There were also discrepancies between the experienced percentage payback in the initial exposures and replications. These discrepancies may have been due to the decreased responding across the experiment.

Discussion

When two participants were exposed to four levels of percentage payback on a slot-machine simulation, gambling behavior did not vary systematically across percentage-payback conditions. These results replicate those reported by Weatherly and Brandt (2004). Weatherly and Brandt suggested that participants might not have responded differentially across percentage-payback conditions because participants might not have received enough exposure to the experimental conditions. The adequacy of the exposure provided by Weatherly and Brandt is difficult to determine because the stability of their participants' behavior was not assessed. The current investigation used a parametric single-subject design with repeated measures to increase the amount of exposure to experimental conditions. Participants experienced each level of percentage payback for a minimum of three and a maximum of ten sessions per phase. This allowed gambling to be assessed at a steady state. In addition, most conditions were replicated once to assess reliability. Participants 1 and 2 experienced 44 and 43 sessions, respectively, across the experiment. Thus, participants received over three times more experience with the conditions than did the participants in the Weatherly and Brandt study. It therefore appears that greater exposure to percentage payback does not alone produce sensitivity to percentage-payback conditions.

Although the procedure was designed to better control percentage payback, there were discrepancies observed between the programmed and experienced levels of percentage payback due to the nature of the gambling task and the fact that participants could quit sessions at any time. In most cases, however, experienced percentage payback varied systematically with the programmed percentage payback across each sequence of exposure to conditions.

Both participants, however, appeared to be sensitive to the overall net loss of the programmed contingencies. Under all conditions in which the percentage payback was less than 100 (conditions that result in a negative net outcome) it is optimal to not gamble. Participant 1 showed a decreasing level of responding across the study and

Participant 2 showed a low level of responding for most experimental sessions. Conversely, under wining conditions (i.e., percentage payback > 100%), gambling on every trial is optimal because doing so will result in an average net gain. High level of gambling were not typically observed during PP110 conditions, however. This effect might have been due to the long exposure to the losing conditions prior to the exposure to the PP110 condition.

Experiment 1b

Experiment 1b was a systematic replication of Experiment 1a with several procedural changes. Because participants in Experiment 1a could quit a session at any time, participants sometimes quit a session after placing few bets (or even zero bets). Thus, participants often failed to contact the programmed contingencies. That is, if a participant did not place 40 bets per session (the number of bets over which percentage payback was calculated; see Experiment 1a procedures) they did not experience the programmed percentage payback. This inadequate exposure to the programmed contingencies could account for a lack of sensitivity to percentage payback. To address this problem, brief forced-exposure sessions were added to Experiment 1b to give each participant exposure to the percentage-payback condition prior to experimental sessions.

In Experiment 1a, the participants experienced PP110 once toward the end of the experiment. That arrangement was problematic because the participant had a great deal of experience with the losing conditions before experiencing PP110, which may have led to the low responding during that condition. Participants in Experiment 1b were therefore exposed to PP110 twice for replication purposes and were exposed to the condition earlier in the experiment.

The value of the credits staked to the participants was also reduced to $0.05 because participants in Experiment 1a earned an average of $10.94 per hour, which far exceeded the state minimum wage. The goal of decreasing the credit value was to make the overall hourly earnings closer to $7.00 per hour.

Finally, upon completion of the experiment, all participants were asked to complete a post-experimental questionnaire. The questionnaire was used primarily to gain information about potential strategies used by the participants over the course of the experiment. Analyzing reported strategies might help identify variables that influence gambling.

Method

Participants

Participants were three college students (2 females, 1 male) recruited from WMU (see Table 1 for SOGS summary data). The average total earnings were $160.28 or $7.90 per hour. The recruitment process and SOGS criteria were the same as in Experiment 1a.

Apparatus and Slot-Machine Simulation

Both the apparatus and slot-machine simulation were the same as in Experiment 1a.

Procedure

To reduce the total earnings, credit value in Experiment 1b was reduced from $0.10 to $0.05 (the attendance bonus was kept at $1.00 per session). Participants were exposed to forced-exposure sessions prior to each experimental session. Participants started each forced-exposure session with 20 credits ($1.00). Prior to the forced-exposure session, participants were instructed:

For the next 30 minutes, you will be given the opportunity to play a computer-simulated slot machine. At the beginning of each session, you must place 40 bets. Once you have placed the 40 bets, you will be removed from the cubicle for a few seconds. When you reenter, you will have the opportunity play the slot machine as long as you like up to 20 minutes

Three symbols will appear on the slot machine as you are playing: Bells, Cherries, and Blanks. The winning combination of these symbols, as well as the payoffs for those combinations, appear on the Payoff Table. To win, a winning combination must appear on the middle row. Each session, you will be staked with 70 credits, 20 for the first 40 bets and 50 to bet as you chose. Each credit is worth $0.05. Thus, you are being staked $3.50 for each session. You will be paid in cash at the end of each day for the total credits you accumulate. You may quit at any time by clicking the "exit" button at the bottom of the screen. The session will end when a) you click "exit," b) you reach 0 credits, or c) 20 minutes has elapsed. Do you have any questions?

During forced-exposure sessions, participants were required to place exactly 40 bets. A message appeared in the center of the computer monitor when the participant had placed 40 bets.

Participants were exposed to all four levels of percentage payback in a counterbalanced order and each was replicated once. Table 2 shows the condition sequences and number of sessions per condition. Upon completion of the study, each participant was asked a series of questions about their participation in the experiment (see Appendix A). All other features of the procedures were the same as in Experiment 1a.

Results

Figure 4 shows the number credits remaining at the end of each session and the total number of trials per session for all participants. Participant 4 was the only participant to show sensitivity to the different levels of percentage payback, however, this effect was only observed in the first exposure to each condition. In the first condition, PP75, the participant's responding stabilized quickly around 50 total trials. When the condition changed to PP110, total trials decreased to 36, but then increased quickly over the next three sessions to 103 total trials. When the percentage payback was reduced to PP50, total trials decreased sharply and continued to decrease across the condition. When the percentage payback was raised to PP95, total trials again increased. In Session 16, total trials appeared to stabilize at a level around 45 total trials per session for the rest of the experiment.

Participants 7 and 22 showed a similar pattern of responding as participants in Experiment 1a. Participant 7 responded variably during the first two conditions (6-55 total trials per session). Following Session 14, in which the participant only earned 10 credits, the number of bets placed decreased and stabilized at a low level (15-20 total trials per session) for the remaining sessions. Participant 22 responded variably (6-119 total trials per session) until Session 23. Following Session 23, in which the participant placed 52 bets and had only 20 credits remaining, the number of bets placed decreased and stabilized at a low level (0-10 total trials per session) for the remaining sessions.

Figure 5 shows the average experienced percentage payback of the final three sessions of each phase. Experienced percentage payback varied systematically across percentage-payback conditions, with lower percentage payback typically experienced in lower percentage-payback conditions. Again, discrepancies between experienced percentage payback and programmed percentage payback sometimes occurred because participants had the option to quit at any time during experimental sessions. Experienced percentage payback was quite close to the programmed percentage payback for Participant 4.

Responses to the post-experimental questionnaire are presented in Appendix A. The primary question of interest on the questionnaire was the first item that stated, "Please describe any strategies that you may have used to earn money. Did any of your strategies change across the experiment?" Both Participants 4 and 7 described a minimum credit value that they tried to stay above (30 and 35 credits, respectively). These reports are quite consistent with the actual bets placed during the experiment. Participant 4 reported a strategy of ending a session at 30 or more credits. Of the 36 sessions completed by this participant, only 6 sessions violated this strategy, and all 6 of those sessions occurred in the condition that resulted in the highest net loss, PP50. Participant 7 reported a strategy of remaining above 35 credits per session. Again, this reported strategy was quite consistent with the observed behavior. This participant violated this strategy only five times over the course of 41 sessions, and none occurred after Session 14 in which a large loss occurred. Participant 22 reported a much different strategy. This participant stated that 15 or more credits remaining at the end of the forced-exposure component would result in "loose gambling," apparently meaning more gambles would be placed. The participant also reported gambling less if the forced-exposure session resulted in 15 or fewer credits. This report is very inconsistent with the actual gambling behavior of this participant because such a strategy should have resulted in systematically different responding between conditions, which was not observed.

Discussion

When three participants were exposed to four levels of percentage payback, the gambling behavior of only one participant (Participant 4) varied across percentage-payback conditions. The lack of effect of percentage payback cannot be attributed to a lack of exposure to percentage-payback conditions, as participants received a brief exposure to the condition prior to each session. It is uncertain why only Participant 4 showed sensitivity to percentage-payback conditions. One possibility is that Participant 4 may have had a unique gambling history compared to other participants. As shown in Table 1, Participant 4 scored a 4 on the SOGS whereas all other participants scored between 0-2. A score of 5 on the SOGS indicates a potential pathological gambling problem. A SOGS score of 4 is the highest score in the non-pathological range and may indicate a higher level of gambling experience than those individuals who scored 0-2. Weatherly and Brandt (2004) suggested that individuals with more experience gambling might show increased sensitivity to percentage-payback manipulations. The performance of Participant 4 supports this possibility.

The results of Experiment 1b provide no evidence that the decreased level of credit value had any effect on the participant's behavior, as responding was generally similar to that of participants in Experiment 1a. That is, Participants 1, 2, 7, and 22 all showed low levels of gambling and little sensitivity to percentage payback across conditions. The pattern of decreased betting following sessions with few credits remaining in Participants 7 and 22 was also similar to that shown in participants in

Experiment 1a. For Participants 7 and 22, Sessions 14 and 16 respectively, marked clear changes in gambling behavior. No such pattern of responding was apparent in Participant 4. The effects, if any, of the forced-exposure sessions are unclear. Participant 22 reported using them as a guide for gambling, however, these statements were inconsistent with performance on the gambling task.

In Experiment 1a, there was little gambling in the positive net outcome condition (PP110). The low responding was attributed to the fact that PP110 was experienced late in the experiment, after a long exposure to the losing conditions. In Experiment 1b, when the PP110 condition was experienced early in the experiment, one participant's (Participant 4) responding was very high in the initial exposure, but not in the replication phase. This suggests that condition order or prior experience might affect performance in high payoff conditions. However, similar results were not seen in Participants 7 and 22.

Compared to the Weatherly and Brandt (2004) study, the present study investigated gambling across a greater range of percentage-payback values and under conditions in which the variability of the programmed outcomes was controlled. Neither investigation seemed to generate a robust sensitivity to percentage payback. It is unclear what the effects of an even greater range of percentage payback or narrower outcome variability would be. Increasing the range of percentage-payback conditions may reduce the external validity of the procedure, however, as very high or very low percentage-payback values may differ too greatly from those typically programmed in real-world gambling scenarios. Further restricting the within session variability may also reduce the external validity of this procedure because sessions may become too predictable and dissimilar to real-world gambling scenarios.

Experiment 2

As described above, Weatherly and Brandt (2004) offered several possible reasons for the lack of differential responding across percentage-payback conditions. In addition to inadequate exposure to the experimental conditions, the authors suggested that behavior might have been sensitive to molecular contingencies within the conjoint RR schedule of reinforcement, but not to the overall rate of reinforcement (i.e., percentage payback). That is, behavior may have been sensitive to the probability of a win occurring on a trial or to win size, but not to the overall probability of winning.

Support for this view comes from Kendall (1987) who trained two pigeons to key peck two, probabilistic response alternatives. The first alternative had a certain probability that a reinforcer would be delivered after a FR 30 schedule had been completed. One key peck was required to select the second alternative, the gamble. The outcomes under this alternative ranged from a high-probability, low-valued outcome, to a low-probability, high-valued outcome. Total reinforcement was held constant across conditions. Kendall showed that subjects tended to prefer the gambling option most during the low-value, high-probability outcome condition. These results suggest that in a gambling preparation, behavior might be more sensitive to molecular components of the reinforcement schedule than to percentage payback. These results also suggest that gamblers should tend to gamble more in high-probability, low-value outcome conditions than in low-probability, high-value outcome conditions.

To explore this possibility, Experiment 2 investigated the effects of win probability and size (WPS) on the number of bets placed per session, while holding the overall programmed probability of reinforcement (i.e., percentage payback) constant.

This manipulation is of interest because it could help explain the apparent insensitivity of gambling behavior to percentage payback. For example, if behavior was sensitive only to outcome size or the overall probability of a win, behavior might appear insensitive to percentage-payback manipulations. Win probability and size conditions were generated by manipulating the probability of each of the five winning outcomes (see Figure 1). To maintain a constant percentage payback, it was necessary to manipulate both probability and size of wins across conditions. This manipulation resulted in a condition of many small wins, several medium sized wins, or a few large wins, each occurring at a percentage payback of 75% ($\pm$5%).

Method

Participants

Participants were three college students (1 female, 2 males) recruited from Western Michigan University (see Table 1 for SOGS summary data). The average total earnings were $150.38 or $7.58 per hour. The recruitment process and SOGS criteria were the same as in Experiment 1a.

Apparatus, and Slot-Machine Simulation

The apparatus and slot-machine simulation were as described in Experiment 1a.

Procedures

Participants were exposed to three levels of win probability and size. Conditions were designated by win probability (0.05, .015, and 0.25) and win size (S for small, M for medium, and L for large). In the WPS 0.05L condition, 8 and 16 credit wins were possible and winning trials occurred with a probability of 0.05. In the WPS 0.15M condition, 2, 4, and 8 credit wins were possible and winning trials occurred with a probability of 0.15. In the WPS 0.25S condition, 1, 2, and 4 credit wins were possible and winning trials occurred with a probability of 0.25. The percentage payback was held constant at 75% across all conditions. Each level of win probability and size was replicated once. Table 3 shows the condition sequence and number of sessions per condition. Outcomes were generated the same way as Experiment 1a at the 75% percentage-payback level. However, the outcome selection process was based on an additional factor (win probability and win size). As in Experiments 1a and 1b, a series of random outcomes containing only the appropriate win sizes was generated at each win probability. Then, six blocks of 40 outcomes that were ± 2% of the programmed win probability and within ± 5% of 75% payback were used to create a 240-outcome sequence. No block was used twice, therefore all sessions within each level of win probability and size were unique. Outcome consisted of bells, cherries, or blanks (see Figure 1 for winning combinations). All other aspects of the procedure were the same as in Experiment 1b.

Results

Figure 6 shows the number of credits remaining at the end of each session and the total trials per session for all participants. Total trials for Participant 25 tended to be higher in the WPS 0.25S condition that the other two conditions, which suggests some sensitivity to the win probability and size manipulation. Responding during the initial WPS 0.05L condition was high and variable, but quickly dropped to a low level. Responding during the replication of this condition was also low. A similar low level of responding was also observed in the initial phase and replication of the WPS 0.15M condition.

Participant 16 and 26 showed no sensitivity to changes in win probability and size. Participant 16 responded consistently through the first 15 sessions, placing approximately 35 bets per session, although a slight decreasing trend was observed. In Session 16, the participant placed 133 bets and ended the session with 8 credits. Following Session 16, the participant's responding decreased to approximately 10 total trials per session($M = 10.29$) and remained at this level for all subsequent sessions. Participant 26 responded at a moderate level ($M = 30$ total trials per session) throughout most of the experiment. For this participant, the number of credits remaining at the end of a session was very consistent. Throughout the experiment, this participant ended a session with fewer than 40 credits only twice out of 39 sessions.

Figure 7 shows the average experienced win probability during the final three sessions of each condition. The size of the wins experienced in each condition fell within the limits described above. The black bars represent the first exposure to the condition and the shaded bars represent the second exposure to each condition (replication). Figure 7 shows that experienced win probability was very systematic. That is, a lower experienced win probability was typically observed in lower win probability and size conditions. As with experienced percentage payback, experienced win probability did not always perfectly coincide with the programmed levels because participants could quit a session at any time. A notable example is WPS 0.05L, in which participants typically experienced a win probability closer to 0.10 than 0.05.

Appendix A lists participants' responses to the post-experimental questionnaire. Participant 16 reported a strategy of trying to stay above $3.00 (i.e., 60 credits) each session (presumably, this referred to earnings in both the forced-exposure and experimental sessions combined). Because participants earned only 10-12 credits in each forced-exposure session, this participant's strategy was to end experimental sessions with approximately 48-50 credits remaining. The participant's performance was consistent with the reported strategy. The participant's performance also suggests that the strategy developed across the experiment because through the first half of the experiment the participant infrequently ended experimental sessions with 48 or more credits (only 5 out of 21 sessions). In the latter half of the experiment, however, this strategy seemed to emerge because the participant had 50 or more credits remaining in 14 of the last 19 sessions. The reported strategy of Participant 26 suggests that the value of 40 credits remaining was an important value. This strategy was also consistent with the participant's performance. That is, this participant ended a session with fewer than 40 credits only twice in 39 sessions. Participant 25, the only participant that showed sensitivity to win probability and size, did not provide a very detailed strategy description. The strategy reported was to win more than the starting amount and quit. This response pattern was not typically observed.

Discussion

When three participants were exposed to three levels of win probability and size, the gambling behavior of only one participant (Participant 25) varied across win probability and size conditions. Participant 25 tended to place more bets in the WPS 0.25S condition that in the other two conditions. A higher level of responding in the WPS 0.25S condition is consistent with a previous study by Kendall (1987) showing that pigeons tended to prefer high-probability, low-value outcomes to low-probability, high-value outcomes. This finding suggests that, at least for some individuals, the probability and size of wins can affect gambling behavior. Because this pattern was observed in only one participant, however, it seems unlikely that sensitivity to win probability and size can explain the insensitivity to percentage payback shown in Experiments 1a and 1b. To demonstrate this more conclusively, however, it would be necessary to expose participants who show sensitivity to win probability and size to different percentage-payback conditions to determine if sensitivity to win probability and size obscures the effects of percentage payback.

Participants 16 and 26 did not respond differentially across win probability and size conditions. Participant 16 showed a decreased level of responding across the experiment. Participant 26 showed a consistent moderate level of responding throughout the experiment. This insensitivity to win probability and size is not due to the variations in experienced probability of wins, as this variable was consistent with programmed levels. It remains uncertain what factors are responsible for these different response patterns across participants.

As noted above, analyzing participants reported strategies might lead to an identification of variables influencing gambling. Participant 16 reported a strategy of ending sessions with 48 or more credits, which was consistent with the participant's performance across the latter half of the experiment. This pattern can be contrasted with the response pattern of Participant 26, who reported a strategy of ending sessions with no less than 40 credits, which was also consistent with this participant's performance. The strategy of Participant 26 resulted in a consistent, yet higher level of responding than Participant 16 because it allowed more gambling to occur before the criteria was met.

These findings therefore suggest that the credits remaining had a clear influence on responding.

General Discussion

The present studies investigated gambling in adult humans on a slot-machine simulation. The primary goal was to explore several potential explanations for the insensitivity of humans to percentage-payback manipulations on a slot-machine simulation reported by Weatherly and Brandt (2004). Weatherly and Brandt suggested that one possible explanation for the insensitivity to percentage payback was an insufficient exposure to the percentage-payback conditions. That is, undifferentiated responding across percentage-payback conditions may have occurred because participants had insufficient experience with the experimental conditions. Experiments 1a and 1b of the current investigation systematically replicated the Weatherly and Brandt studies using a parametric single-subject design. The use of this design provided the participants with greater exposure to the experimental conditions. Four of five participants in Experiments 1a and 1b also failed to respond differentially across percentage-payback conditions, despite the greater exposure to the experimental conditions. The possibility that the current investigation also failed to provide adequate experience with the experimental conditions is unlikely, given that stable levels of gambling were typically achieved. Because most participants did not respond differently across percentage-payback conditions, it appears that insufficient exposure alone cannot account for human insensitivity to percentage payback. Experiment 2 of the current investigation explored the possibility that humans were sensitive to wins of specific probability or size. Only one of three participants (Participant 25) showed sensitivity to the win probability and size manipulation.

Although behavior was insensitive to percentage-payback manipulations, performance may be described as near optimal. That is, gambling under conditions of a losing percentage payback (percentage payback < 100%) results in the net loss of reinforcers because the response-cost punishment contingency results in the removal of more reinforcers than is gained by the conjoint RR schedule of reinforcement. Thus, to maximize earnings (i.e., perform optimally), steady state responding across all losing percentage-payback conditions should be zero. Although participants rarely placed zero bets in a session, low levels of responding were observed in five of eight participants across all experiments. These participants responded at near optimal (near zero) levels only after completing several experimental sessions, which suggests that, on average, considerable experience was needed with the gambling contingency for sensitivity to the losing nature of the gambling task to be observed. It remains unclear, however, why some participants showed sensitivity only to the overall loosing nature of the programmed percentage payback, whereas others showed some sensitivity to percentage payback or win probability and size manipulations.

The response pattern of decreased responding with increased exposure to percentage-payback conditions shown by most participants may have practical implications for understanding gambling in normal adults. All participants in the current investigations were screened for symptoms of pathological gambling and could therefore be considered "normal" or at least non-pathological. Researchers have questioned why many people who occasionally gamble never develop a gambling problem. The results of these experiments provide evidence that, given experience with an overall losing contingency (which is present in all gambling games), most people will cease to respond or respond only at low levels.

As stated above, the present results show that humans do not tend to respond differently across percentage-payback conditions, which might suggest that gaming establishments (e.g., casinos) could reduce their games' percentage payback without reducing the level of gambling by their patrons. However, the present results show that the most severe decreases in gambling always occurred in the lowest two percentage-payback conditions (50% and 75%; note the percentage payback throughout Experiment 2 was 75%). Therefore, casinos may be able to reduce the probability of large decreases in their patrons' gambling behavior by using games that payoff at a relatively high percentage payback. Future experiments could investigate this possibility by examining responding when participants are given extensive exposure to high percentage-payback conditions (e.g., PP95-99) that are common in many of today's casinos. These experiments would determine whether high percentage-payback conditions reduce the probability of observing a sharp decrease in responding.

Several participants in the current investigation showed abrupt decreases in gambling after experiencing a session where many bets were placed and few credits remained at the end of the session. It remains uncertain why participants showed such abrupt shifts in gambling behavior. It is likely, however, that participants may have placed fewer bets following large losses due to the direct suppressive (punishing) effects of the lower net earnings.

In Experiment 2, only one of three participants (Participant 25) showed sensitivity to win probability and size manipulations. This participant tended to place the most bets during the WPS 0.25S condition compared to the other two conditions. This finding suggests that the distribution of outcomes in a gambling preparation may affect participant's behavior, independent of other experimental manipulations. Sensitivity to the probability or size of wins may therefore partially account for insensitivity to percentage payback in some subjects.

A problem with interpreting the effects of win probability or win size on gambling behavior, however, is that to hold percentage payback constant across win probability and size conditions, both the size and probability of the wins must be varied across conditions. The factors of win size, win probability, and percentage payback cannot be completely isolated because one of these factors cannot be manipulated while the other two are held constant. This dilemma creates problems for determining the specific effects of any one of these variables.

Anecdotally, the analysis of the participant's verbal strategies provided insight into their gambling behavior. For example, the effects of the credits remaining after each session appeared to be a salient stimulus, as most participants' reported strategy noted credits remaining as an important factor. Reports that specific outcome amounts influenced participants' responding is consistent with similar findings within risky-choice research that shows a participant's "aspiration level" can affect their behavior (e.g., Lopes & Oden, 1999). That is, participants choosing between probabilistic monetary outcomes often report aspirations for making or retaining a specified amount of money. This type of pattern was similar to that observed in four of five participants (4, 7, 16, and

26) who reported that they wished to end sessions with a certain credit value remaining. The present results therefore suggest that additional research investigating the effects of aspirations levels on gambling is warranted.

The close correspondence between the participants reported gambling strategies and their performance on the gambling task was high, which suggests that self-generated rules may have influenced responding. This possibility is supported by previous research that has indicated that self-generated rules may affect performance on reinforcement schedules (Jacobs & Hackenberg, 1996). These experiments did not systematically analyze the effect of self-generated rules on gambling, so conclusions about the participant's performance based on the strategies are speculative.

Analyzing the effects of rules on gambling may have clinical applications. For example, analyzing the effects of rules on gambling may be helpful in facilitating the treatment of pathological gambling. Such investigations may help develop a procedure for generating adaptive rules or changing maladaptive rules in pathological gamblers.

In summary, the current studies support the findings of previous research, which found that humans do not tend to respond differently between percentage-payback conditions (Schreiber & Dixon, 2001; Weatherly & Brandt, 2004). This effect does not appear to be caused by sensitivity to the probability and size of wins alone, as only one of three participants showed some sensitivity to the win probability and size manipulation. Moreover, the studies show that prolonged experience with percentage-payback conditions increases sensitivity to net losses. Thus, the current investigation contributes to the analysis of gambling in showing that humans without a history of pathological gambling will tend to respond optimally (or at least near optimally) on a gambling task when given considerable experience with losing percentage-payback conditions.

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Table 1

South Oaks Gambling Screen scores for all participants.

Participant	Experiment	SOGS Score
1	1a	1
2	1a	2
4	1b	4
7	1b	0
16	2	1
22	1b	2
25	2	1
26	2	2

Table 2

Condition order and number of sessions completed per condition (in parentheses) for Experiments 1a and 1b.

Experiment 1a		Experiment 1b		
P1	P2	P4	P7	P22
75 (10)	95 (6)	75 (3)	50 (5)	95 (6)
95 (5)	50 (5)	110 (4)	95 (8)	110 (9)
50 (10)	75 (3)	50 (5)	75 (4)	75 (4)
95 (5)	50 (8)	95 (7)	110 (7)	50 (10)
50 (8)	95 (10)	50 (4)	75 (5)	110 (5)
110 (3)	75 (7)	110 (4)	50 (3)	95 (3)
75 (3)	110 (4)	75 (5)	110 (6)	50 (3)
		95 (4)	95 (3)	75 (5)

Table 3

Condition order and number of sessions completed per condition (in parentheses) for Experiment 2.

Experiment 2		
P16	P25	P26
15 (9)	5 (10)	25 (8)
25 (10)	15 (3)	5 (3)
5 (3)	25 (9)	15 (4)
25 (3)	5 (7)	5 (5)
15 (7)	25 (4)	15 (9)
5 (8)	15 (5)	25 (10)

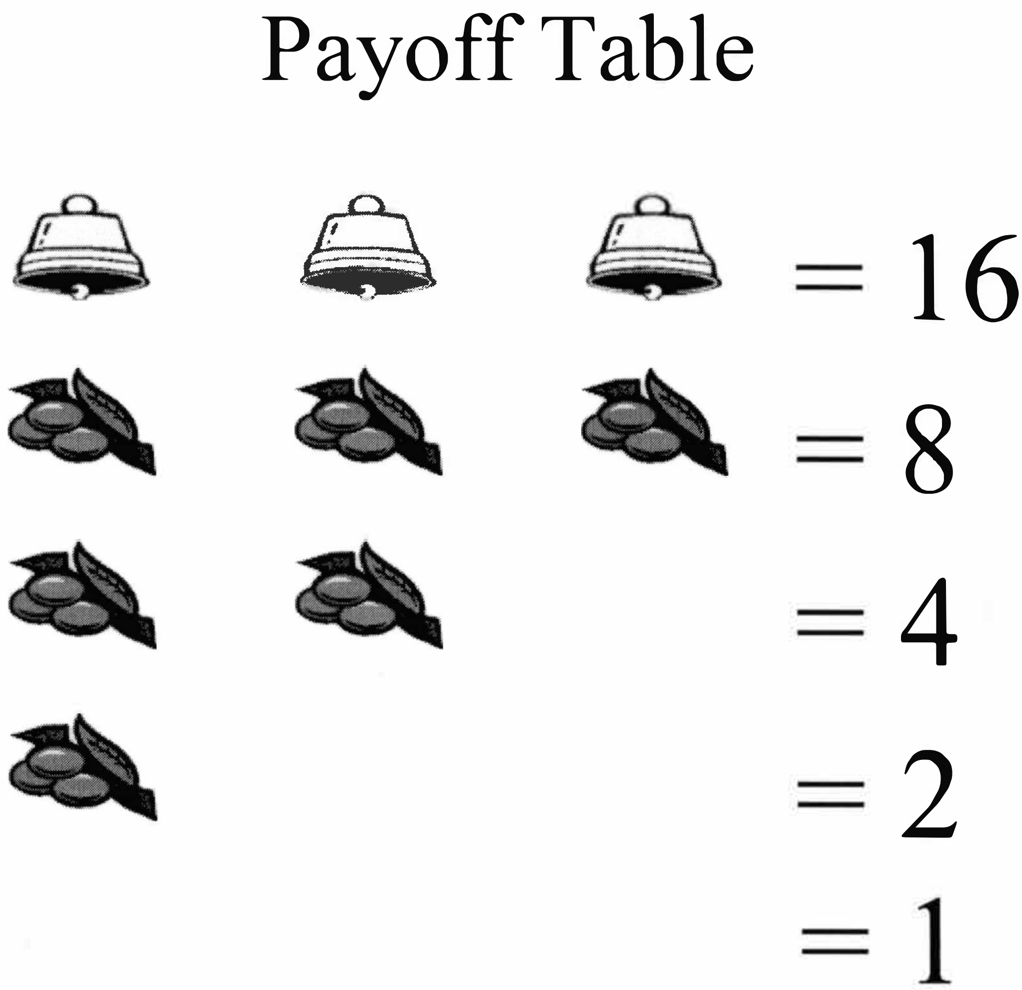

Figure 1. Slot-machine simulation payoff table.

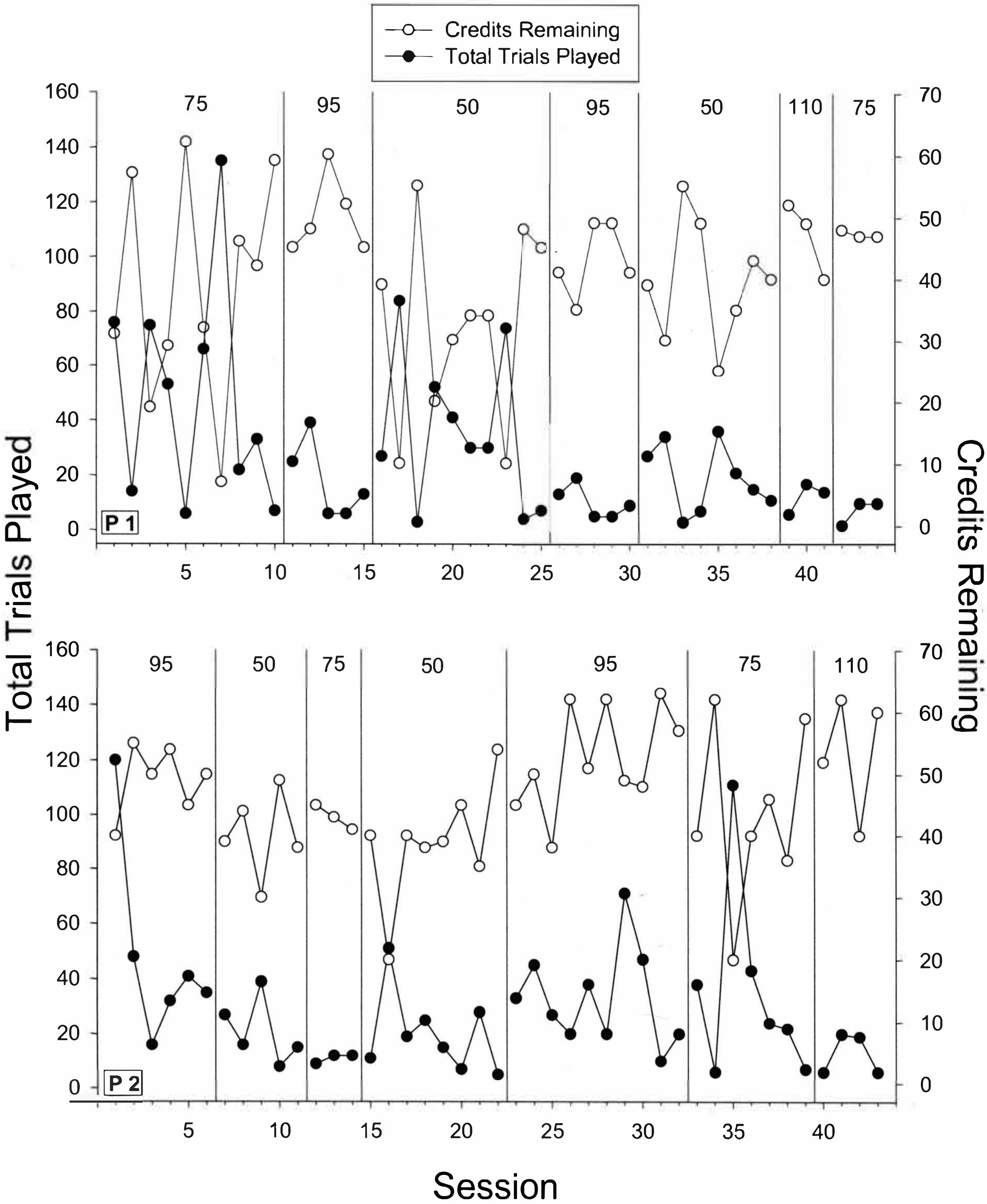

Figure 2. Total trials and credits remaining per session for Participants 1 and 2.

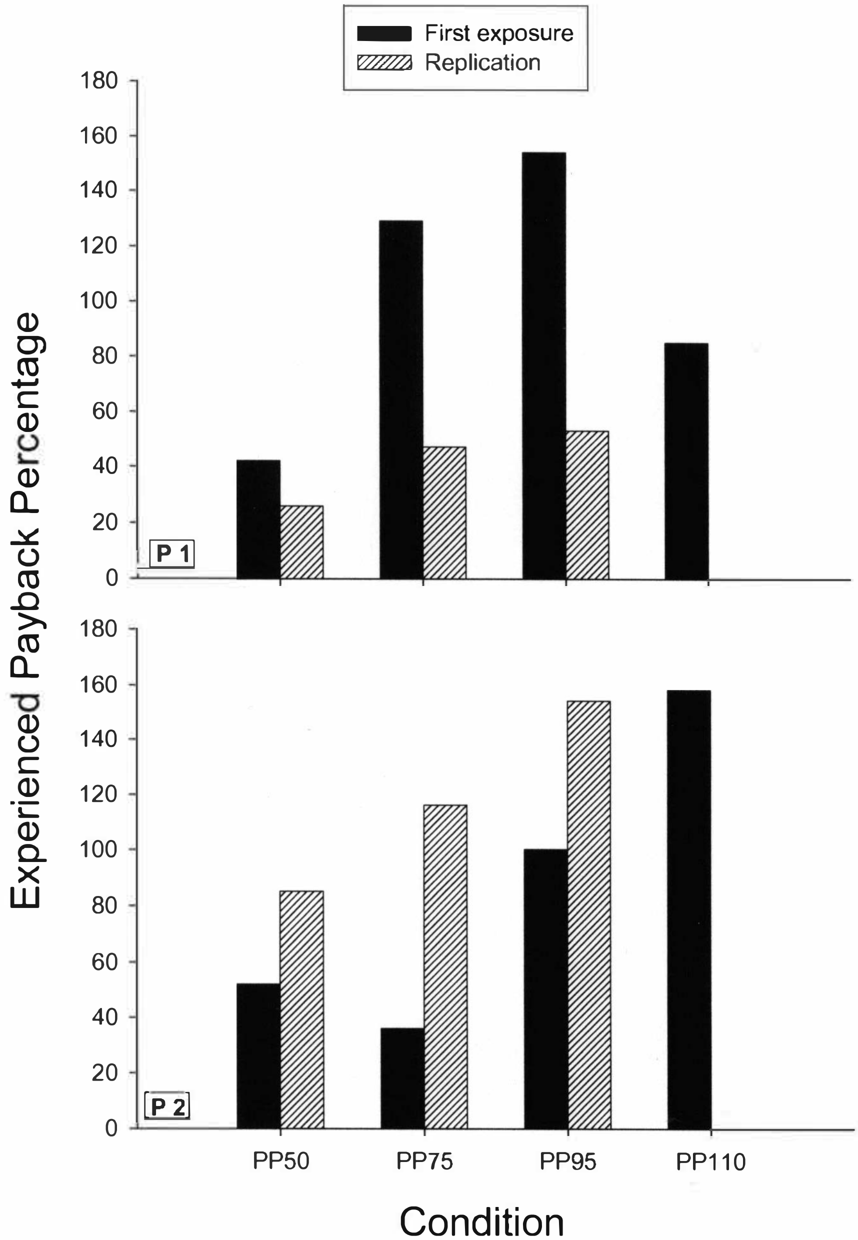

Figure 3. Mean experienced percentage payback across stable sessions for Participants 1 and 2.

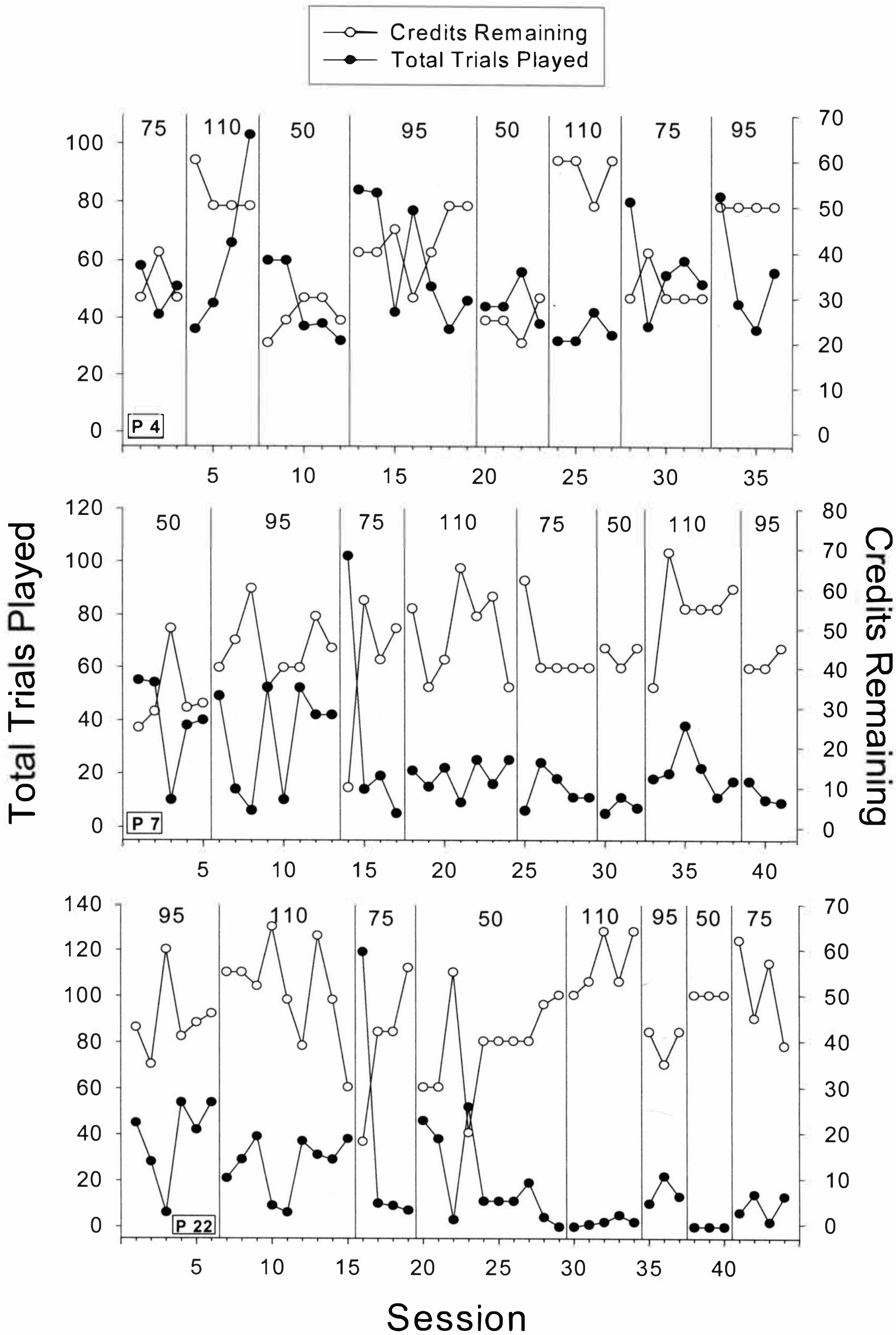

Figure 4. Total trials and credits remaining per session for Participants 4, 7, and 22.

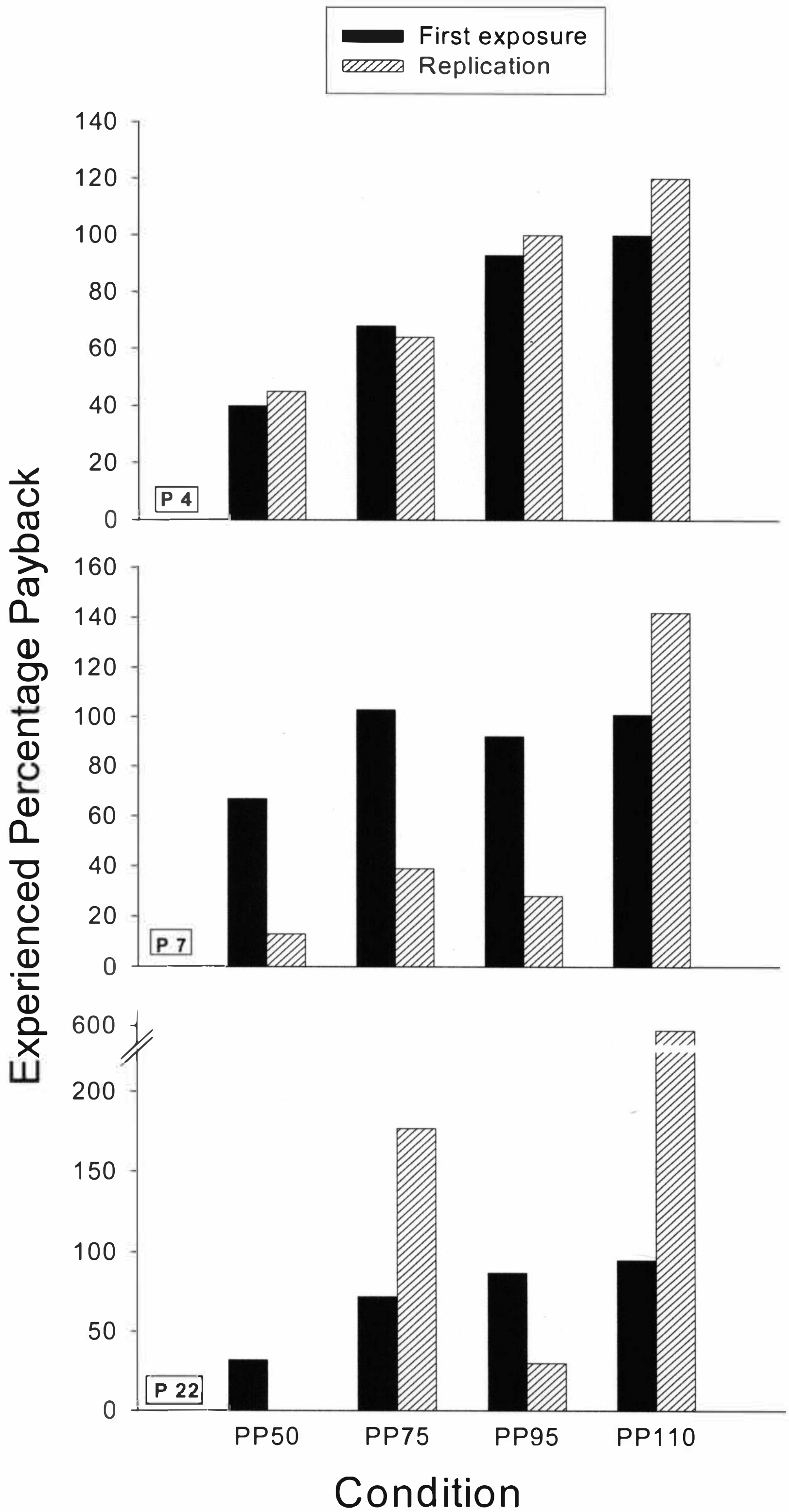

Figure 5. Mean experienced payback percentages across stable sessions for Participants 4, 7, and 22.

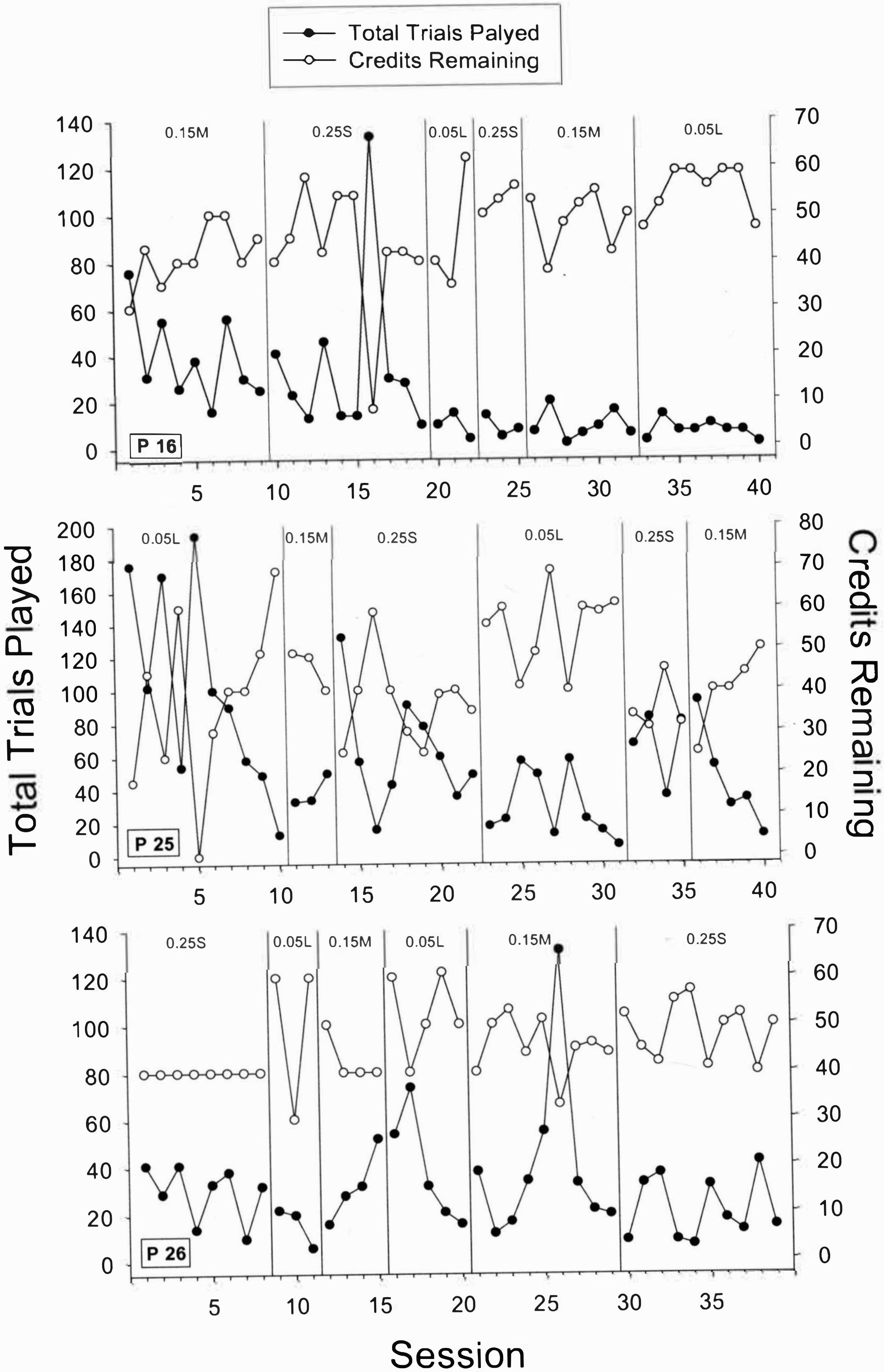

Figure 6. Total trials and credits remaining per session for Participants 16, 25, and 26.

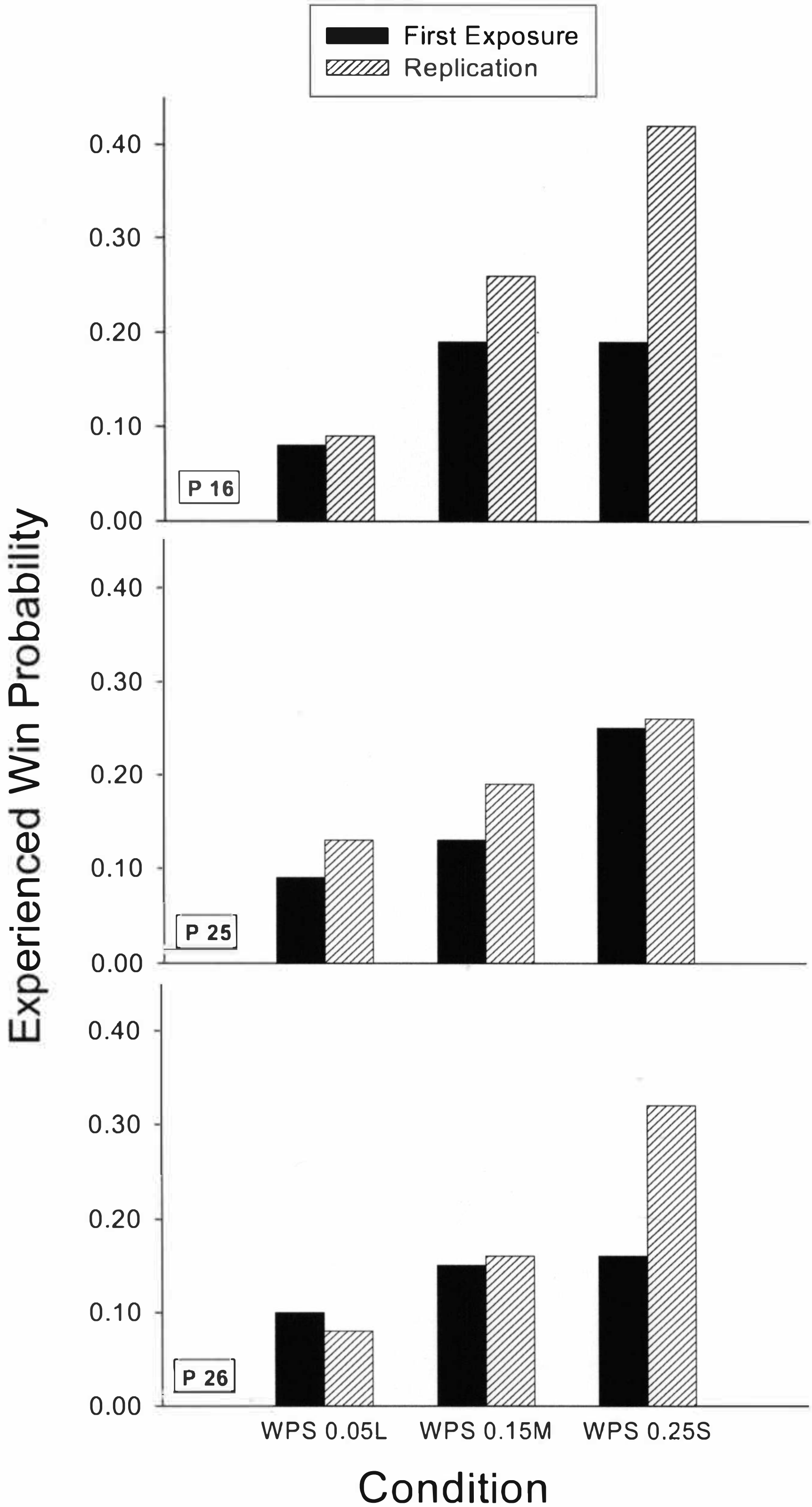

Figure 7. Mean experienced win probability across stable sessions for Participants 16, 25, and 26.

Appendix A

Responses to the Post-Experimental Questionnaire

1. Please describe any strategies that you may have used to earn money. Did any of your strategies change across the experiment?

Participant 4

The only strategy I used to earn money was during the second part of each section (50 credits). I made sure that I did not go under 30 credits. The strategy never changed, but I didn't start using this strategy until the second or third day.

Participant 7

I normally would set a number I didn't want to go below, like 35. Depending on the trial run, if that ended in a higher amount of credits I sometimes would gamble more. If I lost like 10 spins with no win I stopped.

Participant 22

My strategy usually depended on how many credits I accumulated upon entering the second part of the session. If I left the first part with 15 or more credits, I would gamble loosely with my 50. If I was in the negative or below 15, I would either not gamble my 50 at all or hope to get lucky.

Participant 16

Generally, I kept track of where I was and tried to stay above $3.00 for each session.

Participant 25

I started off playing until I either lost most or all the credits or won back the starting value (tied); however my shagety [sic] changed as the study went on. The shagety [sic] I came to use toward the end of the study was to win more than the starting amount and get out.

Participant 26

For the most part, it the [sic] game was played 40 credits; you lost approximately 10 credits from the original. The longer the game is played, the more money you lose. I tried finding a timing pattern between pushing the bet and spin button, but nothing worked out. The experiment stayed consistent. From when I started to finished. I played much slower the first couple days, but then realized time did not matter.

2. Did the money influence any of your decisions or strategies during the experiment? If so, how?

Participant 4

The money did influence some of my decisions. In that, if I obtained 50 or above credits, in the second portion of each section, than I usually stopped with what I had.

Participant 7

Yes and no, sometimes if my trial round was in the negatives, I would only spin like five times because I didn't want to lose too much.

Participant 22

Yes, I wanted to walk away with my 50 credits at least. However, I would sometimes gamble too much to make up for lost moneies [sic] in previous sessions.

Participant 16

If I had gone to gamble with my money I would have been prepared to lose that amount. Since this money was never mine, even if I "lost" I was still making money.

Participant 25

Yes, the money motivation did influence my strategies by causing me to become more cautions and stingy as I realized how much money I was actually losing.

Participant 26

Yes, I knew I was here for a certain amount of time no matter how long I played, so I tried to get (win) as much as I could. The strategy was to get out quick.

3. What, if anything, changed from session to session with respect to the slot machine?

Participant 4

Nothing too noticeable changed from session to session with respect to the slot machine. I felt there was the same opportunity to earn money each day.

Participant 7

Nothing, I don't think.

Participant 22

My attitude towards the gambling. I basically wanted to walk with as much money as possible towards the end.

Participant 16

Nothing.

Participant 25

It seemed that the slot machines started off allowing the player to win but not much. Then toward the middle of the survey, it allowed the player to win more and the[n] decreased again at the last few sessions.

Participant 26

I noticed a change of winning with only berries to only bells for two visits, the visits were consecutive.

4. If you have ever played a real slot machine, how would you rate the similarities between the slot machine you played in this experiment and a real slot machine?

Participant 4

A main difference was that the experimental slot machine had no noise/sounds after hitting a winning combination, and obviously, no money (coins) feel [sic] out of the computer slot machine.

Participant 7

Real slot machines can have more than one line you can win with. Also more of a variety in items lining up to win. But they both do win with same three objects in a row.

Participant 22

I have only played a slot machine a couple of times no long [sic] than for five minutes tops. One similarity in this slot I found to it to vary like a real slot machines winning combos, yet sometimes I would get on a hot streak.

Participant 16

I have played slot machines before and had to general feeling that it's hard to win. This slot machine behaved the same way.

Participant 25

The experimental slot machine offered about the same non-predictable nature as real slot machines from play to play.

Participant 26

The similarities; in the fact that you are going to eventually lose all the money if you do not quit. A real slot machine has many more pay-offs, and the choice to bet more than one credit.

5. Assuming that the money you were staked each session was your money, on average, would you say you typically won or lost money?

Participant 4

On average, I would have to say that I lost money. Mainly, because I started w/ 20 credits the first section and usually ended up below 20 . . . and during the second session I started with 50 and usually only had 30 – 40 each time.

Participant 7

I would say I won money.

Participant 22

I think I averaged out to break even <u>if</u> it were my money. But when I gamble with my money, I usually <u>win</u>!

Participant 16

Lost, but when staked with 20 credits there were many time I would have quit while I was up.

Participant 25

Lost

Participant 26

I lost money, but saved what I could.

Appendix B

Human Subjects Institutional Review Board Approval Letter

WESTERN MICHIGAN UNIVERSITY

Human Subjects Institutional Review Board

Centennial
1903-2003 Celebration

Date: April 28, 2003

To: Lisa Baker, Principal Investigator
Andrew Brandt, Student Investigator for thesis

From: Mary Lagerwey, Chair Mary Lagerwey

Re: HSIRB Project Number 02-12-08

This letter will serve as confirmation that your research project entitled "Behavioral Measures of Non-Pathological Gamblers" has been **approved** under the **full** category of review by the Human Subjects Institutional Review Board. The conditions and duration of this approval are specified in the Policies of Western Michigan University. You may now begin to implement the research as described in the application.

Please note that you may **only** conduct this research exactly in the form it was approved. You must seek specific board approval for any changes in this project. You must also seek reapproval if the project extends beyond the termination date noted below. In addition if there are any unanticipated adverse reactions or unanticipated events associated with the conduct of this research, you should immediately suspend the project and contact the Chair of the HSIRB for consultation.

The Board wishes you success in the pursuit of your research goals.

Approval Termination: December 19, 2003

Walwood Hall, Kalamazoo, MI 49008-5456