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John Haw
Southern Cross University

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The Relationship Between Reinforcement and Gaming Machine Choice

John Haw

Abstract

The present study assessed whether prior reinforcement experiences were related to gaming machine choice and the decision to change gaming machines during a session of gambling. Seventy undergraduate students (48 women, 22 men; mean age = 22.05 years) were presented with two visually identical simulated gaming machines in a practice phase. These simulated machines differed only in the rate of reinforcement. After the practice phase, participants were asked to choose a machine to play in the test phase and were allowed to change machines at will. Two measures of reinforcement were employed; frequency of wins and payback rate. Results indicated that neither measure of reinforcement was related to machine choice, but both were predictors of when participants changed machines. A post-hoc analysis of the 33 participants who changed machines during the test phase found a significant relationship between machine choice and prior reinforcement. For these participants, payback rate was significantly related to machine choice, unlike frequency of wins.

Keywords

Reinforcement , Win frequency, Payback rate, Gaming machine choice

Behaviour-analytic studies of gaming machine play have investigated the choices that players make and the events that initiate and reinforce gaming behaviour. Explanations for these behaviours are framed in the learning history of the person with the environmental stimuli related to the behaviour. Historically, these studies have focused on the reinforcement aspects of gaming machine play, such as post-reinforcement pauses, response rates, reward size and the relationship with persistent

and pathological gambling (e.g., Dickerson et al. 1992; Dixon and Schreiber 2002; Delfabbro and Winefield 1999; Weatherly and Brandt 2004).

One aspect of gaming machine play that has not generated much attention is the relationship between reinforcement and gaming machine choice. Dixon et al. (2006) has conducted the only study aimed at assessing whether response allocation (which slot a person plays) could be predicted by the reinforcement rate. Utilising two identical looking computer simulated slot machines, participants were concurrently exposed to two different schedules of reinforcement. One machine provided a 10 credit win, on average, after every 10 responses and the other provided a 50 credit win, on average, after every 50 responses. The presentation of each schedule type was counterbalanced and preference was measured by the number of gambles or responses on each. The results reported that 83% of participants showed a preference for the machine with small, frequent payouts (the 10 credit win) over the machine with the larger less frequent payouts.

The result from Dixon et al. (2006) suggested that the frequency of reinforcement may predict machine choice, but this is only one type of reinforcement. Reinforcement in slot machine play may also be measured by the average percentage payback or return rate. Frequency of wins is operationalised as the average number of bets per reinforcer, as used in the Dixon et al. (2006) study, and payback rate is operationalised as the monetary value of wins expressed as a percentage of the wins and outlays. For example, if a player bets \$1.00 and wins 75 cents, then the payback rate is 75%.

The payback rate measure of reinforcement was used in a study by Weatherly and Brandt (2004) to assess the effect that it has on the number of bets and bet size. Although not intended as a study of machine preference, the use of response allocations (number of bets made) as a dependant variable does allow conclusions to be drawn and comparisons made. Results from the two experimental studies using three payback rates (75%, 83% and 95%) found that the variations in payback rate were not related to the number of bets placed (or bet size). In contrast to Dixon et al. (2006), this result does not support behaviour-analytic predictions.

It can be argued that both the studies by Dixon et al. (2006) and Weatherly and Brandt (2004) examined machine preference but each only utilised one measure of reinforcement. Dixon et al. found that participants played more games on the machine with the most frequent payout, whilst holding payback rate constant. Weatherly and Brandt found that payback rate was not related to the number of games played (although win frequency was not measured). However, in gaming venues with real gaming machines both types of reinforcement are provided and the relative merit of each has not been evaluated in a single study.

Another aspect of machine choice that relates to reinforcement is the point at which players decide to change machines. Whilst participants allocated more responses to the machine with more frequent payouts, Dixon et al. (2006) did not investigate the point of reinforcement that may have initiated players changing from one machine to another. The marginal value theorem (Charnov 1976 as cited in Davey 1989) is a learning model that suggests a player will leave one machine for another when the net payback reaches the average level for all machines played. That is, play on one machine will cease and another chosen when the average reinforcement rate of all machines in the group has been reached. This is considered to be an optimal strategy to maximise outcomes, however, the empirical support for this proposition has only been based on animal foraging behaviour.

The aim of the present study is to examine the relationship between reinforcement and machine choice. It will extend the findings of Dixon et al. (2006) by including a second measure of reinforcement; payback rate. Specifically, it is hypothesized that there will be a significant relationship between machine choice and the level of reinforcement from prior play. Furthermore, the present study will investigate the role of reinforcement in player decision to change from one machine to another, previously untested in relation to gaming machine play.

Method

Participants

A convenience sample of 70 first year psychology students from the University of Western Sydney, Australia were recruited as participants. For chi-square analysis this

would ensure that expected cell frequency would be <5. There were 48 women and 22 men with a mean age of 22.05 years (SD = 11.03). Participants reported playing gaming machines, on average, 0.96 days in the past 6 months (SD = 2.12) with an average playing session length of 22.43 min (SD = 74.81). Ethics approval for this study was granted by the University of Western Sydney Ethics Review Committee (Human Subjects).

Apparatus

Two identical personal computers were loaded with the simulated slot machine game ('2x Double Cherry' http://www.download-game.com/Slot_Machine_Games-DUP.htm) and placed next to each other in separate booths. The slot machine was of the \$1 denomination and had eight pay lines with no gamble/double-up or special feature games. Monitors were set to the same level of contrast and sound. A brief questionnaire measuring age, sex and level of prior experience with slot machines was also used.

Procedure

Participants were tested individually and informed that they would receive between 0.5% and 1.5% course credit for the time they spent participating in the study. They were instructed that the study consisted of a practice phase in which they must play 40 trials on both machines and a test phase where they must play 120 trials on either of the machines. They were advised that the slot game was the same on both computers and any differences in payouts were due to chance. Each participant was issued with \$500 worth of machine credits and told that this equated to 0.5% course credit. Each \$100 of machine credits was worth .1% course credit and if after 120 trials in the test phase their credit was \$0, they would not receive any course credit for their time. If they were left with, say, \$700 after 120 trials they would get 0.7% course credit and the maximum course credit they could achieve would be 1.5% for \$1500 or above. It was anticipated that this would encourage participants to gamble more realistically as they were staking something of value.

An initial practice phase required participants to play 40 games on each machine (counterbalanced) in which there was no threat to their course credit. Each machine was set up with \$500 and players could bet between \$1 and \$8 by adjusting the number of pay lines played. The experimenter recorded the win frequency and size for each bet outcome. That is, reward frequency and size were not manipulated by the experimenter

but were allowed to vary 'naturally' by the machine during both the practice and test phases.

After completion of the practice phase the participants were asked to complete the questionnaire in a designated position away from the machines. This was to ensure that when they returned for the test phase they did not choose a computer based on its location (i.e., the closest machine). After completing the questionnaire participants were asked to select a machine to play, which was then provided with \$500 in credits. Participants were informed that they could change to the other machine at will, where the experimenter would add the appropriate credits and inform them when they had reached 120 games. Win frequency and size were observed and recorded by the experimenter during the test phase. Following the completion of the test phase each participant was debriefed. For ethical reasons, all participants with <\$500 were given 0.5% course credit for their time. An attempt was made to maintain this deception for those with <\$500 by explaining that the experimenter felt pity for the participant and that the participant should not tell anyone as it was breaking the rules of the experiment.

Results

Frequency of win rate and payback rate were calculated for the practice and test phases. The average frequency of wins was determined by dividing the number of bets placed (40 for practice, 120 for test) by the number of times a win took place. For example, if a win occurred 20 times during the practice phase, the average frequency of wins would be 2 (1 win for every 2 button presses). The average payback rate was determined by dividing the total amount won by the total amount bet. This figure was then multiplied by 100 to provide a percentage. For the current study the difference in win frequency between machines for any single participant during the practice phase was as small as 2 extra wins over the 40 trials and as large as 15 extra wins over the 40 trials. The size of the differences between machines in average payback rate during the practice phase was as small as 1.85% and as large as 251.60%.

Machine Choice

To test the hypothesis that more participants would choose the machine in the test phase that provided them with the greatest reinforcement in the practice phase a chi-square analysis was conducted, with alpha set at .05. Results for frequency of win

revealed that 43 (61%) participants chose the machine, in the test phase, that had provided them with the greatest number of reinforcers in the practice phase and 27 chose the machine that had provided the least number of reinforcers. Chi-square analysis revealed that there was no significant relationship, $\chi^2 (1, N = 70) = 3.66, p = .06$ between frequency of win and machine choice.

A similar analysis was conducted for payback rate. Results revealed that 39 (56%) chose the machine from the test phase that provided the greatest payback rate and 31 chose the machine they had won the least amount of credit on. No significant relationship was found between payback rate and machine choice, with $\chi^2 (1, N = 70) = .91, p = .34$.

Machine Change

To investigate the relationship between reinforcement and machine change, data from the 33 participants who changed machines at least once during the test phase were analysed. Their average frequency of wins during the practice phase, across both machines, was 1 win for every 1.72 (SD = .58) bets and their average frequency of wins per machine at time of change during the test phase was 1.74 (SD = .50). A two-tailed, paired samples t-test revealed no significant differences between the two means, $t (32) = .79, p = .64$. A similar analysis was conducted for payback rate. The mean payback rate for the practice phase was 89.69% (SD = 34.90) which was not significantly different, $t (32) = .07, p = .94$, to the mean payback rate of 89.02% (SD = 49.51) when changing machines in the test phase.

Post-hoc Analysis

Further analysis was undertaken on the 33 participants who changed machines at least once during the test phase. Although, not part of the original hypotheses, it was decided to examine this group's preference for machine choice, as their behaviour suggested that they may represent a different population to the other participants. Results for frequency of win revealed that 20 of the 33 (60%) chose the machine, in the test phase, with the greatest number of reinforcers in the practice phase and 13 chose the machine that had provided the least. Chi-square analysis revealed that there was no significant relationship $\chi^2 (1, N = 33) = 1.49, p = .22$ between frequency of win and machine choice for this cohort. However, for the payback rate variable, results revealed that 26 (80%) had chosen the machine with the greatest payback rate and that a

significant relationship existed between payback rate and machine choice, with $\chi^2(1, N = 33) = 10.94, p = .001$.

Discussion

The hypothesis that there would be a significant relationship between machine choice and level of reinforcement from prior play was not supported. This was with regard to both average frequency of win and payback rate. These results suggest that there is no relationship between machine choice and reinforcement rate from prior experience. In the only other study examining machine choice (Dixon et al. 2006), results suggested that participants preferred machines with more frequent, smaller wins over those with less frequent, larger wins. However, the size and frequency of these wins were manipulated by the researchers to either a 1 in 10 payout (high frequency machine) or a 1 in 50 payout (low frequency machine). None of the practice trials in the current study produced an average frequency of win rate as small or infrequent as these, or with one machine providing five times the frequency of reinforcement as the other. It is suggested that the reinforcement rate for the current study better reflects the reinforcement rate of a true slot machine as there was no manipulation of reinforcement rate undertaken.

Although the results from Dixon et al. (2006) suggested that people prefer slot machines with small frequent wins, the reality is likely that the difference is not detectable in gaming venues with real machines. Their results do concur with the suggestion that slot machines are designed to provide small frequent wins to attract players (Griffiths 1993), however the results of the current study suggest that the issue of machine selection is unlikely to be related to win frequency differences. It is only when the difference between machines has been exaggerated, as in the Dixon et al. study, that players exhibit a preference.

The result for average payback rate was similar to that for win frequency and the results of Weatherly and Brandt (2004). Participants did not show a preference for the machine that returned the most (or least) amount of credit to them. Unlike win frequency, payback rate is much easier for participants to detect as it is reflected in the credit amount shown on the gaming machine screen. Participants could easily work out which machine paid them the most during the practice phase, however, this differentiation was not related to their initial machine choice during the test phase.

The machine change analysis indicated that participants changed machines during the test phase at a point when the reinforcement rate was similar (not significantly different) to the average rate from the practice phase. This was with regard to both win frequency and percentage payback. Theoretically, the machine change results provides some support for the marginal value theorem (Charnov 1976 as cited in Davey 1989) and adds a new dimension to understanding gaming machine playing behaviour.

However, the results from the current study are inconsistent with regard to the role of reinforcement. The results for machine choice suggest that prior reinforcement is not a factor in machine selection but the results for machine change suggest that prior reinforcement is a factor. This inconsistency may be explained by the differences within the sample and the results of the post-hoc analysis. Not all participants changed machines during the test phase and perhaps those who did were paying closer attention to the reinforcement rate from the practice phase. The analysis of the 33 participants who changed machines during the test phase revealed that a significant relationship existed between initial machine choice and payback rate from the practice phase. From this group, 80% had chosen the machine that had provided them with the greatest payback rate from the practice phase. This figure was much higher than the result for all participants and is more closely aligned with learning predictions. It also suggests that the payback rate is a better predictor of machine choice than frequency of wins.

Weatherly and Brandt (2004) suggested that the participants in their study were not sensitive to the payback rate of the machine but hypothesized that more experienced (or problem) gamblers may be. Subsequent analysis of the current study's data, however, revealed no significant difference in gambling experience (days played and session length) between the 33 who did change machines and the 37 who did not. Nonetheless, future research may assess the differences between participants who change machines and those who choose to remain on the one machine.

The factors that determined machine choice for the current sample are unknown and it would have been informative to obtain self-report information from the participant about their initial machine choice in the test phase. There may also be individual characteristics that explain both the machine choice and machine change results. Participants who changed machines appear to be from a different population and there may be psychological variables consistent with this group (e.g., impaired

control; impulsivity, sensation seeking; Dickerson and Baron 2000). There may also be gambling history variables related to individuals who change machines. The current study did not find any significant differences in gambling experience between those who changed machines and those who didn't, however, the students sampled were largely inexperienced gamblers. Initially, the inexperience of the sample was considered a strength as it was anticipated that it would be only the experience from the practice phase would influence play in the test phase. However, their naivety may be directly related to the null results as less experienced gamblers may be less likely to employ a strategy for gaming machine choice than regular players (Delfabbro and Winefield 1999).

The internal validity of the study could have been increased with the use of the simulated slot machine created by MacLin et al. (1999) that was used in the Dixon et al. (2006). This would have eliminated the need for the experimenter to manually record bets and betting outcomes and any possible experimenter effects associated with this. Future studies could also ascertain the level at which reinforcement rate does influence machine selection. The external validity of the study could be improved by the recruitment of a larger, more gender balanced sample. The chi-square analysis is considered to have low power and an increase in sample size may provide a significant result for some of the observed effects. Finally, the sample comprised of more than twice the number of women to men and previous research has emphasized the extent of gender differences across a variety of gambling related behaviours (Grant and Kim 2004).

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