Psychology of Addictive Behaviors
2012, Vol. 26, No. 1, 99–111

0893-164X/12/$12.00 DOI: 10.1037/a0023630

Emergent Response Allocation and Outcome Ratings in Slot Machine Gambling

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The present study describes a contemporary behavior-analytic model of emergent simulated slot machine gambling. Three laboratory experiments investigated the conditions under which stimuli correlated with different slot machine payout probabilities come to have new, emergent functions without those functions being trained directly. After a successful test for verbal relations (A1-B1-C1 and A2-B2-C2), gamblers and nongamblers were exposed to a task in which high- and low-payout probability functions were established for two slot machines labeled with members of the derived relations (B1 and B2). In Experiment 1, participants provided ratings and chose between concurrently presented slot machines labeled with indirectly related stimuli (C1 and C2). In Experiments 2 and 3, participants made ratings and chose under conditions of nonreinforcement and matched payout probabilities, respectively. Across all three experiments, it was predicted that participants would make more selections of, and give higher liking ratings to, the slot machine indirectly related to the trained high-payout probability machine (C2) than the slot machine indirectly related to the trained low-payout probability machine (C1). Findings supported these predictions. The implications for behavior-analytic research on gambling and the development of verbally based interventions for disordered gambling are discussed.

Keywords: slot machine gambling, verbal relations, emergent, nonreinforcement, matched payout probabilities

Recent advances in the analysis of gambling behavior have sought to understand the often-neglected contribution made by verbal behavior (Dixon & Delaney, 2006; Dymond, 2008; Dymond & Whelan, 2007; Weatherly & Dixon, 2006). According to these accounts, disordered slot machine gambling, for instance, may be partially controlled by a complex interplay between cognitive, verbal/relational processes, and the underlying schedule of reinforcement to such an extent that the behavior may appear insensitive to the programmed rate and magnitude of wins and losses. This interaction may help explain the persistence of gambling behavior that occurs either in the absence of direct reinforcement or under conditions of extremely lean reinforcement. These contemporary accounts represent an advance over earlier behavioral approaches to gambling that emphasized the impact of reinforcement schedules alone (Skinner, 1974).

Behavioral research on verbal relations may provide a model of how verbal processes interact with, and overcome, directly experienced reinforcement in slot machine gambling (Dymond & Roche, 2010; Hayes & Hayes, 1992). This research has shown that when verbally able humans are taught a series of interrelated discriminations involving physically dissimilar (arbitrary) stimuli, the stimuli involved often become related to each other in ways not explicitly trained (Sidman, 1971, 1994). To illustrate, if choosing Stimulus B in the presence of Stimulus A is taught (i.e., A-B), and choosing Stimulus C in the presence of Stimulus A (i.e., A-C) is also taught, it is likely that untrained relations will emerge between B and A, C and A (called *symmetry*), B and C, and C and B (called *combined symmetry and transitivity*, or *equivalence*), in the absence of any feedback. When these relations have emerged, a stimulus equivalence relation is said to have formed among the relata (Barnes, 1994; Hayes & Hayes, 1992; Sidman, 1994). These untrained, but nonetheless predictable, verbal relations have been the focus of concerted research attention precisely because they are not readily explained by traditional behavioral principles of discrimination and stimulus generalization. Neither A nor C, for instance, have a history of differential reinforcement with regard to each other (a defining feature of discrimination learning), and therefore, neither should control selection of the other. In addition, the verbal relations that emerge cannot be accounted for on the basis of generalization because the stimuli are all physically dissimilar.

Stimulus equivalence is one of the most widely studied types of verbal relations and is the focus of the present study. To illustrate the relevance of verbal relations for the analysis of gambling behavior, consider the following example of relations comprised of spoken, written, and visual stimuli. For example, the spoken word "casino" participates in a derived relation with pictures of actual casinos and the written word casino. If we consider the spoken word as Stimulus A, the pictures as Stimulus B (i.e., A-B), and the written words as Stimulus C (i.e., A-C), derived, verbal relations

This article was published Online First April 25, 2011.

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The authors thank Alice E. Hoon for assistance with data collection and the anonymous reviewers for helpful comments on a previous version of this article.

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may then emerge without further training. With a relational history such as this, a gambler who experiences a big win in a casino may, while reading or thinking about the casino, show signs of arousal to the covertly experienced word and initiate a casino gambling opportunity. This outcome occurs by virtue of the multisensory stimuli participating in a derived relation such that experience with one is sufficient to actualize the functions of the other, indirectly related members of the relation. In the case of our hypothetical gambler, some of the functions of winning are present in the interactions with the word such that he or she need not directly experience winning in its presence for behavior to be influenced. Verbal relations such as these may account for instances in which someone ""sees" in the absence of the thing seen" (Skinner, 1974, p. 91) and are processes that are considered to be at least partially responsible for gambling behavior (Dixon & Delaney, 2006; Dymond & Roche, 2010).

To further understand the variables involved in the initiation and maintenance of gambling, the analysis of gambling behavior uses computerized simulated gambling tasks (e.g., Haw, 2008; MacLin, Dixon, Daugherty, & Small, 2007; MacLin, Dixon, & Hayes, 1999; MacLin, Dixon, Robinson, & Daugherty, 2006). For instance, realistic computerized simulations of slot machines may be readily arranged that mimic the visual and auditory features of graphics-based computerized games used in modern gambling settings. Computerized simulations not only allow for the recording of various forms of behavioral data, but also permit precise manipulations of winning probabilities, magnitude of reinforcement, structural characteristics, and other determinants of gambling behavior (Dixon & Schreiber, 2004; Hoon, Dymond, Jackson, & Dixon, 2008; Kassinove & Schare, 2001; MacLin et al., 2006, 2007; Weatherly & Brandt, 2004; Zlomke & Dixon, 2006). Despite the potential limitations of laboratory analogue gambling, such as its apparent lack of ecological validity, it does permit a precise degree of experimental control over the multitude of factors that influence a particular instance of gambling (Lyons, 2006; Weatherly & Phelps, 2006). Analogue gambling tasks, then, are well suited to an investigation of the impact of verbal relations on emergent gambling behavior.

Contemporary behavioral approaches have employed computerized simulations to study the role of self-rules and verbal relations in slot machine gambling. In tandem with procedures based on verbal relations it has been shown that gamblers' preferences may be systematically altered over and above that predicted by the underlying reinforcement schedule. Hoon et al. (2008) found that recreational gamblers' choices of concurrently presented slot machines of equal payout probability (0.5) and reinforcement magnitude could be altered when a structural characteristic of one of the machines, such as background color, was established as a cue for "greater than." The identical reinforcement schedules operating with both slot machines should have resulted in relatively equal levels of response allocation ("matching"; Baum, 1974), and this is indeed what participants tended to do during a pretest phase. After the relational intervention, however, the same slot machines were represented and it was found that participants allocated a significantly greater proportion of their responses to the slot machine associated with the greater than cue, despite the matched reinforcement schedules. Other researchers have obtained similar findings with pathological gamblers (Nastally, Dixon & Jackson, 2010) and nongamblers (Johnson & Dixon, 2009; Zlomke & Dixon, 2006).

While these studies clearly demonstrate that choices to play different slot machines may be altered with a relational training intervention, only one previous study has shown that the actual stimuli involved in slot machine gambling may come to participate in derived, verbal relations. Dixon, Nastally, Jackson, and Habib (2009) investigated whether recreational gamblers' ratings of slot machine outcomes as "near misses" and closer to a win than other losing outcomes may, in part, be maintained via verbal/relational processes. To do so, these researchers examined the extent to which closeness to win ratings of various slot machine outcomes (wins, losses, and near misses) could be altered following the formation of equivalence relations. Stimuli consisted of three abstract images (labeled, for purposes of clarity, A1, A2, and A3), the text "win," "loss," and "almost" (B1, B2, and B3, respectively), and three graphic displays of slot machine outcomes depicting a win (i.e., three matching symbols on a payout line), a near miss (i.e., two matching symbols and one different symbol on a payout line) and a loss (i.e., three different symbols on a payout line; C1, C2, and C3, respectively). During a pretest phase, participants were presented with the C1, C2, and C3 stimuli individually and asked to rate how close the image was to a win on a 10-point Likert scale (1 = *Not a Win* and 10 = *Win*). Next, participants were trained, through the delivery of onscreen feedback, in the formation of the A-B and A-C conditional discriminations before being tested, in the absence of feedback, for symmetry (B-A and C-A) and derived equivalence relations (B-C and C-B). Finally, in the posttest slot machine outcome ratings phase, participants were represented with the C1, C2, and C3 stimuli.

Dixon and colleagues predicted that if derived equivalence relations had formed between the B-C and C-B stimuli, then the B3 stimulus, almost, should acquire some of the functions of the C3 loss image and the B2 stimulus, loss, should acquire some of the functions of the C2 near-miss image (the B1 stimulus, win, should remain unchanged as it is related via equivalence to the C1 win image, and vice versa). Dixon et al.'s results indicated that, relative to pretest levels, the majority of participants rated loss stimuli as closer to a win than near miss stimuli. Mean loss/near miss rating ratios showed that the greatest shifts in behavior were seen in those 10 participants out of 16 that passed the equivalence relations test. When the requisite derived relations were not formed, the predicted performances failed to emerge, further supporting the claim that verbal/relational processes are involved in generating the described effects (Dixon & Delaney, 2006; Dymond & Whelan, 2007).

Perhaps one of the most interesting features of verbal relations, and one that is the subject of the present study, is the emergence of novel functions. This involves training a particular behavioral function for one member of a derived relation and then observing that function emerge for one or more additional members of the derived relation, without further training (Smeets & Barnes-Holmes, 2003). For instance, imagine a gambler who plays a slot machine called "Lucky 7's" and enjoys it. Later, he or she may be told by another gambler that other machines called "Big Reels" are similar to Lucky 7's. Next, on being confronted with a choice between the two machines, our gambler may approach and show signs of enjoyment toward Big Reels, despite never having played or won on this machine before. This choice behavior and signs of arousal are based on the directly trained functions attached to

Lucky 7's and the verbal relations described in the statement. This basic effect has been demonstrated in countless studies with Pavlovian eliciting, extinction and avoidance, self-discrimination, and self-reported mood functions, among others (for a review, see Dymond & Rehfeldt, 2000).

To date, only one prior behavior-analytic study has investigated whether gambling relevant response functions may emerge via verbal relations. In a study with children aged from 8 to 10 years old, Dymond, Bateman, and Dixon (2010) showed how new stimuli could come to have functions relevant to gambling without those functions being trained directly. Following a successful derived equivalence relations test (A1-B1-C1 and A2-B2-C2), a simulated board game established high- and low-roll functions for two concurrently presented dice labeled with members of the derived relations (i.e., B1 = high-roll, B2 = low-roll). During the test for emergent functions, children were reexposed to the board game with dice labeled with indirectly related stimuli (i.e., C1 and C2). All participants except one who passed the equivalence relations test selected the die that was indirectly related to the trained high-roll die more often than the die that was indirectly related to low-roll die, despite the absence of differential outcomes. All participants except three also gave the derived high-roll die higher liking ratings than the derived low-roll die.

This growing body of behavior-analytic research on gambling behavior is concerned with understanding the basic behavioral processes that, for instance, evoke responding in children during pregambling activities (e.g., board games, rolling dice) that formally resemble such responding in disordered adult gamblers (Ghezzi, Lyons, Dixon, & Wilson, 2006; Knapp & Crossman, 2006; Weatherly & Dixon, 2007). In this way, the verbal relations may partly explain the emergence of gambling behavior, such as an increased preference for a novel slot machine, that arises in the absence of a direct learning history and may, ostensibly, appear to indicate control over behavior by "erroneous beliefs" (Delfabbro, Lambos, King, & Puglies, 2009; Sevigny & Ladouceur, 2003). Such a demonstration, particularly in a simulated slot machine gambling context, may extend the potential utility of behavioral models of disordered gambling and may help explain the emergence and maintenance of gambling behavior in the absence of direct reinforcement or under conditions of lean reinforcement, and contribute toward potential verbally based interventions to overcome disordered gambling (Dymond et al., 2010; Dymond & Roche, 2010; Petry, 2009). Indeed, a key challenge to behavioral accounts is to explain the persistence of gambling behavior under such conditions and how it may come to be influenced by environmental cues or situational characteristics (Parke & Griffiths, 2006) unrelated to the underlying schedule of reinforcement.

Identifying the core behavioral processes involved in the emergence and maintenance of gambling has relevance for the development of verbally based treatments for disordered gambling. Several behavioral therapies, such as Acceptance and Commitment Therapy (ACT; Hayes, 2004; Hayes, Strosahl, & Wilson, 1999), emphasize the role of verbal contingencies in understanding maladaptive behavior. According to these therapies, clinical problems largely stem from humans' ability to derive bidirectional relations between words and other stimuli, and for the functions of those stimuli to alter in accordance with those relations. Insofar as derived relations research provides a functional account of the verbal processes involved in gambling, it follows that empirical demonstrations of emergent gambling behavior may help to inform verbally based treatments to overcome disordered gambling. For instance, it is not known whether gambling that arises from verbal contingencies quickly comes under the direct control of immediate consequences (i.e., winning or loosing). In other words, the direct monetary consequences of gambling may or may not override the effects of verbal contingencies. Thus, while verbal processes may initiate gambling behavior, such processes may not be solely responsible for the maintenance of such behavior (Dymond & Roche, 2010).

The present study sought to investigate, across three experiments, the emergence of response allocation and outcome ratings during a simulated slot machine task under conditions of lean reinforcement and nonreinforcement with a mixed sample of nongamblers, recreational gamblers, and problem gamblers. In Experiment 1, following a successful derived equivalence relations test, participants were exposed to a slot machine task in which high- and low-payout probability functions were established for two slot machines labeled with members of the derived relations (i.e., B1 and B2). During the critical test for emergence, participants were required to give ratings and choose between concurrently presented pairs of slot machines labeled with indirectly related stimuli (i.e., C1 and C2). It was predicted that participants would make more selections of and rate the slot machine indirectly related to the trained high-payout probability machine (C2) as more likely to result in a win that the slot machine indirectly related to the trained low-payout probability machine (C1), despite never actually playing the slot machines. In Experiment 2, emergence was assessed under conditions on nonreinforcement during actual slot machine play in which participants chose between concurrently presented pairs of slot machines labeled with indirectly related stimuli. Finally, in Experiment 3, emergence was assessed under conditions of matched payout probabilities in which responses were followed by feedback on approximately half of the trials.

Experiment 1: Concurrent Slot Machine Forced Choice

Method

Participants. Thirty participants, 16 males and 14 females, with a mean age of 22 years, recruited from Swansea University, participated in Experiment 1 and were reimbursed with partial course credit at completion of the study. All participants scored 0 on the *South Oaks Gambling Screen* (SOGS; Lesieur & Blume, 1987), except for 3 who scored 1.

Materials and setting. The experiment was conducted in a small experimental room containing a table, chair, and a desktop computer programmed in Visual Basic.NET that controlled stimulus presentation and recorded all responses. Six nonsense syllables (PAF, WIB, YUT, ZID, VEK, QAF) were arranged into two stimulus sets, counterbalanced across participants. Each stimulus was presented in size 24, uppercase black Arial font within a 3.5 × 3.5 cm white colored square on a gray screen background.

Procedure.

Phase 1: Equivalence relations training and testing. The purpose of this phase was to train and test the formation of two, three-member equivalence relations (A1-B1-C1 and A2-B2-C2;

see Figure 1). Participants were first given the following onscreen instructions, which were read aloud by the experimenter:

> On the next screen, there will be three items. One item will be centered at the top of the screen. You are required to click on one of the other items at the bottom of the screen. Only one will be a correct answer. Your task is to get as many correct as possible. The more you get right, the quicker you will finish. On some trials you will be told if you are correct or wrong, and on others you will not. However, it is important that you still try to get them right as your progress will be monitored. Please ask the experimenter now if you have any questions, otherwise press "Start" to begin.

A blocked design was used to first train A-B relations followed by A-C relations before a mixed presentation of both types of relations. During A-B training, A1-B1 and A2-B2 conditional relations were trained in blocks of 12 trials, with each task presented 6 times in a pseudorandom order with the only constraint that the same task could not appear on more than two consecutive trials. On every trial, a sample (A1 or A2) first appeared at the top, center of the screen followed (1 s later) by the comparisons B1 and B2 at the foot of the screen, to the left and right of the sample, respectively. When A1 was presented, clicking on the comparison stimulus B1 produced the feedback, "Correct" in the center of the screen, while clicking on B2 produced the feedback "Wrong." When A2 was presented, clicking on the comparison stimulus B2 produced the feedback, Correct, in the center of the screen, while clicking on B1 produced the feedback, Wrong. Feedback was displayed in size 14 Arial black font within a 4.5 × 2 cm square in the middle of the screen for 1.5 s, and was followed by an intertrial interval (ITI) of 1.5 s. Participants were required to make 12 consecutive correct responses to complete this part of training. Next, the A-C tasks (A1-C1 and A2-C2) were presented and trained in the same manner. On reaching criterion, both A-B and A-C tasks were presented in a mixed block of 24 trials, with each task presented six times. Criterion was set at 22 out of 24 consecutive correct responses (i.e., >90%).

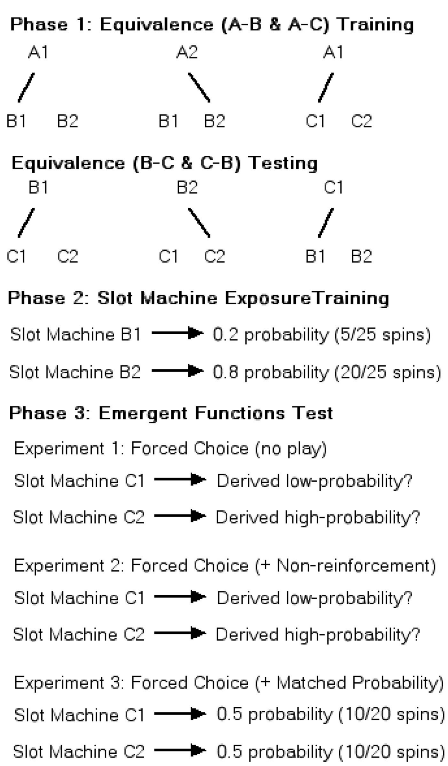

Figure 1. Overview of the experimental procedures. Solid lines indicate trained and test relations; arrows indicate directly trained slot machine functions; arrows and question marks indicate tested functions (see text for details).

On reaching criterion, a test for combined symmetry and transitivity relations (i.e., equivalence) was conducted by presenting B-C and C-B probes, in the absence of further feedback. Each task (B1-C1, B2-C2, C1-B1, and C2-B2) was presented four times in a block of 16 trials. When B1 was presented, clicking on the comparison C1 not C2 was predicted; when B2 was presented, clicking on the comparison C2 not C1 was predicted; when C1 was presented, clicking on the comparison B1 not B2 was predicted; and when C2 was presented, clicking on the comparison B2 not B1, was predicted. Mastery criterion to infer the emergence of derived equivalence relations was set at 16 consecutive correct responses. If participants failed to achieve this, they were reexposed to Phase 1 a maximum of three further times. On achieving criterion, participants progressed immediately to Phase 2.

Phase 2: Successive slot machine exposure training. The purpose of this phase was to provide direct exposure to two computer-based slot machine simulations that differed in payout probability (see Figure 1). Participants were first given the following instructions, which were read aloud by the experimenter:

> You will now play on a series of slot machine simulations. First, you will need to press the "Bet 1" button to bet 1 credit. The amount you are betting is displayed in the "Amount Bet" box above the slot machine. Then, click "Spin" to start the slot machine. You must bet 1 credit before you spin the wheel. You will only win if each of the three reels on the slot machine display the same symbol. The amount you win will be displayed in the "Amount Won" box and added to your total credits. You may find that you win more frequently on one slot machine than another. Each slot machine has a different label so try to remember which one you win more frequently on because you need to win as many credits as possible [this sentence was included to ensure close attention was paid to the labels of the slot machines]. To start, you have been given 100 credits. You will play on two slot machines with labels that you have seen before. Both slot machines will appear interchangeably on the screen. The label above the reels will tell you which one you are playing on a given time. Please keep playing until you are told to stop. Good luck!

The slot machine simulations represented a three-reel slot machine that required three matching symbols to win, and were displayed in the center of the screen on a gray background approximately 2.5 × 4 cm. Each of the three reels contained a range of six common slot machine images (e.g., cherries, gold bars, etc.). Above the reels was positioned the slot machine label corresponding to the B1 and B2 nonsense syllable, respectively, which was displayed in size 24 Arial black font on a white background. Located below the center reel was the "Bet 1" button, which when pressed reduced the total credits by 1 and increased the "Amount bet" total by 1. To control for variation in reinforcement density, once the Bet 1 button had been clicked, it remained inactive until the end of trial. Therefore, the maximum bet was set at 1 credit. Located below the right-hand reel was the "Spin" button, which was disabled until the Bet 1 button had been pressed. When the Spin button was pressed, the three reels started to spin simultaneously and stopped in succession from left to right. The left-side reel stopped spinning after 3.5 s had elapsed, followed (1.5 s later) by the center reel and then (a further 1.5 s later) by the right-side reel. Wins were indicated by three matching images and win noise, and resulted in the addition of five credits to the accumulating total. Losses were indicated as any displays other than three matching images, and resulted in no change to the accumulating total. Immediately after the final reel spin, a Continue button was displayed that, when pressed, initiated the ITI.

On every trial, one of two slot machine simulations was presented in the center of the screen, labeled with the nonsense syllable corresponding to B1 and B2 from Phase 1. The slot machine labeled B1 was programmed to payout (i.e., three matching symbols on the payout line, and the addition of one credit to the accumulating total display) on 5 out of 25 trials (i.e., 0.2 probability). The slot machine labeled B2 was programmed to payout on 20 out of 25 trials (i.e., 0.8 probability). There were a total of 50 trials in this phase, 25 with each of the two slot machines, which were presented in a pseudorandom order such that no more than two consecutive trials with the same slot machine could occur.

After the 50th trial, participants were presented with a Likert rating scale and asked to rate the likelihood of winning on slot machines B1 and B2, where 1 = *Very Unlikely* and 5 = *Very Likely*. Participants performed the ratings by clicking on the numbers 1 to 5 displayed on a slider scale.

***Phase 3: Emergent functions test: Concurrent slot machine forced choice*.** The purpose of this phase was to test for the emergence of functions from B1 and B2 to the concurrently presented slot machine simulations labeled C1 and C2 (see Figure 1). Participants were given the following instructions, which were read aloud by the experimenter:

> On the next screen, you will be given a choice of two slot machines to play. When you have selected one, you will see the slot machine but you will not be able to actually play it. Please select a slot machine as if you were going to play it and try to win as many credits as possible. Please keep selecting the slot machines until you are told to stop. When you are ready to start, click "Continue". Good luck!

After clicking Continue, two buttons labeled with the nonsense syllables corresponding to C1 and C2, respectively, were displayed in the center of the screen. The labels were displayed in size 12 Arial black font on a gray background. When a label was selected, the corresponding slot machine with blank reels was displayed for 1 s, and returned to the choice selection screen. The position (left/right) of the C1 and C2 buttons was pseudorandom, with the constraint that the same label could appear in the same position on no more than two consecutive trials. This phase continued until participants had made 40 selections.

Following the 40th trial, participants were presented with a 5-point Likert rating scale similar to that used before except now they were asked to rate the likelihood of winning on slot machines C1 and C2, where 1 = *Very Unlikely* and 5 = *Very Likely*. On completion of this phase, participants were thanked for their participation and fully debriefed (a copy of the debrief form is available on request from the first author).

Results and Discussion

Phase 1: Equivalence training and testing. All 30 participants achieved criterion on the equivalence test: 13 passed the test on their first exposure, 9 on their second exposure, 4 on their third exposure, and 4 on their fourth exposure.

Phase 2: Successive slot machine exposure training. Figure 2 (upper panel) shows the mean ratings of the likelihood of winning given to the slot machines labeled B1 and B2 in Experiment 1. Participants rated the likelihood of winning on the B2 slot machine ($M = 4.4$, $SD = 0.6$) as greater than that on the B1 slot machine ($M = 2.27$, $SD = 0.78$). The difference between B1 and B2 ratings was statistically significant, Wilcoxon's $T = 388.0$, $p <$ .0001.

Phase 3: Emergent functions test: Concurrent slot machine forced choice. Figure 2 (upper panel) shows the mean ratings of the likelihood of winning given to the slot machines labeled C1 and C2 in Experiment 1. Participants rated the likelihood of winning on the C2 slot machine ($M = 4.2$, $SD = 0.8$) as greater than that on the C1 slot machine ($M = 2.4$, $SD = 0.9$). The difference between C1 and C2 ratings was statistically significant, Wilcoxon's $T = 323.0$, $p < .0001$.

Figure 2 (lower panel) shows the mean number of selections of the C1 and C2 slot machines in Experiment 1. Participants selected the slot machine labeled C2 ($M = 30.8$, $SD = 9.9$) more often than C1 ($M = 9.1$, $SD = 9.9$). This difference in mean number of selections occurred under conditions of forced choice and without directly playing either of the slot machines. The difference in mean number of selections of C1 and C2 was statistically significant, $t(29) = 5.977$, $p < .0001$, $r = .55$.

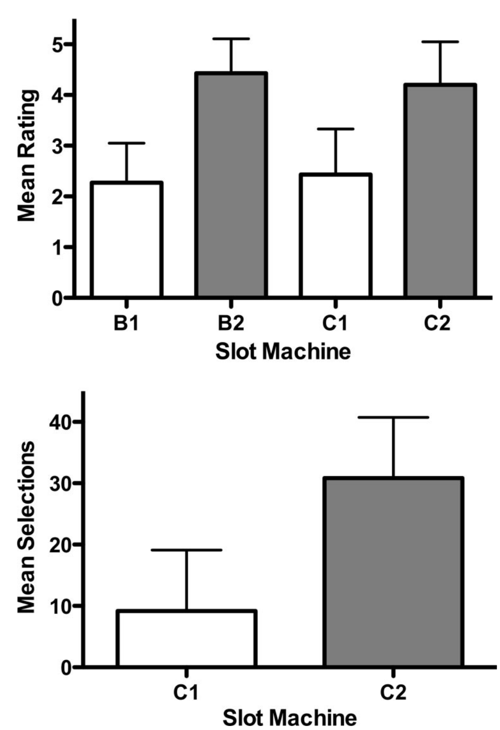

Figure 2. Mean ratings and selection data for Experiment 1. Error bars indicate *SDs*.

Overall, the findings of Experiment 1 showed that participants' selections and ratings of concurrently presented simulated slot machines transferred to slot machines labeled with members of derived equivalence relations. This emergence occurred under forced choice conditions in which participants were not exposed to the underlying reinforcement schedules operating with the slot machines. Such a demonstration illustrates the impact of verbal relations on gambling behavior, but may be considered as lacking in ecological validity. For instance, apart from the obvious fact that the study was conducted in a laboratory setting with participants "gambling" with conditioned reinforcers in the form of onscreen credits, it is rare for slot machine gamblers to be exposed to choices of different machines, but not to actually experience outcomes while playing those machines. A more realistic laboratory analogue of slot machine gambling would be to expose participants to a test for emergence under conditions of nonreinforcement or extinction (i.e., in the absence of feedback following each reel spin), because this more accurately reflects how random ratio schedules are arranged on slot machines (Crossman, 1983). Experiment 2 was designed to address this issue.

Experiment 2: Slot Machine Play During Nonreinforcement

Method

Participants. Thirty participants, 14 males and 16 females, with a mean age of 25 years, recruited from Swansea University, participated in Experiment 2 and were reimbursed with partial course credit at completion of the study. Two participants failed to meet criteria during Phase 1, leaving a final sample of 28 participants (13 males and 15 females). The majority of the participants scored 0 on the SOGS, except for 4 who scored 1, 3 who scored 3 (potential problem gambling), and 1 who scored 6 (potential pathological gambling).

Procedure. In Experiment 2, participants were exposed to *Phase 1: Equivalence training and testing* and *Phase 2: Successive slot machine exposure training* in the same manner as Experiment 1. During Phase 3, however, emergence was tested under conditions of nonreinforcement (i.e., extinction).

Phase 3: Emergent functions test: Slot machine play during nonreinforcement. The purpose of this phase was to test for emergence of functions from B1 and B2 to the concurrently presented slot machine simulations labeled C1 and C2. Participants were given the following instructions, which were read aloud by the experimenter:

> On the next screen, you will be given a choice of two slot machines to play. When you have selected a slot machine, you will be able to bet and spin the reels. You will only be able to see the amount bet, not the amount won or your total credits. That is, on each wheel spin you will not know if you have won or lost. Please continue to play as well as you can and keep playing until you are told to stop. When you are ready to start, click "Continue". Good luck!

After clicking Continue, two buttons labeled with the nonsense syllables corresponding to C1 and C2, respectively, were displayed in the center of the screen. When a label was selected, the corresponding slot machine spun as before but each reel successively stopped on a blank display. This manipulation ensured that participants were not provided with any feedback on the outcomes of the slot machines trials (i.e., nonreinforcement). Neither the "Amount Won" nor "Total Credits" counters were updated following trials and both remained at zero values for the duration of this phase, which continued until participants made 40 selections.

As before, participants made ratings of the likelihood of winning on slot machines C1 and C2. On completion, participants were thanked for their participation and fully debriefed (a copy of the debrief form is available on request from the first author).

Results and Discussion

Phase 1: Equivalence training and testing. Two participants failed to achieve mastery criteria after four exposures to the equivalence test and were excused from the remainder of the experiment. Of the remaining 28 participants, 12 passed the test on their first exposure, 8 on their second exposure, 5 on their third exposure, and 3 on their fourth exposure.

Phase 2: Successive slot machine exposure training. Figure 3 (upper panel) shows the mean ratings of the likelihood of winning given to the slot machines labeled B1 and B2 in Experiment 2. Participants rated the likelihood of winning on the B2 slot machine ($M = 4.3$, $SD = 0.4$) as greater than that on the B1 slot machine ($M = 2.1$, $SD = 0.5$). The difference between B1 and B2 ratings was statistically significant, Wilcoxon's $T = 406.0$, $p < .0001$.

Phase 3: Emergent functions test: Slot machine play during nonreinforcement. Figure 3 (upper panel) shows the mean ratings of the likelihood of winning given to the slot machines labeled C1 and C2 in Experiment 2. Participants rated the likeli-

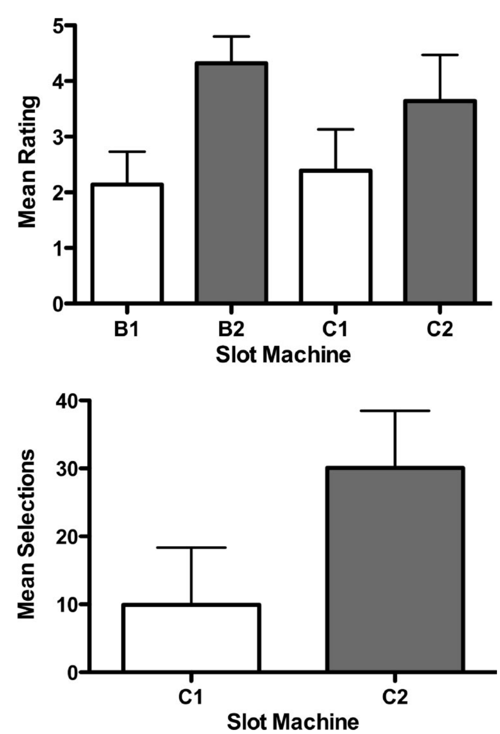

Figure 3. Mean ratings and selection data for Experiment 2. Error bars indicate *SD*s.

hood of winning on the C2 slot machine ($M = 3.6$, $SD = 0.8$) as greater than that on the C1 slot machine ($M = 2.3$, $SD = 0.7$). The difference between C1 and C2 ratings was statistically significant, Wilcoxon's $T = 170.0$, $p = .0003$.

Figure 3 (lower panel) shows the mean number of selections of C1 and C2 in Experiment 2. Participants selected the slot machine labeled C2 ($M = 30.0$, $SD = 8.4$) more often than C1 ($M = 9.9$, $SD = 8.4$). This difference in mean number of selections occurred during slot machine play under conditions of nonreinforcement. The difference in the mean number of selections of C1 and C2 was statistically significant, $t(27) = 6.333$, $p < .0001$, $r = -.59$.

Overall, the findings of Experiment 2 show emergent transfer of selections and ratings of concurrently presented slot machines under conditions of nonreinforcement. Participants showed statistically significant differences in both preferences for, and ratings of, the slot machine labeled C2 that was indirectly related to the trained high-probability slot machine, B2. The majority of participants continued to show a clear selection preference for the C2 slot machine despite never winning while playing it. This is the first such demonstration of the emergence of slot machine gambling under conditions of nonreinforcement, and lends further support to the behavioral model of gambling. The findings indicate that high probability winning outcome functions established during direct exposure training may come to participate in derived relations and influence the persistence of slot machine selections under conditions of nonreinforcement.

In research on verbal relations and emergent functions, it is customary to present critical probes in the absence of feedback as not doing so would entail further direct training with the ongoing schedule of reinforcement. In seeking to further develop a behavioral model of slot machine gambling initiation and maintenance, however, it may be necessary to test emergent transfer under conditions that approximate real-world reinforcement schedules. Previous research on concurrent slot machine schedules has shown that participants' responding generally conforms to the predictions of the matching law (Baum, 1974) that is, relative response rates usually match relative reinforcement rates (cf. Weatherly, Thompson, Hodny, & Meier, 2009). Experiment 3 sought to investigate this issue further by testing emergence under conditions of matched payout probabilities with pairs of concurrently presented slot machines.

Experiment 3: Slot Machine Play Under Matched Payout Probabilities

Method

Participants. Forty-three participants, 6 males and 36 females, with a mean age of 25 years, recruited from Swansea University, participated in Experiment 3 and were reimbursed with partial course credit at completion of the study. Three participants failed Phase 1, leaving a final sample of 40 participants (6 males and 34 females). The majority of the participants scored 0 on the SOGS, except for 11 who scored 1 and 2 who scored 2.

Procedure. In Experiment 3, participants were exposed to *Phase 1: Equivalence training and testing* and *Phase 2: Successive slot machine exposure training* in the same manner as the previous experiments. During Phase 3, however, emergence was tested under conditions of matched payout probabilities.

Phase 3: Emergent functions test: Slot machine play under matched payout probabilities. The purpose of this phase was to test for emergence from B1 and B2 to the concurrently presented slot machine simulations labeled C1 and C2. Participants were given the following instructions, which were read aloud by the experimenter:

> On the next screen, you will be given a choice of two slot machines to play by pressing their corresponding buttons. When you have selected a slot machine, you will be able to bet and spin the reels. As before, you will only win if each of the three reels displays the same image. You will then have to select which slot machine to play next. You can play on the two slot machines interchangeably. This is your last chance to win as many credits as possible. Please keep playing until you are told to stop. Good luck!

After clicking Continue, two buttons labeled with the nonsense syllables corresponding to C1 and C2, respectively, were displayed in the center of the screen. When a label was selected, the corresponding slot machine spun as before and displayed the outcome of each trial.

Each slot machine was programmed on a random ratio (RR) schedule of reinforcement to payout at a probability of 0.5 (i.e., a winning outcome on 10 of 20 trials). The outcomes of the RR schedules were predetermined for every participant, with the program controlling for credits won/lost such that all participants received the identical amount of reinforcement despite their different choices between the two slot machines. Participants received the same predetermined sequence of win/loss trial outcomes: no near misses were scheduled (Hoon et al., 2008; MacLin et al., 2006; Zlomke & Dixon, 2006). Participants started with 1 credit, each bet cost 1 credit, each win resulted in the addition of 5 credits to the accumulating total, and this phase continued until 40 selections in total were made.

As before, participants made ratings of the likelihood of winning on slot machines C1 and C2. On completion, participants were thanked for their participation and fully debriefed (a copy of the debrief form is available on request from the first author).

Results and Discussion

Phase 1: Equivalence training and testing. Three participants failed to achieve mastery criteria after 4 exposures to the equivalence test and were excused from the remainder of the experiment. Of the remaining 40 participants, 14 passed the test on their first exposure, 20 on their second exposure, 4 on their third exposure, and 2 on their fourth exposure.

Phase 2: Successive slot machine exposure training. Figure 4 (upper panel) shows the mean ratings of the likelihood of winning given to the slot machines labeled B1 and B2 in Experiment 3. Participants rated the likelihood of winning on the B2 slot machine ($M = 4.4$, $SD = 0.5$) as greater than that on the B1 slot machine ($M = 2.0$, $SD = 0.5$). The difference between B1 and B2 ratings was statistically significant, Wilcoxon's $T = 780.0$, $p < .0001$.

Phase 3: Emergent functions test: Slot machine play under matched payout probabilities. Figure 4 (upper panel) shows the mean ratings of the likelihood of winning given to the C1 and

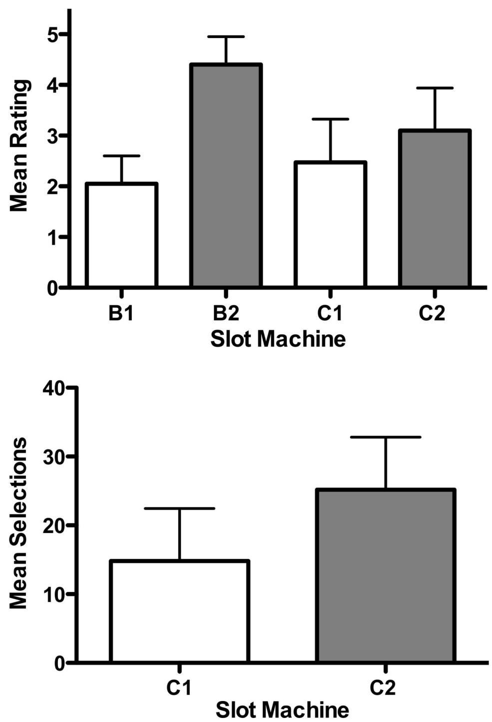

Figure 4. Mean ratings and selection data for Experiment 3. Error bars indicate *SD*s.

C2 stimuli in Experiment 3. Participants rated the likelihood of winning on the C2 slot machine (M = 3.1, SD = 0.8) as greater than that on the C1 slot machine (M = 2.4, SD = 0.8); only 12 of the 40 participants gave equal ratings to both machines (see Appendix). The difference between C1 and C2 ratings was statistically significant, Wilcoxon's T = 208.0, p = .0109.

Figure 4 (lower panel) shows the mean number of selections of C1 and C2 in Experiment 3. Participants selected the slot machine labeled C2 (M = 25.2, SD = 7.7) more often than C1 (M = 14.8, SD = 7.6). This difference in mean number of selections occurred during slot machine play under matched probability conditions. The difference in mean number of selections of C1 and C2 was statistically significant, $t(39) = -4.749$, p = .000, $r = -.95$.

***Comparison across Experiments 1 to 3*.** Friedman's ANOVA showed that there was a significant difference in ratings given to B1 and B2, $\chi^2(5) = 108.627$, p = .000, to C1 and C2, $\chi^2(5) = 62.020$, p = .000, and between selections of C1 and C2, $\chi^2(5) = 70.385$, p = .000, across experiments.

Overall, the findings of Experiment 3 demonstrate emergence under conditions that approximate real-world concurrent slot machine schedules. Participants showed a preference for, and gave higher likelihood of winning ratings to, the slot machine labeled with an indirectly related member of the derived relations, despite never having experienced a higher payout percentage playing it. These emergent preferences and ratings transferred via equivalence from the B2 slot machine to the C2 slot machine and were maintained under test conditions involving a lower payout percentage (0.5) than that directly trained for the higher payout machine (0.8). The emergence of differential response allocation and outcome ratings for the C2 slot machine over the C1 machine was predicted on the basis of findings from the previous experiments, and the vast literature on emergent transfer (e.g., Dymond et al., 2010; Smeets & Barnes-Holmes, 2003). The findings of Experiment 3 supported this prediction, and showed emergent slot machine gambling under conditions of matched payout probabilities. It is likely that the directly experienced 0.5 payout percentages, which were higher than that directly trained with B1 and lower than that directly trained with B2, interacted with the predicted emergent control exerted by the relations between the B and C stimuli. Indeed, this is supported because of the fact that compared with Experiments 1 and 2 the response differential occasioned by C2 over C1 was lower, but still significantly different. The Appendix shows that, across the three experiments, the majority of participants selected C2 over C1. Together, the findings show an interaction between derived contingencies and matched payout probabilities in concurrently presented slot machines.

General Discussion

The findings of the present experiments demonstrate, for the first time, the emergence of response allocation and outcome ratings during a simulated slot machine task under conditions of lean reinforcement and nonreinforcement. In Experiment 1, the slot machine (C2) that was indirectly related via equivalence to the trained high-payout probability slot machine (B2) occasioned a statistically greater number of selections and higher winning outcome ratings than the slot machine that was indirectly related to the trained low-payout probability machine. This occurred in the absence of actually playing either slot machine during the crucial test phase. In Experiment 2, similar findings were observed during actual slot machine play under conditions of nonreinforcement. The findings of Experiment 3 showed that emergent response allocation and outcome ratings occurred under conditions of matched payout probabilities, when participants chose between concurrently presented pairs of machines labeled with stimuli indirectly related via equivalence. Taken together, these findings show how slot machine gambling generally, and emergent choices of which slot machine to play specifically, may come to be influenced by stimulus features that have not been trained directly.

Across the three experiments, the vast majority (i.e., 96%) of participants passed tests for the formation of derived equivalence relations in Phase 1 within the predetermined four test exposures. Adopting a fixed test exposure criterion was both consistent with previous research (e.g., Dymond et al., 2010) and necessary to prevent inadvertent feedback from continued training and testing cycles influencing participants' responding. That is, repeatedly recycling between training and testing phases until criterion was met would have served to indicate to participants that they needed to change their pattern of responding during the equivalence tests (i.e., "I keep getting the same tasks without feedback. I must be doing something wrong."). By limiting exposures to a maximum of four, the present procedures allowed sufficient time for the "delayed emergence" (Sidman, 1994) of equivalence relations to occur while also mitigating against the effects of adventitious feedback (Dymond & Rehfeldt, 2000).

Identical procedures were used across all three experiments during successive slot machine exposure training in Phase 2. The ratings obtained at the end of this phase were intended to verify that participants had discriminated between the differing payout probabilities associated with each slot machine. Consistent significant differences were obtained in each experiment with participants giving reliably higher likelihood of winning ratings to the slot machine labeled B2 than the machine labeled B1, which confirmed that the exposure training was effective in making each slot machine discriminative for differing payout probabilities. During Phase 3, emergent transfer was also measured with ratings of the slot machines labeled C1 and C2 after participants had either not directly played each machine (Experiment 1), or had played under conditions of nonreinforcement (Experiment 2), or matched reinforcement (Experiment 3). Ratings were again found to be consistently significantly different between C1 and C2, suggesting that the self-report functions attached to B1 and B2 had transferred via equivalence despite the differing contingencies of each phase. While further studies are needed to identify the conditions under which emergent transfer might be inhibited (Dymond & Rehfeldt, 2000), the present findings are, however, in line with those of previous studies that have included self-report ratings-based measures of emergent functions (e.g., Dixon et al., 2009; Smyth et al., 2006).

Before obtaining the ratings-based measures in Phase 3, the emergence of novel response allocation was also inferred from selections between the simultaneously presented C1 and C2 slot machines. The same concurrent presentation format was adopted across the three experiments, which only differed by the consequences that followed selection of one of the two slot machines labeled C1 and C2 (i.e., forced choice, nonreinforcement, and matched probability, respectively). According to research on verbal relations and emergent transfer, it was predicted that participants would select the C2 slot machine that was indirectly related to the directly trained high-probability payout slot machine (B2), despite the differential consequences that followed selections across each of the experiments. The findings were broadly in line with this prediction. Mean selections of the C2 and C1 slot machines were comparable and highly significant across experiments. The proportion of selections, although still significant, was relatively diminished in Experiment 3 relative to Experiments 1 and 2, however, when participants' responses were followed by slot machine reel spins that were reinforced according to matched payout probability schedules. To some extent, this finding may be expected because the control exerted by the derived relations of equivalence that emerged between B2 and C2 and B1 and C1 likely interacted with the directly experienced matched payout probabilities that followed each selection. In effect, during Phase 3, participants' choices of one slot machine over the other were intermittently reinforced according to the programmed 0.5 payout percentages. Thus, unlike Experiment 1 where participants made forced choices and did not actually play either of the slot machines, and Experiment 2 where choices were not followed by feedback (i.e., nonreinforcement), participants' responses in Experiment 3 had a 0.5 probability of being followed by winning outcomes on both machines. It is, therefore, likely that in Experiment 3 the emergent control predicted by equivalence to be exerted by the C1 and C2 slot machines was inhibited by the directly experienced, intermittently scheduled outcomes of the slot machines (Hoon et al., 2008; Zlomke & Dixon, 2006).

Usually, emergence is tested under conditions of extinction (resembling those seen in Experiment 2, and to a lesser extent, Experiment 1), yet the procedures of Experiment 3 were designed to resemble the real world gambling choices that slot machine players are often confronted with. Specifically, on entering a casino, a slot machine player often faces an array of concurrently available choices as to which machine to play. Indeed, "the verbal human is exposed to a variety of contingencies and verbal stimuli when engaging in a gamble" (Dixon & Delaney, 2006, p. 173). Such verbal stimuli may consist of "a fellow casino patron instructing the slot machine player that one game is "hotter" than another" (Dixon & Delaney, 2006, p. 174), among others. Derived relations inherent in instructions and statements such as these may resemble the processes exerted during the present tests for emergent functions in that the participants had no direct experience of playing the C1 and C2 slot machines yet responded in a consistent and predicted fashion in accordance with training. Selecting C2 by virtue of its derived relation with the directly trained B2 slot machine is a derived outcome in much the same way as playing an unfamiliar slot machine that is described as hotter than another: the behavioral processes that mediate this behavior are, according to contemporary behavior analytic accounts, identical. For instructions and rules to exert control over behavior, the objects and events they describe must participate in derived relations with actual events; this is what is meant by rules "specifying" contingencies in modern accounts of rule-governed behavior (Hayes, 1989; O'Hora & Barnes-Holmes, 2001; cf. Skinner, 1969). The present findings, therefore, demonstrate that explanations based solely on schedules of reinforcement as the controlling variable in gambling behavior are likely to be incomplete without also appealing to the explanatory concepts of verbal relations and emergent function transfer (Dymond & Roche, 2010).

Previous gambling research employing concurrently available slot machines has shown that human choice behavior often shows differential sensitivity to programmed reinforcement rates and that such preferences may be subsequently altered after a relational training intervention (e.g., Dixon, MacLin, & Daugherty, 2006; Hoon, Dymond, Jackson, & Dixon, 2007, Hoon et al., 2008; Weatherly et al., 2009). Weatherly et al. (2009) found that 6 nonpathological female gamblers playing concurrently available commercial slot machines in a simulated casino environment programmed to pay out at different rates did not always show preferences for the higher paying machine, despite extensive experience (see also, Weatherly & Brandt, 2004). Participants' slot machine gambling on concurrent schedules was predicted to show sensitivity to reinforcement and result in choices to play the higher paying machine. The findings were contrary to this prediction and the authors argued that such differential sensitivity to payback percentage indicates that the participants' gambling was partially rule-governed. Weatherly et al. (2009) suggested that such findings mean that researchers should consider alternatives to direct-contingency, reinforcement-based accounts of gambling.

With concurrently available slot machines of equal payout probability and reinforcement magnitude, other studies have shown that recreational and problem gamblers' choices may be altered when a structural characteristic of one of the machines (i.e., color), is established as a cue for greater than (Hoon et al., 2008; Nastally et al., 2010; Zlomke & Dixon, 2006). Following a relational training intervention similar to that used here, the "matching" of levels of responding to relative reinforcement rates (Baum, 1979) usually seen under conditions of equal payout probability and magnitude was effectively overridden. This resulted in a significantly greater proportion of responding being allocated to the slot machine associated with the greater than cue, despite the identical reinforcement schedules (Hoon et al., 2008; Nastally et al., 2010). Thus, explaining slot machine gambling solely with reference to the underlying schedule of reinforcement is unlikely to be a complete account of the dynamic interactions that occur between programmed reinforcement rates, structural characteristics, and rule-governed behavior. The present findings illustrate that verbal relations have potential to supplement these explanations by providing a contemporary, functional account of the role played by verbal processes in the emergence of gambling behavior, such as an increased preference for a novel slot machine that arises in the absence of a direct learning history.

The present findings have implications for the behavior-analytic understanding of gambling behavior and may help provide verbally based interventions to overcome disordered gambling. Empirical research on gambling tends to be dominated by cognitive-based theories, models, and treatment strategies (Nastally & Dixon, 2010; Petry, 2009; Sevigny & Ladouceur, 2003) that emphasize predisposing factors such as personality factors and erroneous beliefs that lead an individual to develop pathological gambling. On the other hand, the growing body of behavior-analytic research on gambling behavior is concerned with understanding how basic behavioral processes, like verbal relations, come to explain gambling behavior that at first appears to be insensitive to underlying reinforcement contingencies comes to be established in a gambler's repertoire. This approach is reflected in modern behavior therapies, such as ACT (Hayes, Luoma, Bond, Masuda, & Lillis, 2006; Hayes et al., 1999), where metaphors and experiential exercises are used to undermine emergent transfer via verbal relations (e.g., Masuda, Hayes, Sackett, & Twohig, 2004). Specifically, these techniques alter the verbal/relational contexts that enable transfer to occur, rather than seeking to alter the structure or content of specific verbal relations directly (Blackledge, 2007) and can produce extinction of derived verbal functions (Roche, Kanter, Brown, Dymond, & Fogarty, 2008). The goal of one such technique, cognitive *defusion*, is "to change the way one interacts with or relates to thoughts by creating contexts in which their unhelpful functions are diminished" (Hayes et al., 2006, p. 8). Clients may be guided to see their thoughts of escape from feelings (e.g., urges to gamble), overt actions (e.g., actual gambling), and further thoughts (e.g., intentions to gamble) as mere thoughts, and to be mindful of, and remain psychologically in contact with, the alternatives to avoidance of these unpleasant states (Blackledge, 2007; Masuda et al., 2004). Defusion exercises may entail asking a client to repeat aloud a word or phrase associated with problematic urges or behavior with which the client has unsuccessfully attempted to avoid, such as "I want to gamble today." By repeatedly uttering the word or phrase out loud, the sounds of the phrase rather than its emotional content come to exert influence over subsequent behavior. With each repetition, the client increasingly notices the sounds of each word, and not the psychological functions fused with them. In conjunction with other experiential exercises and metaphors, the client may as a result be less likely to respond gambling urges. The present findings offer an insight into the behavioral processes at work in these situations. Further empirical analysis of the mechanisms of therapeutic change is warranted, with one possibility being the extension of defusion techniques to the amelioration of emergent gambling preferences (cf. Roche et al., 2008). Indeed, it is clear that further demonstrations of the role of verbal relations in gambling behavior are needed if such techniques are to inform development of a brief, behavior-analytic intervention for disordered gambling.

The present experiments have several noteworthy features that warrant further investigation. First, the procedures of Experiment 3 may permit a novel investigation of persistence during slot machine gambling. Factors such as the frequency of "near misses" and "big wins" have been shown to lead to greater persistence (Dillen & Dixon, 2008; Haw, 2008; Kassinove & Schare, 2001; cf. Weatherly, Sauter, & King, 2004), but no study to date has evaluated the point at which derived preferences may be overridden by matched payout probabilities. Future research on this topic would do well to adapt the procedures of Experiment 3 and present varying numbers of derived test trials with differing payback percentages. Second, a systematic comparison of recreational, problem, and pathological gamblers' derived response preferences and ratings for slot machines of differing payout probabilities may permit identification of differential sensitivity as a function of gambling severity. Finally, the present findings should be extended to verbal relations other than equivalence relations, such as derived comparative relations of more than and less (e.g., Munnelly, Dymond, & Hinton, 2010), and by so doing, extend the reach of the account.

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(*Appendix follows*)

Appendix

Appendix: Outcome Ratings and Response Allocation for All Participants in Each of the Three Experiments

Experiment 1	Ratings				Response allocation	
P	B1	B2	C1	C2	C1	C2
1	2	5	2	5	0	40
2	2	5	2	5	20	20
3	2	4	3	5	3	37
4	2	5	3	4	5	35
5	2	5	2	4	5	35
6	2	4	3	4	8	32
7	3	4	4	3	30	10
8	2	4	3	3	10	30
9	3	5	3	3	38	2
10	2	4	2	4	11	29
11	2	5	2	5	0	40
12	2	5	2	5	0	40
13	2	5	2	4	8	32
14	2	4	2	4	10	30
15	3	5	3	5	10	30
16	2	4	2	4	5	35
17	4	4	5	5	18	22
18	2	4	2	4	6	34
19	3	5	3	5	3	37
20	2	4	2	4	0	40
21	4	4	3	3	15	25
22	4	2	4	2	30	10
23	1	4	1	4	0	40
24	1	5	1	5	0	40
25	2	4	2	3	17	23
26	2	5	2	5	5	35
27	1	5	1	5	0	40
28	2	4	2	5	5	35
29	3	5	3	4	13	27
30	2	5	2	5	0	40
Experiment 2	**Ratings**				**Response allocation**	
P[a]	B1	B2	C1	C2	C1	C2
31	2	4	2	4	12	28
32	1	4	3	3	22	18
34	1	5	2	4	1	39
35	2	5	2	4	8	32
36	2	4	2	4	3	37
37	3	5	2	4	9	31
38	2	4	2	4	11	29
39	3	5	3	4	17	23
40	2	4	3	3	6	34
41	2	4	2	4	8	32
42	3	4	3	3	8	32
43	2	5	2	5	0	40
44	2	5	1	5	0	40
45	3	4	2	4	25	15
46	2	4	2	4	4	36
47	3	4	3	3	3	37

(*Appendix continues*)

Appendix (*continued*)

Experiment 2	Ratings				Response allocation	
P[a]	B1	B2	C1	C2	C1	C2
48	2	4	2	4	9	31
49	2	4	2	4	3	37
50	1	5	1	1	16	24
51	2	4	2	4	1	39
52	2	4	2	4	4	36
54	2	4	3	3	6	34
55	3	4	3	4	14	26
56	2	4	3	3	13	27
57	3	4	3	3	18	22
58	2	4	4	4	16	24
59	2	5	4	2	36	4
60	2	5	2	4	5	35

Experiment 3	Ratings				Response allocation	
P[b]	B1	B2	C1	C2	C1	C2
61	2	5	2	3	10	30
62	2	5	1	3	8	32
63	2	5	2	3	11	29
64	2	5	3	3	19	21
65	2	4	3	4	16	24
66	2	4	1	1	21	19
67	2	5	2	2	16	24
68	2	4	3	3	15	25
69	2	5	3	3	23	17
70	1	4	4	2	35	5
71	2	4	3	3	7	33
73	3	5	2	4	16	24
74	2	4	2	3	3	37
75	2	5	2	3	11	29
76	2	5	2	5	18	22
77	3	3	3	3	25	15
78	3	4	2	4	18	22
79	3	5	3	3	14	26
80	2	4	3	3	21	19
81	1	5	3	3	9	31
83	2	4	1	2	16	24
84	3	4	4	2	28	12
85	2	4	3	4	17	23
87	1	5	4	2	26	14
88	2	4	1	3	7	33
89	2	4	1	4	8	32
90	1	5	3	4	16	24
91	2	4	2	4	0	40
92	2	5	3	4	9	31
93	2	4	3	4	18	22
94	2	4	4	2	22	18
95	2	4	2	3	10	30
96	3	5	2	3	11	29
97	2	4	3	3	17	23
98	2	4	2	4	5	35
99	3	4	2	2	22	18
100	2	5	3	3	25	15
101	1	5	3	2	6	34
102	2	4	2	4	4	36
103	2	4	2	4	10	30

[a] Two participants (P33 and P53) failed to achieve criterion in Phase 1. [b] Three participants (P72, P82, and P86) failed to achieve criterion in Phase 1.

Received September 24, 2010
Revision received January 13, 2011
Accepted March 4, 2011 ■