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A Preliminary Investigation of Relational Network Influence on Horse-Track Betting

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A PRELIMINARY INVESTIGATION OF RELATIONAL NETWORK INFLUENCE ON HORSE-TRACK BETTING

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Adult gamblers completed a task that assessed preference among eight horses during a computerized pari-mutuel horse racing game. During Experiment 1, assessments of bet allocation were conducted before and after temporal and visual discrimination training procedures where 3 three-member stimulus classes were established. Experiment 2 controlled for participant reinforcement histories by blocking the results of each horse race. Results indicated that some participants tended increase responding toward specific horses that shared similar formal properties to those stimuli used in visual discrimination training even though such features had no bearing on race outcomes.
Keywords: transformation, derived relational responding, gambling, horse racing, relational frame theory

Gambling establishments are becoming increasingly popular across the United States, with forty-eight states with some form of legalized gambling. Of these, forty-three have legalized pari-mutuel wagering, typically including horse racing, jai alai, and greyhound or dog racing. Recently, gambling establishments have begun to merge different gaming activities together, resulting in racetracks with casino games and attractions. Combining slot machines and other casino games into a racetrack environment may introduce slot machine gamblers to horse races and vice versa (see Dunstan, 1997). Therefore, identifying contextual variables that potentially maintain gambling behaviors within any type of gambling environment is important to understanding how gambling pathology may develop.

Prior behavior-analytic research on contextual variables maintaining gambling behaviors has investigated the role of verbal behavior. One particular research approach has visually altered various quantitative functions of different aspects of the game. This approach typically includes training selection-based responding and later testing for emerged relations within a shared stimulus class. These demonstrations are typically conducted utilizing a conditional discrimination procedure known as matching-to-sample (Sidman, & Tailby, 1982; Rehfeldt & Hayes, 1998). Once stimulus classes are developed, participants are able to select members within the stimulus class to other members of the same stimulus class without any direct training (Sidman 1994; Sidman & Tailby, 1982). For example, if a verbally competent person is trained by direct reinforcement that A is the same as B, and B is the same as C, then without any further training, the person will be able to derive that A is the same as A (reflexivity), B is the same as A (i.e. symmetry), C is the same as A (equivalence), and A is the same as C (transitivity).

Contextual cues or higher order conditional discriminations have been cited as additional variables that alter functional relations involved in gambling behavior. For example, Zlomke and Dixon (2006) conditionally trained the relations “greater than” and “less

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than" in the presence of two contextual cues based on the formal property of color (i.e. yellow and blue respectively). Participants gambled on two concurrently available slot machines before and after relational training. Following relational training, eight of nine participants demonstrated a preference for the slot machine that had formal similarity to the contextual cue paired with "greater than". Hoon, Dymond, Jackson, and Dixon (2008) replicated and extended Zlomke et al. (2006) by utilizing a two stimulus response task during contextual control training, and again found that the majority of participants would eventually show a preference for the slot machine containing formal similiarity with the contextual cue "more than". Nastally, Dixon, and Jackson (2010) most recently extended these studies by incorporating a contingency reversal to assess differences in response patterns following exposure to relational training, and comparing these differences across pathological and nonpathological gamblers. Participants' selection of slot machines based on formal similarity was assessed after training of each contingency, "greater than" and "less than". Nastally et al. reported that non problem participants increased their responding toward the slot machine with the same formal similarities as the contextual cue trained as "greater than" while pathological gamblers did not. Furthermore, non-problem participants decreased their responding toward the slot machine with the same formal similarities as the contextual cue trained as "less than" after the contingency reversal. These findings demonstrate how differences in training structure as well as how various contextual factors may transfer through multiple-exemplar training. Furthermore, these results demonstrate how these factors may also affect participants differently based on a history of problem gambling.

Although most of the derived relational responding literature has concentrated in the various visual characteristics of stimuli and how they may transfer or transform following relevant training, some behavioral researchers have also explored the transfer of discriminative temporal control to members of equivalence classes. For example, Rehfeldt and Hayes (1998) established such control via a conditional discrimination procedure, where participants responded on a conjunc FR5 t_1 < IRT < t_2 reinforcement schedule. During equivalence tests, participants responded to novel stimuli with similar temporal responses, even though the stimuli used during the equivalence tests were not used during the discrimination training. Overall, these results suggest that responding can come under discriminative temporal control, and can emerge without formal discrimination training. The transfer of temporal discriminative function may have value in a gambling context. Take for example, a "fast" sounding horse name like "Speed Demon", or a name that is not fast sounding at all like "Blueboy". Here, a relation is made based on a much more subtle transfer, based on the name of the horse and an individual's history with that particular name and other derived responses from that name. One gambler may have a history with winning on horses with names such as "Speed Demon" or "Speed Racer", and therefore the function of winning and speed may transfer and increase the likeliness that the gambler will bet on "Speed Demon". Furthermore, "Blueboy" may contain functions similar to an ice cream stand name "Boy Blue" that the gambler used to work at. And, when working there, on Saturday nights all the neighborhood muscle cars would park outside the stand revving their engines. Those fast cars, the gamblers prior history with the name "Boy Blue", and the functions that exist for him with the words "Blue Boy" may result in increased gambling. To date, no previous research has examined the role of temporal relations in an analysis of gambling.

Therefore the purpose of the present study was to determine if the derived comparison relations of “faster than” and “slower than” could be contextually controlled and subsequently influence gambling behavior. This study blended the procedures found Zlomke and Dixon (2006) and Hoon, Dymond, Jackson, and Dixon (2008) with those Rehfeldt and Hayes (1998) within the context of a simulated horse track game.

EXPERIMENT ONE
METHOD

Participants

Ten graduate and undergraduate students (7 females, 3 males) participated in the study for (extra) course credit. The mean age of participants was 24 (SD = 5.12) years. Nine participants were Caucasian, four had previously received a bachelor’s degree, and none reported having a gambling treatment history. Eight participants reported making $20,000 or less per year in annual income.

Apparatus and Materials

All sessions were conducted in a small laboratory room located on a university campus. The room was approximately eight feet by ten feet. Participants were seated at a computer desk in front of a desktop PC with only a mouse to operate. Sound dampening headphones were available as a substitute for speaker audio upon request. The computer activity was programmed in Microsoft Visual Studio 2008, and the program was installed onto five desktop computers in the laboratory where the experiment took place. The simulated horse track was modeled from horse racing events in casinos (see Figure 1). The horse track included eight lanes of different color horses, a betting card with open betting options across horses, and a button to start the race.

All participants completed the South Oaks Gambling Screen (SOGS; Lesieur & Blume, 1987) prior to participating in the study. The SOGS is a widely used instrument used to assess problem gambling and consists of 20 self-report items regarding the frequency and form of gambling. The average SOGS score was 0.5 (range = 0-2). The computer presented all stimuli and automatically recorded the participant’s responses throughout the study. All stimuli used during the computer activity are represented in Figure 2. The C stimulus class (i.e. the color square stimuli) varied randomly across computers to further control for any pre-experimental functional control. Two computers featured the blue color square in the first class, orange in the second, and purple in the third. One computer used the purple, blue, and orange stimuli in the first, second, and third classes, respectively. The remaining two computers included orange in the first stimulus class, purple in the second, and blue in the third. Colors were randomly assigned to temporal training schedules to control for any pre-experimental history participants may have had with any of the colors. An experimenter was always present while a participant completed the computer program to observe responses, explain the procedures, and answer any questions before the study began.

Procedure

The current experiment consisted of five total phases. The first phase consisted of a preassessment of response allocation during a horse track game. Participants could wager on an array of horses for eight races. The second and third phases replicated the procedures used by Rehfeldt and Hayes (1998) where discriminative temporal control was established for three arbitrary stimuli on three unique conjunct FR-5 schedule of reinforcement. Phase four conditionally trained a three three-member equivalence class. In the final phase, participants were asked to play on the simulated horse track game. Similar to the first phase, bet allocation was assessed for each participant.

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Figure 1. The simulated horse track game used in both experiments. The color of each horse is listed within brackets on the figure for the reader; these did not appear to the participants during the experiment.

Horse Track Assessment. After the participant was seated at a computer, the experimenter entered participant information in to the program for data collection. Next, a window presented the following instructions:

> "You will be able to gamble credits on a horse track. You will have 20 credits to gamble on each race. You can bet up to 20 credits on one horse, or place bets on multiple horses. Winnings will be added to your total after each race. Try to win as many credits as you can!"

The experimenter read the instructions aloud and asked if the participant had any questions. Answers to questions were taken directly from the on-screen instructions. The experimenter directed the participant to click on a "Next" button on the screen which displayed the simulated horse track.

Participants placed their bets by entering the number of coins bet and selecting the "bet" button. Participants bet up to twenty hypothetical credits per trial, on increments of 5 per bet per horse. There was no minimum bet requirement and the participant did not have to bet all 20 credits. A betting card, located in the top right of the screen, would subtract overall credits each time the participant placed a bet on a horse. Information about total credits won and total credits gambled were displayed at all times. The race began after the participant selected the button labeled "start the race". After each race, a label appeared beneath the start button identifying the first horse to reach the finish line. During each race, a Windows Media Player played a recorded version of "The Mexican Hat Dance" to further simulate auditory stimulations during the race. Each horse was linked to a timer with the interval set at 100 milliseconds (ms). After each interval, the horse moved one pixel toward the finish line. Along the track are five change points. When a horse reached one of these points, the timer interval associated with the speed of the horse's motion would randomly change to a number between 50 ms and 150 ms. Thus, all horses sped up or slowed down randomly five times throughout each race. The horse that arrived at the designated finish line first was

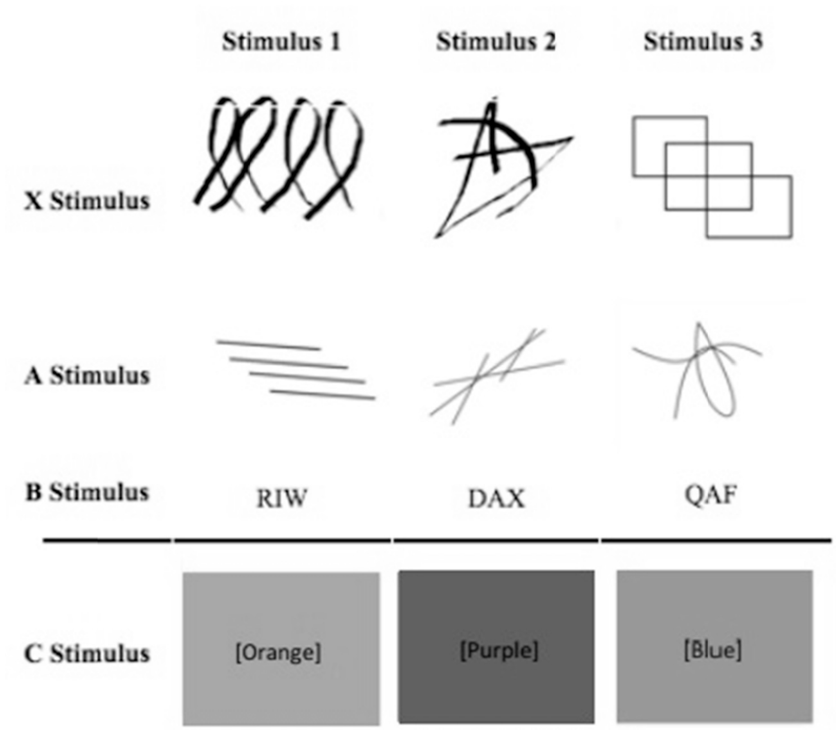


Figure 2. Stimulus sets used during conditional and temporal discrimination training and testing procedures for Experiment 1 and 2. The arrangement of the C stimulus class was only used in Experiment 2. The color of each of the C stimuli has been added in brackets on the figure for the reader. These words did not appear on the stimuli during the experiment.

thereby random and unpredictable as speeds changed multiple times. When the race was finished and all horses reached the finish line, credits were added to the betting card for winning bets. Additionally, the music was terminated and a reset button was presented. The total time of each race varied between 40 and 50s. The program automatically recorded the bets placed on each horse. The game continued until the participant had completed 8 races.

Pretraining of conjunct FR-5 schedule. During this phase, participants responded on an FR-5 schedule to earn reinforcement across fifteen total trials. The experimenter read the following instructions that were presented on the screen to the participants:

> "There will be a figure presented in the screen. You must click on each picture. If you respond correctly, you will earn a point- try to earn as many points as possible. Pay close attention"

The experimenter again answered any questions by referring to the instructions. The participant clicked on the "Start" button, the instructions disappeared, and a random stimulus from the X stimulus class was presented in the middle of the screen on a 3" by 3" button. Beside the image was a label that showed the total correct number of responses. Responding was considered correct after 5 consecutive mouse clicks on the image. Correct responding resulted in an auditory tone and the presentation of the word "Good!" beside the picture. One point was added to the participant's total score each time reinforcement was delivered. This phase lasted until ten correct responses were recorded. Stimuli were used only to establish responding on an FR-5 schedule, and were not used in the remainder of the study.

Temporal Differentiation Training. During this phase, temporal differentiation was trained for the A stimulus class. The instructions and setup in this phase were the same as those above, but the participant was informed that mouse clicks on the picture must be timed in a certain way to earn a point. In this phase, each stimulus was paired with a different conjunct temporal schedule of reinforcement. Stimulus A1 was paired with a conjunc FR5 0.0 < IRT < 0.5 schedule of mouse-clicks. During this schedule, the participant was required to click on the picture five times with an inter-response time (IRT) of less than .5s. If all responses met this requirement, a tone and the word "Good!" were presented. If responses did not meet the IRT criterion, following the fifth response, a 3s inter-trail interval occurred. All stimuli were removed and replaced with a black screen during this interval. After the interval was completed, the trial was presented again. After 15 correct responses to the A1 stimulus, the A2 stimulus was presented on a conjunc FR5 0.5 < IRT < 1.5 schedule of reinforcement. The participant was required to click on this stimulus 5 times with an IRT of 0.5 to 1.5s. After 15 correct responses, the A3 stimulus was presented with an IRT requirement of 1.5 to 3s. During the testing portion of the phase, each stimulus in the A stimulus class was presented five times in random order. The testing phase was repeated until participants responded correctly on at least 12 out of 15 trials.

Conditional Discrimination Training and Testing. During this phase, 3 three-member stimulus classes were developed using a match-to-sample paradigm. The following instructions appeared on the screen and were read to the participant before the task began:

> "In a moment some words and symbols will appear on the computer screen. One symbol will appear at the upper middle of the screen and three additional symbols will appear at the lower left middle and right of the screen. Your task is to choose the correct symbol from among those in the lower portion of the screen by "clicking on it" using the computer mouse and cursor. During the first part of the experiment you will receive feedback telling you whether your choices are correct or wrong. Later in the experiment you won't receive feedback. However there is always a correct answer. It is important that you try to make as many correct choices as possible. If you have any questions please ask them now. When you are ready please click on the BEGIN button."

The experimenter answered any questions by reinstating the relevant section of the instructions. After the participant selected the begin button, a sample stimulus was presented at the top of the computer screen. Three comparison stimuli were presented at the bottom of the screen. The order of presentation of all stimuli and the position of the comparison stimuli were randomized. Selecting the correct stimuli along the bottom of the screen resulted in an auditory chime tone and the presentation of the words "Good job". An incorrect response resulted in an auditory tone of a buzzer. During all training phases, the experimenter prompted the participant by stating, "you want to hear a ding", on a variable interval schedule.

A-B relations were trained first across all participants. One stimuli from the A stimulus class was presented at the top of the screen, and three stimuli from the B stimulus class were placed on the bottom of the screen for 18 trials. An example of a trial was as follows: in the presence of A1 select B1 (instead of B2 or B3), and in the presence of A3 select B3 (instead of B1 or B2). If the participant responded correctly on 16 of 18 trials, the next trial block was presented. If the criterion was not met, the current trial block started over.

The second block trained B-C relations. Similarly, if the participant responded correctly on 16 of 18 trials, mixed A-B and B-C training was initiated. Otherwise, the trial block was repeated until the criterion was met. The final training trial was the mixed A-B and B-C training section. Here, A-B and B-C relations were intermixed. Participants responded accurately at least 32 out of 36 trials before starting the testing portion of the phase.

The testing portion was presented in the same manner as the training portion, however, no feedback was provided following any response. Reflexivity relations were tested first (A-A, B-B, C-C) over 27 trials. Symmetry relations between untrained relations B-A and C-A were tested across 18 trials. Next, transitivity and equivalence relations between A-C and C-A were tested across 18 trials respectively. No criterion was placed to proceed to the next phase.

Post Horse Track Assessment. All participants were re-exposed to the horse track game during the final phase of the study. Participants started with zero points. After eight races were completed, the experimenter read a debriefing script and the participant was excused from the study.

RESULTS AND DISCUSSION

Participant performance on conjunct schedule training and discrimination testing are displayed in Table 1. Total trial blocks needed for completion of temporal training, or phase 2, ranged from 1 to 29 (M=10.9, SD= 8.74). Following completion of the temporal discrimination phase, participants were exposed to equivalence training and testing phases. All participants responded correctly 16 out of 18 trials before proceeding to the next phase. Following training, participants were then tested for emergence of reflexive relations (A-A, B-B, C-C), symmetry relations (B-A, C-B), and equivalence and transitivity relations (C-A and A-C respectively). There was no criterion in place during the testing phase. As such, participants P1, P4, and P6 failed reflexive testing. However, symmetry and equivalence relations emerged for P1 and P4, while only equivalence relations emerged for participants P6. Overall, two participants (P3 and P6 scored lower than 80% correct during the equivalence tests.

Participant response allocation during the horse track game was assessed before and after discrimination training. The top panel in Figure 3 displays differences in participants' response allocation towards the horse with similar formal properties as the "fast" temporal training schedule. This stimulus was in the same class as the stimuli paired with the fast IRT schedule. Difference scores were obtained by subtracting the average bet at post from the average bet at pre. Positive scores reflect additional bets allocated during post play, while negative scores reflect fewer bets allocated during post play. Only three participants (P3, P8, P10) bet fewer times on the orange horse following training. The middle panel displays differences in response allocation towards the horse sharing similar formal properties as the C2 stimulus. This stimulus was in the same stimulus class as the stimuli paired with the medium IRT schedule Here, participant responding was variable with five participants allocating fewer bets following training. The last panel displays differences in response allocation towards the horse with similar formal properties as the C3 stimulus. This stimulus was in the same stimulus class as the stimuli paired with the slow IRT schedule. Seven of ten participants allocated more responses on this particular horse following training.

Average bet across participants is represented in Table 2. On average, participants wagered between 2 and 3 credits per trial on the horses with formal similarities as the fast, medium, and slow horse (2, 2.37, and 2.68

Figure 3. Differences in response allocation for horses with formal properties as paired with the "fast", "medium", and "slow" temporal discriminations during Experiment 1 across all participants.

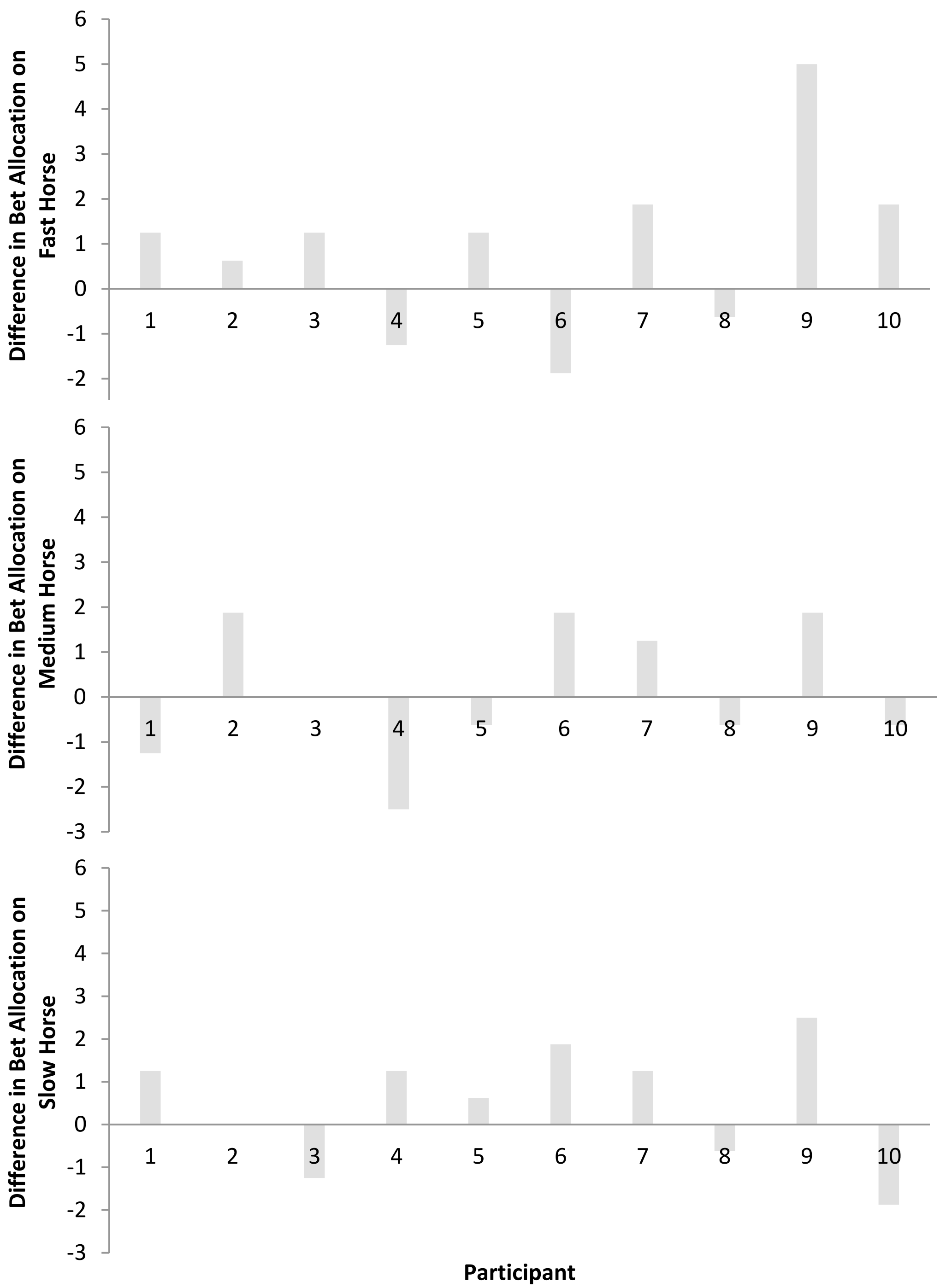


Table 1. Total number of temporal training trial blocks and percent correct on equivalence tests across participants during Experiment 1.

		Phase 4:						
		Discrimination Training			Discrimination Testing			
Participant Number	Phase 3: Temporal Testing (trial blocks)	A-B Training (trial blocks to criterion)	B-C Training (trial blocks to criterion)	Mixed A-B/B-C Training (trial blocks to criterion)	Reflexivity (%)	Symmetry (%)	Equivalence (%)	Transitivity (%)
P1	1	2	2	1	74.4	100	100	100
P2	2	2	2	1	100	100	94.4	100
P3	9	1	1	4	96.2	83.3	22.2	44.4
P4	13	3	1	1	48.1	100	100	89
P5	17	4	2	1	85.2	100	100	100
P6	29	5	8	1	52	61.1	94.4	78
P7	1	2	2	1	92.6	100	100	94.4
P8	16	1	1	1	100	100	100	100
P9	8	2	2	1	100	100	100	100
P10	13	2	4	1	85.2	100	100	89

credits respectively) prior to any training. Following both temporal and equivalence discrimination training and testing phases, participants increased the magnitude of bets wagered across all three horses (2.9, 2.5, 3.18 on fast, medium, and slow horses respectively).

Participants responded correctly on average of 89.4% (range 44-100%) of trials in equivalence test at the end of the conditional discrimination task. Overall, only seven of ten participants increased betting on the horse sharing formal properties as the "fast" temporal schedule. Concomitantly, seven of ten participants also increased betting on the horse sharing formal properties as the "slow" temporal schedule, while four of ten increased betting on the "medium" horse. However, it is unclear as to the role of the reinforcement history across participants, as the outcomes of the horse race were based on a random ratio schedule. Therefore, Experiment Two replicated and extended the procedures used during Experiment 1 to control for reinforcement effects, by blocking the participants view of the game during the final 5-10s of each race.

EXPERIMENT TWO
METHOD

Participants

Three graduate students (2 females) participated in the study for (extra) course credit. The mean age of participants was 34 years (SD = 2.65). All three participants were Caucasian, made less than $20,000 a year, and reported earning a Bachelor's degree prior to the study.

Materials and Setting

Participants were asked to download and install the computer program used in Experiment 1 to a personal computer. The computer activity was programed in Microsoft Visual Studio 2008, and all stimuli and formatting was the same as in Experiment 1. Participants completed the SOGS (Lesieur & Blume, 1987) prior to participating in the study, and all scored a 0.

Procedure

A non-concurrent multiple baseline design was used in the current experiment.

Table 2. Average credits bet per trial across horses with formal similarity as with the "fast," "medium," and "slow" horses across participants during Experiment 1.

	Average Credits Bet Per Trial					
	Fast		Medium		Slow	
Participant Number	Pre	Post	Pre	Post	Pre	Post
P1	3.125	4.375	1.875	.625	1.875	3.125
P2	3.75	4.375	1.25	3.125	4.375	4.375
P3	3.125	4.375	1.25	1.25	3.125	1.875
P4	2.5	1.25	3.75	1.25	2.5	3.75
P5	1.25	2.5	3.125	2.5	1.875	2.5
P6	1.875	0	3.75	5.625	4.375	6.25
P7	1.875	3.75	1.25	2.5	.625	1.875
P8	.625	0	1.875	1.25	1.875	1.25
P9	.625	5.625	1.875	3.75	2.5	5
P10	1.25	3.125	3.75	3.125	3.75	1.875

Temporal differentiation training was conducted the same as in Experiment 1, except that all participants were exposed to the color orange (C1) with the "fast" temporal schedule, the color purple (C2) with the "medium" temporal schedule, and the color blue (C3) with the "slow" temporal schedule (see Figure 2). All procedures in the conditional discrimination phases were the same as in Experiment 1 and will not be discussed here. Differences in the horse track game are described below.

Horse Track Assessment. All instructions were the same for this phase. After reading the instructions, participants placed their bets by entering the number of coins bet and selecting the "bet" button. Similar to Experiment 1, participants bet up to 20 hypothetical credits per trial, on increments of 5 per bet per horse. There was no minimum bet requirement and the participant did not have to bet all 20 credits. A betting card, located in the top right of the screen, would subtract overall credits each time the participant placed a bet on a horse. Information about total credits won and total credits gambled were displayed at all times. The race began after the participant selected the button labeled "start the race". Each race outcome was blacked out to control for reinforcement history across participants. In other words, before a horse crossed the finish line, a black screen appeared that covered the finish line for the last 5-10s of the race. The black-out period occurred during both pre and post play.

RESULTS AND DISCUSSION

Participant performance on temporal differentiation testing and all equivalence phases are displayed in Table 3. Total temporal trial blocks needed for completion ranged from 3 to 22. Discrimination training and testing trials were assessed during phase 4. During the A-B training phase, participants completed between 3-6 total trial blocks before starting the B-C training. During the B-C training trials, participant P12 completed 33 trial blocks and reported not having any sound during that particular phase. Participants then completed the mixed training phase in 1 - 2 trial blocks. Participant P11 and P12 responded with

Table 3. Outcomes for all discriminative training and testing trials during Experiment 2 across participants.

		Phase 4: Discrimination Training			Discrimination Testing			
Participant Number	Phase 3: Temporal Testing (trial blocks)	A-B Training (trial blocks to criterion)	B-C Training (trial blocks to criterion)	Mixed A-B/B-C Training (trial blocks to criterion)	Reflexivity (%)	Symmetry (%)	Equivalence (%)	Transitivity (%)
P11	3	3	1	1	100	100	100	100
P12	22	6	33	2	100	100	100	100
P13	13	3	4	1	100	100	100	94.4

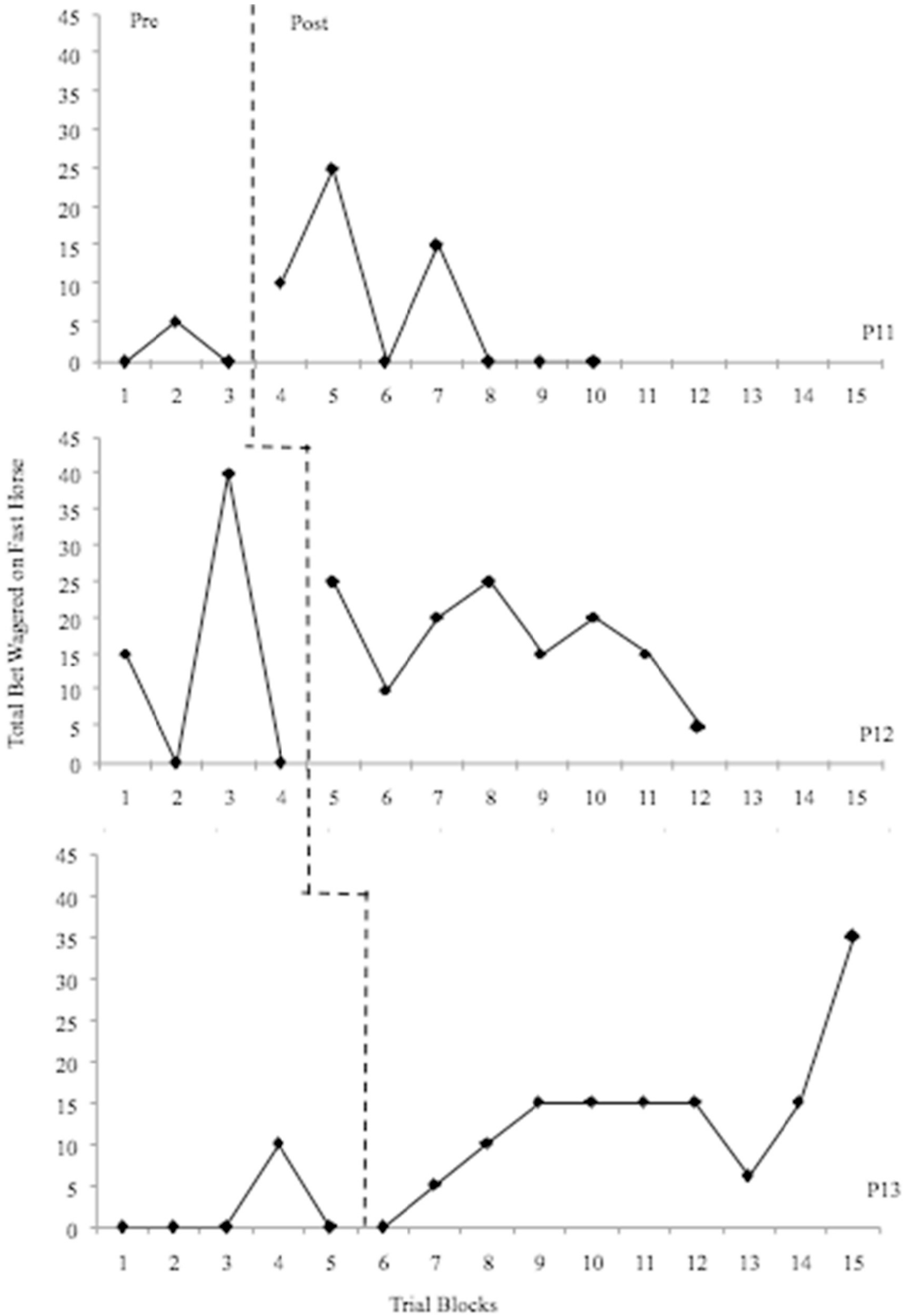
100% accuracy on all novel discrimination tests, while P13 responded about 90% accuracy on all novel tests.

Participant response allocation during the horse track game was assessed before and after discrimination training. Table 4 represents the average credit bet for horses with formal similarities as the stimulus paired with the temporal differentiation task. The temporal differentiation tasks are labeled as “fast”, “medium”, and “slow”. All three participants increased the total amount wagered on the horses sharing formal similarities with the “fast” and “medium” schedules, while only P11 increased amount wagered on the horse with the same formal similarities as the “slow” schedule. Figure 4 displays bet allocation towards the horse sharing similar formal properties as the C1 stimulus across participants. A visual analysis of the data suggests that all three participants increased the number of bets placed on the orange horse, yet the magnitude of each bet did not increase. Overall, two of three participants demonstrated a preference for the horse with similar formal properties as with the “fast” temporal schedule. Extending the findings reported in Experiment 1, these results controlled for history of reinforcement by blocking the participant’s view of the outcome of each horse race. These findings suggest that arbitrary temporal relations may maintain gambling behavior even without receiving any direct reinforcement for response selections.

Participant Number	Average Credits Bet Per Trial: Fast		Medium		Slow	
	Pre	Post	Pre	Post	Pre	Post
P11	2.75	3.46	4.33	1.32	.667	5
P12	.33	1.39	1.75	4.75	2.75	2.25
P13	.4	2.32	1.04	2.59	2.08	1.85

Table 4. Average credits bet per trial during the horse track assessment across participants during Experiment 2.

Figure 4. Total bet wagered on horse with formal similarities with "fast" temporal discrimination during Experiment 2 across blocks of five trials.



GENERAL DISCUSSION

Together, the present two experiments are replications of previous research on effects of discriminative (e.g. Zlomke & Dixon, 2006; Hoon et al., 2008; Nastally et al., 2010) and temporal stimulus control (Rehfeldt & Hayes, 1998) in a gambling context. Following temporal discrimination training and subsequent discrimination training of sameness, some participants' response allocation toward the horse with similar properties as the "fast" temporal schedule increased after training in both Experiment 1 and 2. Participants' response allocation toward the horse with similar properties as paired with the "medium" temporal schedule were variable in Experiment 1, however in Experiment 2, 2 of 3 participants increased average bet size on this horse. Furthermore, bet size on the horse sharing formal properties as the "slow" temporal schedule increased for 5 of 10 participants in Experiment 1, and for 2 of 3 participants in Experiment 2. In the present experiments, a transformation of functions of faster than (associated with the orange horse in Experiment 2) suggest that arbitrary stimuli may acquire similar functions through differential reinforcement, a defining feature of transformation of stimulus functions (see Dymond and Rehfeldt, 2000 for review). However, these results are only preliminary as consistency in responding and in alterations of responding upon relational training across all participants was absent.

The current investigations are not without limitations. One particular limitation was the lack of criterion during equivalence testing phases. Without a criterion, participants may not have received adequate training trials necessary to establish stimulus classes. Emergent equivalence relations for participants P3 and P6 during Experiment 1 did not exceed 80% during testing phases. However, P3 and P6 bet allocation during the post horse track assessment varied across temporal differentiation, with P6 betting more on the "fast" horse following training than P3. During Experiment 2, participant P12 reported not having any sound during the first discrimination training phase, and resulted in 33 trial blocks before completion. This difference in auditory feedback may have altered the strength of the first trained stimulus class, and is particularly interesting when compared to other participants who received auditory and textual feedback. Future research should investigate type of feedback delivered during a MTS paradigm, as it may be beneficial in determining effective feedback. Another limitation may have been the stimuli used during temporal discrimination training, as the majority of participants reported having difficulty completing this phase of the study. As such, the stimuli used during this phase of the study may not have acquired the intended temporal function, therefore limiting the post assessment responses. Also, the requirement of a reflexivity test may have forced participants to respond on structural identity and not function. Future research should further assess the relevance of temporal relations in a gambling context, specifically with arbitrary stimuli.

In conclusion the present research suggests that the non-formal features of "time" or "speed" may transfer in idiosyncratic ways for a gambler. In our study speed was related to the color of a horse on a computerized track race. It is quite possible that such information may have value for the understanding of pathological gambling. For example when a gambler makes irrational choices such as wagering too much, wagering with poor odds, or wagering longer than he/she should, it may be the case that such a decision is made via the transfer or transformation of irrelevant stimulus characteristics in relational frames unique to that specific gambler. As a result, intervening on this gambler by speaking to the odds of winning, the need to manage finances more effectively, or to just say "no" to gambling will be futile attempts. Instead, what needs to occur is a careful understanding of the functional relationships that maintain this maladaptive behavior. Only by awareness of, and investigation surrounding, a verbal behavior account of problem gambling will we become successful at treating the pathological gambler. While our study explored the mechanisms at play that impact gambling and not necessarily gambling itself, this type of investigation may serve as a preliminary step towards understanding the complexity of decision making a gambler is engaging in when deciding how much and on what should he or she gamble.

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