Analysis of Gambling Behavior

Volume 12 Article 1

2019

Exploration of Social Reinforcement for Gambling in Single Case Designs

Mack S. Costello
Rider University, mcostello@rider.edu

Bahijah D. Sheibanee
Rider University, bahijah27@yahoo.com

Anneka Ricketts
Rider University, annekaricketts@yahoo.com

Jamie L. Hirsh
Western Michigan University, jamie.l.hirsh@wmich.edu

Neil Deochand
University of Cincinnati, deochanl@ucmail.uc.edu

Exploration of Social Reinforcement for Gambling in Single Case Designs

Cover Page Footnote
Mack S. Costello, Bahijah D. Sheibanee, and Anneka Ricketts affiliated with the Department of Psychology, Rider University. Jamie L. Hirsh affiliated with the Department of Psychology, Western Michigan University and with Rider University. Neil Deochand affiliated with Health and Human Services, University of Cincinnati. Portions of this research were presented at the 13th Annual New Jersey Association for Behavior Analysis Conference in Somerset, NJ, and at the 44th Annual Convention of the Association for Behavior Analysis in San Diego, CA. Correspondence concerning this article may be addressed to Dr. Costello at mcostello@rider.edu

Analysis of Gambling Behavior; 2019, 12, 1-21

Exploration of Social Reinforcement for Gambling in Single Case Designs

Mack S. Costello[1], Bahijah D. Sheibanee[1], Anneka Ricketts[1], Jamie L. Hirsh[2, 1], & Neil Deochand[3]

[1]Rider University

[2]Western Michigan University

[3]University of Cincinnati

Social reinforcement could be a variable that facilitates gambling behavior. Unfortunately, there are relatively few studies examining the impact that contingent social stimuli can have on betting behavior. Using simulated slot machine games and confederates, we investigated possible maintaining social contingencies for gambling with four recreational gamblers. Results indicated a small effect from a social positive reinforcement contingency for betting more credits than the previous trial. Four additional participants were recruited to replicate the effects of social positive reinforcement when structural aspects of the game were also changed, such as sound, win magnitude, and credit value. Lastly, one participant returned to the laboratory at a later time to examine the effects of different confederates providing social stimuli. This participant bet more in the presence of the confederate who had previously provided social positive reinforcement. Across the experiments, the social positive reinforcement contingency effect was replicated in five participants.

The presence of other people has several effects on gambling behavior. These effects include players' reports about their gambling in both blackjack (Gunnarsson, Whiting, & Dixon, 2014) and slot machines (Weatherly, Bushaw, & Meier, 2009), and actual betting behavior in some situations (McDougall, Terrance, & Weatherly, 2011). In the gambling literature, the presence of others has been theorized to facilitate gambling by intensifying it (e.g., Rockloff, & Dyer, 2007), though the empirical evidence for this social facilitation effect is mixed (Molde, Mentzoni, Hanss, Sagoe, Andersen, & Pallensen, 2017). Pfund and colleagues (2018) posited that the mixed results are because types of social interactions have different effects. Those researchers exposed 109 female gamblers to either "warm" interactions (i.e., conversation), "cold" interactions, or no interactions from confederates and measured concurrent effects on gambling in a group design. Participants in the warm interactions condition were, on average, betting more credits and less often than participants in other conditions.

An analysis of basic behavioral processes may explain individual differences in the area of social influence on gambling. In a behavior analytic model, an individual's

reinforcement history with gambling and social variables explains their behavior within a functional framework. This may account for some of the variations on the social facilitation effect, and for differences in responding across types of interactions. A thorough understanding of social effects on gambling could be beneficial in predicting and influencing gambling. Social reinforcement has not often been studied in a gambling context, and much of the relevant behavior analytic gambling work that has been done does not involve direct observation of behavior. For example, on self-report tools such as the Gambling Functional Assessments (GFA; Dixon & Johnson, 2007; Dixon, Wilson, Belisle, & Schreiber, 2018; Weatherly, Miller, & Terrell, 2011), social items for gamblers to endorse that affect their gambling behavior include items such as "[I gamble] when my friends are with me," and "I enjoy the social aspects of gambling such as being with my friends or being around people who are having a good time and cheering me on."

Social reinforcement as a concept has been studied for decades, often within conversation frameworks. In behavior analytic theory, contextualized approval can be generalized conditioned reinforcement (Skinner, 1953; Vollmer & Hackenberg, 2001). This framework is supported by a number of experiments and demonstrations (Borrero et al., 2007; Krasner, 1958; McDowell & Caron, 2010). However, there are both differences in the measurement of reinforcement across studies, and cases where reinforcing effects are not replicated (see Simon & Baum, 2017 for a summary). Some of these difficulties can be explained in that social approval so often is *assumed* to be reinforcing, but theoretically it is not reinforcing in all contexts. The topography of what utterances may be reinforcing varies over time, by culture, context, and so on. There are few, if any, studies examining social reinforcement contingencies directly in a gambling context.

In summary, social stimuli influence gambling behavior in many ways, and breaking down these effects to behavioral processes may inform how to predict and influence gambling behavior. A possible explanation of social facilitation is that social stimuli provide reinforcement for betting and create discriminated operants of betting in the presence of others. Awareness of reinforcement contingencies is not necessary for them to be effective (e.g., Lieberman, Sunnucks, & Kirk, 1998; Kennedy, 1970), thus the self-report assessments such as the GFAs may not always correctly identify this control.

In order to experimentally examine social reinforcement for gambling, development and testing of a gambling-specific procedure for analyzing social reinforcement was required. In applied behavior analysis, procedures examining reinforcement contingencies for effectiveness often provide single-operant conditions as tests of a contingency (e.g., Beavers, Iwata, & Lerman, 2013). We planned to test contingencies for betting with contextualized utterances as consequences. We chose contextualized utterances (as opposed to any utterance) because in a generalized conditioned reinforcement framework, the utterances should be discriminated within context. (For example, if Person A greeted Person B, and Person B replied with nonsense words, the exchange would likely not be reinforcing for Person A, although a contextual utterance would be reinforcing.) Additionally, previous work on social effects has shown that particular interaction types differentially affect gambling (Pfund et al., 2018). The nature of this work was exploratory, and we were interested in testing contingencies with

social approval and with complaints because of their common nature and reported contribution to gambling on tools such as the GFAs.

In the present research, social contingencies were examined in a human operant laboratory setting for their effect on betting. The goals of this research were to develop and test a procedure for an analysis of social reinforcement. Slot machine programs on personal computers were used. Three experiments are reported.

GENERAL METHOD

Participants

Participants were recruited through flyers around Rider University and surrounding communities (in central New Jersey, USA) that described a research study for persons who gambled in their leisure time; prospective participants were instructed to e-mail or call the laboratory to assess potential participation. Upon receiving an inquiry, an experimenter responded with an e-mail or a phone call to the potential participant to confirm interest and to set up an initial meeting to discuss the study and informed consent procedures. In order to participate in the study, participants must have reported that they gamble in their leisure time at least twice per week. This was clear before making the initial meeting, and was then assessed in the screening questionnaire after consent. Participants who completed the study were compensated with $20. For participants in conditions where credits were valuable, an additional credit payout was possible depending on gambling behavior.

Setting and Apparatus

The laboratory setting consisted of three separate rooms: a game room, a waiting room, and a control room. The game room included a desk with two chairs and two computers (Dell Optiplex 790s with monitors) with slot machine games available on the computer screens. The waiting room included chairs along the walls, a coat rack, and was decorated with paintings and photographs. A control room included laptops and materials the experimenters used. The waiting room contained doors to the other rooms, as well as an unused laboratory room.

In the game room, a computerized slot machine simulation was used as a gambling task simulation (described in Brandt & Martin, 2015 p.173; winning outcomes were programmed to occur 28% of the time, the payback percentage was programmed at 83% [this was manipulated in Experiment II], and no near misses occurred). Participants started conditions with 100 credits, and could bet up to 10 credits per trial in all conditions.

Measures

After consenting to participate, all participants completed screening and demographic questionnaires, the Gambling Functional Assessment-Revised (GFA-R; Weatherly, Miller, & Terrell, 2011) to assess self-report of contingencies on gambling, and the South Oaks Gambling Screen (SOGS; Lesieur & Blume, 1987) to assess potential for

disordered gambling. The SOGS has been found to have consistent psychometric properties (e.g., Wulfert, Hartley, Lee, Wang, Franco, & Sodano, 2005). Scores of 0 on the SOGS indicate no problems with gambling; scores 1-4 on the SOGS indicate some potential problems with gambling; scores of 5 or more on the SOGS indicate potential pathology. The GFA-R assesses the degree to which respondents endorse the influence of positive reinforcement or negative reinforcement (escape) on gambling behavior. The GFA-R contains 16 items (eight items for each contingency), and each item can be rated from 0-6. Each contingency can be scored from 0-48. The GFA-R structure has been tested with non-clinical samples in the United States (Weatherly, Miller, Montes, & Rost, 2012), United Kingdom (Weatherly, Dymond, Samuels, Austin, & Terrell, 2014), Japan (Weatherly, Aoyama, Terrell, & Berry, 2014), and Italy (Iliceto, Fino, & Schiavella, in press), and with self-identified disordered gamblers (Weatherly & Terrell, 2014). Participant demographic information and measure scores are in Table 1.

Table 1. Participant demographics and gambling experience

Reported participant information				
Participant	Income	Age/Gender	SOGS	GFA-R
01	N/A	33/F	3	31+, 9-
02	N/A	28/F	5	29+, 12-
03	24,000	F	1	0
04	60,000	F	2	30+, 8-
05	30,000	34/M	4	34+, 10-
06	22,000	29/F	3	31+, 9-
07	40,000	33/M	6	32+, 11-
08	35,000	27/M	5	29+. 9-

Note: Some parts of the demographic form were not consistently reported, when the information was illegible or missing an "N/A" is reported. SOGS scores of 1-4 indicate some potential problems with gambling; scores of 5 or more on the SOGS indicate potential pathology. The GFA-R assesses the degree to which respondents endorse the influence of positive reinforcement or negative reinforcement on gambling behavior. The GFA-R scores are reported as the positive reinforcement score followed by a "+" then the negative reinforcement score followed by a "-".

Ethics

The Rider University Human Subjects Institutional Review Board approved the procedures described in this article, and informed consent was obtained from participants before participation.

EXPERIMENT 1

The first experiment was exploratory in nature. We examined social contingencies on betting in terms of both putative positive reinforcement (addition of contextually approving social attention) and negative reinforcement (removal of contextualized complaints) in ABAB designs for six participants.

Previous research has shown that providing verbal rules about games to participants changes their behavior away from the control of the game's structural contingencies

(Dixon, 2000; Dixon, Hayes, & Aban, 2000). Therefore, our confederates did not provide explicit instructions about the games in the social interactions. A potential explanation for the rule-governance overpowering the contingency in previous research is a demand or compliance effect (Petry, Madden, & Roll, 2007). Said another way, confederates did not specify the programmed contingency at any time in sessions. The social content was contextualized to gambling, as the nature of such content being conditioned reinforcement may lie in a history of stimulus relations among the verbal stimuli and game (Wilson & Dixon, 2015).

Method

Design. Within-subject ABAB designs were used to examine betting across conditions. The independent variable was a contingency designed to examine a social reinforcer's effect on betting (these conditions are termed "Social" conditions); the contingency differed across participants as described below. The design format was ABAB (Baseline, Social, Baseline, Social). Most designs were withdrawals, where the social contingencies were added in the 'B' conditions and removed in the 'A' conditions. We did include a variation on a reversal design for one participant, where the contingency in the 'B' condition was reversed in the next 'B' condition. This is described in detail below.

Procedure. After going through consent and measures described above, the experimenter showed the participant the slot machine game in the game room. The participant was told another person would play the same game on the other computer in the room. A confederate was then led into the game room and said hello. When both the confederate and participant were seated, the experimenter read the following information:

> "You are about to play a simulated gambling game. Do not press "begin" until I tell you it is okay. Once you push "begin" you will see a slot machine interface on screen. You may bet up to 10 credits at a time. The credits are imaginary, please act as if they are real. You will start with 100 credits. To play the game, you must set an amount to bet, press the "set bet" button, and then press the "spin" button with your mouse. When you press "spin," the game will play like a regular slot machine, and you will win or lose credits. Play as much or as little as you like. I will monitor the game for 10 minutes, then we will take a break. If you run out of credits, let me know. Do you have any questions?"

The experimenter would answer any questions, then instructed the participant and confederate to use their mouse to press "begin" on their screen, and when the participant did, the session began. The experimenter was seated in the waiting room, with a clear view of the monitors, participant, and confederate. The experimenter took data on bets and bet amounts to compare with the automated data, and interactions (described below in the Procedural Fidelity section). If a participant ran out of credits, the timer and games were paused, and the experimenter facilitated a re-buy of credits. Each condition was 10-minutes, with the exception of Participant 4, for whom the session times were irregular; with Participant 4, the experimenter visually checked the bet data around 5 minutes, and as

the bets were reliably occurring and the amounts were not trending in any clear direction, the condition ended (we later used 5-minute conditions in experiments described below). Regarding the instructions read by an experimenter, for Participant 4 "I will monitor the game for 10 minutes" was changed to "I will monitor the game for a few minutes". For later Participants, it was changed to "I will monitor the game for 5 minutes" when relevant to the experimental conditions.

The social interactions in the conditions could be relevant to gambling (e.g., as approval of betting, "nice one" or "there it is"), but did not include instructions (e.g., "you should bet more"). The first or second author practiced with confederates before running sessions (The training protocol is included in the supplementary materials).

Conditions. A Baseline condition involved a participant playing the slot machine game in the game room while a confederate made non-contingent conversation at least every 15 seconds while playing their game (e.g., "I won", "It's warm in here"). A confederate played at the other computer for the Social conditions, as well. Social conditions where the consequence was an addition of contextually approving social attention are labeled as "Social +" or Social positive. Social conditions where the consequence was a removal of contextualized complaints are labeled "Social -" or Social negative. For Participant 1, the Social + condition was social attention (some form of approval) provided by a confederate contingent on betting. For Participant 2, in order to better isolate an effect, social attention was provided contingent on "bigger betting" in the Social + condition. In bigger betting conditions, the contingency was for betting more than the previous trial's credits with a cap at a bet of 10 credits (the maximum bet). So once a participant bet 10 credits, on the next trial 10 credits would still result in the programmed consequence. If a participant bet 6 credits, then bet an amount equal to or less than 6, for example 4, there would not be a programmed consequence. However, if a participant bet 6 credits, then bet an amount more than 6, for example 7, there would be a programmed consequence. For Participant 3, social attention (complaining) was ceased by a confederate contingent on bigger betting (a test for negative reinforcement) in the Social - condition. For Participant 4, both Social (adding praise and ceasing complaining) conditions were performed in a variation on a reversal design with a bigger betting contingency. In this case, the first Social condition was "Social +" and the next Social condition was "Social – ". Participant 4 also bet high amounts consistently. In the case of high betting consistently, betting lower relative to the previous bet was the contingency in the Social conditions.

Dependent Variable. For Participant 1, betting was the dependent variable. For the remaining participants, bigger betting was chosen as the dependent variable. This was chosen because it is a behavior that the authors believed could receive social reinforcement outside of the laboratory. That is, the authors have observed that big bets often receive some social attention in a gambling environment. Thus, social reinforcement for bigger betting is a contingency that could be discriminated by participants due to similarity with natural gambling contingencies. Thus, we would be unlikely to shape totally new behavior considering our participants already gambled in their leisure time. When betting was near the bet ceiling in baseline (this occurred for Participant 4), the dependent variable changed

to lower betting. Lower betting may be a more arbitrary behavior (i.e., less likely to be shaped in a natural gambling environment).

Participants. These participants (1-4) were female, and all confederates were also female.

Procedural Fidelity. The slot machine program recorded all information from a trial, such as bet amount and win or loss amount. Each trial also contained a timestamp, but it was computer-specific instead of set to a clock. These data were compared with the experimenter-recorded bet times and amounts by a researcher. There were no errors found. An observer or experimenter familiar with the procedures recorded procedural fidelity with a checklist at 15-second intervals. An interval was checked as correct if confederates socialized as the condition programming prescribed.

Analysis. Data were recorded and analyzed with visual analysis of bets per interval using template graphs that could be easily created between and after sessions. Wins were also charted, as well as a cumulative record of bets.

Results and Discussion

Figure 1 contains graphs of bet amounts, win amounts, bigger bets, and a cumulative record of bets for participants. Table 2 contains the bigger bets and amounts across phases.

For Participant 1, the Social + conditions did not show a clear change in betting amount from a contingency on simply betting. Thus, for Participant 2, the contingency for the Social + condition was for bigger betting; with this contingency, magnitude and proportion of bigger bets showed a more clear effect from the social interaction. Participant 2 bet a higher amount more often in the Social + conditions. Participant 3 did bet more often in the first Social - condition, though this did not replicate. Participant 3's Social - condition involved the social negative reinforcement contingency, which may affect behavior differently than the social positive reinforcement contingency. Participant 4's session times were shorter and irregular, as experimenters ended conditions when bets were stable. The condition times were between 5 minute 45 seconds and 6 minutes 30 seconds. Social conditions were first Social +, then Social -. Participant 4 often bet high in Baseline, so the contingency was for lower betting, rather than bigger betting. Participant 4 bet the maximum during nearly all opportunities. Due to small variance of the bet amounts during the Social conditions, both versions of the Social condition had a small effect on lower betting. The lower betting being influenced by social contingencies is perhaps more arbitrary than the bigger bets being influenced by social contingencies, and further research on social reinforcement may help better understand the social negative reinforcement process.

One participant in Experiment 1 never contacted the programmed bigger bets contingency, and was dropped from the data set (the data are available in the supplementary materials).

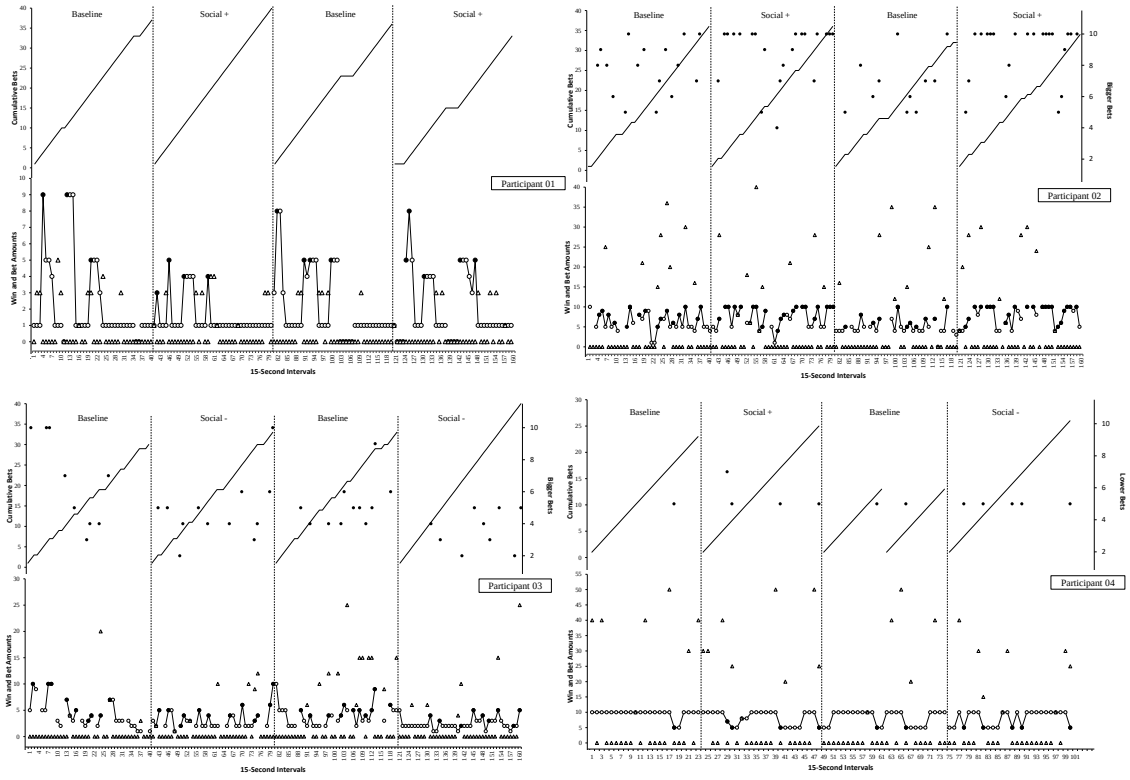

Figure 1. Experiment I Results. For each participant, the top panel shows the cumulative record of bets throughout each condition by interval, as well as the bigger bets that resulted in social consequences. For each participant, the bottom panel shows the bets and wins throughout the session. In the bottom panels, the bigger bets are filled circles (For participant 01, there was no bigger bet contingency, but the bigger bets are shown in the bottom panel for comparative information), and the open circles are bets that did not qualify as bigger bets. The open triangles are win amounts.

The effect in Participant 2's data indicated the social positive contingency had an effect on bigger betting. Participant 3's data are less clear, regarding the social negative contingency. Only the first "AB" pair showed a potential change, thus the social negative reinforcement contingency did not replicate its effect. It is worth noting that Participant 3 indicated she gambled in her leisure time at least twice a week, but scored a 1 on the SOGS, indicating few to no problems gambling and little experience, as well as a 0 on both the positive and negative reinforcement scales of the GFA-R. Participant 4's data showed more lower bets in the Social conditions (first was social positive, then social negative), and this effect may have been clearer had the bet ceiling been different. The authors theorized that the credits themselves were not valuable to the participant because of the near-constant high betting.

A limiting consideration is that for most participants in the Social conditions, the rate of bets slightly increased. Considering rate increase appeared to occur for most participants, it may be a side effect of the contingency. The amount increase in Participant 2 was the target dimension of betting. There was not much room to increase the rate relative

to baseline considering participants were restricted to betting only at the beginning of a bet trial (per how slot machines operate) and did bet most of the time in session. Free-operant gambling preparations may be helpful in identifying the nature of the rate increase in future research (see Witts & Harri-Dennis, 2015).

The results of Experiment I indicated social positive reinforcement in the form of approval for betting more credits than the previous trial (with a bet ceiling from the program) was an effective contingency for influencing bet amounts. Participant 2's data suggest this. In the second experiment, this contingency was examined further by replicating the effect then changing structural game characteristics (win magnitude, sound, and credit value) while the contingency was in place.

Table 2. Bigger bets within conditions

	Conditions in Experiments I and II										
	A	B	A	B	C	D	B	E	F	E	F
Participants											
01	3,23	4,16	4,23	5,27							
02	16,125	21,186	11,76	22,196							
03	9,60	12,58	11,60	9,33							
04	1,5	4,22	2,10	5,25							
05	11,83	21,197	5,39	8,75	10,97		12,118				
06	9.66	15,140	3,25	7,61		7,65	9,82				
07	9,59	14,117	5,41	7,63				3,23	6,43		
08	6,31	9.72						11,45	13,82	5,24	7,50
	Conditions in Experiment III										
	G	H	G	H							
Participant											
08b	12,75	19,135	7,62	17,135							

Note: The numbers are the [number of bigger bets, total bigger bet amount] within each condition. The bigger bets are reported for each participant, with the exception of Participant 4, for whom the contingency was for lower bets. Participant 1 did not have a bigger bet contingency in place in the social conditions, but her progressive bets are reported here for informational purposes (For Participant 1, the contingency was on simply betting). The condition notations are as follows: (A) is Baseline, (B) is Social, (C) is Win Reduced, (D) is Sound off, (E) is Baseline Value, and (F) is Social Value. The subscripts indicate the presentation of the condition to a participant. The order (ABABCDBEFEF) is the appearance of the conditions in sequence and appearance in this article. The lower portion of the table includes the same information for Experiment III. The condition notations are as follows: (G) is Control Confederate, (H) is Familiar Confederate.

EXPERIMENT II

Social positive reinforcement in the form of approval for bigger betting for may have changed behavior for Participant 2 in Experiment I. The purpose of Experiment II was to replicate the effect and test if it would maintain with systematic changes to three other putative gambling reinforcers.

Slot machines are widely used, and several structural aspects of slot machines have been shown to have an effect on gambling behavior (Parke & Griffiths, 2006). Sounds, in

particular, have been theorized as important aspects of reinforcement in gambling (Parke & Griffiths, 2006; Schull, 2005), and have been shown to increase preference and playing despite losses in slot machines (Dixon et al., 2014). Wins have also been shown and theorized to reinforce gambling behavior (Rachlin, Safin, Arfer, & Yen, 2015); losses disguised as wins, on the other hand, show less reinforcing effects than wins, and do not reliably produce reinforcement in short-term laboratory settings (Leino et al., 2016; Sagoe et al., 2017). Finally, gambling with valuable credits changes gambling behavior in the laboratory such that participants bet less than when credits are imaginary or valueless (Weatherly & Brandy, 2004; Weatherly, McDougall, & Gillis, 2006).

Given that slot machine structural variables like sounds, win size, and credit value are reinforcing, the differential effect of social reinforcement from structural reinforcement is unclear. That is, the social positive reinforcement effect from Experiment I may have been an artifact of the game already being reinforcing. The potential significance of the social reinforcement contingency's effectiveness lies in if it controls behavior in the natural environment above and beyond the slot machine's structure. Thus, if the effect is more fickle with slot machine features than with individual's learning histories, its significance to maintaining gambling or leading to disordered gambling may be slight. We examined the social positive contingency when game sound was on versus off, when win magnitude (payoff) was changed so that wins only returned the bet amount, and when credits had cash value. Each condition in which some putatively reinforcing stimuli are taken away ("Sound Off" and "Wins Reduced") was a test of the reinforcing ability of the social positive reinforcement contingency under potentially less reinforcing circumstances overall. We also included Baseline and Social + conditions where credits had cash value ("Baseline Value" and "Social Value") to test against our typical Baseline and Social + conditions.

Method

Design and procedure. Single-case experimental designs were used to examine bigger betting across conditions. The goal of this experiment was to examine the social positive contingency while changing structural variables of the game and while changing the value of credits. To achieve changing putatively reinforcing structural variables, the design format was ABABCB (Baseline, Social, Baseline, Social, Win Reduced, Social) for Participant 5, and ABABDB (D being Sound Off) for Participant 6. The procedures for Baseline and Social were the same as in Experiment I (Social procedures being the social positive contingency). In the Win Reduced condition, we reduced the win magnitude for all possible wins to a factor of one, meaning wins only returned the bet amount. In the Sound Off condition, we turned the game's sound (simulation of slot machine sounds) off. The social positive contingency for bigger betting continued in both the Win Reduced and the Sound Off conditions. With these designs, C and D conditions were those in which the social positive contingency was in place while structural aspects of the game were changed.

To examine the social positive contingency while changing credit value, the design format was ABABEF for Participant 7, and EFEFAB for Participant 8. Conditions E and F were Baseline Value and Social Value, respectively. In these conditions, the 100 staked credits in each condition had value. This was the case for conditions E and F. For these

participants, the instructions read by the experimenter before these conditions differed slightly from the Experiment I instructions above. The instructions were:

> "You are about to play a simulated gambling game. Do not press "begin" until I tell you it is okay. Once you push "begin" you will see a slot machine interface on screen. You may bet up to 10 credits at a time. The credits are worth 10 cents each, please act as if they are real. You will start with 100 credits, or 10$. To play the game, you must set an amount to bet, press the "set bet" button, and then press the "spin" button with your mouse. When you press "spin," the game will play like a regular slot machine, and you will win or lose credits. Play as much or as little as you like. I will monitor the game for 10 minutes, then we will take a break. If you run out of credits, let me know and I will credit you 100 more credits, however to get the credits at the end you must make more than 100 credits. Do you have any questions?"

When the relevant condition was 5 minutes, "I will monitor the game for 10 minutes" was changed to reflect this. At the end of their participation, the total in credits at the end of each condition was paid out to Participants 7 and 8.

Participants. These participants were three males (Participant 5, 7, and 8) and one female (Participant 6), and confederates were the same gender as each participant.

Results and discussion. Figure 2 contains bet amounts, win amounts, bigger bets, and a cumulative record of bets for Participants 5, 6, 7, and 8. Table 2 contains the bigger bet number and amounts for participants across phases. For Participant 5, in the Wins Reduced condition, bigger betting continued. For Participant 6, in the Sound Off condition, bigger betting also continued. For Participant 7, bigger betting continued in the Social Value conditions. For Participant 8, when the conditions all had valuable credits, the Social Value condition still had an effect on bigger betting. These results show that despite changes in the game conditions, social contingencies may continue to have an effect on gambling behavior when in place. However, across participants the effect on bigger betting from the first Baseline condition to the first Social + condition was stronger than the effect from the second Baseline to the second Social + condition. This suggests the social effect may be transitory. Additionally, considering that conditions changed based on time, rather than a number of bets, the rate problem described in the Discussion section of Experiment I still hampers interpretation of the number of bets in these data. Future research may examine tighter contingencies to assess the nature of the possible reinforcement in the contingencies reported herein.

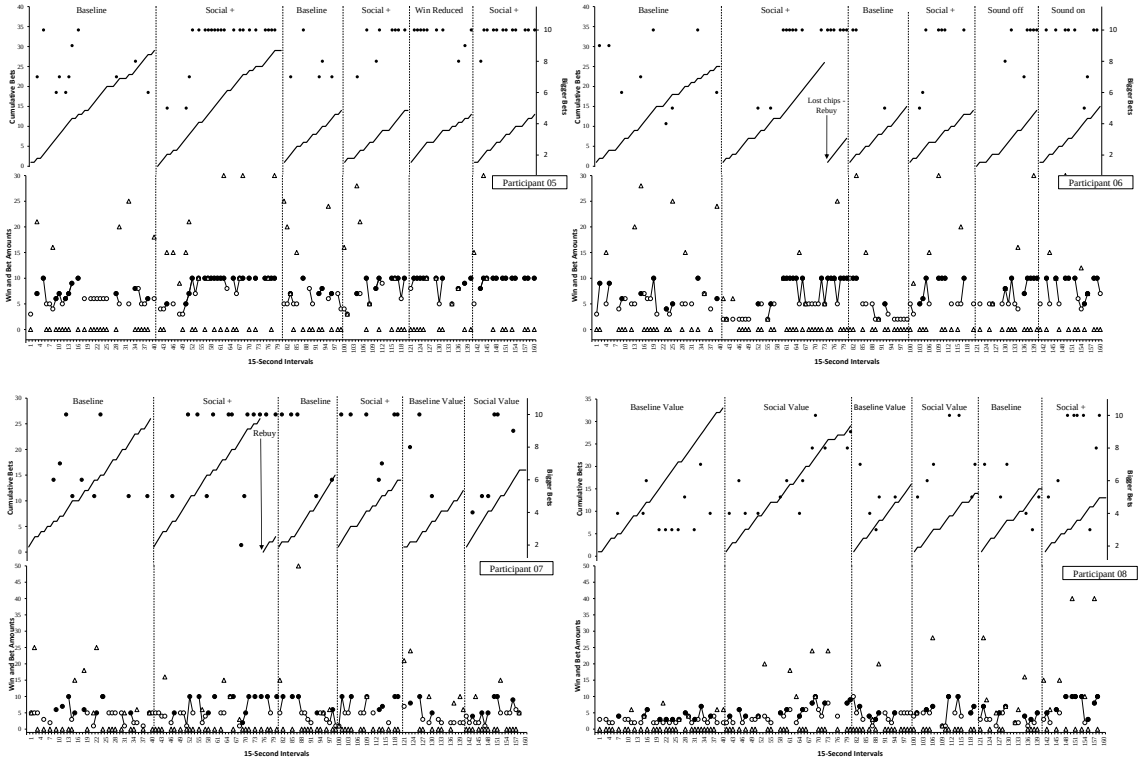

Figure 2. Experiment II Results. For each participant, the top panel shows the cumulative record of bets throughout each condition by interval, as well as the bigger bets that resulted in social consequences. For each participant, the bottom panel shows the bets and wins throughout the session. In the bottom panels, the bigger bets are filled circles, and the open circles are bets that did not qualify as bigger bets. The open triangles are win amounts.

An unanswered question was if this would have a measurable effect on later behavior. In theory, the discriminated operant should be more likely to appear in conditions similar to the learning conditions. Said another way, if someone's betting while playing slot machines came under partial control of social contingencies, one might expect that in similar social situations, similar betting patterns would emerge. We decided to test whether a participant would later gamble more in the presence of the same confederate from the original test conditions than in the presence of a different confederate.

EXPERIMENT III

We tested the reinforcing efficacy of social positive reinforcement in the form of approval for bigger betting against non-contingent talk and changing other putatively reinforcing structural variables for four participants in Experiment II. The effect from the social contingency appeared for all four participants. In the present experiment, we tested whether Participant 8 from Experiment II would gamble more in the presence of the confederate from the conditions in Experiment II or a different confederate. The rationale was that if the social positive contingency we identified is indeed a discriminated operant,

properties of the situation (i.e., the confederate) should be more likely to evoke the operant behavior (bigger betting) than other stimuli (an unfamiliar confederate).

Method

Design and procedure. A within-subject reversal design was used to examine betting across conditions. The goal of this experiment was to examine bigger betting in two conditions: 1) In the presence of the confederate who had previously enforced the social positive reinforcement contingency for bigger betting, and 2) in the presence of an unfamiliar confederate. To achieve this, the design format was GHGH (Control Confederate, Familiar Confederate, Control Confederate, Familiar Confederate) for Participant 8 from Experiment II. The confederates in both conditions followed the procedure from Baseline (the social positive reinforcement contingency was not in place). A participant who had previously gone through Experiment II was invited back to the laboratory, and returned seven days after their participation in Experiment II.

Participant. Participant 8 from Experiment II participated.

Results and discussion. Figure 3 contains bet amounts, win amounts, bigger bets, and a cumulative record of bets for Participant 8 in this experiment. Number and amount of bigger bets across phases are in Table 2. There were increased bigger bets in the Familiar Confederate conditions than the Control Confederate conditions, though the difference was small.

These results could be interpreted as the confederate from Experiment II taking on discriminative stimulus properties for bigger betting. There are also bigger bets in the Control Confederate conditions, including bets at the ceiling (10). There are no ceiling bets in the Baseline condition from Experiment II, or in the Baseline Value conditions. This could be an indication that there was generalization to the similar situation and presence of a confederate in the Control Confederate conditions from the Social Positive conditions. However, this interpretation should be treated with caution, as the betting patterns would have likely changed over time, and the order of conditions may have contributed to the effect.

GENERAL DISCUSSION

Previous laboratory research has shown that social variables have effects on gambling behavior. In this study, we conducted experiments to test for the reinforcing effect of social contingencies on gambling. We tested non-contingent contextualized social attention (Baseline conditions) against different forms of contingent social attention (Social conditions), and found a social positive reinforcement contingency had an effect on betting more credits. We further tested the social positive contingency against changes to the structure of the game, and found the effect on bets, when present, can maintain despite other putatively reinforcing aspects of the game changing. Finally, we examined betting patterns of a participant who had shown the effect a week later in the presence of the same confederate and a different confederate, both providing non-contingent attention, and

found increased bigger bets overall, and more in the presence of the same confederate who had implemented the contingency.

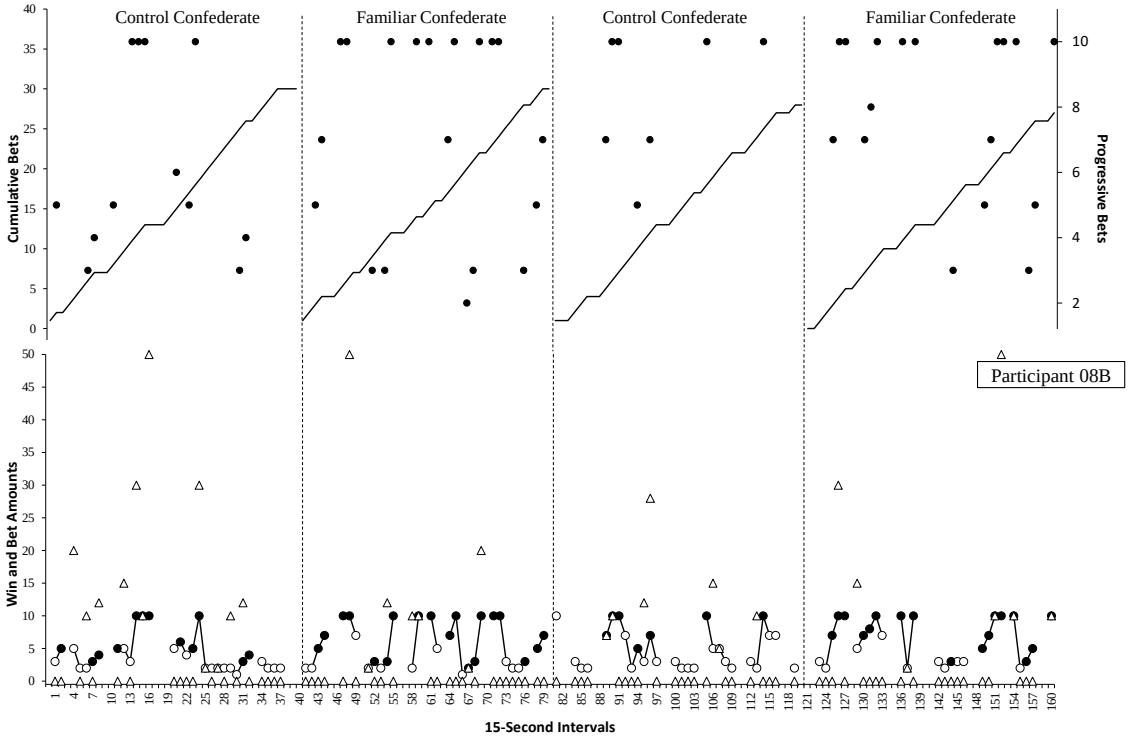

Figure 3. Experiment III Results. For each participant, the top panel shows the cumulative record of bets throughout each condition by interval, as well as the bigger bets that resulted in social consequences. For each participant, the bottom panel shows the bets and wins throughout the session. In the bottom panels, the bigger bets are filled circles, and the open circles are bets that did not qualify as bigger bets. The open triangles are win amounts.

These data lend to a behavior analytic interpretation of social maintenance of gambling. The presence of others may facilitate gambling as part of a learned reinforcement contingency, which could involve people engaging socially in a reinforcing manner while gambling. One could extrapolate that for some people, social interactions may be more likely when in a gambling venue, and more intensified in their likelihood under big bet or related "attention-getting" situations in these settings. This partial social maintenance could play a part in the development of disordered gambling, though this would have to be examined in future research.

This study had a number of limitations that could be addressed in future research. Experimental control over the number of bets was lacking in this study, as conditions changed based on time. Changes in the rate of betting across conditions are difficult to interpret, and this effects our ability to interpret the effect from the social positive contingency. Furthermore, the social positive effect did replicate within subjects, but typically to a smaller degree than the initial demonstration. Therefore, in future research tighter experimental control would help understand the nature of the effect we identified.

An additional limitation is that conceptualizing the magnitude and consistency of different presentations of attention delivery as equal to one another is difficult. Our confederates were "socially savvy" and in some cases had extensive theatre training. This could have contributed to effectiveness of the procedures. Non-contextualized (at cultural and situation levels) social consequences are less likely to be reinforcing (e.g., Foxx, 1996, p. 227). Thus, contextualizing the responses with some soft skills may be necessary for procedures such as these to be reliable, as is the case with many social procedures. Confederate trait variables such as gender may also play a role for any given participant. Additionally, the structural variables we manipulated in Experiment II were hardly exhaustive of game variables that contribute to reinforcement; for example, win schedule is likely a strong component of reinforcement (Skinner, 1953), and the interaction of social contingencies with such variables is likely to be important.

Conceptually, predicting if the social positive contingency for bigger betting will be effective for a given individual is also challenging. Therefore, more research is required to develop tools that are predictive of this outcome. Another difficulty in predicting the social positive contingency procedure's efficacy is measures of contingency motivation such as the GFA-R have not been used to isolate social contingencies away from any other maintaining contingencies (for a discussion of functional assessment of gambling see Dixon, Wilson, Belisle, & Schreiber, 2018). Additionally, for people who report motivation for escape on the GFA-R, modifications to our less successful social negative reinforcement procedure may be appropriate to explore.

Notably, we did not exhaustively demonstrate that the effectiveness of the reinforcement contingency had an effect on gambling in the presence of similar confederates or similar social situations at a later time. More research in this area would further support the interpretation that contingencies such as these may contribute to the development of gambling patterns. On a related note, we cannot assess from this study whether participants learned the contingency during session, or had the relevant learning history such that under these conditions the behavior was evoked. Given the unusual nature of the programmed contingency, a combination of existing stimulus control and contingency shaping is likely. There are numerous ways to analyze the data we have collected. We included the raw data for each participant and the study protocol in the supplementary materials, per recommendations for single case research in behavior science (Tincani & Travers, 2019).

Finally, our single operant test may or may not be appropriate. In applied behavior analysis, the single operant conditions in a functional analysis of problem behavior are useful for populations where the problem behavior is conceptualized as strongly related to reinforcement (Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994). Addictive behavior can also be conceptualized as behavior resulting from reinforcement pathology. However, gambling problem behavior is multiply maintained. The data from the GFA-R studies above support this. The small effects captured from our social contingency procedure also supports this interpretation. We additionally calculated effect sizes for the bets across phases, which were small (effect sizes are in the supplementary materials, calculated using Ratio of Distances, a measure for single case designs; see Carlin &

Costello, 2018). Additionally, indirect assessments of problem behavior in applied behavior analysis have suggested that with more sophisticated stimulus relations being learned (perhaps meaning more complex behavior), single operant functions of problem behavior may give way to multiple functions (Belisle, Stanley, & Dixon, 2017). These considerations, and more free-operant examinations, may be useful in examining social effects on gambling going forward (Witts & Harri-Dennis, 2015).

Finally, the theoretical contingency herein is in the Skinnerian tradition (Skinner, 1969), and that is pragmatic, but may benefit from more empirical analysis (Killeen, 2018; Killeen & Jacobs, 2017). The contingency, as an organizational unit, involves both contingency-shaped (in this context referring to reinforcement from the game) and verbal behavior including rule-governed behavior (Blakely & Schlinger, 1987; Costello & Fuqua, 2017, p. 3; Hayes, Brownstein, Zettle, Rosenfarb, & Korn, 1986); the nature of the stimuli involved with verbal behavior in a contingency analysis, however, remains theoretically unresolved. This is likely important for any in-depth theorizing about social effects. Discussions in the gambling literature on the analysis of rule-governed behavior and contingency-shaped behavior (e.g., Weatherly & Dixon, 2007) suggest that a complete functional model should account for both. Such a model could reliably inform assessment of what functional relations to address when intervening on gambling behavior, including social relations.

Gambling research from the behavior analytic perspective has been largely experimental (Costello, Whiting, Hirsh, Deochand, & Spencer, 2016; Dixon et al., 2015; Witts, 2013), and should lead to some effect on ameliorating disordered gambling (Costello & Fuqua, 2017). Effective behavior analytic models of gambling involve contingency analysis of more variables than the game structure (see Dymond, McCann, Griffiths, Cox, & Crocker, 2012; James & Tunney, 2017). Particular properties of the gambling context, such as social variables, may be more evocative of gambling, or could cue relapse even outside of the particular gambling event. The social contingencies identified in this study may also be appropriate to extinguish in cases where social facilitation evokes gambling that is problematic, although future research should examine this.

REFERENCES

Beavers, G. A., Iwata, B. A., & Lerman, D. C. (2013). Thirty years of research on the functional analysis of problem behavior. *Journal of Applied Behavior Analysis, 46,* 1-21. doi: 10.1002/jaba.30

Belisle, J., Stanley, C. R., & Dixon, M. R. (2017). The relationship between derived mutulally entailed relations and the function of challenging behavior in children with autism: Comparing the PEAK-E-PA and the QABF. *Journal of Contextual Behavioral Science, 6,* 298-307. doi: 10.1016/j.jcbs.2017.07.004

Brandt, A. E., & Martin, J. (2015). Simulating personal wealth in the laboratory. *The Journal of General Psychology, 142*, 167-181. doi: 10.1080/00221309.2015.1060937

Blakely, E., & Schlinger, H. (1987). Rules: Function-altering contingency-specifying stimuli. *The Behavior Analyst, 10*, 183-187. doi: 10.1007/BF03392428

Carlin, M. T., & Costello, M. S. (2018). Development of a distance-based effect size metric for single case research: Ratio of distances. *Behavior Therapy, 49*, 981-994. doi: 10.1016/j.beth.2018.02.005

Costello, M. S., & Fuqua, R. W. (2017). Considering contingencies of gambling research in conjunction with the *Behavior Analyst Certification Board Professional and Ethical Compliance Code*. *Analysis of Gambling Behavior, 11*, article 1, 1-12. Retrieved from http://repository.stcloudstate.edu/agb/vol11/iss1/1/

Costello, M. S., Whiting, S. W., Hirsh, J. L., Deochand, N., & Spencer, T. (2016). Annotated bibliography of behavior analytic scholarship outside of Analysis of Gambling Behavior: 2013-2015. *Analysis of Gambling Behavior, 10*, article 1, 1-10. Retrieved from https://repository.stcloudstate.edu/agb/vol10/iss1/1/

Dixon, M. R. (2000). Manipulating the illusion of control: Variations in risk-taking as a function of perceived control over chance outcomes. *The Psychological Record, 50*, 705-719. doi: 10.1007/BF03395379

Dixon, M. R., Hayes, L. J. & Aban, I. B. (2000). Examining the roles of rule following, reinforcement, and preexperimental histories on risk-taking behavior. *The Psychological Record, 50*, 687-704. doi: 10.1007/BF03395378

Dixon, M. R., & Johnson, T. E. (2007). The Gambling Functional Assessment (GFA): An assessment device for identification of the maintaining variables of pathological gambling. *Analysis of Gambling Behavior, 1*(1), 44-49.

Dixon, M. R., Whiting, S. W., Gunnarsson, K. F., Daar, J. H., & Rowsey, K. E. (2015). Trends in behavior-analytic gambling research and treatment. *The Behavior Analyst, 38*, 179-202. doi: 10.1007/s40614-015-0027-4

Dixon, M. R., Wilson, A. N., Belisle, J., & Schreiber, J. B. (2018). A functional analytic approach to understanding disordered gambling. *The Psychological Record, 68*, 177-187. doi: 10.1007/s40732-018-0279-y

Dymond, S., McCann, K., Griffiths, J., Cox, A., & Crocker, V. (2012). Emergent response allocation and outcome ratings in slot machine gambling. *Psychology of Addictive Behaviors, 26*, 99-111. doi: 10.1037/a0023630

Foxx, R. M. (1996). Twenty years of applied behavior analysis in treating the most severe problem behavior: Lessons learned. *The Behavior Analyst, 19* (2), 225-235. doi: 10.1007/BF03393166

Gunnarsson, K. F., Whiting, S. W., & Dixon, M. R. (2014). The near-miss effect in blackjack: Group play and lone play. *Analysis of Gambling Behavior, 8*(2), 87-94.

Hayes, S. C., Brownstein, A. J., Zettle, R. D., Rosenfarb, I., & Korn, Z. (1986). Rule-governed behavior and sensitivity to changing consequences of responding. *Journal of the Experimental Analysis of Behavior, 45,* 237-256. doi: 10.1901/jeab.1986.45-237

Iliceto, P., Fino, E., & Schiavella, M. (in press). Validity and reliability of the Italian Gambling Functional Assessment-Revised. *International Gambling Studies.* doi: 10.1080/14459795.2017.1409247

Iwata, B. A., Dorsey, M. F., Slifer, K. J., Bauman, K. E., & Richman, G. S. (1982/1994). Toward a functional analysis of self-injury. *Journal of Applied Behavior Analysis, 27,* 197-209. Reprinted from *Analysis and Intervention in Developmental Disabilities*, 1982. doi: 10.1901/jaba.1994.27-197

James, R. J. E., & Tunney, R. J. (2017). The need for a behavioural analysis of behavioural addictions. *Clinical Psychology Review, 52*, 69-76. doi: 10.1016/j.cpr.2016.11.010

Kennedy, T. D. (1970). Verbal conditioning without awareness: The use of programmed reinforcement and recurring assessment of awareness. *Journal of Experimental Psychology, 84*(3), 487-494. http://dx.doi.org/10.1037/h0029289

Killeen, P. R. (2018). The futures of experimental analysis of behavior. *Behavior Analysis: Research and Practice.* In press. doi: 10.1037/bar0000100

Killeen, P. R., & Jacobs, K. W. (2017). Coal is not black, snow is not white, food is not a reinforcer: The roles of affordances and dispositions in the analysis of behavior. *The Behavior Analyst, 40*, 17-38. doi: 10.1007/s40614-016-0080-7

Krasner, L. (1958). Studies of the conditioning of verbal behavior. *Psychological Bulletin, 55*, 148-170. doi: 10.1037/h0040492

Lattal, K. A. (1995). Contingency and behavior analysis. *The Behavior Analyst, 18*, 209-224. doi: 10.1007/BF03392709

Lattal, K. A., & Poling, A. D. (1981). Describing response-event relations: Babel revisited. *The Behavior Analyst, 4*, 143-152. doi: 10.1007/BF03391861

Lieberman, D. A., Sunnucks, W. L., & Kirk, J. D. J. (1998). Reinforcement without awareness: I. Voice level. *The Quarterly Journal of Experimental Psychology, 51B* (4), 301-316.

Leino, T., Torsheim, T., Pallesen, S., Blaszczynski, A., Sagoe, D., & Molde, H. (2016). An empirical real-world study of losses disguised as wins in electronic gaming machines. *International Gambling Studies, 16*, 470-480. doi: 10.1080/14459795.2016.1232433

Lesieur, H. R., & Blume, S. B. (1987). The South Oaks Gambling Screen (SOGS): A new instrument for the identification of pathological gamblers. *American Journal of Psychiatry*, *144* (9), 1184-1188.

McDougall, C. L., Terrance, C., & Weatherly, J. N. (2011). The effect of male confederate presence, betting, and accuracy of play on males' gambling on blackjack. *The Psychological Record, 61*, 411-424. doi: 10.1007/BF03395769

McDowell, J. J., & Caron, M. L. (2010). Matching in an undisturbed natural human environment. *Journal of the Experimental Analysis of Behavior, 93*, 415-433. doi: 10.1901/jeab.2010.93-415

Molde, H., Mentzoni, R., Hanss, D., Sagoe, D., Andersen, S. L., & Pallensen, S. (2017). People around you – do they matter? An experimental gambling study. *International Gambling Studies, 17*, 349-365. doi: 10.1080/14459795.2017.1333130

Parke, J., & Griffiths, M. (2006). The psychology of the fruit machine: The role of structural characteristics (revisited). *International Journal of Mental Health and Addiction, 4*, 151-179. doi: 10.1007/s11469-006-9014-z

Petry, N. M., Madden, G. J., & Roll, J. M. (2007). The alloplastic nature of pathological gambling. *Analysis of Gambling Behavior, 1*(1), 25-26.

Pfund, R. A., Ginley, M. K., Whelan, J. P., Peter, S. C., Wynn, B. S., Suda, M. T., & Meyers, A. W. (2018). Influence of social interaction on women college students' electronic gambling machine behaviour. *Journal of Gambling Issues, 38*, 237-251. doi: 10.4309/jgi.2018.38.12

Rachlin, H., Safin, V., Arfer, K. B., & Yen, M. (2015). The attraction of gambling. *Journal of the Experimental Analysis of Behavior, 103*, 260-266. doi: 10.1002/jeab.113

Rockloff, M. J., & Dyer, V. (2007). An experiment on the social facilitation of gambling behavior. *Journal of Gambling Studies, 23,* 1-12. doi: 10.1007/s10899-006-9042-4

Sagoe, D., Eide, T.A., Øhrn, H., Leino, T., Mentzoni, R. A., & Pallesen, S. (2017). Negative wins do not reinforce 'short-term' slot machine gambling intensity, game evaluation, and gambling beliefs. *International Journal of Mental Health and Addiction,* in press. doi: 10.1007/s11469-017-9761-z

Schull, N. D. (2005). Digital gambling: The coincidence of desire and design. *Annals of the American Academy of Political and Social Science*, *597*, 65–81. doi: 10.1177/0002716204270435

Simon, C., & Baum, W. M. (2017). Allocation of speech in conversation. *Journal of the Experimental Analysis of Behavior, 107*, 258-278. doi: 10.1002/jeab.249

Strauss, B. (2002). Social facilitation in motor tasks: A review of research and theory. *Psychology of Sport and Exercise, 3*, 237-256. doi: 10.1016/S1469-0292(01)00019-X

Skinner, B. F. (1969). *Contingencies of reinforcement: A theoretical analysis.* New York: Appleton-Century-Crofts.

Skinner, B. F. (1953). *Science and human behavior*. New York: Macmillan.

Tincani, M., & Travers, J. (2019). Replication research, publication bias, and applied behavior analysis. *Perspectives on Behavior Science*. in press. https://doi.org/10.1007/s40614-019-00191-5

Verplanck, W. S. (1955). The control of the content of conversation: Reinforcement of statements of opinion. *The Journal of Abnormal and Social Psychology, 51*, 668-676. doi: 10.1037/h0046514

Vollmer, T. R., & Hackenberg, T. D. (2001). Reinforcement contingencies and social reinforcement: Some reciprocal relations between basic and applied research. *Journal of Applied Behavior Analysis, 34,* 241-253. doi: 10.1901/jaba.2001.34-241

Weatherly, J.N., Aoyama, K., Terrell, H.K., & Berry, J.C. (2014). Comparing the Japanese version of the Gambling Functional Assessment – Revised to an American sample. *Journal of Gambling Issues, 29*, 1-20. doi:10.4309/jgi.2014.29.4

Weatherly, J. N., Bushaw, B., & Meier, E. (2009). Social influence when males gamble: Perceptions and behavior. *Analysis of Gambling Behavior, 3*(2), 36-47.

Weatherly, J. N., & Brandt, A. E. (2004). Participants' sensitivity to percentage payback and credit value when playing a slot-machine simulation. *Behavior and Social Issues, 13,* 33-50. doi: 10.5210/bsi.v13i1.34

Weatherly, J. N., Dixon, M. R. (2007). Toward an integrative behavioral model of gambling. *Analysis of Gambling Behavior*, *1,* 4-18.

Weatherly, J. N., Dymond, S., Samuels, L., Austin, J. L., & Terrell, H. K. (2014). Validating the Gambling Functional Assessment – Revised in a United Kingdom sample. *Journal of Gambling Studies. 30,* 335-347. doi: 10.1007/s10899-012-9354-5

Weatherly, J. N., McDougall, C. L., & Gillis, A. A. (2006). A bird in hand: Discouraging gambling on a slot machine simulation. *The Journal of Psychology, 140*, 347-361. doi: 10.3200/JRLP.140.4.347-361

Weatherly, J. N., Miller, J. C., Montes, K. S., & Rost, C. (2012). Assessing the reliability of the Gambling Functional Assessment – Revised. *Journal of Gambling Studies*, *28,* 217-223. doi: 10.1007/s10899-011-9275-8

Weatherly, J. N., Miller, J. C., Terrell, H. K. (2011) Testing the construct validity of the Gambling Functional Assessment – Revised. *Behavior Modification, 35*, 553-569. doi: 10.1177/0145445511416635

Weatherly, J. N., & Terrell, H. K. (2014). Validating the Gambling Functional Assessment-Revised in a sample of probable problem/disordered gamblers. *Analysis of Gambling Behavior, 8* (1), 39-52.

Wilson, A. N., & Dixon, M. R. (2015). Derived rule tacting and subsequent following by slot machine players. *The Psychological Record, 65*, 13-21. doi: 10.1007/s40732-014-0070-7

Witts, B. N. (2013). Cumulative frequencies of behavior analytic journal publications related to human research on gambling. *Analysis of Gambling Behavior, 7* (2), 59-65.

Witts, B. N., & Harri-Dennis, E. (2015). Free-operant research in the experimental analysis of human slot-machine gambling. *Analysis of Gambling Behavior, 9* (2), article 2, 1-12. Retrieved from http://repository.stcloudstate.edu/agb/vol9/iss2/2

Wulfert, E., Hartley, J., Lee, M., Wang, N., Franco, C., & Sodano, R. (2005). Gambling screens: Does shortening the time frame affect their psychometric properties? *Journal of Gambling Studies, 21*, 521-536. doi: 10.1007/s10899-005-5561-7