12-1-2015

Relational training of contextual cues and self-rule formation in simulated slot machines

Rocco Giovanni Catrone
Southern Illinois University Carbondale, roccocatrone@gmail.com

RELATIONAL TRAINING OF CONTEXTUAL CUES AND SELF-RULE FORMATION IN SIMULATED SLOT MACHINES

by

Rocco Giovanni Catrone

B.A., Elmhurst College, 2013

A Thesis

Submitted in Partial Fulfillment of the Requirements for the

Masters of Science in Behavior Analysis and Therapy.

Department of Behavior Analysis and Therapy

in the Rehabilitation Institute

Southern Illinois University Carbondale

December, 2015

THESIS APPROVAL

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Masters of Science

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Approved by:

Dr. Mark R. Dixon, Ph.D., BCBA, Chair

Dr. Ruth Anne Rehfeldt, Ph.D., BCBA

Dr. Ryan Redner, Ph.D., BCBA

Graduate School

Southern Illinois University Carbondale

11/6/15

AN ABSTRACT OF THE THESIS OF

ROCCO CATRONE, for the Masters of Science degree in BEHAVIOR ANALYSIS AND THERAPY, presented on 11/3/2015, at Southern Illinois University Carbondale.

TITLE: RELATIONAL TRAINING OF CONTEXTUAL CUES AND SELF-RULE FORMATION IN SIMULATED SLOT MACHINES

MAJOR PROFESSOR: Dr. Dixon

Between 1% and 1.4% of people who engage in gambling behaviors lead to disordered or pathological gambling (Whiting & Dixon, 2015), while 44% of all money spent on legal gambling is done so with slot machines (Choliz, 2010). Various behavioral concepts have been theorized as a possible source of gambling addition; losses disguised as wins (LDWs), near-miss, gamblers' fallacy, illusions of control, and verbally constructed self-rules related to these topics. The current study sought to extend the previous research on condition discrimination in altering slot machine preference while also analyzing the effects of vocalized self-rules during slot machine selection. Conclusions are drawn regarding results comparing cumulative selection to various vocal statement categories. Limitations are expressed and future research is suggested.

Keywords: conditional discrimination training, slot machines, gambling, self-rule

DEDICATION

The following work is dedicated to a few important people. My family for raising me through adversity and teaching me to be curious about the world around me while accepting no limits placed upon by others or myself. To my professors for their patience with me during this entire process and their focused feedback. Most of all, to my wife, Annie. She has been my cheerleader and rock through all my troubles and successes throughout this entire program. Without her, I would not be where I am today.

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CHAPTER 1

INTRODUCTION

Various modes of gambling are on the rise in in terms of popularity and, perhaps more importantly, availability (Whiting & Dixon, 2013; Dixon, Wilson, and Habib, 2014). With the ease of access to online gambling in an age where most everyone owns, or has access to, devices capable of connecting to the internet, or downloading an “app” on a phone or tablet, this creates a very low response cost in terms of gaining access to this type of entertainment. Although these games may be subjectively fun, there is cause for concern. Between 1% and 1.4% of people who engage in gambling behaviors lead to disordered or pathological gambling (Whiting & Dixon, 2015), while 44% of all money spent on legal gambling is done so with slot machines (Choliz, 2010). These “safe” games, given these statistics, have the capability of eliciting disordered gambling (Dixon, Bihler, & Nastally, 2011). Slot machines are visually appealing with many lights and sounds depicting wins, loses, and loses disguised as wins (LDW). One can play a round for as little as a penny, making this a cheap form of entertainment for those who do not have a lot of money. Couple this with ease of access and this type of gaming becomes very attractive to its users, eliciting them to spend more of their money which can, in time, can lead to serious pathologies as defined in the DSM-V for disordered gambling (American Psychiatric Association, 2013; Choliz, 2010; MacLaren, Ellery, & Knoll, 2015).

Slot machines, beyond being visually appealing, have other qualities that may lead to addictive behaviors. Unlike many types of gambling (i.e. various cards games, roulette, sports gambling etc.) the payouts happen with a greater immediacy – once the slots stop spinning, the person immediately knows whether or not they lose or win some sort of prize. This can promote an impulsive allocation towards something that is immediately available, making it more appealing than those games that are delayed in delivering reinforcement. Coates and Blaszczynski (2014) suggest that the amount of funds and the fatigue of the person is really only a few things that limit this continuous, rapid play with its random reinforcement ratios. To help ameliorate these limitations, casinos place comfortable chairs in front of these machines. They keep their customers well fed and serve drinks frequently. These two environmental changes help to address a fatigue or hunger limitation to playing these games. Finally, offering a variety of slot machines at varying levels of "pay to play" ensures that there is a slot machine for every type of spender starting at penny slots.

Although these environmental factors may draw people in and make it easier to stay, the contingencies presented by slot machines are also an important variable in the occurrence and maintenance of gambling behaviors. With people generally like smaller rewards more often versus larger rewards after a delayed amount of time (Dixon & Tibbetts, 2009), slot machines have a unique advantage over other modes of gambling (i.e. sports betting, card games etc.). In sports betting, the time between the bet and reward can be over days (the upcoming game), weeks (betting on certain game outcomes), or even months. Fantasy Football leagues are a form of sports betting that have a delayed reinforcing schedule that can last anywhere between a few days (betting a certain outcome of a game) or several months (an entire football season) before they see whether or not their bet will yield any monetary results. This type of gambling may be maintained by the weekly point accumulation, but this is a conversation for future research. The main point is that slot machines have a very short latency period between the time the bet is place and when the gambler is told the results. However, at times, the slot machine may display a "win" regardless of the actual payout when compared to the amount of accumulated bets.

A loss disguised as a win (LDW) is one type of feedback that has been suggested as a way to further gambling behaviors (Dixon, Collins, Harrigan, Graydon, & Fugelsan, 2015). In an LDW, the person who is playing the game may have won that round, but in the end, actually lost money. As an example, if someone placed a bet in a slot machine for $1 dollar, they start the slots and in the end, they "won" fifty cents, although they technically won some of that money back, they still lost fifty cents from what they started with. The lights and sounds, however, given for a true win are also utilized for a LDW. This reinforcement still elicits a similar response from the player like that of a true win – their heart rate increases, they start sweating more, pupils dilate etc. (Dixon et. al, 2015). These LDWs can easily be coded into slot machine programs/machines and therefore are utilized. Another contributing addictive factor to slot machine gambling, and perhaps even lottery tickets, is the concept and presentation of a "near miss" (Billieux, Linden, Khazaal, Zullino, & Clark, 2012). In this scenario, the player is close to the win. As an example, if there is a slot machine with three slots, a near-miss could be where two of the items match, while the third doesn't (i.e. two diamonds than a spade). A near-miss and a full-miss (i.e. three different symbols in a simple slot machine) are objectively the same, however, the former has been shown to increase the ratings of whether or not someone will continue to play (Billieux et. al, 2012).

LDWs and near-misses contribute what has been termed as part of a "gambler's fallacy." This concept, although partially mentalistic in nature, is where a gambler will play, or continue to play, based on a false sense of "winning" or "losing" streaks (i.e. multiple wins or losses in a row) (Coates, & Blaszczynski, 2014; Dixon et. al, 2014). This is especially the case in slot machines as the rapid, repeated play creates an ideal environment of win and loss ratios, contrasted with comparatively slower games like blackjack or poker. To illustrate, in an idealized example with a slot machine the one person may lose 5 times in a row then gets up, while another gambler comes to sit down in that recently vacant chair to play their odds with a belief of "it has to win soon with so many losses." As another example, continually playing at a machine since that person is on a "losing streak" and a win is perceived to eventually come up. The person would not react any differently if this was their own self-rule they generated when a win came up, in the past, superstitiously reinforces it – rating the likelihood of picking the same stimulus will win as greater than the probability of it actually happening (Dixon et. al, 2014). This repeated engagement of behaviors that are contrary to one's best interests (Cowley, Briley, & Farrell, 2015; Hinvest, Brosan, Rogers, & Hodgson, 2014; Johnson & Dixon, 2009; Skinner, 1969) since, as stated before, they have no overt control over the outcome of the game. These gambling persist without true regard to the contingencies that the person is coming in contact with (Johnson & Dixon, 2009). Regardless of the less than desirable contingencies that one comes in contact with, the false sense of control over the odds maintains the gambling behavior.

This "illusion of control" can be described as when a person thinks, and subsequently behaves, in a way suggesting a fallacious sense of control over events that are otherwise uncontrollable (Billieux et. al, 2012; Cowley et. al, 2015). Slot machine wins are not contingent on the topography of the one who is playing. The speed at which a button is pressed, the pattern of wins falsely perceived and acted upon by the individual, or speaking to the machine have no effect on the odds. The creation and maintenance of these behaviors are in turn intermittently reinforced the win/loss algorithms set in place by the machine. However, at variable schedules, the perceived behavior can be reinforced by a win thereby strengthening these superstitious behaviors (Delfabbro, 2004). The wins accessed by the participant, and all those behaviors that may have been associated (or *framed*) with it, has even been shown to display a neurological effect in the part of the brain associated with numbers and language (Dixon et. al, 2014). This suggests that there are neurological correlates which are associated with verbally constructed gambling behavior(s).

In his book "*Verbal Behavior"* Skinner (1957) defines this as ''behavior reinforced through the mediation of other persons'' (p. 2). Rules can be placed on an individual through the verbal community. Examples include persons of authority (i.e. police officers, teachers, parents etc.) instructing another/multiple individual(s) through spoken or written verbal behavior to complete an expected response. This control can take place when conflicting consequences are come into contact with (Skinner, 1953). Behaviors are changed and shaped by the consequences, positive or negative, that are placed upon them by the verbal community or the individual. These consequences, either contingency-shaped or rule-governed, can be associated with other stimuli and contingencies to form complex networks of "frames" that elicit a pattern of behaviors to a given antecedent. The concepts brought up in Skinner's work are difficult to support entirely from an empirical standpoint and thus, other theories of learning sought to extend this seminal work.

Sidman and Tailby (1982) suggests a procedural approach in an effort to understand and change language and learning which he terms as *stimulus equivalence.* There are three main conditional relations in which this concept is identified by. The first demonstration is *reflexivity*, often referred to as "identity matching" (Sidman and Tailby, 1982; Sidman, 2000). In this concept, the stimulus is compared and related to others. When looking for a stimulus equivalent under this demonstration, one is essentially matching two identical items. In a match-to-sample task, if there are three objects (let's say a coin, key, and pencil), when given a coin, the person should be able to match the coin they were given to its identical counterpart in the field. If the coin is stimulus A, reflexivity would be matching A to A (sample coin to example coin). In order to test this relation to see if the person truly understands it as opposed to matching because of other features (i.e. matching round object to round object), a second concept is needed (Sidman and Tailby, 1982). This second demonstration is considered *symmetry* in which one stimulus serves as a comparison for a second stimulus. For example, when given a coin sitting at a slot machine, the coin (stimulus A) is supposed to go in the coin slot (stimulus B). Therefore, the coin and slot are related although they are not identical, that are equivalent. If the person was given a coin and they were able to match it to the coin slot, in order to test the generativity of understanding of that object and its stimulus equivalents, a third demonstration is necessary. This final demonstration is that of *transitivity*. Here, given the coin example, if the coin (A) is related to the slot (B), and the slot (B) is related to the activation of the game (C; i.e. lights and sounds), then the coin, is equivalent to playing the game. All of these properties need to be true in order to be called a "matching to sample" task (Sidman & Tailby, 1982). This concept is the basis of *conditional discrimination* where, based on a feature of an object, the person is able to discriminate its matching stimulus and/or function. In the prior example, a coin has been taught that it leads to gameplay. This concept has been used to teach discriminative abilities in identify different trees (Arntzen, Halstadtro, Wittner, & Kristiansen, 2014), the creation long term retention of equivalence classes while utilizing verbal descriptors (Rehfeldt & Hayes, 2000), the teaching and maintenance of discriminative skills using gustatory-visual equivalence with minimal reinforcement (Rehfeldt & Dixon, 2005), the generalization of newly trained relations with mental retardation (Rehfeldt & Root, 2004), and the altering of preferences in slot machines (Zlomke & Dixon, 2006; Hoon, Dymond, Jack, & Dixon 2008; Nastally, Dixon, & Jackson, 2010). Although stimulus equivalence may account for the creation of equivalence classes, the proposed functions of these relations deals more with nonarbitrary relations between stimuli. The transformation of stimulus function may account for the addictive qualities and behavior generation towards slot machines.

Relational frame theory (RFT) takes a functional contextual procedural approach, an extension of Sidman's *stimulus equivalence,* in an effort to help explain complex human behavior and how language/verbal behavior is formed. This theory works on the concept of "relational framing" which is when two things (i.e. items, people, pictures, events etc.) form a relationship based on arbitrary features (Hayes, Barnes-Holmes, & Roche, 2001; Vizcaino-Torres, Ruiz, Luciano, Lopez-Lopez, Barbero-Rubio, & Gil, 2015). Associating a smell with a memory, although both arbitrarily related as they have no distinct concrete similarities, can elicit one another. Another example would be the training of one colored slot machine to mean "more than" the other color (Zlomke & Dixon, 2006). Strictly speaking, color does not signify anything. The relationship only comes through experience or specific training of this concept. To form these relationships, a common method used is multiple exemplar training (MET). Here a stimulus, like a color, is compared against a variety of stimuli. Through feedback, an experimenter or practitioner can train relationships between these stimuli (Vizcaino-Torres et. al, 2015; Ruiz & Perete, 2015). Before moving into how this can relate to gambling and slot machines, let's first look at the various theoretical concepts first.

The first property of RFT is mutual entailment which states that if stimulus A is related to stimulus B, then B is related to A (Hayes, Barnes-Holmes, & Roche, 2001; Vizcaino-Torres, et. al, 2015). As an example, if a child sees a card that is solid yellow, then hears the word "yellow" from their parent, eventually, these two will relate to each other. If the parents asks the child to give them the yellow card, the word "yellow" is a discriminative stimulus to receptively grab the yellow card. Once they give the card to the parent and they ask them to tact the card, the child is expected to say, "Yellow." In this example, if the child does this successfully, they were able to relate the spoken word to the color itself (A-B) in their receptive task while relating the color to the spoken word (B – A) in her expressive task.

The second property is combinatorial entailment (Hayes, Barnes-Holmes, & Roche, 2001; Vizcaino-Torres, et. al 2015). Much like mutual entailment, stimulus A is related to stimulus B and vice versa (A ⇔ B). Now, it goes another step further – B is related to C. In this sense, it is like two mutual entailment frames put together. However, once this is learned a new function is derived. If A is related to B and B is related to C, then A and C are related. That relationship between A and C does not need to be taught directly. For the purposes of the previous example, stimulus A is the color itself while B is the spoken word. A third stimulus is introduced, the written word "yellow" on an index card. The parent now wants to teach the child the relation between the spoken word "yellow" and its written companion. When they say, "Give me yellow," the child is expected to grab the card that has the written word yellow on it. Again, they hold up the card and ask, "What does this say?" The child is expected to say yellow. There are now two mutually entailed relations that were taught – color ⇔ spoken word; spoken word ⇔ written word. Now, the parents place three colored cards out in a field – red, blue, and yellow. They hand the child the written word "yellow" and say, "match!" The child is expected to look at the card and match that card to the solid yellow card. If she does this correctly, A to C (i.e. color to written word) did not have to be trained, creating a mutual entailment of the two stimuli through combinatorial entailment.

The third property in RFT is the transformation of stimulus function, suggesting that the stimulus of a function that is mutually or combinatorial entailed can change the functions of the other stimuli in that frame without having to be directly training (Vizcaino-Torres et. al, 2015;

Barnes & Keenan, 1993). Using the previous examples of a yellow card, as well as the spoken and written word yellow, let's say that every time the child grabbed the yellow card when asked to do so, the parent tickled the child, which in this case, the child laughs and smiles. Now, every time the child hears or sees the word "yellow," he may ask for tickles if he didn't get any or anticipate in the form of laughing and watching the parent. Other examples include the formation of prejudice feelings towards people who may be labelled as "terrorists" (Dixon, Dymond, Rehfeldt, Roche, & Zlomke, 2003) or being afraid of a physical snake and any mention, sight of the word, spoken word, or picture of a snake (Vizcaino-Torres et. al 2015). This transformation of stimulus function is a potent concept that, through the training of contextual cues, can change effect the choices a person makes.

Zlomke & Dixon (2006) completed a study in which colors were taught as contextual cues for altering slot machine preference. They had 9 undergraduate students who were over 18 and have, in the past, played a slot machine in a casino setting and were exposed to a computer program created using Visual Basic 6.0. The participants were first presented with a slot-machine pretest on this program during which the participants were told to gain as many points as possible playing this game. The first screen presented two slot machines that were the same design and had the same probabilities of winning. The only difference was that one slot machine was yellow and the other was blue – their positions were switched to help control for a side bias. Once a choice was made, they were brought to a slot machine that had the same background color (yellow or blue) as the one the participant picked on the previous screen. When they pressed the "spin" button, a credit was subtracted from their cumulative bets and the wheels sun for roughly 3 seconds. If the participant won, two credits were added to their pool, and if they lost, the one credit that was bet would be removed. This continued for 50 trials and then the participant moved onto the conditional discrimination phase. During this phase, participants were presented with a sample stimulus – one of several stimuli related to gambling (i.e. money, playing cards, grades etc.). One stimuli was placed at the top of the screen and three stimuli were at the bottom, evenly spaced. Behind the example stimuli was a larger rectangle which was either a solid yellow or solid blue color. During the “less than” phase, if the blue rectangle was surrounding the sample stimuli, the correct response was to click the item that was less than the sample (i.e. sample stimulus as $10 would warrant the $5 dollar picture to be picked). During the “more than” phase, when the rectangle in the back was yellow, the participant had to choose the one that was more than the sample stimulus. During the mixed phase, both less than and more than colors and stimuli were present (as done so in the previous two phases) in random order. When correct, the word “correct” would appear in addition to a chime sound while an incorrect response a chord sound would play along with the word “wrong.” Participants did not advance to the next phase until they reached criterion (89% correct in block of 18 trials). Afterwards, there was a testing phases in which the same stimuli (as in the previous phases) were presented along with a new set of stimuli. The rules still applied – blue warrants a less than response while yellow a more than. This time, however, no feedback or points were given and it went on for 54 trials. Once the participants met criteria of 85% correct or better. They moved onto the final phase of the study which was identical to the first slot machine phase and were able to choose between the two colors.

Before relational training, no participant had a preference for one color over another. However, after the training, 8 of the 9 participants chose the slot machine that was yellow and trained as “more than” over the blue machine (Zlomke & Dixon, 2006). The results of this study suggest that the researchers were able to successfully alter slot machine color preference based on contextual cue training suggesting a successful transfer of stimulus function. The frame is as follows. In the first pre-test phase, the colors were associated with the slot machines. No training was done as to what each picture would represent, however the association between slot machines and the colors was established as something the participants could expect – a mutual entailment of slot machines to the color. During relational training, the color was associated with the stimuli examples as it was behind the multiple example stimuli. Choosing one of those stimuli was trained as being correct or incorrect. The relationship between the colors and whether or not they were "more than" or "less than" was not directly taught (i.e. no rule stating this relation) so the participant had to come in contact with the contingencies in order to figure out the rule. If colors (A) and stimuli (B) are related, then stimuli (B) and the feedback (C) were trained, the relationship between color (A) and feedback (C) were indirectly trained, showing a derived combinatorial entailment. When participants met mastery criteria for the relational training, the function of the colors were transformed by the feedback that was given – yellow now serves the function of being "more than" while blue as "less than." When returning to the posttest slot machine phase, the color of the machine choice has now transformed the function of that slot machine to represent more than or less than. During the initial slot machine exposure (baseline), responding was fairly even across all participants between yellow (49%) and blue (51%). The results of this study were successful in training this relationship based on transforming the function of the contextual cues – 89% of response allocation towards the yellow slot machine occurred after the relational training across all participants. All but one of the participants met criterion for the relational training of yellow as "more than" and blue as "less than." The   A "more than" outcome could be more desirable than the opposite thereby making it the more appealing choice. Regardless of which machine was picked, they both had the same reinforcement rate. Participant responding (i.e. the control over choice) was reinforced during the training on a fixed-ratio (FR) of one while the testing phase (i.e. moving onto the next phase) was set on a FR 54 (i.e. needed 54 correct trials to advance). This control was concrete as their choices did have an effect on the game. When moving to the slot machine, this may have also created a false sense of control. Previously, they had real control during the training and testing phases. When moving to the posttest, the stimuli (i.e. colors) were the same while the reinforcement (slot machine wins) was no longer directly associated with the choice of the participant thereby fostering a possible illusion of control with choices being intermittently reinforced resulting in one color being chosen over another. These results show that preference can be altered and that choice in slot machine can be controlled by training visual stimuli through the training and association of other comparison stimuli (i.e. money, gaming chips etc.).

Hoon et. al (2008) suggested that the Zlomke & Dixon (2006) presentation of multiple comparison stimuli might have accidentally trained the "more than" to be equivalent to an opposite cue. This was cause for concern as Hoon et al (2008) brought to attention that the participants might not have learned all the correct pairings of the stimuli. The example given was if a $5 dollar bill was presented with a $1, $10, and $20 bill with a contextual cue as yellow (meaning more than), then technically, there are two correct answers – the $10 and $20 dollar bill. Because of this, they speculate that the participant would thus choose the $20 bill every time in this scenario while the glossing over the relation that the $10 bill is also considered "more than." This is a valid observation as the relationship, in this scenario, is only being trained to one particular stimuli and not being generalized to the other, correct stimuli – which may create a bias in responding when there are other correct answers.

As a result, Hoon et. al (2008) intended to replicate the study while also including a few procedural changes. The first change was that there would only be two comparison stimuli and the second, of introducing a mixed format on the outset of the experiment – which could control for an order effect. The participants were also given the South Oaks Gambling Screen (SOGS) to pre-screen for possible pathological gambling tendencies. The slot machine pre-test was Identical to the Zlomke & Dixon (2006) study. Once this phase was completed, relational training and testing were implemented, however, instead of a colored rectangle behind the sample stimuli, the form background on the screen of the program screen was either yellow or blue. Then only two pictures, no sample stimuli, were presented at a time with the background screen color. The stimuli were randomly chosen from eight sets of picture associated with gambling and had three items in each category (i.e. dice – 1, 4, 6; playing cards – 4, 9, king etc.). Again, when the background color on the screen was yellow the participant had to pick the item that was either "more than" (yellow) or "less than" (blue). When the participant received a correct response, the word "correct" would appear on the screen while the incorrect one was met with the word "wrong" on the screen. Participants had to meet a designated criteria for this training which set at 43 correct responses out of 48 possible responses. Like the Zlomke & Dixon (2006) article, if criteria was not met, the participants went through the block again. If they did meet criteria, however, they went onto a testing phase. This was exactly like the training phase with the exception that feedback was not given for correct responses and a strict criteria was set at 48 correct trials out of 48 possible, as suggested by Zlomke and Dixon (2006), in order to clearly establish the relations between the colors and their taught cues of more than and less than. Once this phase was completed, a post test phase with the slot machines, identical to the pre-test, was completed. The results of the study replicated those of Zlomke & Dixon (2006) in that more people chose the yellow "more than" slot machine in the posttest over the blue slot machine.

This was another example of a transformation of stimulus function that altered the preferences for one slot machine over another. However, this procedure was not completed with those who are pathological gamblers. This is a necessary extension as pathological gamblers, or even potential to pathological gamblers, are more able to read the volatility of a game than those who are not pathological gamblers (Coates & Blaszczynski, 2014).

Nastally et. al (2010) sought extended the literature of this area of research by including study of pathological gamblers and adapting some of the procedures utilized in previous studies. Like that of Hoon et. al (2008), participants were tested on their SOGS scores and the result was two groups of seven people with one group being pathological gambling group and the other as the non-pathological gambling group. All programing for the study was created using the newest version of Microsoft Visual Basic available (which was the 2010 version). All slot machine phases (baseline, posttest 1 and posttest 2) were identical. This slot machine phase was similar to the one Hoon et. al (2008) as well as Zlomke and Dixon (2006) utilized with the exception that the amount of trials each participant went through (either 50, 70, or 90) was randomly determined prior to beginning this phase. Once their trial set was completed, participants moved onto the nonarbitrary relational training phase. This phase was a similar to that of Hoon et. al (2008), including stimuli used, with the extensions that based on the preferences of the slot machine pretest, that the opposite of the one chosen most (i.e. 70% or above response allocation in pretest) was utilized – if there was no preference chosen, one was randomly assigned. The procedure for choosing the “more than” or “less than” response was identical to Hoon et. al (2008). After criteria was met (43 correct responses out of 48 total), they moved onto the testing phase with the adaptation that the previous taught stimuli were not added in and 4 novel sets of stimuli were used as well as the same mastery criteria (43 out of 48) was expected to advance.

During the slot machine task posttest 1, participants were re-exposed to the same slot machine seen in pretest. They were able to continue with the test if they chose the “greater than” slot machine more than baseline or were excused from the experiment if they choose it less than (Nastally et. al, 2010). Once completed, the second nonarbitrary training and testing phases was implemented only the color for “greater than” was opposite from the one that was trained in the first one. Once again, when criteria was met, they oved onto the posttest which was identical to the first slot machine posttest. Results of the study showed that the non-problem gambling group were able to meet criterion for relational training faster and showed a clear preference shift based on the trainings than those in the problem gambling group. Of note, all of the people from the non-gambling group made it to the second slot machine posttest while only 4 of the gambling group advanced to that level.

There was an observable difference between the groups in terms of the amount of training it took to pass the first relational training and testing phase. Another important observation of their results was that not everyone in the non-gambling group made it to the posttest. This may suggest that those who did not make it, out of the group that was more exposed to and prone to gamble pathologically, might have allocated their responses based on an illusion of control and the gambler’s fallacy. For example, if in the pre-test for one of the gambling group participants showed a preference towards the blue machine in the pretest, then during the relational training, the yellow would be trained as “more than.” Moving to the posttest 1, where choosing the yellow machine is the correct answer, those who did not make did not meet the criterion and as a result, reverted back to the machine they had chosen during pretest. As in gambler’s fallacy and its illusion of control, it can be speculated that their prior history with this task associated, at least to some extent, wins with their preferred pretest stimuli and had interfered the learning of a new relational frame. Further analysis of this data or future studies would benefit from replicating the current study and analyzing this concept in terms of "winning streaks" much like how Cowley, et. al (2015) did. Their results indicated that those with a higher illusion of control were more likely to continue picking a similar choice during a coin toss task, supporting a selective attention hypothesis (MacLellan, Shore, & Milliken, 2015; Skinner, 1953) where the participant willingly focusses on only the positive outcomes of their own responding. The concept of "willingness" cannot not necessarily be described in behavior terms as it happens within the skin of the person and can be deemed as a "private event." In light of this, the previous studies (Zlomke & Dixon, 2006; Hoon et. al, 2008; Nastally et. al, 2010) suggested that in order to gain a better idea at why a choice was made during their procedures, and analysis of verbal behavior would be a useful tool in explaining the results. Suggestions have included a questionnaire after completion of the study or a "talk-aloud" procedure during the study itself (Zlomke & Dixon, 2006; Nastally et. al, 2010). Both of these studies could, as suggested, benefit from a verbal analysis of response allocation. In gambling research, where in natural setting observations present difficult procedural and ethical challenges (Brandt & Pietras, 2008).

Skinner (1957) went on to refine his definition of verbal behavior to include the concept that both the speaker and the listener can be within the same skin. In a later work, he also states that "when a man controls himself, choses a course of action, thinks out the solution to a problem, or strives towards self-knowledge, he is behaving" (Skinner, 1953, pp. 228). These two ideas are suggesting that behaving happen both overtly (outside of the body; publicly observable) and covertly (inside the body termed as a private event; only privately observable). This presents a methodological problem for the behavior analytic research community as private events are not directly observable and thus, have not held much attention in the field which is contrary to the cognitive psychology community whom capitalize on self-report measures, which are methodologically flawed as people can lie. Despite the limitations, these private events can help to understand why people are behaving the way in which they do. Watson, a founding father of behaviorism, creating a "think-aloud" task with his subjects in order to analyze that overt behavior as speaking aloud can publically observed (Hayes, White, & Bisset, 1998). When referring to winning and losing streaks, assumptions can be drawn by the objective win/loss ratio and how that person behaves, but a piece is missing as to what self-rules those participants are generating that either support illusion of control and gambling fallacy theories. Without an objective way to analyze vocalized self-rules, measures of pure self-report may lead to inaccurate results. There is clear practicality of operationalizing the variables associated with vocalized self-rule generation (Chambers & Rehfeldt, 2003).

Hayes et. al (1998) created an attempt to formalize (extending the work of Ericsson and Simon, 1993) a way of analyzing vocalized reports of a participant in a study. They termed this procedural task analysis as the "silent dog" method in reference to the Sherlock Holmes mystery called "Silver Blaze" as the vocalization, or lack thereof, of a dog in the story helped to solve a murder (Hayes, et al, 1998). There are three controls in this method that classify talk-aloud procedures as valid (referred to as *controls*) as being rule-governed. The first control refers to the performance and the talk-aloud procedures being functionally equivalent; the self-rule and the task must relate to each other. The second control dictates that the behavior must change if the self-rule does as well. The third and final control states that if the rule is said in the presence of another person, that person will alter their task performance based on that external rule. If all three of these controls are utilized, then the vocalization can be deemed functional self-rules. Arntzen, Halstadtro, and Halstadtro (2009) completed a talk-aloud procedure under the controls of the “silent dog” in which they were able to teach two boys, diagnosed with an autism spectrum disorder, new computer skills through a taught self-instruction procedure. One boy was able to learn the skills by self-instruction while the other learned from the first boy’s self-talk [about the rules learned in the first study]. Faloon and Rehfeldt (2008) were able to establish self-rules with participants who had been diagnosed with a mild developmental disability to learn a daily living skill with little experimenter-generated reinforcement. The results suggest that, with little external reinforcement, the responses may be attributed to the effects of the generated self-rules. Rules can be followed by overtly observing other’s self-rules or by deriving them in the individual based off of contingencies they come in contact with (both reinforcing and punishing) (Faloon & Rehfeldt, 2008). However, the vocalization of self-rules as it relates to gambling, especially slot machines, has seldom been researched.

Wilson and Dixon (2015), in an effort to observe how self-rules are created prior to a performance, completed a conditional discrimination study in terms of teaching a verbal tact in which the participants would then follow. Their study, unlike Zlomke and Dixon (2006) or Hoon et. al (2008), utilized a multiple baseline across participants with each of their 6 participants being randomly assigned to a varying amount of gambling time (10, 12, and 14 minutes of gambling). The participants were seated in front of a working slot machine (not a computer program simulated one) with the payout rate covered up by three arbitrary symbols with the experimenter pointing to them as they explain this to the participant. First, they were given a worksheet to which they were instructed to write down, next to each symbol (identical to those that covered the payout rates) what they thought it meant. They were then given a multiple choice worksheet where they had to circle the word they thought belonged to each symbol. When this was completed, they then were able to choose one of two coins (red or silver) and were able to play for the designated amount of time dictated by which leg of the multiple baseline they were in – 10, 12, or 14 minutes. Once this was completed, they then moved onto a conditional discrimination training procedure. This procedure was similar to the aforementioned studies in that there was one sample stimulus (on the left side) and three sample stimuli (on the right). They were instructed to pick the one that related to the sample stimulus and pay close attention because, like previous studies (Zlomke & Dixon, 2006; Hoon et. al, 2008), those symbols would have a greater meaning later. Based on the slot machine pretest, the allocation of red versus silver coins played a role in the training. Whichever coin was used less during this time, the word associated with that coin was used in the training. Once the participant met mastery criteria for each of their six equivalence phases (i.e. A-B, B-C, Intermixed, equivalence relations for the final 3 phases), they moved onto a slot machine posttest. This was identical to the pretest with the major dependent variable being response allocation between the red or silver coins. Results of the study showed that the trained color, which was previously the lowest used in the slot pretests, was now used more often in the post test and the rule was explicitly state by the participant (i.e. "play red/silver coins"). The rules that were taught were never explicitly trained yet the participants were able to derive them. Much like how a transformation of stimulus function seen in previous studies (Zlomke & Dixon, 2006; Hoon et. al, 2008), the color [coins] was trained and created a preferential bias towards that stimulus. What's more, these rules were derived then explicitly state by the participants themselves – a successful creation of a derived self-rule.

To the knowledge of this study, specifically looking at how self-rule generation affects slot machine preference has not been completed. Given the success of prior conditional discrimination studies to alter slot machine preference (Zlomke & Dixon, 2006; Hoon et. al, 2008; Nastally et. al, 2010) the current study will first seek to extend the literature on altering these preferences through relational training using arbitrary stimuli instead of colors (like those used in Wilson & Dixon, 2015). This study will also observe and analyze the effects of self-rule generation on slot machine preference based on a variety of applicable categories statement categories.

CHAPTER 2

METHODS

Participants

There were 5 participants (4 male, 1 female) recruited from personal contacts in a large Midwestern city. Participants' ages ranged from 24-28 (M= 25.6), 3 identified as white, 2 as Hispanic, had education levels from high school to doctorate/professional degree, and had a salary range between $30,000 and over $70,000. Each participant was given the South Oaks Gambling Screen (SOGS) prior to beginning the study. Scores ranged from 0 to 3 (participant 3 was the only one who had a score above 0; scored a 3).

Apparatus and data collection/scoring

Each participant worked on an ASUS touchscreen laptop computer with a mouse (participant could have chosen between using the mouse or touchscreen) provided to them with the experiment programmed in Visual Basic 2013. This program controlled all presentations of stimuli in each phase (slot machine game and relational training/testing phases). During completion of the study, the on-screen choices were recorded via Xbox DVR while vocalizations were recorded using the Voice Recorder app on Windows 10. Additionally, an experimenter recorded slot machine choice, win, and brief vocalized statements made during each of the three slot machine phases.

For verbal reports during the study, each utterance was placed under one of 6 categories. *More/Less* referred to any statement that was related to how one picture meant more and one picture meant less. *Win/Loss* referred to any statement that mentioned the winning rate of one picture over another or statements that mentioned a "winning streak." *Pattern* was associated with statements in which the participant talked about choosing an item in some sort of pattern (i.e. a winning pattern, back and forth, switch every 2, etc.). *Side bias* referred to statements in which the participants said they chose a particular slot machine based on its location (left or right) on the screen. *Likes pic* refers to statements associated with the participant choosing a particular slot machine based on liking the way a picture looked. *Other* referred to any statement that did not fall under the previous 5 categories. Each statement counted as 1. If a trial had no statements, then nothing was counted for that trial. A total tally for each category was completed and plotted in a table (see tables 1 – 6).

Procedure

Slot-machine task (baseline). This phase and its procedures were similar to Hoon et. al (2008) with three notable exceptions (see figure 2); the design was different, winning combinations received a chimes sound while losing received chord sound in addition to a panel which had typed "!!! WIN !!!" or "Try Again" labels on them, and when "SPIN" was pressed, it automatically bet 1 credit and the "STOP" button to stop the reels from spinning. When the participant sat in front of the computer, they were presented with two slot machines (see figure 1), each having a different arbitrary symbol on top of them. The symbols switched places randomly after each win/loss response from the program throughout the duration of this phase. The participants were able to pick either by clicking (or touching) the arbitrary picture or the slot machine under it. After their choice, the options disappeared and a slot machine was presented without the arbitrary stimuli. The participants were instructed to click (or touch) the "SPIN" button which would be replaced by a "STOP" button and the reels of the slot-machine rotated between symbols. The participants pressed "STOP" when they pleased to which the reels would cease moving and present either a winning or losing combination. If it was a win, the chimes sound played and the "!!! WIN !!!" panel appeared. If it was a loss, the "Try Again" panel would appear. The panels covered the buttons and winnings for 10 seconds to which the original slot machine choice panel would reappear. Reinforcement was set on a .5 concurrent random-ratio schedule (random ratio referred to as RR for continuation of this paper) with winnings held at the same magnitude (one credit net gain or loss). All participants started and ended the pretest with same amount of credits. The participant did this procedure for 50 trials and then moved onto the next phase.

Relational training and testing part one. This phase was a replication of Hoon et. al (2008) where contextual cures for both slot machines were trained – picture 1 as "more than" and picture 2 as "less than." Stimuli were set in U.S. currency, as opposed to U.K. currency used in Hoon et al. (2008). There were eight sets stimuli, each containing three pictures associated with gambling: U.S. currency notes ($1, $5, $100), dice (1, 4, 6), poker chips ($5, $50, $100), letter grades (F, C, A), coins (1 penny, 1 dime, 1 quarter), jackpots ($10, $5000, $20,000), playing cards (2, 9 and King of spades), and places in competition (10th, 5th, 1st). Participants were first trained on 4 sets of stimuli (U.S. currency notes, dice, letter grades, and places in competition) and then tested on the remaining four novel stimuli sets (coins, jackpots, playing cards, poker chips). Unlike the procedures completed in Hoon et al. (2008), but suggested by them as a possible future study, the participants were instructed to explain, out loud, why they responded the way they did. These responses were video recorded which would save their vocal responses while focusing on the computer screen so as to later compare what vocal responses were associated with which trial.

When training the first four sets of stimuli, first picture 1 or 2 (i.e. the pictures of the slot-machines in the pretest) preceded two comparison stimuli (i.e. $1 and $100) presented next to each other on the lower half of the screen and were instructed to choose the correct stimuli. An additional modification of the Hoon et. al (2008) study, was that feedback was given in the form of an audio file saying "correct" or "wrong." Picture 1 was taught as "more than" and as a result, when that symbol appeared, the correct answer would be to click the stimuli that is more than the other (i.e. $100 is more than $1) and thus, was reinforced with the "correct" audio file. When picture 2 appeared, the participant had to choose the "less than" stimulus (i.e. F is less than/worse than A in letter grades) and was subsequently reinforced with a "correct" audio file. Any stimuli chosen that were not correct received a "wrong" audio file. The "correct" and "wrong" audio files were followed by a 2.5 second intertrial period where no stimuli were presented and a blank screen was shown. In order to go onto the testing phase of the relational training, the participants had to get 43 or 48 consecutive trials correct. Once this criterion was met, they immediately moved onto the training phase – if not, they were re-presented with the training until they met criterion.

The four remaining novel sets of stimuli were then presented interspersed with the previously trained stimuli with the stipulation that no more than two types of stimuli were presented consecutively (trained stimuli versus novel). During this phase, no feedback was given for any response and the participants were instructed to quickly explain their response, identical to the training phase. Again, a blank screen appeared during the intertrial period for 2.5 seconds. As suggested in Hoon et al. (2008) a stringent criteria of getting 48 consecutive trials correct was in place in order to clearly establish relations between the arbitrary pictures and the contextual cues of "more than" and "less than." Once this criteria was met, the participant moved onto the second slot machine phase (referred to as slot 1). If not, the participant was sent back through the training followed by the testing until they reached the necessary criterion.

Slot machine posttest 1 (slot 1). As in the pretest, the participants were represented with a combination of any two slot machines with either picture 1 or 2 above them and were able to pick the one they desired. Once the participant saw their win or loss, they were instructed (via the win/loss panel) to say why they chose that slot machine. All responses were logged via the experimenter, vocal responses recorded with the voice recording Windows 10 application, and after the 50 total trials of the Slot 1 phase, the participant continued onto the second phase of relational training.

Relational training part two/testing and slot machine posttest 2 (slot 2). The procedures are identical to relational training part one. The only difference was that picture 2 was now trained as "more than" and picture 1 as "less than." Once the participant met criterion for both training and testing, they moved onto an identical slot machine phase (referred to as slot 2) with all responses logged via the experimenter, and vocal responses recorded with the voice recording Windows 10 application. Once they were completed with this phase, they were free to go.

Variable for error correction. For all relational training phases, if the participant did not meet criteria after the 4th attempt during training, the participant then received an error correction procedure by the experimenter consisting of asking why they were choosing which symbol. No correct answers were given to the participant by the experimenter.

CHAPTER 3

RESULTS

Participants 1 and 2 met criterion for both relational testing/training phases on the first attempt. Participants 3 and 4 failed the discrimination training phase (i.e. did not pass training on first 4 attempts) and as a result, experimenter provided the error correction procedure. After error correction procedure, participant 3 met criterion after 2 more attempts while participant 4 met criterion after 3 more attempts. Participant 5 went through two tries each of the testing phases in relational training/testing 1 and relation training/testing 2.

Figure 5 is the total percentage of response allocation for picture 1. Participants 1, 3, and 4 allocated more of their responses to picture 1 after the first relational training phase when compared to baseline. Participants 2 and 5 responded favorable to picture 2 after the relational training phases. Figures 6 – 10 depict the cumulative selection of each participant for each picture throughout all the phases. Tables 1 – 5 are a graphic representation of the total amount of vocal responses and which category they fell in to. Participants 1, 3, and 4 picked the first picture trained as "more than" during the first slot phase more than they chose it during baseline (see figure 5). Participants 1 and 5 chose picture 2 trained as "more than" more than baseline following the relational training/testing 2 phase (figure 5). Of note, participant 5 chose only picture 2 during the second slot machine phase (figure 5 and figure 10) which is correlated with the amount of *pic bias* statements (table 5) emitted.

For the verbal responses to the slot machines, participant 1 said the most statements as to why they picked the picture they did due to *pattern* (23 statements; table 1). Participant 2 said 13 statements for both the *win/loss* and *pic bias* categories, the most out of the 6 possible categories (table 2). Participant 3 said 9 statements related to the *win/loss* category accounting for the most statements out of the 6 categories (table 3). Participant 4 said the most statements (9) in the categories of *win/loss*, *pattern,* and *other* (table 4). The most statements uttered in any one category for participant 5 fell in the *pic bias* category (22 statements; table 5).

CHAPTER 4

DISCUSSION

The current study did not support the results of previous studies (Zlomke & Dixon, 2006; Hoon et. al, 2008; Nastally, et. al 2010; Wilson & Dixon, 2015) to the extent at which they were observed. Participants 3 and 4 needed experimenter aid in order to advance to the next phases in the study. The error correction procedure was successful in getting them to meet criterion. Participant 4 did show a noticeable change in their cumulative selection (see figure 9) between baseline and slot 1 phases. In baseline, there was an equal distribution of response allocation between picture 1 and picture 2 where picture 1 was trained as “more than.” During the reversal training, the responding for picture 1 did go down while picture 2 increase suggesting that the training may have been successful. When looking at the verbal responses (table 4), they had an even distribution between statements relating to win/loss, pattern, and other. In this case, it could be argued that the relational training had transformed the stimulus function of the picture to mean more than. Their increase in these statements is related to their performance on these tasks supporting a gamblers fallacy and illusion of control theory.

Participant 1 began baseline with a fairly even cumulative selection between both pictures (figure 6). After the first relational training, his responses for picture 1 increased to rates above baseline, showing that relational training may have been successful in changing his responses. When looking at the vocal response by statement (table 1), his statements were mainly related to side bias and pattern. Further examination in future studies would benefit from analyzing response allocation related to patterns compared to picture selection. Regardless, this participant’s data are in support of Zlomke and Dixon (2006) and Nastally, Dixon, and Jackson (2010) showing that the relational training had an effect on altering their preference between the baseline and slot 1. During the second set of training the slot 2, response allocation between the two pictures reverted closer to that of baseline.

Participant 2 had a fairly even distribution of vocal responding across statements when compared to the other participants. This verbal responding was related to their slot machine response allocation in that they started with choosing the picture trained as “more than” until that picture came in contact with losing contingencies and their preference switched to the other picture. This switch was then intermittently reinforced by the win/loss probability ratio of the computer program during slot 1. This preference may have interfered with the second training phase as the first picture continued to be chosen more.

Participant 3, who was the only participant to receive a SOGS score indicating possible pathological gambling habits, showed that training did not work for them as the results were almost inverse of what was expected. When looking at his cumulative record (figure 8), between baseline and the slot 1 phase, they had similar rates of responding. This result is consistent with similar results observed in Nastally et. al (2010) when some of the pathological gambling participants, did not pass the first post-test due to reverting back to baseline (i.e. generally sticking with that they chose before). These results can be, as stated previously, be a result of the gambler’s fallacy and its illusion of control. This conclusion is also supported by his verbal reports with statements relating to win/loss as his most prominent vocal response suggesting that he may have been more susceptible to sticking with the same picture based on winning streak.

Although participant 4 received the error correction procedure, they still met criterion and continued onto the next phases. Their response allocation supported previous studies in being able to alter a lot machine preferences (Zlomke & Dixon, 2006; Hoon et. al, 2008; Nastally et. al, 2010) and then, through a reversal training, alter the preference again (Nastally et. al, 2010). The only difference between this participant and others (excluding participant 3) was that they received the error correction procedure and then proceeded to be exposed to the training and testing more. Similar to participant 3, this extended exposure may have resulted in solidifying the relationship between the pictures and their trained contexts.

Participant 5 (table 5 and figure 10) began choosing one picture then remained at that picture. Their verbal statements are in support of this claim of picture bias. Here, their state self-rule was that she liked picture 2 over the other one and remained with the picture during baseline and slot 1. When the second round of relational training occurred, their preferred picture was now trained as "more than." As a result, she has said a statement relating to how her picture bias was now being reinforced and was excited every time she won and glanced over the times she lost, avoiding the contingencies she was coming in contact with through a selective attention paradigm; only focusing on one picture.

CHAPTER 5

CONCLUSION, LIMITATIONS, AND RECOMMENDATIONS

Every participant emitted statements related to the “gambler’s fallacy” in terms of and “illusion of control.” With the expectation of participant 1, the statements relating to win/loss were either the first or second most frequent statement class they emitted, support the illusion of control idea. This is also evidenced by their cumulative responses as participants 1 and 3 began responding favorably in slot 1 (i.e. picture 1 as it was trained as “more than”) but as they came in contact with the contingencies that picture 2 was not winning as many times as they may have liked, they began to switch their responding.to another picture, again, trying to find a patter than was related win/loss. A difference that might have changed the results from previous studies was that the participant was able to both spin and stop the reel. By pressing the “STOP” button, it can be argue that there is a perceived element of control. The variety of patterns that some of the participants thought they were coming in contact with, under this perceived illusion of control, may also be attributed to superstitious behaviors (Delfabbro, 2004). Participants 1, 2, and 4 all had their highest frequency statements related to those of patterns in the winning. Their behaviors may have been intermittently reinforced at times with their response topography having nothing to do with their win or loss outcomes. This skill, as seen in previous research (Zlomke & Dixon, 2006; Hoon et. al, 2008; Nastally et. al, 2010; Wilson & Dixon, 2015) trained as the “more than” stimulus might have generalized to the slot machine training. Serving as a function of “more than,” the pictures in the respective trainings and the response allocation to pick this trained topic could support the concept of the illusion of control. Again, regardless of their preference and ultimate choice, the slot machine still have an even ratio or wins versus losses. So their response allocation did not have any effect on the probability of winning, yet, at times, it was still chosen.

This study had several limitations to take note of. First and foremost, the sample size was small very homogenous in terms of demographics (i.e. race, sex, education level etc.) and in SOGS scores (only one person might have been at risk/show tendencies towards pathological gambling). Future research would benefit from having a larger sample size with participants who have varying pathological gambling tendencies and taken from a broader range of demographics. A second limitation of the study was the lack of prompting for the talk aloud procedure. This may be due to an extinction of this vocal responding. There was no overt prompting to get people to speak and they were able to advance to the next trial even when they did not vocally respond (i.e. explain their slot machine choice). In addition, there was no reinforcement given from the program or experimenter on a consistent basis (i.e. FR1 schedule) for responding. Before of these lack of reinforcement opportunities, the study suspect that this type of responding was inadvertently put on extinction. Future research intending to extend this current study would benefit from the procedures described in Rehfeldt and Hayes (2000) in terms of a training session to socialize the participants into speaking during every trial, then reminded and prompted to speak constantly. A third limitation was that the participants were not playing for any concrete rewards such as varying amounts of money, school credit, or number of entries into a lottery to win a large prize. By increasing the stakes, it may create more of a naturalistic environment to that of a casino where one has the opportunity to win and lose real money or incentives. When there is no incentive, the trials may seem arbitrary and the responding may not be indicative of what they actually would do when incentives were present. The final limitation of the study was related to the level of analyses completed. There was no inter-observer agree taken for the vocal response data and the analyses for this could benefit from a deeper examination comparing vocal responses to the win/loss level. An analysis like that done in Cowley et. al (2015) analyzing the responses people made could shed light on relationships between vocal responses (response reasoning), physical responses (clicking the preferred slot machine), and probability outcomes as previously suggested by Zlomke and Dixon (2006) as it related to response patterns. Future studies would also benefit from altering the probabilities of the slot machine choice to observe the participants' sensitivity to the volatility (payback rate) as it correlates to their relational training.

Every human being has a lifetime of behaviors in which they interact with various contingencies, shaping the way one reacts to stimuli and environmental factors (Stockwell & Moran, 2014), either directly taught or derived, which allow people to conditionally discriminate between various stimuli and expectations. This study was, to the knowledge of the experimenter, one of the first to take the suggestion of Zlomke and Dixon (2006) to add a verbal analysis of response allocation emitted by the participant. Although the results did not exactly replicate those of previous studies (Zlomke & Dixon, 2006; Hoon et. al, 2008; Nastally et. al, 2010; Wilson & Dixon, 2015), it did raise questions for future researchers to examine more thoroughly the use of a talk-aloud procedure in this type of conditional discrimination study. This study was an initial step into a behaviorally complex concept in an effort to observe the verbal behavior of its participants as they responded to the on-screen stimuli.

Table 1

Total vocal response by statement during slot machine phases.

Phase	More/Less	Win/Loss	Pattern	Side Bias	Pic Bias	Other
Baseline	0	0	0	0	1	0
Slot 1	3	0	3	10	1	1
Slot 2	0	1	20	1	1	1
Total	3	1	23	11	3	2

Note. This table depicts the total of each self-rule statements for participant 1 across all slot machine phases. See methods section for complete details.

Table 2

Total vocal response by statement during slot machine phases.

Phase	More/Less	Win/Loss	Pattern	Side Bias	Pic Bias	Other
Baseline	0	0	0	0	0	0
Slot 1	6	3	5	0	8	0
Slot 2	2	5	8	0	5	1
Total	8	8	13	0	13	1

Note. This table depicts the total of each self-rule statements for participant 2 across all slot machine phases. See methods section for complete details.

Table 3

Total vocal response by statement during slot machine phases.

Phase	More/Less	Win/Loss	Pattern	Side Bias	Pic Bias	Other
Baseline	0	0	0	0	1	0
Slot 1	0	8	2	2	0	0
Slot 2	2	1	4	0	1	0
Total	2	9	6	2	2	0

Note. This table depicts the total of each self-rule statements for participant 3 across all slot machine phases. See methods section for complete details.

Table 4

Total vocal response by statement during slot machine phases.

Phase	More/Less	Win/Loss	Pattern	Side Bias	Pic Bias	Other
Baseline	0	0	0	0	0	0
Slot 1	1	8	3	0	0	5
Slot 2	2	1	6	0	0	4
Total	3	9	9	0	0	9

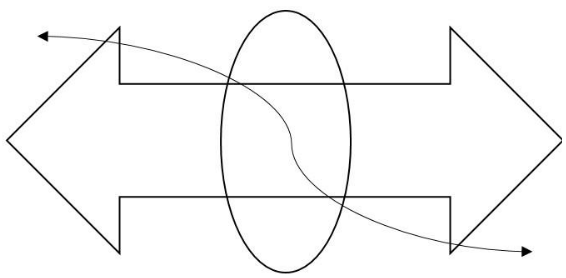
Note. This table depicts the total of each self-rule statements for participant 4 across all slot machine phases. See methods section for complete details.

Table 5

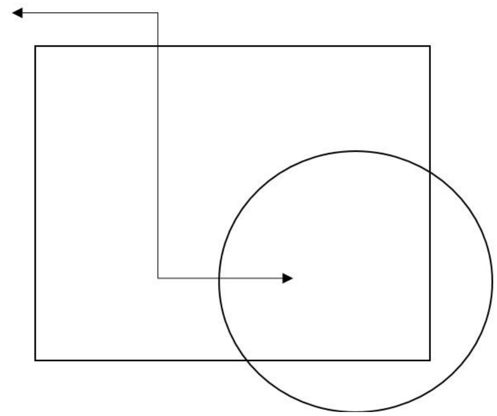
Total vocal response by statement during slot machine phases.

Phase	More/Less	Win/Loss	Pattern	Side Bias	Pic Bias	Other
Baseline	1	0	1	2	1	2
Slot 1	0	3	1	9	15	2
Slot 2	0	2	0	0	6	2
Total	1	5	2	11	22	6

Note. This table depicts the total of each self-rule statements for participant 5 across all slot machine phases. See methods section for complete details.



Picture 1



Picture 2

Figure 1. Arbitrary pictures. This figure depicts how these pictures will be referred to during this entire article.

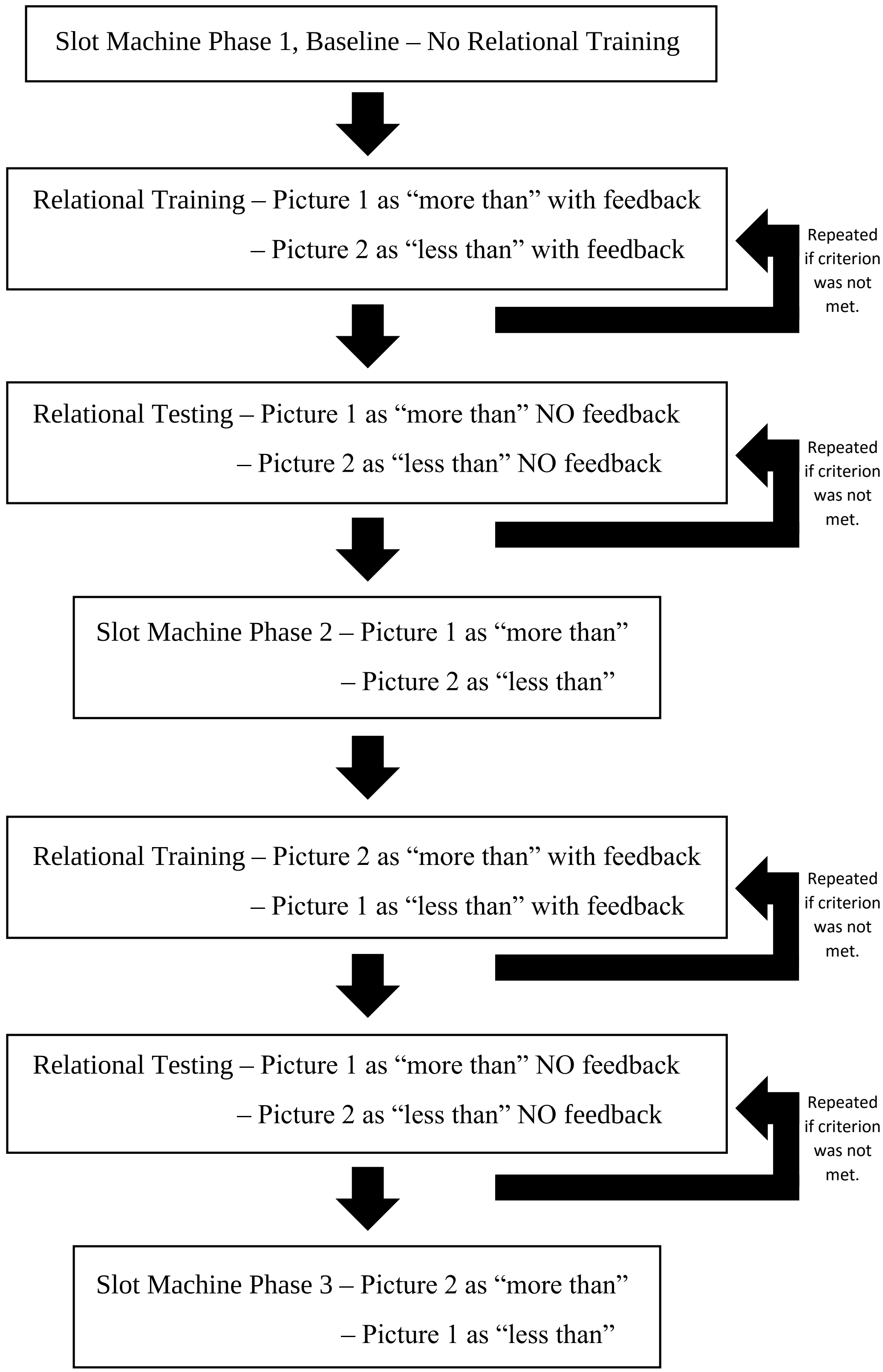


Figure 2. Study procedural flow chart. Visual representation of the study procedures.

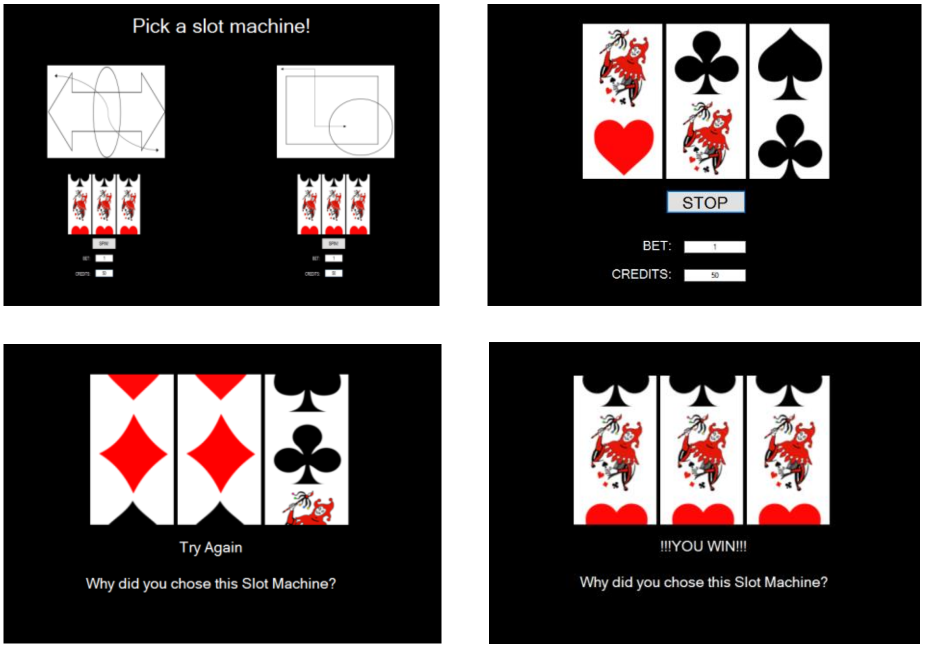


Figure 3. Screenshot of slot machine aplication view. This figure depicts the screenshots of what slot machine phase looked like. The participant was shown a screen with two slot choices (top left). Once they picked an option, they were showed a slot machine where they clicked “spin” and “stop” (top right). If they lost, a “chord.wav” file was played along with the message (during slot phase 1, there was no, “Why did you choose this machine?” script) (bottom right). If they won, a “chimes.wav” file was played along with the message (during slot phase 1, there was no, “Why did you choose this machine?” script) (bottom left). After 10 seconds, the choice screen (top right) popped up again and the trials continued.

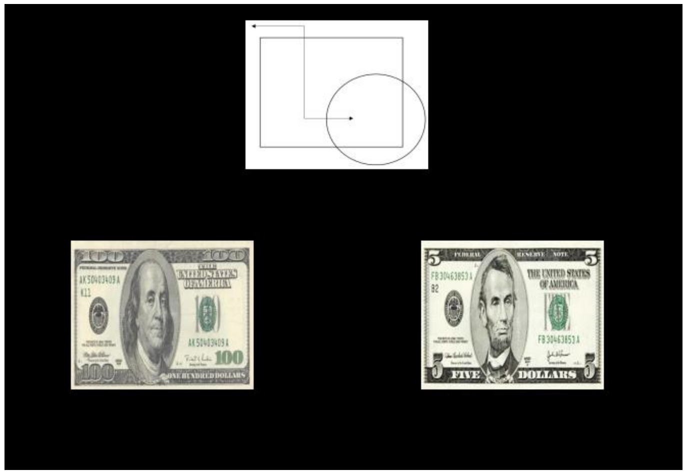


Figure 4. Screenshot of relational training. This is a screenshot of what each relational training phase looked like for the participant. When the participants were presented with picture 1 in relational training and testing phase 1, they had to click on the picture that was more than/greater than/better than the other picture. During relational testing and training phase 2, picture 2 was trained as more than/greater than/better than. During testing phases, correct answers were met with a blank screen and the .wav file of "correct" – incorrect responses were met with the .wav file "wrong." Testing phases received no feedback.

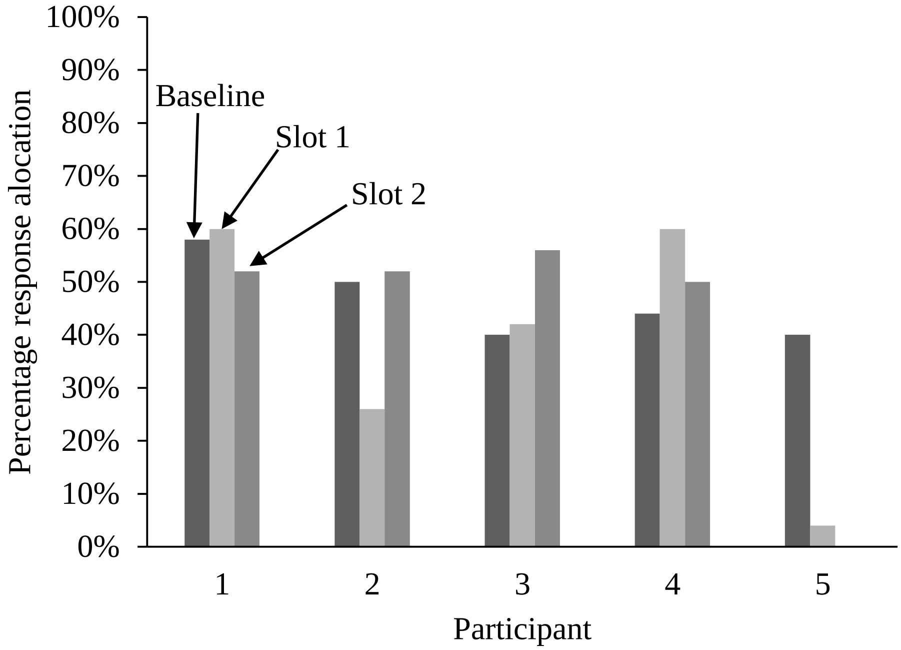


Figure 5. Percentage of response allocation charts. This figure depicts percentage of response allocation for picture 1 with each participant between baseline, slot 1, and 2.

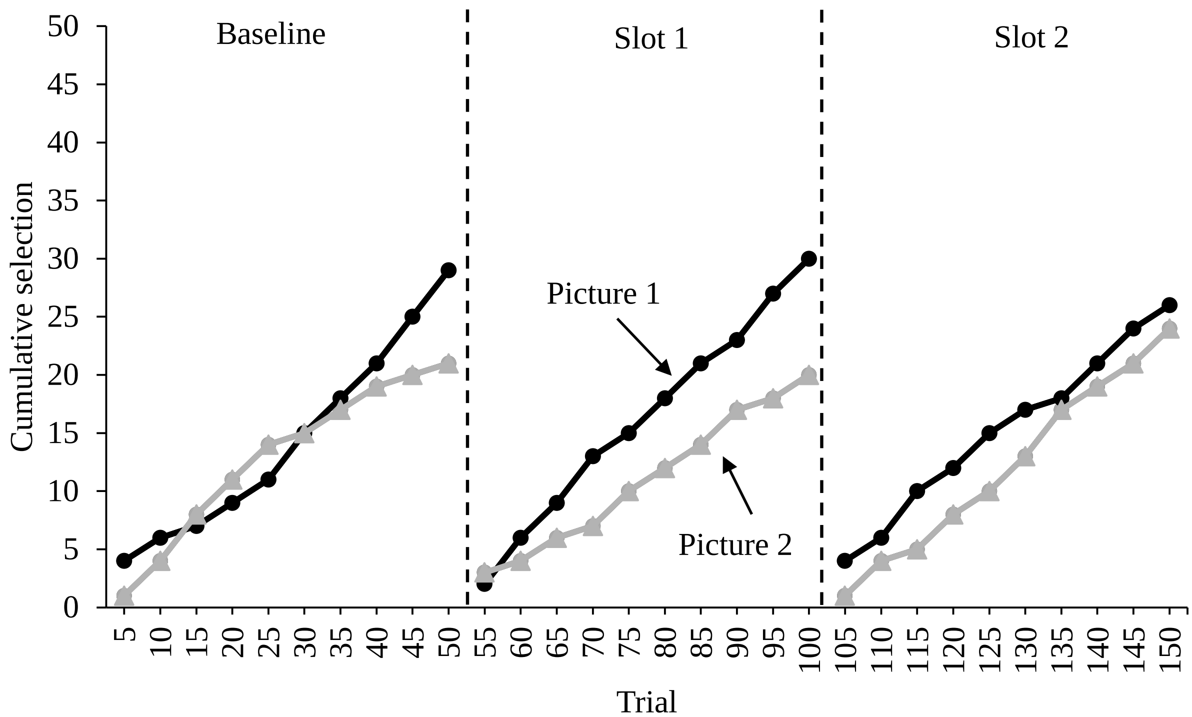


Figure 6. Participant 1 cumulative selection graph**.** This figure depicts the cumulative selection of picture 1 and 2 for participant 1 across all slot machine phases. This is a collapsing of the data with points noted at every 5 trials.

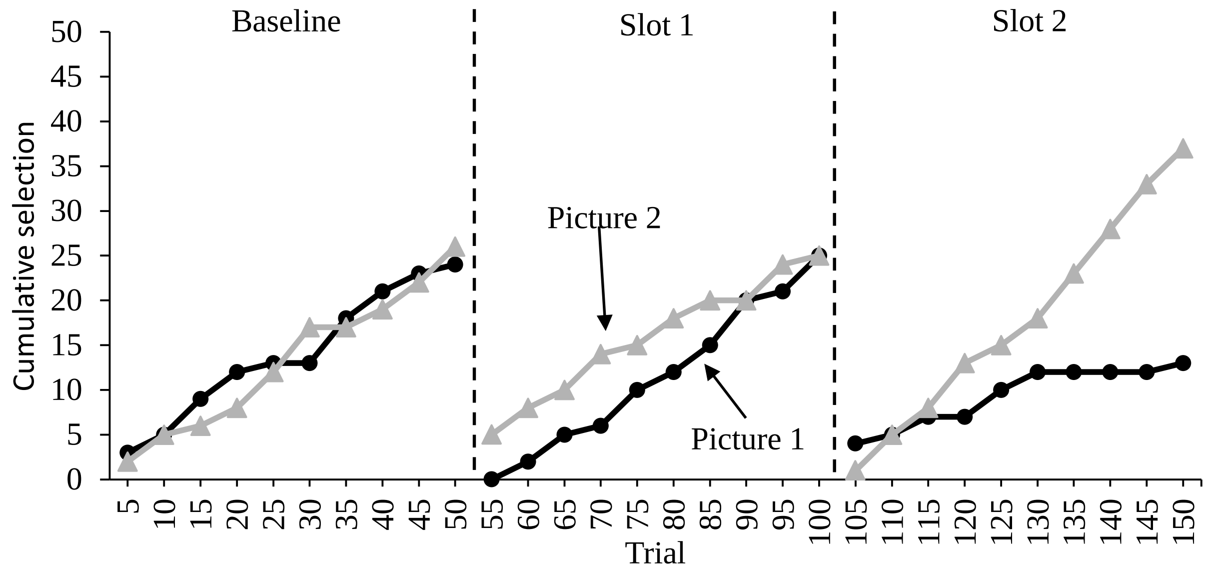


Figure 7. Participant 2 cumulative selection graph. This figure depicts the cumulative selection of picture 1 and 2 for participant 2 across all slot machine phases. This is a collapsing of the data with points noted at every 5 trials.

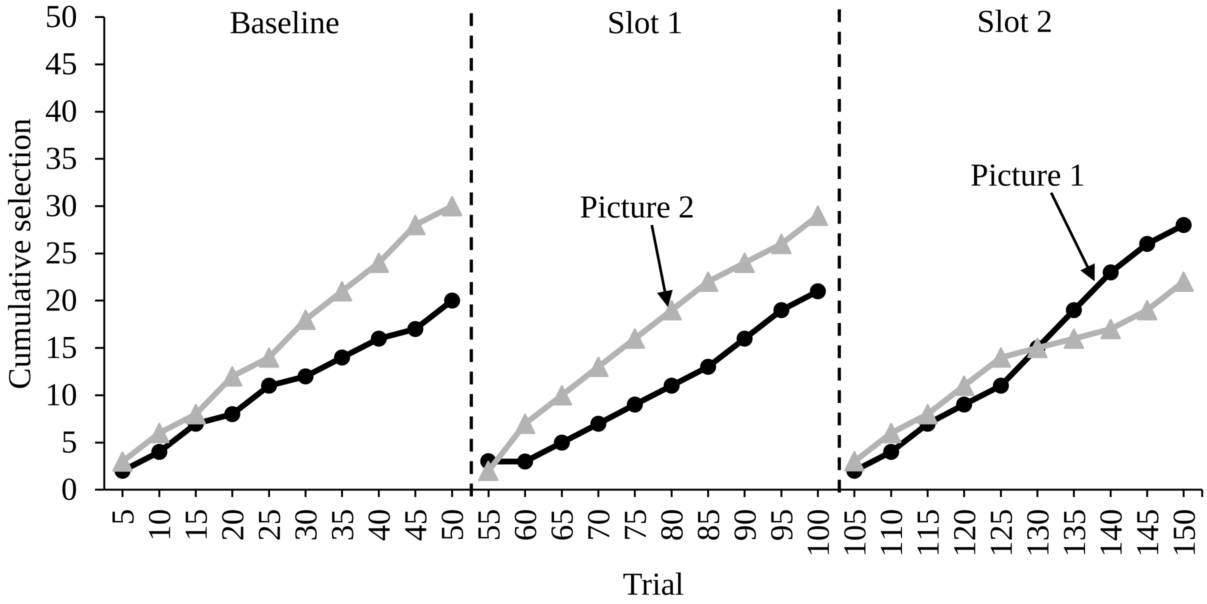


Figure 8. Participant 3 cumulative selection graph. This figure depicts the cumulative selection of picture 1 and 2 for participant 3 across all slot machine phases. This is a collapsing of the data with points noted at every 5 trials.

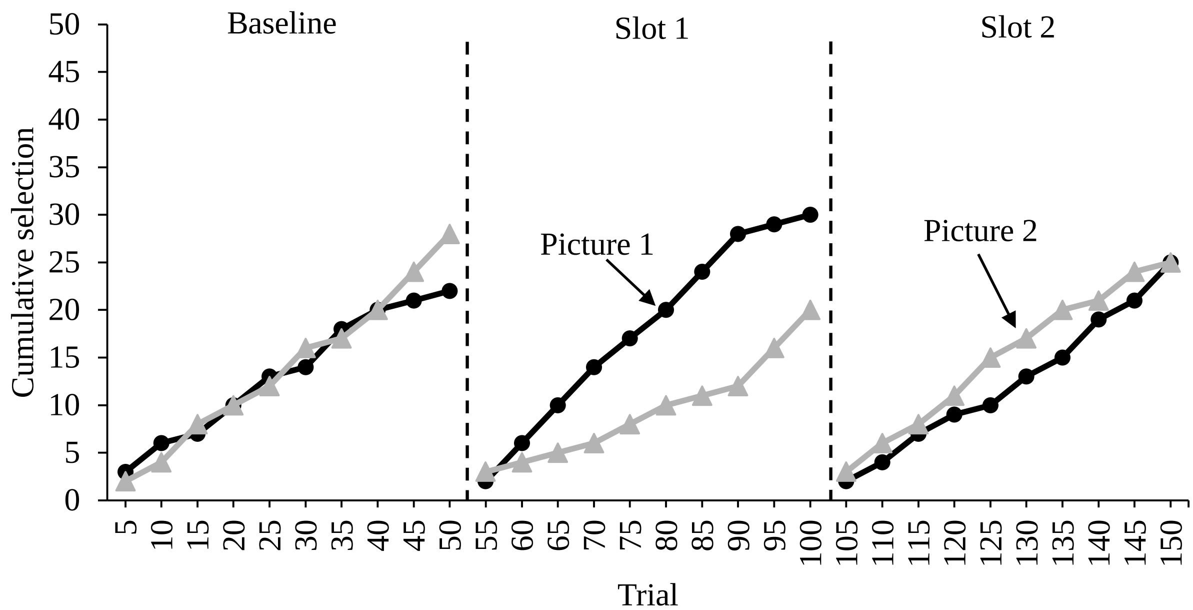


Figure 9. Participant 4 cumulative selection graph. This figure depicts the cumulative selection of picture 1 and 2 for participant 4 across all slot machine phases. This is a collapsing of the data with points noted at every 5 trials.

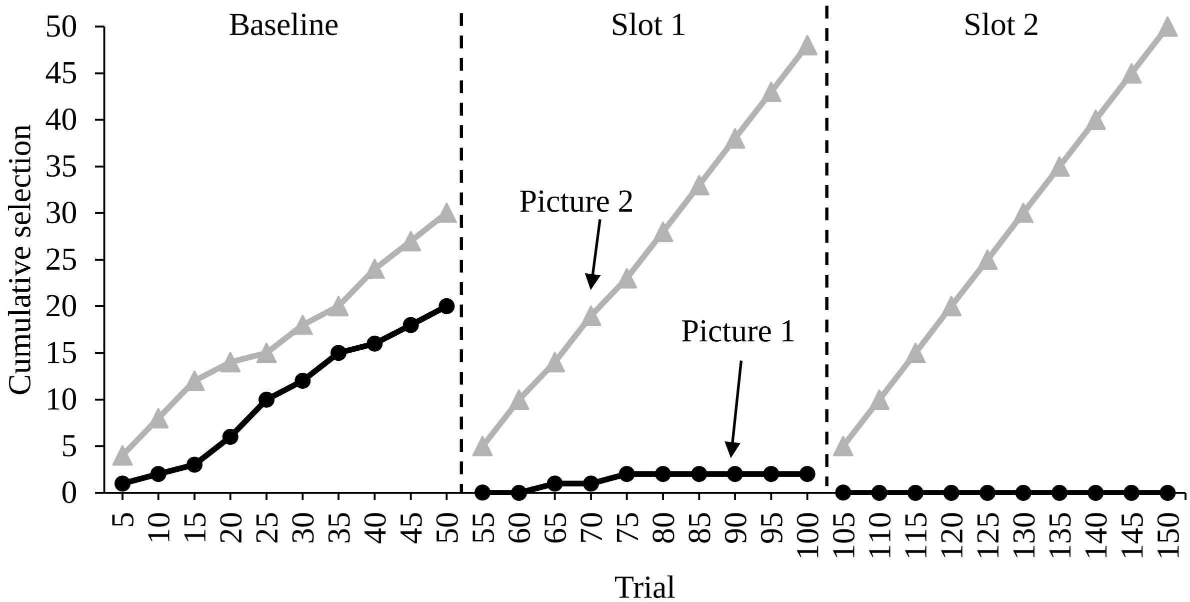


Figure 10. Participant 5 cumulative selection graph. This figure depicts the cumulative selection of picture 1 and 2 for participant 5 across all slot machine phases. This is a collapsing of the data with points noted at every 5 trials.

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VITA

Graduate School

Southern Illinois University

Rocco Giovanni Catrone

Roccocatrone@gmail.com

Elmhurst College

Bachelor of Arts, Psychology and Intercultural Studies, June 2013

Thesis Paper Title:

Relational training of contextual cues and self-rule formation in simulated slot machines

Major Professor: Dr. Mark R. Dixon