Choice, Preference, and Response Durability

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Choice, Preference, and Response Durability

By

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Abstract

Preference for situations containing two or more response options, called free choice situations, have been observed in humans and nonhumans. However, basic and applied studies have also identified instances in which preference for situations containing only a single option, called restricted choice situations, is present, in addition to situations where no clear preference is identifiable. In the current study, adult participants earned points for playing a chance-based computer game where they selected between free or restricted choice situations. Once a participant’s preference, or lack thereof, was identified, an attempt was made to alter preference through manipulating points for a particular choice situation. Implications for the research in relation to a behavior analytic conceptualization of choice and preference are discussed along with limitations and potential modifications.
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Chapter I: Introduction

Preferences for situations containing two or more response options have been observed in humans (Ackerlund Brandt, 2013; Fisher, Thompson, Piazza, Crosland, & Gotjen, 1997; Karsina, Thompson, & Rodriguez, 2011; Sellers et al., 2013; Skowronski & Carlston, 1982; Tiger, Hanley, & Hernandez, 2006) and non-humans (Catania, 1975, 1980; Catania & Sagvolden, 1980). These situations are called free choice situations. From a behavior analytic perspective, this phenomenon can be best explained as resulting from a history of differential reinforcement in which situations containing multiple response options have been advantageous more often than not (Catania, 2013; Fisher & Mazur, 1997; Karsina et al., 2011).

Researchers have also identified arrangements in which humans and non-humans allocate a higher proportion of their responding to choice situations containing only one option (Hayes, Kapust, Leonard, & Rosenfard, 1981; Ono, 2004). These situations are called restricted choice situations. Hayes et al. found that under some concurrent-chains conditions (an arrangement containing two sets of simultaneously presented identical or different schedules), pigeons showed a preference for restricted choice, particularly when access to the reinforcer was virtually eliminated in one of the terminal link choices by reducing the duration of reinforcer availability to 0.25 s (Hayes et al., 1981). Additional factors such as response effort (Polick, Johnston, & Carr, 2013), delay to reinforcement (Savastano & Fantino, 1996), and situational novelty (Ono, 2004) have been shown to influence choice responding towards restricted choice arrangements. Additionally, in some instances, no clear preference between the two different choice situations is identifiable (Ackerlund Brandt, 2013).

Many controlling factors have been identified that affect the probability of how an individual will respond given different choice situations. Even so, the exact mechanisms
responsible for a free or restricted choice preference are not yet fully understood. The present paper aims to add to the existing behavior analytic choice literature with a behavioral preparation to address preferences between free and restricted choice situations, preference durability under a progressively changing reinforcement procedure, temporal generalization of selected choice situations preferences when conditions return to baseline settings, and what correlation, if any, exists between participant performance and scores obtained from the Maximization and Regret Scales.
Chapter II: Literature Review

Choice and Preference

Choice is defined as the allocation of responding among concurrently available response options (Ackerlund Brandt, 2013; Catania, 2013; Fisher & Mazur, 1997). When an individual eats a piece of candy instead of an apple, they are said to have made a choice. Martin, Yu, Martin, and Fazzio (2006) provided the following definition of choice in their review of the subject:

The presence of two or more salient discriminative stimuli, at least one of which is a relatively effective \( S_D \), as compared to others in that situation. If two or more of these discriminative stimuli are \( S_D \)s, we may call the arrangement a free choice situation. If only one of them is an \( S_D \), we may call it a restricted choice situation. The discriminative stimuli may be presented simultaneously or sequentially, so long as all of the choice stimuli are presented before the individual chooses (p. 236).

Martin et al. characterized the primary factors related to choice as the salience of the \( S_D \)s, the distinction between free and restricted choice situations (number of alternatives available), the presentation of \( S_D \)s prior to the choice response, and reference to the operant influence of the stimuli (the effectiveness of the \( S_D \)s). Choice, it could be argued, is inherent in every operant response.

Stimulus saliency refers to the effect a stimulus has on an individual due to an individual’s history with the stimulus. For instance, a person will typically come across many stimuli each day, few of which actually influence the individual’s responding. The carpet’s color, the wood’s grain pattern, and the hum of lights often fail to provide any control over responding
for many individuals, yet they are often present daily. When an object fails to influence responding, they are relegated to being a non-stimulus. It is not that we “choose” to ignore these objects, but rather that they are not salient discriminative stimuli for most people in most contexts.

Confusion is had in studying choice, as choice is both a scientific and a lay term, and within science choice amounts to procedural variations, response allocations, and consequences for responding. An everyday use of the term “choice” generally takes on one of four meanings, including “(a) a variety or array from which to choose, (b) the act of choosing, (c) an alternative, and (d) that which is chosen” (Martin et al., 2006, p. 234). According to Martin et al., meanings (a) and (b) are of most interest to behaviorists as they portray the antecedent arrangement (a) that sets the occasion for the response (b) of choosing. Yet there is no clear distinction between the two meanings when only the singular term “choice” is used to signify both. Martin et al. suggested that this changeability is detrimental to the discussion and study of the subject matter. Therefore, “choice” will be used ongoing to designate the behavior of an individual while “choice situation” will be used to designate the antecedent arrangement.

Related to choice, but operationally distinct from it, is preference. Whereas a single instance of response allocation to one stimulus over another can be considered a choice, an observable pattern of response allocation in time is required for a preference to be determined. Preference describes the relative strength of an $S^D$ established within an individual’s history of differential reinforcement (Catania, 2013; Fisher & Mazur, 1997). While there is no clear requirement in terms of the number of responses needed to induce a preference from a non-preference, it is logical to assume that the greater the history an individual has with different available $S^D$s, the fewer response allocations required determine a preference between stimuli.
For example, if an individual is offered an apple or a banana to eat and chooses the apple it can assumed that in that moment the apple was more preferred than the banana. Conversely, if the same individual was offered a rambutan or a salek (two edible fruits) to eat and chooses the salek, even though s/he had never had an opportunity in the past to try either, the choice does not necessarily correlate with the individual’s preference, as one does not yet exist.

In applied treatment situations, it is common to use preference assessments to determine what stimuli might be made contingent upon some response to maximize the effectiveness of a treatment program (see Hagopian, Long, & Rush, 2004 for a review of preference assessment procedures). For example, during a paired-stimuli preference assessment or forced choice assessment, multiple items and/or activities are presented two at a time in an order that ensures each item is presented with every other item at least once. The individual’s response allocation towards an item is documented and the item that is selected the most following completion of every trial is considered the most preferred. Using this method, a preference hierarchy can be established in which stimuli of differing quantitative or qualitative value to the individual are presented contingent upon some targeted response.

In a similar manner, a preference between free and restricted choice situations might be identified using similar procedures. Fisher et al. (1997, experiment 1) applied this type of approach with three participants who had to press one of three microswitch keys paired with free choice, restricted choice, and a control stimulus. A stimulus preference hierarchy was established for each participant. During the high preference phase, the first and second highest ranked items were available to the participants following key presses on either the free or restricted choice microswitches. Each switch was assigned an independent but concurrent variable interval (VI) 15 or 30 s schedule depending on the participant; key presses on the
control key resulted in no access to the preferred items. Presses on the free choice key resulted in an opportunity for the participant to select between his/her two highest preferred items, while restricted choice key presses resulted in a therapist selection between the two highest preferred items. Restricted choice selections were yoked to participant choices during free choice trials.

Results showed that participants preferred free choice situations almost exclusively to the restricted choice and control conditions. In this study, the authors were able to control differential reinforcer values by yoking restricted choice items to free choice items, showing that a preference for free choice situations likely existed independent of differences found in the relative value of the reinforcers themselves.

Choice and preference are inseparable in relation to a choice sequence when the behaver is someone with adequate operant experience. When a choice is made, it is most likely made towards the preferred item or situation and away from the lesser preferred item or situation.

From an applied perspective, providing choice opportunities has been found to affect behavior in desirable ways. For example, Tasky, Rudrud, Schulze, and Rapp (2008) found that the facilitation of choice to three adults with traumatic brain injury was correlated with increased on-task performances, while assignment to tasks was not. Similarly, Dunlap et al. (1994, Study 1) found that when choice opportunities were provided to three elementary school students with emotional and behavioral challenges, appropriate classroom behavior increased relative to the restricted choice condition.

In addition to discovering that choice over task is correlated with desirable behavior outcomes (Bambara, Ager, & Koger, 1994; Dyer, Dunlap, & Winterling, 1990; Romaniuk &
Miltenberger, 2001; Powell & Nelson, 1997; Ulke-Kurcuoglu & Kiracaali-Iftar, 2010), choice procedures related to task presentation order (Kern, Mantega, Vorndran, Bailin, & Hilt 2001) and reinforcer selection (Dyer et al., 1990; Waldron-Soler, Martella, Marchland-Martella, & Ebey, 2000) have also been found to correlate with desirable behavior.

It has been suggested that choice allows an individual to maximize access to preferred stimuli, regulate the amount of stimulus variation available, and specify reinforcer access in relation to momentary changes in stimulus preferences (Ackerlund Brandt, 2013). In other words, choice opportunities permit the individual to operate upon their environment or control some aspect of it. When an individual’s responding is under the influence of multiple effective \( S^D \)s, they are able to allocate responding in a manner that is most beneficial to them in the moment.

Studies on choice responding and situations typically employ concurrent chains schedules (Herrnstein, 1961). The concurrent chains schedule consists of an arrangement in which at least two response options are available to the individual prior to the instance of choice responding. The amount of responding allocated towards each alternative by the individual is measured to determine which option is more preferred. While one can infer a preference for one stimulus over another using two independent single operant arrangements, noting the amount of responding allocated towards each arrangement individually (i.e., either duration or frequency; see Geckeler, Libby, Graff, & Ahearn, 2000 for a comparison of single-operant and concurrent schedules procedures), the concurrent schedule design allows for a simultaneous comparison between two or more available response options, arguably providing for a better evaluation of momentary individual preferences (Tiger, Toussaint, & Roath, 2010).
Concurrent schedules are typically presented in a chain schedules format or “two or more simple schedules combined in a fixed sequence” (Fisher & Mazur, 1997, p. 400). The first set of simple schedules, called the initial-link sequence, consists of two or more identical schedules (e.g., two VI 30 s schedules) in effect simultaneously that are identifiable by some previously paired S^D (e.g., colored lights). Responding on either of the initial-link sequences and meeting the schedule’s response criteria produces the corresponding terminal-link sequence. One set of terminal-links might be two independent schedules (e.g., fixed ratio [FR] 10 and variable interval [VI] 10 s) presented simultaneously (free choice) while the other terminal-link could consist of one schedule (e.g., VI 10 s; restricted choice). For example, we can tell an individual s/he can choose candy or crackers (free choice terminal-link) after touching the available blue card (initial-link on an FR 1 schedule) or someone else will choose candy or crackers for him/her (restricted choice terminal-link) after touching the available red card (initial-link on an FR 1 schedule). We now have a scenario in which the two S^D s (colored cards) indicate not only what reinforcer will be delivered contingent upon the targeted response but how the reinforcer will be delivered. This arrangement is common within the choice literature (see Ackerlund Brandt, 2013; Lerman et al., 1997; Tiger, Hanley, & Hernandez, 2006).

Matching

Herrnstein (1961) discovered that individuals tended to allocate responding in a manner roughly approximate to the amount of reinforcement available. He referred to this phenomenon as matching. An example of matching can be seen when an individual is presented with an arrangement containing two (VI) schedules of independent sizes (e.g., VI 20-s and VI-60-s). Typically, an individual’s behavior under this type of arrangement will alternate between the two schedules and by doing so allow him/her to access to more reinforcers. Conversely, when
the schedules presented are variable-ratio (VR) schedules of independent sizes, (e.g., VR-100 and VR-20), switching between the alternatives adds no benefit for the individual and eventually s/he would learn to respond only to the most favorable alternative (in this case, the VR-20 schedule). Simply defined, the matching law states that the proportion of an individual’s responding is roughly equivalent to the proportion of reinforcement available under differing concurrent schedules of reinforcement, so long as the topographies of the responses are similar (see Herrnstein, 1997 for a more in-depth review of matching).

While matching provides an effective and formulaic representation of choice responding, it has been found that individuals rarely perform perfect matching, especially outside of laboratory environments. Less than optimal matching is actually the rule and not the exception. Several deviations have been discovered related to less than optimal matching including undermatching, overmatching, and bias. Undermatching occurs when an individual’s responding is “less extreme than the matching relation would predict” or the individual’s responding fails to meet the schedule requirement to maximize reinforcement (Baum, 1974, p. 232). Conversely, overmatching occurs when an individual’s relative response rate towards a stimulus is greater than what is required to access reinforcement (Reed & Kaplan, 2011). Lastly, bias occurs when an individual’s behavior is under the influence of some variable unrelated directly to the schedules in effect. For example, a child tasked with sorting cards into two stacks, both of which are on differing VI schedules, might show a preference for the right deck over the left simply due to handedness.

When applied to behavior occurring in a natural environment, matching can provide additional insights into response probabilities not available to the researcher or practitioner otherwise. For example, McDowell and Caron (2010) investigated the occurrence of bias and
undermatching in relation to the function of the verbal behavior of 81 13-14-year old boys with deviant behavioral difficulties. “Rule-break” and “normative talk” verbal behavior was operationalized as conversational topics that included “a violation of legal and/or conventional norms of conduct” and typical age appropriate material such as “gossiping about friends, and talking about school, family, or what to do for fun,” respectively (McDowell & Caron, p. 475).

During sessions, one target boy and one peer would engage in videotaped conversations for 25-minutes. Each conversation session included 5 topics that were prompted by the researcher including an initial 5-minute warmup about the session itself. Behaviors were coded into the two mutually exclusive verbal behavior categories mentioned above. Results showed that the matching law, specifically the generalized matching equation (Reed & Kaplan, 2011; Poling, Edwards, & Weeden, 2011) was well suited for explaining the verbal behavior of the participants.

Generally, it was found that the boys’ targeted verbal behavior was strongly biased towards normative talk and that their biases decreased in relation to an increase in deviance. However, this finding was odd as there was little to no difference in the specific properties of the different target behaviors. The authors hypothesized that the bias towards normative talk may be due to their histories of reinforcement and punishment in relation to the two response classes.

Matching provides a quantitative means of analyzing response rates or durations in relation to reinforcer availability. However, as is seen in the below paragraphs, in naturalistic environments variables such as response effort, delay discounting and reduction, and reinforcer disparity are important components of understanding why individuals tend to allocate responding in less than optimal ways (Mace, Neef, Shade, & Mauro, 1996).
Response Effort

When two response forms are relatively similar (e.g., point to the blue card or point to the red card), it is easier to assume that the individual’s response is mostly under the influence of the contingent consequence associated with either the blue or red card. However, when there is a disparate level of effort required on the part of the individual to access different reinforcers, it is not uncommon for the individual to allocate their responding towards the easier of the two reinforcers to access (Friman & Poling, 1995; Polick, Johnston, & Carr, 2013).

The applied literature has provided many examples of how either increasing response effort for a behavior targeted for reduction and/or decreasing response effort for a behavior targeted for increase can influence the probability of the individual engaging in that behavior form over time. For example, response effort has been manipulated to increase mand skills in children with autism (Buckley & Newchok, 2005; Richman, Wacker, & Winborn, 2001), decrease challenging behaviors such as self-injurious behavior (Zhou, Goff, & Iwata, 2000) and hand mouthing (Irvin, Thompson, Turner, & Williams, 1998), and treat pica maintained by automatic reinforcement (Piazza, Roane, Keeney, Boney, & Abt, 2002).

In an applied study to investigate the influence response effort and delay have on response probabilities related to choice, Polick et al. (2013) employed a matching task with three typically developing children. The matching blocks design task allowed the authors to manipulate the effort variable by adding weights to the blocks and the delay variable by inserting time delays between task completion and the presentation of social praise and the tangible reinforcer. Results showed that the participants all displayed a consistent preference for the low-effort task (lighter weight boxes) over the high-effort task (heavier weight boxes) when presented together. Conversely, not all participants showed as consistent a preference with time
delay, with two-thirds of the participants responding variably in relation to the time to reinforcer delivery. The results of this study indicate that effort and time, while both shown to influence choice responding in isolation, might be distinct and have independent effects on choice (2013.)

Historically, response effort has been conceptualized as a physical property of the stimuli and the effort required of the individual to engage it. For example, Miller (1970) used pounds of force required to move a lever in a two component (chain) contingency and concluded that increased response force (effort) was punitive as response rate decreased as response effort increased. However, response effort seems as though it would be best conceptualized as a function of the individual’s history of differential reinforcement with the stimuli and not only some physical property of the environment. For example, a child might be more likely to allocate increased responding towards a coloring sheet than a math worksheet even when the reinforcer for the math worksheet is of relatively more value than the reinforcer contingent upon the coloring sheet. But how does this apply to choice?

Mace et al. (1996, Study 1) investigated the effects of arithmetic problem difficulty and reinforcer quality on the amount of time two children allocated towards two concurrently available response options, in this case, two different stacks of math problem cards. Results from Study 1 showed that when the concurrent response options were of equal difficulty and on different but concurrent VI 30 VI 120 s schedules, both children allocated their time in a manner that approximated the proportion of reinforcement available, meaning both children matched the duration of responding to the two reinforcement schedules, respectively. Interestingly, the response/reinforcement correspondence continued even as the response effort diverged across the two stacks of math problems. The math problems identified as being more challenging for each child was placed under the VI 30 s (dense) schedule of reinforcement, while the relatively
simpler math problems were placed under the VI 120 s (lean) schedule of reinforcement. Yet, there was no noticeable disruption observed in the participants’ response allocation. This finding contrasts sharply with prior studies that did show response effort as an affective independent variable (e.g., Carr & Durand, 1985; Weeks & Gaylord-Ross, 1981.)

Delay Reduction

As stated by the Delay Reduction Theory (DRT; Fantino & Romanowich, 2007), an organism, when presented with concurrently available response options, will respond towards the option in which the delay between the initial link and terminal link reinforcement is the shortest (Chung & Herrnstein, 1967; Lattal, 2010). It is argued that any delay that occurs between a terminal response and the delivery of a reinforcer alters the value of the reinforcer and is therefore an aversive process. Individuals tend to discount the actual value of a reinforcer when there is a prolonged period of time between a response (e.g., a choice) and the delivery of the reinforcer (see Odum, 2011).

Delay Reduction Theory asserts that although varying reinforcer qualities such as magnitude, quality, and rate might be typically called upon when explaining choice allocation phenomena, temporal contiguity might be the best framework for explaining choice responding in the presence of multiple response options (Hartl & Fantino, 1996). For example, Savastano and Fantino (1996, experiment 2), used a modified concurrent chains arrangement to isolate the influence temporal delays had on response allocation with pigeons and found that choice was controlled by terminal link difference in relation to temporal contiguity. Using several choice models to calculate results, including Herrnstein’s matching theory (1964), Grace’s (1994) contextual choice model among others, the authors identified that DRT best predicted response allocation in a constant-difference (constant initial link and difference terminal link) condition.
**Differential Reinforcement**

When experimental factors are kept constant between the differing choice alternatives (i.e., the above variables cannot better explain the response pattern of the individual), it is reasonable to assume that the history of reinforcement in relation to the items/situations being presented has a causal status; although in natural settings, a history of differential reinforcement is likely always present in addition to other variables.

Karsina et al. (2011) examined the effects of a history of differential reinforcement on choice arrangement preferences of 11 undergraduate college students. Trials were presented via a computer-game in which participants were initially exposed to free and restricted choice arrangements (only 1 arrangement per exposure trial) in an alternating manner over an exposure phase. Reinforcement during the initial exposure phase was kept equal across free and restricted choice arrangements. An eight-trial baseline was then run to assess preference between the choice arrangements. Participants showing a preference for free choice arrangements during the baseline phase were excluded from the study following this phase. In total, seven participants met criteria to complete the study and be exposed to the differential reinforcement phases.

During the differential reinforcement phases, participants were again exposed to both free and restricted choice arrangements in an alternating manner, however ratios of reinforcement were set to select either free or restricted choice arrangement response allocation. All but one participant’s responding came under the influence of the differential reinforcement procedures, however the single participant’s responding did eventually come under the influence of the procedures when the differential reinforcement ratios were expanded. Results of the study supported prior research (Catania, 1980) that a history of differential reinforcement might influence preferences between choice arrangements even after rates of reinforcement are
returned to equal. Additionally, the authors found that a differentially reinforced preference for free choice situations may generalize to novel contexts where no differential differences are found.

**Resistance to Change or Response Durability**

Behavior that has been established by a history of reinforcement in the presence of a \( S^D \) tends to persist under altered conditions (Mace et al., 1990). For example, a young child’s crying that has historically functioned for attention from his/her parents maintains at a consistent rate even after a differential reinforcement procedure is implemented in which only early vocal verbal behavior is immediately reinforced. Nevin and Grace (2000b) discussed the construct of *response strength* or conditioned reinforcement value within the concurrent-chains literature, in relation to effects of a history of reinforcement in a “distinctive stimulus situation” (p. 80). What this implies is that the more experience an individual has under specific stimulus situations, the greater the probability of resistance to change. This scenario is not unfamiliar to any practitioner when trying to modify a behavior that has been functional for an extended period of time and reinforced on an intermittent basis.

Specific to differential reinforcement of alternative behavior, Nevin and Shahan (2011) identify that there are some “counterintuitive and potentially counterproductive effects of alternative reinforcement” found when previously reinforced behavior is placed on extinction (p. 877). The term “disrupter” is used to signify any variable that interferes in some way with the reinforced behavior. For example, when reinforcement is discontinued several aspects of the previously reinforced context are disrupted or changed—the contingency between response and reinforcer is no longer active, the environment no longer includes reinforcers and as time between response and reinforcer increases, it is assumed that the effects of extinction increase. In
an applied example, Mace et al. (1990) investigated the persistence of behavior of two adult men diagnosed with an intellectual disability. A sorting task, in which the individuals were asked to sort red and green utensils, was used and rate of sorting responses per minute was the primary dependent variable. During the baseline condition, reinforcement (5 pieces of popcorn for one participant and 50mL of black coffee for the other) was arranged using a multiple-schedule procedure. During part 1 of the baseline phase, sorting responses for participant 1 were reinforced on a VI 60 s schedule during red utensil components and on a VI 240 s schedule for green utensil components. Reinforcer and utensil color pairings were reversed for participant 2. During each trial, the experimenter would hand each participant a randomly selected utensil with the instruction, “You can sort for popcorn/coffee.” No additional feedback was provided, either as praise or correction, from the experimenter during this phase.

During part 2, a VI 6 s schedule was in effect for both red and green utensils. In addition, response-independent reinforcers were delivered on a variable time (VT) 30 s schedule during the red components for participant 1 and green components for participant 2. Lastly, a concurrent distracting stimulus phase was implemented to assess participant resistance to change under the differing schedules of reinforcement. During this phase the baseline multiple-schedule procedures remained in effect while a distractor (videotape of action excerpts from popular television and video) was presented concurrently. Results showed that during the baseline multiple-schedule VI 60 s and 240 s procedures, rates of responding were very similar across schedules, phases, and participants. The distractor stimulus presented concurrent to the sorting task affected the response rate of both participants, resulting in decreased performances. However, the response rates during the VI 60 s schedule were consistently higher than those seen during the schedule with the VI 240 s.
Results from part 2, in which noncontingent reinforcement (NCR) was delivered, showed that rates of responding were much higher when only the VI 60 s schedule was in place as opposed to both the schedule and NCR. The overall results of this study showed that the resistance of performance to distraction is a positive function of the frequency of reinforcement available and that the effect is independent of the baseline response rate and response-reinforcer contingency.

Maximizing, Satisficing, and Choice Overload

Historically, the predominate theory of choice favored outside of the field of behavior analysis, called rational choice theory, suggested that people are rational choosers and make their decisions in ways that maximize the relative value of their decisions (Schwartz et al., 2002). Said in a more behavioral way, people were thought to match their rate responding to the reinforcement available. They allocated their responding amongst available stimuli in a manner that was most beneficial and from an economic and rational standpoint. However, human beings and other organisms routinely violate the primary tenets of rational choice theory and in the same manner, the matching law (see Baum, 1974; 1979; Poling, 2011; Reed & Kaplan, 2011).

Several possible reasons for these deviations have been proposed. Within the rational choice theory literature, it has been noted that in order for a person to make a perfectly rational choice, all relevant information about the choice must be made available to the person. This is often not possible, therefore, people appear to make relatively poor choices. Many of these conclusions are not unexplainable, especially from a behavior analytic viewpoint, and many of the more recent explanations offered from outside of behavior analysis are not necessarily incompatible with the insights reached through the choice literature.
Currently, one of the newer theories used to explain less than optimal choice making behavior is choice overload theory. Choice overload theory states that the proliferation of choice, especially when the alternatives fall within a class of goods or options, can have deleterious effects of the person choosing (Schwartz, 2000). This negative effect is also sometimes referred to as “cognitive depletion” and is correlated with a person experiencing “post decision feelings of regret.”

Schwartz and his contemporaries have identified that while some individuals do not seem to experience negative effects related to choice situations, referred to as satisficers, some do, referred to as maximizers. Satisficers are generally defined as people that make decisions based upon a “good-enough” standard, meaning they have a minimum acceptable level for which any alternative that falls above is acceptable. Conversely, maximizers are generally defined as people who will expend a great deal of energy ensuring the choices they make are of the relatively highest value and therefore maximally beneficial.

Schwartz et al. (2002) identify three factors that contribute to the negative effects of choice making for some people; first, people will struggle to gain adequate information about the options to make a choice, second, as the number of alternatives increases, the person’s standards for what is and what is not acceptable increases as well, and third, as the number of alternatives increases, people will be more likely to blame themselves for a relatively poor decision in the presence of so many alternatives.

In a series of studies, Schwartz et al. (2002) examined what effects choice situations had on people identified as maximizers using the maximization scale and regret scales. During Study 1, Likert scale questionnaire were provided to 7 groups of participants (n = 1,747). The goal of the questionnaires (which became the Maximization and Regret Scales) was to identify
correlations between people who were identified as maximizers and well-established measures of well-being. Results from this initial assessment showed that people who rated as maximizers also tended to report “significantly less life satisfaction, happiness, optimism, and self-esteem, and significantly more regret and depression” compared to those who were rated as satisficers (2002, p. 1184.)

During Study 4, undergraduate psychology students served as participants (n = 84). Participants completed a computer-based game that simulated a 2-player ultimatum game. Each participant had completed the Maximization and Regret scale questionnaires approximately 7 weeks prior. The computer-game, which consisted of two versions, a “standard” version and a “modified” version, both of which each participant was exposed, involved 10 rounds. Each round consisted of a textual prompt that informed the participant that they were “Player 1” and the computer was “Player 2.” Additionally, player 1 was informed that the actions of the computer (player 2) were yoked to the responses of previous players, and that each round’s criteria was yoked to a different previous player. Player 1’s job was to make a monetary offer to player 2 based upon the amount of money they were told they had during that round and see if player 2 would accept the offer. If player 2 accepted the offer (e.g., $5.00), player one would be awarded the difference (e.g., $6.00.) However, if player 2 rejected the offer, neither player received any money. The “modified” version of the game was the same as the above standard version with the addition of a screen that showed player 1 the minimum amount player 2 would have been willing to accept.

Results of Study 4 showed that (1) participants offered their counterpart half of the initial sum on 53.4% of trials, less than half on 37.3% of trials, and more than half on 9.3% of trials and that (2) there was no significant difference between males and females related to rates of offering
less than half of the initial sum. Additionally, (3) the participants’ maximization scores were not significantly correlated with offers less than half of the initial sum. However, there was (4) a significant interaction between gender and maximization score in that males with higher maximization scores tended to offer less than half significantly more than males with lower maximization scores or their female counterparts with higher maximization scores. Lastly, when the minimum reservation prices were revealed during the modified version of the game, maximizers were much more likely to offer less than half in comparison to the standard version of the game in which reservation price was not revealed.

The results of Schwartz et al. (2002, Study 4) showed that in general, those identified as maximizers were less satisfied with outcomes than those identified as satisficers. Reed et al. (2011) found similar outcomes in their study with human service workers with those identified as being “maximizers” showing the highest amount of decision regret in comparison to those identified as being “satisficers.”

The maximization and regret scales provide interesting insight into the general choice behavior tendencies of people, however they do not provide any additional information regarding possible mechanisms influencing the individual’s behavior or to what extent a maximizer’s or satisfier’s responding is amenable to change under the influence of competing contingencies of reinforcement.
Chapter III: Statement of Purpose

The aims of this research were (a) to determine a baseline choice preference for each participant under a fixed reinforcer value arrangement between free and restricted choice situations, (b) assess durability of the participants’ preferences under an adjusting reinforcement procedure in which the ratio of high to low point values changes over time to favor the nonpreferred choice arrangement, (c) assess the durability of the recently reinforced non-preference situations when the choice situation returns to baseline or fixed values during a withdrawal condition, and (d) see if a correlation existed between participants’ performance and their self-ratings obtained using the Maximization and Regret Scales.
Chapter IV: Methods

Participants and Setting

Six undergraduate students enrolled at a mid-sized Midwest university participated. The participants included 6 females and 1 male with a mean age of 22.83 years (range 21-27). Participants received monetary compensation for their participation in the study. IRB approval was obtained and informed consent procedures were followed for each participant. All sessions were conducted in an approximately 6.5 m by 2.6 m divided research room. A space approximately 1.5 m by 2.6 m in the back of the room was partitioned off and used for storage. The participant space consisted of two long tables (1.21 m and 1.05 m) each with a computer monitor and a chair. Only one participant completed the study at a time.

At the end of the study, each participant was given a copy of the debriefing statement, due to the use of deception, which explained how and why deception was used (more on this below) and compensated for participating and completing the study.

Materials

A computer program was used to present all study components including the informed consent, demographic questionnaire, the Maximizing and Regret Scales, participant training, training quiz, and the experimental procedure. The research software was hosted on a private server and was accessible via a web address. Participants were assigned individual login information including a username and a password. Research assistants were present to log each participant into the program. Participants used a standard computer mouse to input information into the program.
**Design and Reliability**

An A-B-A or withdrawal design was used. Thirty-one baseline trials were presented followed by 30 intervention trials and 30 withdrawal trials, resulting in a total of 91 trials. Due to the automatization of the data collection procedure, program accuracy was assessed by taking response data from video-recorded pilot sessions and comparing these data to the automatically compiled data from the software. Data collection reliability for the software was found to be 100% across three consecutive pilot study sessions.

**Procedure**

Participants were brought into the lab and shown to the computer they would be using to complete the study by a research assistant. They were informed that all information pertaining to the study would be presented to them via the computer program. After participant consent was obtained, demographic information on age and identified gender were collected. Participants then completed two brief questionnaires, the Maximization Scale and the Regret Scale. These scales are intended to assess decision-making approaches and post-decision feelings of regret, respectively. Following completion of the scales, participants were shown a training on how to complete the study and given a 5-item quiz to ensure understanding was obtained. Participants needed to score 100% on the quiz to move onto the next phase of the study. If a participant failed to score 100% on his or her first try, they were provided a printed out copy of the training to review a second time and retake the quiz. No participants failed to pass the quiz.

A concurrent-chains arrangement was used to measure preference between free choice and restricted choice situations. Trials consisted of a blue, red, and green array that represented free choice, restricted choice, and a control array, respectively. The free choice array was a blue
100 cell array arranged in a 10x10 manner or a square. The restricted choice array was a red 100 cell array also arranged in a 10x10 manner. The control array was a green 1 cell array of the same dimensions as the free and restricted choice arrays. The location of each array was randomly assigned from left to right each trial using a randomization formula.

Initially, the array arrangement showed all three array types as single cell boxes of the same dimensions as the 100 cell arrays. The participant selected one of the arrays by clicking one time anywhere within an array figure. This response represented the initial-link choice. Once an array was selected, the selected array moved to the center of the screen and displayed a 100 cell arrangement for free and restricted choice arrays or a single cell arrangement for the control array. Screen captures of the array stimuli can be seen in Figure 1.

When a free choice array was selected, the participant clicked on 3 of the 100 available cells of his or her choosing; the position of the mouse cursor at the time of clicking corresponded with the cell selected. This response represented the terminal-link choice for free choice arrays. Similarly, when the restricted choice array was selected the participant was able to activate 3 cells. However, unlike in the free choice arrangement in which the participant selected 3 cells of their choosing, the restricted choice arrangement automatically selected 3 cells for the participant. The participant was still required to click 3 times within the array figure, with a single random cell activating following each mouse click. During restricted choice arrays, the placement of the mouse cursor at the moment of a mouse click had no influence on what cell would be activated. This represented the terminal-link choice for restricted choice arrangements. Lastly, when the control array was selected during the initial-link, the participant was required to click one additional time anywhere within the array figure to complete the array requirement.

**Points.** During the study, participants were able to earn points when they selected the free
or restricted choice arrays. Total trial point values were shown to the participant at the end of each trial and the sum of points earned was shown in a score box in the upper right-hand side of the computer screen. Individual cell point values ranged from 0 to 4 points. The total point value per trial for the free and restricted choice arrays was the sum of the 3 individual cell values and ranged from 0 to 12 points. Selection of the control array always resulted in 0 points.

All point values were predetermined by the author using a randomization formula. The randomization formula allowed point values to be selected at random given an assigned probability out of 100, meaning if the point value 3 was assigned a 40% probability, there would be a 4 in 10 chance of 3 being selected when the randomization formula was run 10 times.

During training, participants were informed that for each point earned during the study, they would be compensated an additional $0.01. However, as points were predetermined by the author for 2 of the 3 phases, all participants were compensated for the maximum number of points possible in the study, which was 700 points.

During the baseline and withdrawal phases, the free and restricted choice trials were equivalent; regardless of which array the participant selected, the same number of points would be earned for that trial. The probability of 0 and 4 point values being selected during randomization were set to 10% or 100:10, with 1 and 3 points set to 20% (100:20), and 2 points set to 40% (100:40). The rationale for setting probabilities at an unequal distribution during the baseline and withdrawal phases was to reduce the likelihood of very high or very low total trial point values during baseline and withdrawal phases. This probability arrangement clustered individual cell point values and total trial point values around the median values of 2 and 6 points, respectively, with all baseline and withdrawal total trial point values falling within 2 or fewer points away from the median. Additionally, during the baseline phase, there was a flat
trend from trial 1 to 31 in the total point values, while there is a very slight increasing trend from trial 61 to 91 found during the withdrawal phase.

During the intervention phase the overall trend or total trial point values for preferred and nonpreferred choice arrangements diverged progressively over the course of 30 trials. For the purpose of this study, this progressive divergence of reinforcer values will be called the adjusting reinforcement procedure (ARP). Unlike the procedure used during the baseline and withdrawal phases in which free and restricted choice arrangement point values were identical, inverse point values were used during the intervention phase. This was done to modify the relative reinforcing value of the different choice arrangements over time.

A total of 7 ratio modifications occurred over 30 intervention phase trials. Ratio modifications occurred every 3 trials until trial 53, at which point the ratio arrangement was stable until trial 61. As can be seen in Table 1, the preferred and non-preferred choice arrangement changes are inverse of one another. For example, during trials 32 through 34, the ratios for point values 0, 1, 2, 3, and 4, are 100:15, 100:20, 100:20, 100:20, and 100:25, for the non-preferred choice arrangement, and 100:25, 100:20, 100:20, 100:20, and 100:15, for the preferred choice arrangement, respectively. The point values 0, 1, 3, and 4 change 5 percentage points in assigned probability every 2 ratio change phases or 6 trials, while the point value 2 remains at 20% or 100:20 throughout the entire phase.

To determine individual cell point values for the intervention phase, only one set of values was created. In this case, 90 numbers were randomized (30 trials of 3 numbers each) for the non-preferred choice arrangement. To balance the relative reinforcer value across choice conditions, (e.g., non-preferred and preferred choice arrangements), the inverse value was determined with 2 being the median value. For instance, if the randomized 3 number sequence
for the non-preferred choice arrangement was 3-2-0, the inverse 3 number sequence for the preferred choice arrangement relative to the number of points away from the median is 1-2-4, with 2 being the median single cell value and therefore not having an inverse number. Lastly, there were two intervention conditions. If the participant showed a preference for the free choice arrangement during the baseline phase, the restricted choice arrangement would have an increasing trend in the intervention phase under the ARP and the free choice arrangement will have a decreasing trend. Conversely, if a preference for the restricted choice arrangement was observed during the baseline phase, the free choice arrangement would have an increasing trend and the restricted choice arrangement would have a decreasing trend. See figure 2 for a graphical display of assigned point values per trial and per phase.

**Response Measurement.** The computer program recorded all mouse clicks related to the demographic questionnaire, Maximization and Regret Scales, training quiz, and responses towards initial and terminal links for each trial into a Comma Separated Value (CSV) format stored on the program server.

Choice preference was determined using several procedures. First, choice preference was calculated for each phase and for each participant by taking the number of restricted choice terminal link selections divided by the total number of trials per phase subtracted from the number of free choice terminal link selections divided by the total number of trials per phase. The resulting value (hereafter referred to as the “per phase choice quotient”) was a number between -1 and 1, with -1 indicating an exclusive preference for restricted choice arrangements and 1 an exclusive preference for free choice arrangements.

Second, a “running choice quotient” was calculated by taking the number of restricted choice terminal link selections divided by the total number of trials to elapse subtracted from the
number of free choice terminal link selections divided by the total number of trials to elapse. Again, the resulting sum was a number between -1 and 1, with -1 indicating an exclusive preference for restricted choice arrangements and 1 an exclusive preference for free choice arrangements. This figure is different from the per phase choice quotient as it provides a trial by trial change in choice preference across all 91 trials. This data also presents different outcomes as the number of trials in the divisor are greater than in the per phase choice quotient beginning in the intervention phase, meaning changes in quotient score from one trial to the next are considerably smaller as more trials occur in comparison to trial to trial changes calculated with fewer trials.

Third, two cumulative records were created for each participant. The first cumulative record shows the number of choice arrangement selections per phase while the second cumulative record shows the total choice arrangement selections across all 91 trials. Both figures show the same data, however, given the difference in range of the y-axis, allows for different aspects of the data to be highlighted.

Lastly, Maximization Scale and Regret Scale scores were calculated. Both scales use a 7-point Likert scale from “Completely Disagree” to “Completely Agree”. The 6-Item Maximization Scale was used as it retains the same sub-scales of the original 13-item Maximization Scale but has been found to have superior psychometric properties in its Goodness of Fit Index (GFI; 0.99) and validity measure (0.28). The reliability measure for the short form assessment scale (0.75) is less than the original scale (0.84), however this is offset by the higher GFI. Maximization score was determined by taking the total sum of responses per participant and dividing the sum by 6. Additionally, three factor scores were determined related to (1) alternative search, (2) decision difficulty, and (3) high standards. Lastly, each participant’s
Regret Scale score was calculated by taking the sum of the responses and dividing the sum by 5. Question 1 of the Regret Scale was reverse scored, meaning if a participant selected “Completely Agree”, which is equal to 7-points, the score was changed to a ‘0’, as is standard practice for this scale.
Chapter V: Results

Choice Quotient Data

The per phase choice quotient for each participant is shown in Figure 3 while the running choice quotient for each participant is shown in Figures 4-6. Of the six participants, only participant 3 and participant 4 showed a clear preference during baseline, both for the free choice situation, as evidenced by baseline choice quotients (BLCQ) of 0.68 and 0.42, respectively. Participant 5 showed a minor preference for the free choice arrangement (BLCQ = 0.19). Participants 1 (BLCQ = -0.03), 2 (BLCQ = 0.03), and 6 (BLCQ = -0.03) did not show any preference between the free and restricted choice situations. However, due to the use of 31 baseline trials, all participants’ baseline data fell into an uneven proportion of responses between the two choice situations allowing the computer program to assign them to one of the two intervention procedures. Due to this, participants 1 and 6 were scored as allocating more responses towards restricted choice situations and participants 2 and 5 were scored as showing more responses towards free choice situations. No participants showed a clear preference for the restricted choice situation.

Following baseline trials, participants were exposed to the corresponding ARP intervention procedure related to their baseline preference. All participants’ responding came under the control of the ARP. For participants 1 and 6, who showed no preference during baseline but whose proportion of responding favored the restricted choice situation, the ARP procedure progressively favored free choice situation selections over the course of the phase. For each participant, the intervention procedure had clear influence over their responding with the intervention choice quotient (ICQ) for participant 1 being 0.73 and 0.67 for participant 6.
Participants 3 and 4, who showed a clear preference for free choice during baseline, and participants 2 and 5, who showed either no preference during baseline but a higher proportion of responding towards free choice or a minor preference, respectively, were all placed under the ARP that progressively favored restricted choice situations during the intervention phase. Intervention Quotient Scores for participants 2, 3, 4, and 5 were -0.87, -0.27, -0.53, and -0.40, respectively, showing the majority of responding during the intervention phase was allocated towards the restricted choice situation, with participant 2’s responding showing the strongest effect and participant 3’s showing the weakest.

For all participants, the ARP was terminated following 30 intervention trials and conditions were returned to baseline to assess the effects of the recent history of reinforcement for one choice situation over another. For 3 of the 6 participants, the effects of the reinforcement procedure appeared to be transient, with 3 of the participants showing a clearer and altered preference during the withdrawal condition. The Withdrawal Choice Quotient (WCQ) for participants 1 and 6, both of whom showed no preference during baseline but a higher proportion of responding towards restricted choice, had a WCQ of 0.73 and 0.53, respectively, showing a clearer preference during the withdrawal phase for the free choice situation. For participants 2 and 5, who showed either no preference during baseline but a higher proportion of responding towards free choice or a minor preference a WCQ of -0.27 and 0.20 were found, respectively. Lastly, for participants 3 and 4, who both showed a clearer preference for free choice during baseline, a WCQ of 0.00 and -1.00, respectively, were found.

**Cumulative Record Data**

Differentiation between phase responding for each participant is clearer in the Per Phase Cumulative Records (PPCR) and All-Trials Cumulative Records for each participant. For
participant 1 (see figure 7), no clear preference between the choice situations was present during the baseline condition, with the participant mostly preferring to alternate her choice selection between the two choice situations each trial. In total, 15 responses were allocated towards the free choice situation and 16 responses were allocated towards the restricted choice situation during baseline. However, a clear effect can be seen approximately a third of the way through the intervention phase when the participant’s responding began being allocated to the free choice situation exclusively. The effect of the reinforcement procedure carried over into the withdrawal condition, with participant 1 allocating 26 of her 30 responses towards the free choice situation.

For participants 2 (figure 8) and 6 (figure 12), similar patterns of responding were found to that of participant 1’s, with free and restricted choice data “entangled” during baseline and clear preferences during and following the ARP. Interestingly, while participants 1 and 6 allocated one additional response to the restricted choice situation during baseline, participant 2 allocated one additional response towards the free choice situation during baseline. However, the trajectory of their data over the course of the study is remarkably similar. Given each participant’s lack of preference between the two choice situations during baseline, it seems likely that the points earned during the intervention phase was exclusively influential on their responding, regardless of which choice situation was progressively reinforced.

For participants 3 (figure 9) and 4 (figure 10), a shorter period of response alternating between the two choice situations occurred during baseline with a clearer preference for the free choice situation emerging by trial 12 for each participant. This preference carried over into the intervention phase for 9 and 7 trials for participant 3 and 4, respectively, before switching to the progressively higher value reinforced choice situation (restricted choice for both participants.) Participant 3 maintained responding exclusively to the restricted choice situation for the last 15
trials of the intervention phase while participant 4 allocated her final 23 responses towards the restricted choice situation during the intervention phase. Finally, during the withdrawal condition for participants 3 and 4, a wide variation in response patterns was seen. Participant 3 ended up allocating 15 responses towards the free choice situation and 15 responses to the restricted choice situation, given them no preference during the final condition. Conversely, participant 4 allocated all of her responding towards the restricted choice situation, showing an exclusive preference for the opposite of her baseline choice situation preference.

Participant 5 (figure 11), who showed a minor preference for the free choice situation during baseline did respond as expected to the ARP, although not to the same extent of the other participants. Unlike participants 1, 2, and 6, in which response allocation showed a clear effect of the ARP and participants 3 and 4, whose responding showed a delayed yet eventual clear effect of the ARP, participant 5 allocated seven consecutive responses towards her preferred choice situation (free choice) in the middle of the intervention phase. These responses were surrounded by 10 consecutive responses towards the nonpreferred choice situation in the front and 11 consecutive responses towards the nonpreferred choice situation on the back end. The cause of this change in responding is unknown, however it seems possible that due to the progressive nature of the ARP, participant 5 continued earning high enough total trial point values between trials 44 and 50 to maintain her responding before the ARP point distribution became too varied for responding to continue towards the preferred choice situation. Interestingly, participant 5 was the only participant to return to baseline level responding during the withdrawal condition indicating that while the ARP did influence responding during the intervention phase, its effect was transient (note that this effect is not shown in the running choice quotient chart as the choice
quotient over all was too small to show an effect in the withdrawal phase compared to the baseline phase.)

Lastly, each participant’s Maximization Scale and Regret Scale scores are shown in figure 13. Upon initial analysis, no clear correlation can be found between scores on these self-rated questionnaires and participant performance.
Chapter VI: Discussion

The results of the current study extend previous research findings (e.g., Catania, 1980; Karsina et al., 2011) that shows that a history of reinforcement for one choice situation over another, even after a preference for the opposite choice situation is identified, can affect response allocation or preference when conditions are returned to a relatively equal probability of reinforcement. Specific to the work of Karsina et al. (2011), which was the first laboratory demonstration with human participants to show maintenance of a free choice situation preference upon return to an equal odds condition following differential reinforcement, the current research was able to demonstrate this effect with restricted choice situations as well as free choice situations. The implications of this preliminary work further support the ontogenic or instrumental argument for choice in that the individual’s history of reinforcement might be the most influential variable related to choice and choice situation preferences.

Consistent with the current choice literature using human participants (Ackerlund Brandt, 2013; Fisher, Thompson, Piazza, Crosland, & Gotjen, 1997; Karsina, Thompson, & Rodriguez, 2011; Sellers et al., 2013; Skowronski & Carlston, 1982; Tiger, Hanley, & Hernandez, 2006), the participants in the current study that did show a measurable preference for a choice situation during baseline all did so for the free choice situation. Whereas no participants showed a preference for the restricted choice situation during baseline. This finding, although limited due to the number of participants, does add some potential validity to a phylogenic argument related to choice preference, in which a preference for the ability to control is a more innate characteristic of the individual. However, given that only 2 of the 6 participants of this study showed moderate to high preference for free choice, any conclusions regarding the ontogenic or phylogenic roots of a choice situation preference are impossible to make at this time.
While only a small number of individuals participated in the current study, several patterns of responding emerged. For the three participants that did not show a preference during baseline (participants 1, 2, and 6), the effect of the ARP during the intervention phase much more consistently influenced responding towards the choice situation returning progressively higher point values. For participant 1, response allocation during the withdrawal phase matched that found during the intervention phase. Participant 2 and 6’s responding showed a relatively strong preference when reinforcer values were returned to baseline levels, however, each emitted increased switching behavior between the two choice situations during withdrawal. As these participants did not show a preference during baseline, it is reasonable to assume that some unaccounted for variable could be responsible for their responding during the withdrawal condition. It is possible that the ability to switch back and forth between the choice situation arrays was in and of itself reinforcing.

For the three participants that did show a preference for the free choice situation during baseline (participants 3, 4, and 5), the effect of the ARP and return to baseline conditions was much more variable. For example, participant 3 showed the strongest free choice situation preference during baseline, but only a moderate preference for restricted choice during the intervention phase. However, when conditions were returned to baseline levels, participant 3 allocated an equal number of responses (15) between the two choice situations. Due to this, it appears that the cumulative effect of a baseline choice situation preference and a reinforcement procedure that progressively reinforces the nonpreferred choice leads to no preference, in a way, cancelling each other out. Conversely, participant 4 showed a different response pattern between baseline and withdrawal conditions. Whereas participant 4’s free choice situation preference was not as strong as participant 3’s, participant 4 allocated all responding towards the restricted
choice situation during the withdrawal phase. Additionally, participant 4 appeared to be more sensitive to the ARP during intervention, although this might be due to the weaker preference found during baseline. Lastly, participant 5 was the only participant to recover completely to baseline levels during withdrawal. Participant 5 showed the weakest preference for the free choice situation out of the three participants that showed a preference and responded between participant 3 and 4 in regards to preference during the intervention phase. Overall, these three participants’ responding have little in common other than showing a preference during baseline.

One of the potential limitations related to earlier research (e.g., Karsina et al., 2011) was that the participants in that study were earning extra credit for college courses; performance was in no way related to the value of the reinforcement earned. In an attempt to alter and manipulate motivation, the participants in the current study were under the impression that their performance (points earned) was directly correlated with the amount of money that would be paid out to them at the end of the study. By doing so, it was hoped that participant responding would be additionally sensitive to point values and changes in them over the course of the study. At this time, no clear benefit of using money as a motivator can be determined until a replication of the study without the use of money is conducted.

There are several limitations worth mentioning related to this research. The primary limitation found in the design of this study is that baseline reinforcement was not as controlled as has historically been the case. For example, many researchers have used forced exposure trials (Karsina et al., 2011) in which the reinforcement presented is controlled and equally distributed across both choice conditions, yoked schedules (e.g., Fisher et al., 1997) in which the reinforcement in the restricted choice arrangement is yoked to reinforcement in the free choice arrangement, or through the use of highly preferred items in both conditions (e.g., Smith, Iwata,
This is done as isolating choice as a variable is challenging and failing to hold reinforcement consistent between the choice situations compromises the isolation of the choice variable. However, by designing the current research in the manner it was and using weighted probabilities for reinforcer values, the research participants never experienced a clear or salient change from one condition to the next. From the point of view of the participant, all 91 trials were relatively the same. It is unclear if this modification added more than it detracted from the quality of the research data, however, replication should allow better analysis of this procedure and its effects on preference during baseline conditions.

A second limitation of the current study is the relatively small participant sample. While each participant served as his or her own baseline, deducing larger conclusions about choice as a whole, is difficult without additional data to refer to. Again, with replication and extension, additional insights might become available. Said another way, as patterns diverged between participants, we need additional single-case analyses to help determine if the effects seen are indicative of general response patterns or were simply noise from additional unmeasured variables.

Lastly, it is important to note that the choice situation and context of the current research is only applicable to itself, for the most part. Participants playing a computer game to earn points by clicking on cells, while maybe encompassing some generality to gambling behaviors, such as whether to select your own lottery numbers or allow the system to select them for you, has very little obvious generality to choice behavior in the larger sense. This might also be why no clear correlation was found between the Maximization and Regret Scales and participant responding. Something of the mundane everyday choices people make is missed in this type of research. It is these mundane choices that the Maximization and Regret Scales seek to understand and predict.
However, this does not mean to imply that investigation of the likely mechanisms of which a complex response such as choice is affected by is not important, only that something is lost when the response occurs in such a contrived way.

Future researchers might wish to replicate and extend the research presented here in one of several ways. First, given the small participant sample used in the current study, a replication of the study as it was conducted would allow for a larger sample of response patterns to investigate. While some patterns emerged during this initial research, it is likely that additional patterns would be found along with a typical or most prevalent pattern. Second, future research might want to look at choice situation preference without the added motivation of earning money. It seems unlikely that responding would be similar when this variable is removed, but future research will be able to shed light on this. Third, all point totals used during the current study were positive integers, excluding zero. Initially, it was thought that by using only positive integers, all trials would contain some level of reinforcement. However, preliminary analysis of responding from one trial to the next taking point values earned into account shows that depending on the general range of points earned over some number of recent trials, what functioned as a reinforcer or a punisher changed. For example, while a 5 might have functioned as a reinforcer during baseline, therefore, leading to another response towards whatever choice situation the 5 occurred with, it functioned as a punisher later in the intervention phase. This effect appears to be due to the participants’ ability to compare the relative values of numbers to each other and based upon their recent experience. Further research on this phenomenon would be interesting. Additionally, the use of negative integers (numbers less than zero) would be another simple to conduct and interesting extension to the current research. Lastly, future research might want to look at social comparison as a source of motivation for participants.
completing this type of research. In such a study, the participants could be shown constant or occasional updates about how other participants performed (how many points earned) up to that point. Again, likely a relatively simple extension of the current research.
References


### Appendix A: Tables

#### Table 1

Reinforcer Value Assigned Probability Per Phase

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Non-preferred choice situation</th>
<th>Preferred choice situation</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Baseline</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-31</td>
<td>10%</td>
<td>20%</td>
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<tr>
<td>Intervention</td>
<td>32-34</td>
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</tr>
<tr>
<td></td>
<td>35-37</td>
<td>15%</td>
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<td></td>
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<td></td>
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</tr>
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<td>59-61</td>
<td>0%</td>
</tr>
<tr>
<td>Withdrawal</td>
<td>62-91</td>
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</tr>
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</table>
Figure 1. Screen shot of an initial-link choice situation (top) and the terminal-link choice situation for the restricted choice (top), free choice (middle) and control (bottom) array type.
Figure 2. Per trial total point value per phase. Solid circles are used for baseline and withdrawal phase data points. The solid square data points represent the total trial point values for the preferred choice situation while the open squares represent the inverse total trial point values for the nonpreferred choice situation.
Figure 3. Per phase choice quotients for all participants. Per phase choice quotients were determined by taking the proportion of responses allocated towards the free choice situation minus the proportion of responses allocated towards the restricted choice situation per phase. The resulting quotient is a number between 1 and -1 with 1 showing exclusive preference for the free choice situation and -1 showing an exclusive preference for the restricted choice situation.
Figure 4. Running choice quotient data for participants 1 (top) and 2.
Figure 5. Running choice quotient data for participants 3 (top) and 4.
Figure 6. Running choice quotient data for participants 5 (top) and 6.
Figure 7. Per phase cumulative record (top) and all-trials cumulative record for participant 1. Free choice is represented by the solid circle while restricted choice is represented by the solid triangle.
Figure 8. Per phase cumulative record (top) and all-trials cumulative record for participant 2. Free choice is represented by the solid circle while restricted choice is represented by the solid triangle.
**Figure 9.** Per phase cumulative record (top) and all-trials cumulative record for participant 3. Free choice is represented by the solid circle while restricted choice is represented by the solid triangle.
Figure 10. Per phase cumulative record (top) and all-trials cumulative record for participant 4. Free choice is represented by the solid circle while restricted choice is represented by the solid triangle.
Figure 11. Per phase cumulative record (top) and all-trials cumulative record for participant 5. Free choice is represented by the solid circle while restricted choice is represented by the solid triangle.
Figure 12. Per phase cumulative record (top) and all-trials cumulative record for participant 6. Free choice is represented by the solid circle while restricted choice is represented by the solid triangle.
Figure 13. Maximization Scale scores for each participant along with a factor breakdown of the Maximization Scale. Regret Scale scores are shown in white on the right-hand side of each participant display.