An Examination of Behavioral History Effects on Preference for Choice in Elementary Students

Dissertation

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Abstract

The current investigation examined the effects of behavioral history on elementary students’ preference for making a choice in two studies. Previous research on choice has focused on the arrangement of current contingencies and has not accounted for the effects of behavioral history. Study 1 examined participants’ preference for two options (i.e., two math problems) or one option (i.e., one math problem) conditions based on prior exposure to certain option conditions. During baseline, participants were allowed to choose to complete math problems in either the two or one option condition. During the history building condition, participants were exposed to either two options, one option, or a mixed condition (alternating between two and one option conditions). The subsequent return to baseline assessed behavioral history effects on preference for choice. The results of Study 1 indicated that behavioral history did not affect the preference for choice for 4 of the 6 participants. For 2 participants, behavioral history effects were possible; however, responding was variable across sessions and across replication of the conditions. Study 2 assessed the effects of behavioral history on selection of a reinforcer. Experimental conditions were set up similar to Study 1. During baseline, participants were able to choose math problems to complete that resulted in the participant selecting the reinforcer or the experimenter selecting the reinforcer. During the history building condition, participants were exposed to either the participant selects the reinforcer, the
experimenter selects the reinforcer, or a mixed condition (alternating between the participant or experimenter selecting the reinforcer). The subsequent return to baseline assessed behavioral history effects on preference for who selected the reinforcers. The results from Study 2 indicated that preference for selection of the reinforcer was highly individualized. Study 2 was not able to adequately control for the influence of confounding variables. The lack of experimental control resulted in either no or minimal effects of behavior history on preference for selection of a reinforcer.

Keywords: Behavioral history, preference, choice, free or forced choice, academic tasks, reinforcers
Dedication

I would like to dedicate this dissertation to my parents, Jim and Laura Haberlin, and grandmother, Noni, whose encouragement and support has helped me in ways they will never fully know. Without them, I could never have accomplished what I have done. No matter how far away, their presence is felt in every goal I achieve and every lesson I learn.
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Chapter 1: Introduction

Preference for Choice

Researchers across many domains (e.g., psychology, education, and economics) have examined the effects of choice on the behavior of organisms. Choice is an important part of any person’s life. Particularly, choice allows people to express their preferences and allows them to have some control over their environment (Cannella, O’Reilly, & Lancioni, 2005). For example, the first amendment of The Bill of Rights of the United States of America is founded on ideals of freedom to choose religion, where to assemble, or what say or write. The freedom to choose has been at the forefront of the American society.

Offering students choices is a way for students to express their preferences in an activity and to allow them to gain more control over their environments (Cannella et al., 2005). Choices can be offered in numerous contexts, such as the order of academic activities, meals, choosing a friend to sit next to, play materials, etc. When children are given choices they tend to be more cooperative, engaged in the activity, and better behaved (Cole & Levinson, 2002; Graff, Libby, & Green, 1998; Killu, Clare, & Im, 1999). In classroom settings, children with disabilities are taught specific curricula that may include academic (e.g., reading, math, science, etc.) and/or functional daily living (e.g., tooth brushing, toileting, grocery shopping, etc.) skills. The number of choices provided to a student could be limited because of the need for teachers to ensure that
students meet their educational requirements in the time allotted for a school year. Allowing students choice making opportunities during lessons (e.g., which activity to complete first, what book to read, type of snack, color of markers, etc.) could slow the down the teaching process, particularly if students are indecisive or have long processing times. These inconveniences to teachers should not be reasons to limit the choices available to students. Given that choice is an important component to teaching students and is an avenue for students to express their preferences, researchers have to examine factors that influence choice in a variety of contexts.

**Preference for Free or Forced Choice Arrangements in Basic Research**

Research has indicated that many different species prefer free choice situations when choice alternatives are similar (Catania, 1975; Catania & Sagvolden, 1980; Cerutti & Catania, 1986; Suzuki, 1997; 1999). For the purpose of this paper, free choice will refer to a situation in which an organism can respond to two or more options, and each option leads to a consequence. Previous research has defined forced choice as a situation in which the organism can respond to only one option that leads to a consequence (Catania, 1975; Catania & Sagvolden, 1980; Ono, 2004). If the organism prefers an arrangement with two or more options, then it can be said that the organism prefers free choice to forced choice arrangements (Ono, 2000). Preference for a free choice arrangement has been demonstrated in pigeons (Catania, 1975) and humans (Suzuki, 2000).

Literature on preference for free or forced choice has examined the effects of altering environmental variables, such as varying the number of options (Suzuki, 1997; 1999; 2000), providing informative stimuli (Catania, 1975), varying stimulus position
(Catania & Sagvolden, 1980), and varying the probability and dimension of the reinforcer (Hayes, Kapust, Leonard, & Rosenfarb, 1981; Suzuki, 1997; 1999; 2000). These studies provided evidence that there was preference for free choice arrangements and this preference was not due to stimulus variables related to number, position, or informational value of the stimuli. In addition, these studies provide some support that preference for a free choice arrangement was not influenced by changes to the current environmental arrangements, but that preference for free choice alternatives had been developed due to past experiences.

Ono (2000) was interested in examining preference for choice when reinforcement for the alternatives was uncertain (i.e., probability less than 1) and certain (i.e., probability of 1). The results from this study were interesting. The pigeons exposed first to the uncertain condition demonstrated a strong preference for free choice. Following exposure to the certain condition, the pigeons demonstrated indifference between free and forced choice. However, the pigeons that were first exposed to the certain condition followed by the uncertain condition demonstrated indifference for either free or forced choice alternatives across both of the conditions. Results from this study suggested that history effects of prior contingencies changed preference for choice.

**Development of Preference for Choice**

Catania (1975) and Catania and Sagvolden (1980) discussed the results of their studies in relation to ontogenic and phylogenic origins of preference for choice. Ontogeny refers to the history of an organism’s interactions with the environment, that is, characteristics that are learned or acquired in the organism’s lifetime. Phylogeny refers to the evolutionary history of the organism, that is, characteristics that are innate, genetic, or
hereditary (Pear, 2001). Catania stated that past environmental interactions could aid in the development of preference. For example, a pigeon may have learned from previous exposure to the key lights that choosing the option with more alternatives would lead to a greater probability of accessing a reinforcer. However, choosing an alternative with one option would lead to a situation where the probability of reinforcement might be less. An ontogenic origin of preference assumes that the organism has had similar experiences over time. That is, the organism has been exposed to both free and forced choice situations and, based on these experiences, has developed a preference for a free choice arrangement. A phylogenic origin of preference suggests that over the course of an organism’s evolutionary history, choice situations have led to a better chance of survival (i.e., access to better food supplies). Thus, an organism that prefers free choice is more likely to survive and breed; transmitting this preference to its offspring (Skinner, 1975).

Although Catania (1975) and Catania and Sagvolden (1980) provided some ideas on the development of preference for choice, other researchers have developed more specific ideas on how preference for choice is developed. Fisher et al. (1997) proposed that choice could be looked at as a conditioned reinforcer. A conditioned reinforcer is a stimulus that was initially neutral and through repeated pairings with another reinforcer, the stimulus functions as a reinforcer itself. That is, choice has been paired with preferred reinforcers, and because of these pairings, the act of choosing has developed reinforcing properties. Thus, a preference for choice could be viewed as a preference for a conditioned reinforcer. This views choice as a reinforcer for responding. Given the view of choice as a conditioned reinforcer, then it is plausible that choice is susceptible to motivating operations as well. That is, as a conditioned reinforcer, choosing could be
susceptible to satiation and deprivation. Another possible interpretation of choice as a conditioned reinforcer is that if choice has been paired with less preferred items, then the motivation to engage in choice would decrease. The repeated pairings of free choice with less preferred items could lessen the value of free choice, thus reducing preference for free choice and/or increasing preference for the forced choice option.

**Choice Research in Applied Settings**

Research has indicated that providing choices to people with disabilities has a positive impact on their lives. Choice research has demonstrated that choices can reduce problem behavior and/or increase participation in activities (Cole & Levinson, 2002; Graff et al., 1998; Killu et al., 1999).

Applied studies on choice have used both a single operant and concurrent operant designs. The type of design chosen for the study seems to influence the results of the study. In single operant research, demonstration of a preference for free choice or forced choice has been inconsistent. However, multiple studies examining choice using concurrent operant designs have demonstrated a more consistent preference for free choice conditions (Fisher et al., 1997; Geckeler, Libby, Graff, & Ahearn, 2000; Hanley, Piazza, Fisher, Contrucci, & Maglieri, 1997; Hanley, Piazza, Fisher, & Maglieri, 2005; Thompson, Fisher, & Contrucci, 1998; Tiger, Hanley, & Hernandez, 2006).

When single operant designs are used, researchers have demonstrated that responding is generally similar between the free choice condition and yoked forced choice condition when the same stimuli are used across conditions. (Bambara, Ager, & Koger, 1994; Killu et al., 1999; Mintz, Wallace, Najdowski, Atcheson, & Bosh, 2007; Parsons, Reid, Reynolds, & Bumgarner, 1990). These studies give the impression that in
applied settings humans preferred both choice and yoked forced choice arrangements when similar stimuli are provided. However, the use of a single operant design in these studies makes it difficult to identify if there is a preference for making a choice because there is no direct comparison of the opportunity for making a choice versus not making a choice. It may be that the use of highly preferred items was responsible for the increase in respond rather than the opportunity to make a choice (Gaff et al., 1998; Lerman et al., 1997).

Few researchers have compared participant responding under concurrent and single operant designs (Brigham & Sherman, 1973; Geckeler et al., 2000; Graff & Libby, 1999; Smeltzer, Graff, Ahearn, & Libby, 2009). The results of these studies indicated that responding was similar across both free and forced conditions during the single operant arrangement. However, when a concurrent operant arrangement was used, participants allocated more responding toward the free choice option. These studies suggested that it might be more difficult for participants to discriminate conditions when a single operant arrangement is used.

A number of researchers have examined participant preference for an intervention or reinforcer under concurrent operant arrangements (Fisher et al., 1997; Hanley et al., 1997; Hanley et al., 2005; Heal & Hanley, 2007; Tiger et al., 2006). Tiger et al. (2006) examined 6 preschool children’s preference for making a choice in a series of studies. These studies used a concurrent operant arrangement to demonstrate how different arrangements of the reinforcer influenced preference for choice. The experiments conducted by Tiger et al. indicated that (a) free choice is not always preferred over a forced choice condition, and (b) the value of choice increased as more selection options
were provided. These studies demonstrated that a concurrent operant design was sensitive to preference for different choice arrangements.

Conclusions about Choice Research

Both basic and applied studies have repeatedly shown that organisms prefer making a choice. Basic and applied researchers have looked at how current contingencies have affected preference for free choice. However, more research is needed to examine how additional variables influence the preference for free choice. In addition to the variables already mentioned, history effects could also influence preference for choice in educational contexts. Behavior exists on a continuum and historical influences could affect preference for making a choice.

Behavioral History

Most operant research has focused on examining how current contingencies in the environment influence responding. Researchers who examine current environmental arrangements are under the assumption that implementing the new environmental conditions long enough will override any effects of prior histories of responding (Salinger, 1996). It may be that researchers are more interested in studying behavior under current contingencies because many studies that have investigated operant conditioning have demonstrated that behavioral history effects are weak or occur for a short period of time.

Defining Behavioral History

Skinner (1953) stated that an organism’s present behavior could be explained by variables in the current and past environments. Freeman and Lattal (1992) proposed a definition of behavioral history that has been cited more recently in the research
literature. These researchers defined behavioral history effects as sources of control over current responding that have not been eliminated by current contingences, and confounds the obtained functional relations between responding and the current contingences. A parsimonious definition of behavioral history may be difficult to achieve given that the definition may need to discuss proximal versus distal histories, extra-experimental versus experimental history, research design, and permanence of history effects.

**Proximal versus distal history.** Proximal histories would be a history of responding that was temporally close to the experimental conditions that test if history effects are present. Distal histories would be a history of responding that was established further away in time from the experimental conditions that test for the behavioral history effects. Most studies investigating behavioral history effects have looked what could be classified as effects of proximal histories. That is, histories that have been developed days and weeks before a test of history effects occur. A reason that researchers have not investigated the effects of distal behavioral histories may be that longitudinal studies can be difficult due to the financial, logistical requirements, and time costs required to examine different lengths of history on current responding.

**Extra-experimental versus experimental history.** Basic non-human animal research uses naïve subjects for experiments (i.e., non-human animals with no programmed experience with contingencies from prior experiments; non-human animals will be referred to as animals). Using naïve subjects helps to minimize the effects of prior histories on experimental conditions. Nevertheless, no subject is completely naïve. Each subject will bring its experiences of being raised, transported, and housed in various laboratory settings (Wanchisen, 1990). These events can influence responding during
experimental conditions. One of the main issues raised about the differences between human and animal research is the different types of the behavioral histories. People live in highly individualized living arrangements, and this may contribute to variations between extra-experimental histories in humans; however, animals live in more controlled settings and develop similar extra-experimental histories (Wanchisen & Tatham, 1991). The difference between extra-experimental histories may be due to the number of extra-experimental experiences each organism brings to the study rather than the effect of similar versus non-similar experimental histories. An inclusion of this type of history in a definition of behavioral history may be too large and would not be reliable for experimental use.

**Experimental design.** Research studies need to be designed to build and test behavioral history effects. Thus, studies should include a history building condition and history testing condition. In the history building condition, the researcher exposes the participant to a particular set of contingencies until steady state responding is achieved. The purpose of this condition is for the participant’s responding to come under the control of the current contingencies; thus, establishing a history of responding under a new, experimenter arranged set of contingencies. A single-subject design would test history effects in a reversal design (ABA). The A condition is used as a baseline to assess response levels under a particular contingency arrangement without prior history manipulations. The following B condition would be the history building condition. The purpose of this condition is to establish steady state responding under the contingency arrangements. The return to condition A is to test for the presence of history effects. Responding in the second presentation of condition A is compared to responding in the
first presentation of condition A. If there is a difference between the A conditions, this would lead the researcher to identify the presence of a behavioral history effect (Tatham & Wanchisen, 1998). However, an ABA design has been used minimally in behavioral history research (Metzger & Lettal, 1998; Ono, 2004; Wanchisne, Sutphin, Balogh, 1998).

A more common design is a between group design (Freeman & Lattal, 1992; Lopez & Menez, 2005; Wanchisne, Tatham, Mooney, 1989; Weiner, 1969). In a between-group design, the experimental group would be exposed to the history building condition followed by exposure to the history testing condition. The control group would be exposed to only the contingency arrangements that are present in the history testing condition. Response patterns from the history testing conditions would be compared between the experimental and control groups to identify if there is a behavioral history effect.

**Permanence of history effects.** Behavioral history research should recognize that some history effects are short-term, causing a transition state, while other history effects are long-term and will permanently affect behavior. A transition state is defined as responding that changes from one steady state of performance to a different steady state of performance (Johnston & Pennypacker, 1993). Many behavioral history effects can be look at as a transition from previously arranged contingencies to the current contingencies.

**Behavioral History Effects on Schedules of Reinforcement**

Wanchisen (1990) stated that an examination of behavioral history should begin with examining history effects in relation to schedules of reinforcement. Research on
schedules of reinforcement has been vast and has demonstrated that there is a predictable pattern of responding for the different types of schedule arrangements, particularly for animals. Using schedules of reinforcement as a manner to systematically analyze behavioral history effects can provide some insight as to how history effects develop and persist.

Behavioral histories have typically been examined in the context of a fixed ratio (FR) or differential reinforcement of low rate behavior (DRL) schedule on a subsequent fixed interval (FI) schedule of reinforcement (Baron & Leinenweber, 1995; Lopez & Menez, 2005; Wanchisen et al., 1989; Weiner, 1964; 1969). After an FR or variable ratio (VR) history building condition, responding on a following FI schedule was initially high, and then decreased to an intermediate level (Wanchisen et al., 1989; Weiner, 1964, 1969). When a DRL schedule was in place during a history building condition, responding on a following FI schedule was low, and then increased until it stabilized at an intermediate level (Weiner, 1964, 1969). Doughty et al. (2005) obtained similar results when testing the effects of a VR and DRL behavioral history on a subsequent variable interval (VI) history testing condition.

Weiner (1969) speculated that FI schedules share important characteristic with FR schedules such as response-dependent reinforcement and reinforcement that is not contingent on inter-response time as in DRL schedules. Responding on an FI schedule can vary within the interval yet still produce the same number of reinforcers. It may be that the participants had a difficult time discriminating the difference between the FR and FI conditions because the number of responses emitted could be similar and/or the number of reinforcers received could be similar.
A majority of the research examining the effects of behavioral history has used a
time-based history testing condition (i.e., FI or VI). Cohen, Pedersen, Kinney, and Myers
(1994) examined the history effects with progressive ratio (PR) schedules of
reinforcement. A PR schedule is when a reinforcer is delivered after a fixed number of
responses, and this number is increased after each reinforcer delivery until some break
point (i.e., responding stops) is reached. Cohen et al. demonstrated that history effects
were similar to other studies, that is VR and FR schedules produced higher responding as
compared to the DRL schedule on the PR schedule. However, these effects were short
lived, only lasting a few sessions. These results are similar to some studies (Baron &
Leinenweber, 1995; Wanchisen, et al., 1989) but dissimilar to other studies (Weiner,
1964; 1969). Cohen et al. speculated that FI schedules might be more sensitive to history
effects than PR schedules. Under a FI schedule, a wide range of response rates can still
produce similar reinforcement rates whereas on a ratio schedule, the rate of reinforcement
is directly tied to the number of responses. Thus, responding on a ratio schedule is more
likely to come under control of the current contingencies and be affected less by history
effects.

The results of these studies indicated that the schedule of reinforcement used
during the history building condition did have an effect on the subsequent history testing
condition. The largest effect of the history building condition was likely to occur during
the initial sessions of the history testing condition, rather than during sessions that
occurred after extended exposure to the new schedule of reinforcement. Schedules with
lower response rates (i.e., DRL) produce a greater resistance to change (Doughty et al.,
2005). As a group, these studies provide evidence that behavioral history effects are
generally transitory when studied under most schedules of reinforcement, particularly ratio schedules of reinforcement. More research on behavioral history and transition states could provide information on how to control transition states based on the type of schedule of reinforcement present in the history building condition (Metzger & Lattal, 1998).

Applied Implications of Behavioral History Research

Challenging behavior that is resistant to interventions for a short time may partly be a function of history effects from prior conditions (Martens et al., 2003). Individual differences in children’s responsiveness to intervention procedures are likely due in part to different reinforcement histories. Identifying schedules of reinforcement that are more persistent can provide some indication that resistance to new interventions may occur, or provide some indication that new interventions may need a longer time to take full effect. On the other hand, identifying schedules of reinforcement that are more persistent can aid in developing interventions that will be more resistant to treatment integrity failures and aid in generalization procedures.

Choice and Behavioral History

The above discussion has presented the literature related to preference for choice and behavioral history effects separately. An analysis of the literature has indicated that these two areas of behavior analysis have been studied jointly in a few studies. Two applied studies have looked at behavior history effects on choice responding (Neef et al., 2004; Martens et al., 2003). Martens et al. (2003) indicated that exposure to a certain schedule of reinforcement can affect the selection and accuracy of math problems. Neef et al. (2004) indicated that exposure to certain antecedent interventions can effect choice
responding under new contingency arrangements. These studies provided some initial evidence that behavioral history can affect choice making behavior in applied contexts.

To date only, one published study has investigated the effects of behavioral history on preference for making a choice. Ono (2004) examined how different arrangements of behavioral history could influence 3 pigeons’ preference for a free or forced choice. The study used an ABA design, where A was baseline and B was the history building condition. During the baseline condition, preference for free or forced choice alternatives was assessed. In the history building condition, each pigeon was exposed to a different experimental arrangement: forced choice, free choice, or a mix of both free and forced choice alternatives. The results of this experiment demonstrated that during the first baseline, all pigeons expressed a preference for the free choice alternative. The results from the second baseline were interesting. For the pigeon exposed to the forced choice history building condition, preference was clearly for the free choice alternative. For the pigeon exposed the free choice history building condition, initial preference was for the force choice alternative, and with continued exposure to the contingencies, preference shifted toward indifference between free and forced choice alternatives. For the pigeon exposed to the mixture of both choice alternatives, there was no change in preference relative to the baseline condition. These results demonstrated that preference for choice was influenced by behavioral history and that history effects were similar to the findings of other studies, in that history effects were transient in nature.

A possible explanation for the occurrence of the results in the Ono (2004) study is motivating operations. That is, preference for choice could be susceptible to motivating
operations. Michael (2004) stated that a motivating operation is an environmental event or stimulus condition that has two functions: it alters the effectiveness of another event (e.g., reinforcement or punishment) and it alters the occurrence of behaviors associated with that event. In Ono’s study, pigeons had selected the free choice alternative during the initial baseline. In the history building condition, one pigeon was given forced exposure to the free choice alternative. The combination of free choice selection in baseline and the history building condition could have satiated the pigeon’s preference for free choice. Thus, during the history testing condition, the pigeon’s initial preference for forced choice could be due to satiation of free choice.

**Summary and Purpose of this Study**

The number of studies on choice and the expression of preference make it clear that it is an important area of research. Choice has been examined in both basic and applied research to identify how preference is influenced and how this preference relates to response outputs; however, the variables that influence preference for choice have not been completely studied in the empirical literature. Developing an understanding of how behavioral history influences choice in the classroom may provide more insight as to why challenging behavior persists in classroom settings and/or how to maintain appropriate behavior.

The purpose of the current investigation was to examine the effects of behavioral history on preference for making a choice for children who are typically developing and with moderate disabilities. The specific research questions addressed were: (a) how will past choice experiences affect preference for choosing academic tasks? and (b) how will behavioral history affect preference for selecting a reinforcer?
Chapter 2: Literature Review

The purpose of this literature review is to summarize the relevant literature on preference for choice in basic and applied settings, behavioral history effects, and behavior history effects on preference for choice. First, basic and applied literature on preference for choice will be discussed. Examples of how making a choice corresponds to response output and a reduction of challenging behavior in applied settings are reviewed. Second, basic research on behavioral history effects will be examined. Finally, research on behavioral history and preference for making a choice will be reviewed. Each of these areas of research are relevant to review because there are few applied studies that have examined preference for making a choice in relation to a history of choice making. The research literature is discussed in terms of what has been conducted, limitations of the literature, and focus on the current study. Specifically, the presented research will be examined to address the following question: What has research indicated to suggest behavioral history affects an organism’s preference for making a choice?

Preference for Choice

Researchers across many domains (e.g., psychology, education, and economics) have examined the effects of choice on the behavior of organisms. Choice is an important part of any person’s life. Particularly, choice allows people to express their preferences and allows them to have some control over their environment (Cannella, O’Reilly, & Lancioni, 2005). For example, the first amendment of The Bill of Rights of the United
States of America is founded on ideals of freedom to choose religion, where to assemble, or what say or write. The freedom to choose has been at the forefront of the American society.

Offering students choices is a way for students to express their preferences in an activity and to allow them to gain more control over their environment (Cannella et al., 2005). Choices can be offered in numerous contexts, such as the order of academic activities, meals, choosing a friend to sit next to, play materials, etc. When children are given choices they tend to be more cooperative, engaged in the activity, and better behaved (Cole & Levinson, 2002; Graff, Libby, & Green, 1998; Killu, Clare, & Im, 1999). In classroom settings, children with disabilities are taught specific curricula that may include academic (e.g., reading, math, science, etc.) and/or functional daily living (e.g., tooth brushing, toileting, grocery shopping, etc.) skills. The number of choices provided to a student could be limited because of the need for teachers to ensure that students meet their educational requirements in the time allotted for a school year. Allowing students choice making opportunities during lessons (e.g., which activity to complete first, what book to read, type of snack, color of markers, etc.) could slow the down the teaching process, particularly if students are indecisive or have long processing times. These inconveniences to teachers should not be reasons to limit the choices available to students. Given that choice is an important component to teaching students and is an avenue for students to express their preferences, researchers have to examine factors that influence choice in a variety of contexts.
Preference for Free or Forced Choice Arrangements in Basic Research

Research has indicated that many different species prefer free choice situations when choice alternatives are similar (Catania, 1975; Cerutti & Catania, 1997; Suzuki, 1997; 1999). For the purpose of this paper, free choice will refer to a situation in which an organism can respond to two or more options, and each option leads to a consequence. Previous research has defined forced choice as a situation in which the organism can respond to only one option that leads to a consequence (Catania, 1975; Catania & Sagvolden, 1980; Ono, 2004). If the organism prefers an arrangement with two or more options, then it can be said that the organism prefers free choice to forced choice arrangements (Ono, 2000). Preference for a free choice arrangement has been demonstrated in pigeons (Catania, 1975), humans (Suzuki, 1999).

Studies that have examined preference for choice in the basic research have typically used concurrent-chain procedures. The following is a description of a concurrent-chain procedure of a choice arrangement using a pigeon in an operant chamber as an example (see Figure 1). In this procedure, there are two links in a response chain: the initial and terminal link. During the initial link, two keys are illuminated (e.g., red and white). If the pigeon responds to either of the keys (e.g., pecks the red key), this will activate a particular schedule of reinforcement (e.g., variable interval 10 s). When the initial link schedule requirement has been met, the pigeon will enter the terminal link. If the pigeon chooses the free-choice terminal link then two keys will be illuminated. If the pigeon chooses the forced choice terminal link, then only one key will be illuminated. Upon completion of the terminal-link schedule requirement, the pigeon will be given access to a primary reinforcer (e.g., food). Regardless of the terminal link chosen, the
pigeon will receive the same schedule of reinforcement and access the same reinforcer. The responses made in the initial link of the chain are used to measure preference for free or forced choice.

Figure 1. Diagram of a two-link concurrent chain procedure. During the initial link, two keys are illuminated. Pecks on the left key leads to a forced choice trial in the terminal link while pecks on the right key leads to a free choice trial in the terminal link. The completion of the terminal link leads to the reinforcer. After delivery of the reinforcer, initial link is reinstated.
Literature on preference for free or forced choice has examined the effects of altering environmental variables, such as varying the number of options (Suzuki, 1997; 1999; 2000), providing informative stimuli (Catania, 1975), varying stimulus position (Catania & Sagvolden, 1980), and varying the probability and dimension of the reinforcer (Hayes, Kapust, Leonard, & Rosenfarb, 1981; Ono, 2000; Suzuki, 1997; 1999; 2000).

Catania (1975) conducted a series of experiments that investigated pigeons’ preference for free choice versus forced choice. Using a concurrent-chain procedure, Catania demonstrated that pigeons chose a free choice arrangement over a forced choice arrangement when reinforcement for each alternative was held constant. In addition, the study demonstrated that pigeons had a preference for stimuli that were informative (i.e., keys colors were associated with a particular consequence). This indicated that preference was influenced by the current stimuli in the environment.

Catania and Sagvolden (1980) replicated the results of Catania’s (1975) study on preference for free or forced choice while systematically examining other stimulus variables (i.e., number of stimuli, position, and informational signals). This study assessed how changes to the current environment could influence preference. To assess the effects of various stimulus variables, pigeons were exposed to a free choice condition in which three green keys led to the same reinforcer while one red key led to no reinforcement (i.e., extinction). In the forced choice condition, there was one green key and three red keys present. This study allowed for preference to be examined when the number of keys (i.e., four keys present) and stimulus variety (i.e., one odd color key in the stimulus array) were held constant. This study provided evidence that there was preference for a free choice arrangement and this preference was not due to stimulus
variables related to number, position, or informational value of the stimuli. This study provides some support that preference for a free choice arrangement was not influenced by changes to the current environmental arrangements, but that preference for free choice alternatives had been developed due to past experiences.

Catania (1975) and Catania and Sagvolden (1980) demonstrated that preference for a free choice alternative is preferred over a forced choice alternative when reinforcement is held constant. However, choice in everyday life does not always lead to the same amount, quality, immediacy, or magnitude of a reinforcer. Generally, organisms experience free choice situations that can include the choice between two equally preferred items, a preferred and non-preferred item, more or less of a preferred item, or constant or uncertain probability of accessing a reinforcer. The type of choice options could influence an organism’s preference for free or forced choice alternatives.

Many studies that have examined preference for choice alternatives have delivered the reinforcer with a probability of 1. That is, every time the terminal link is completed the organism will receive the reinforcer. Ono (2000) was interested in examining preference for choice when reinforcement for the alternatives was uncertain (i.e., probability less than 1) and certain (i.e., probability of 1). In the uncertain condition, the initial link led to either a forced choice or free choice terminal link. In the free choice terminal link, two keys were present; each key was randomly assigned a fixed interval (FI) schedule of reinforcement or extinction with a probability of 0.5. The responding on the FI schedule key resulted in access to food while responding on the extinction key resulted in no access to food. In the forced choice terminal link, one key was lit, with the probability of 0.5 of being programmed with the FI schedule of reinforcement or
extinction. In the certain condition, completion of either the forced or free choice terminal link led to food. Pigeons experienced both certain and uncertain conditions in a counterbalanced arrangement. The results demonstrated that the pigeons exposed first to the uncertain condition demonstrated a strong preference for free choice. Following exposure to the certain condition, the pigeons demonstrated indifference between free and forced choice. However, the pigeons that were exposed first to the certain condition followed by the uncertain condition demonstrated indifference for either free or forced choice alternatives across both of the conditions.

The results from the group of pigeons exposed to the certain followed by the uncertain condition differ from previous research on preference for free or forced choice (Catania, 1975; Catania & Sagvolden, 1980; Cerutti & Catania, 1986). One possible explanation for the different results could be due to some procedural variations such as using the same color key lights on all terminal link alternatives or that a peck on the terminal link light turned off the other key light. Other studies have used different key lights to indicate a difference between two schedules in the terminal link and have kept these keys lit. This study elucidated that certain procedural variables could possibly influence preference for choice, particularly when reinforcement is uncertain. Results from this study also suggested that history effects of prior contingencies might change preference for choice. This study provided some evidence that preference might be influenced by experience with a certain type of schedule of reinforcement. This study is relevant because the uncertain condition is an example of an intermittent schedule of reinforcement. Research has indicated that intermittent schedules of reinforcement should prolong responding. However, this study demonstrated that preference was not
maintained after a history of intermittent reinforcement. This may indicate that preference for choice is influenced by the frequency of reinforcement and may degrade quickly when the schedule for reinforcement is faded too quickly.

Hayes et al. (1981) investigated pigeons’ preference for free and forced choice when the choice alternative included a preferred alternative or non-preferred alternative. In this study, a green key was associated with a 4 s delay to food then 4 s access to food and a red key was associated with immediate access to food for 2 s. Over the course of the experiment, the length of access to the immediate food alternative was shortened to 0.25 s. Pigeons demonstrated a preference for the forced choice condition (i.e., access to the green key). The results of this experiment demonstrated that pigeons did not prefer the free choice alternative when one of the alternatives in the choice arrangement led to a decrease in access to food (i.e., non-preferred alternative). Hayes et al. concluded that when free choice includes an unfavorable alternative, the organism may demonstrate indifference toward free choice or avoid the free choice alternative.

The results of Hayes et al. (1981) concluded that free choice might not always be the preferred option. However, their experiment varied different dimensions of reinforcement against each other. That is, the researchers looked at delayed reinforcement with constant access to the reinforcer compared to immediate reinforcement with decreasing access to the reinforcer. This study altered the current environment to shift preference from free to forced choice or indifference between the arrangements. As compared to Catania and Sagvolden (1980), who had manipulated different dimensions of the stimulus, manipulating different dimensions of the reinforcer appeared to have more influence over preference in the current environment. It may be that that varying
reinforcer dimensions is more powerful than varying dimensions of a stimulus in changing preference for free choice.

Research on preference for free choice has examined varying the probability and dimension of reinforcement between choice alternatives while others have examined varying the number of choices between the free and forced choice alternatives (Suzuki, 1999). Suzuki (1997; 1999; 2000) conducted a number of studies that investigated the number of choice alternatives on preference for choice across a variety of species. Suzuki (1997) examined how the number of options and varying the amount of reinforcement in the free choice alternative would affect preference for free or forced choice in undergraduate participants. Suzuki (1997) used a concurrent-chain procedure, where undergraduate students made choices via button presses on a computer. Participants were divided into three different groups; each group received a different experimental arrangement. Groups 1 and 2 were exposed to one option versus two option conditions with different amounts of reinforcement available in the two option condition. For example, in the one option condition, a participant could earn 10 points, and in the two option condition, the participant could earn 10 or 15 points. The third group of participants was presented with three options in the free choice condition (i.e., the participant could earn 10, 15, or 15 points). The terminal link provided reinforcement with a probability of 0.4 regardless of experimental arrangement.

The results of this study indicated that humans preferred a free choice condition to a forced choice condition. That is, preference for the free choice over the forced choice condition did not depend on the number of options (i.e., two or three). Nor did it depend on the different point values available in the free choice condition. A between group
comparison indicated that participants preferred three options to the two options when point values were equal to or were equal to and greater than the two option condition. Suzuki replicated these results with monkeys (1999) and again with undergraduates (2000). The conclusions from these studies suggest that organisms will continue to prefer a free choice condition when the options are either equal to or greater than the forced choice condition.

Basic research has provided a foundation to examine preference for choice making in the natural environment. These studies have demonstrated that when reinforcement is held constant between free and forced choice arrangements, the organism will prefer the free choice arrangement. When the probability of the reinforcer is certain or uncertain, the order of exposure to free or forced choice can influence preference for free choice. However, when dimensions of reinforcement are altered, shifts in preference from free choice to forced choice or indifference have been observed. Finally, multi-choice alternatives are preferred even when one of the alternatives is equal to the force choice alternative.

Future research should compare the effects of changing stimulus and reinforcer dimensions on preference for choice. Additionally, when examining the effects of certain or uncertain reinforcement on preference for choice researchers should investigate if how procedural differences influence the results of the study.

These studies support the conclusion that the ability to make a choice is a preferred behavior across organisms. However, a majority of the studies discussed in this section manipulated variables in the current environment and measured the effects on preference for choice. To develop a better understanding of how preference for free
choice is influenced, researchers need to examine other influences such as the effects of behavioral history.

Development of Preference for Choice

Catania (1975) and Catania and Sagvolden (1980) discussed the results of their studies in relation to ontogenic and phylogenic origins of preference for choice. Ontogeny refers to the history of an organism’s interactions with the environment, that is, characteristics that are learned or acquired in the organism’s lifetime. Phylogeny refers to the evolutionary history of the organism, that is, characteristics that are innate, genetic, or hereditary (Pear, 2001). Catania stated that past environmental interactions could aid in the development of preference. For example, a pigeon may have learned from previous exposure to the key lights that choosing the option with more alternatives would lead to a greater probability of accessing a reinforcer, whereas choosing an alternative with one option would lead to a situation in which the probability of reinforcement might be less. An ontogenic origin of preference assumes that the organism has had similar experiences over time. That is, the organism has been exposed to both free and forced choice situations and, based on these experiences, has developed a preference for a free choice arrangement. A phylogenic origin of preference suggests that over the course of an organism’s evolutionary history, choice situations have led to a better chance of survival (i.e., access to better food supplies). Thus, an organism that prefers free choice is more likely to survive and breed; transmitting this preference to its offspring (Skinner, 1975)

In the studies conducted by Catania (1975) and Catania and Sagvolden (1980), pigeons’ individual preference for the free choice option was consistent throughout the experiment, indicating that preference for free choice was not influenced by current
environmental arrangements. Additionally, the consistency of the pigeons’ preference could provide evidence that preference for free choice was developed through either ontogenic or phylogenic sources. The study conducted by Ono (2000) provided some evidence that preference is of ontogenic origins. In the Ono study, the order of experimental condition resulted in different patterns of preference. Thus, based on the pigeons’ experiences with different choice arrangements, preference for the free choice alternative changed. This study involved a between group analysis and the type of experimental design could be a reason for different response patterns between the groups. Researchers should examine within-subject replications of these types of choice arrangements to determine whether or not preference for choice is influenced by history variables.

Trying to understand the origin of preference for choice and/or how preference for choice is developed will help researchers understand how the availability of choice will influence an organism’s responding. Ultimately, this information can be translated to practitioners and teachers. This information may help teachers develop a better understanding of situations in which preference for choice will change and how this will affect student responding. That is, if preference is based on phylogenic origins, then researchers and teachers can be fairly certain that this preference will be stable during the course of a study or during the school year. However, if preference for choice is ontogenic origins, then preference for choice is more susceptible to the changes in the environment. Although Catania (1975) and Catania and Sagvolden (1980) provided some ideas on the development of preference for choice, other researchers have developed more specific ideas on how preference for choice is developed.
Fisher et al. (1997) proposed that choice could be looked at as a conditioned reinforcer. A conditioned reinforcer is a stimulus that was initially neutral and through repeated pairings with another reinforcer, the stimulus functions as a reinforcer itself. That is, choice has been paired with preferred reinforcers, and because of these pairings, the act of choosing has developed reinforcing properties. Thus, a preference for choice could be viewed as a preference for a conditioned reinforcer. This views choice as a reinforcer for responding. Given the view of choice as a conditioned reinforcer, then it is plausible that choice is susceptible to motivating operations as well. That is, as a conditioned reinforcer, choosing could be susceptible to satiation and deprivation.

Another possible interpretation of choice as a conditioned reinforcer is that if choice has been paired with less preferred items, then the motivation to engage in choice would decrease. The repeated pairings of free choice with less preferred items could lessen the value of free choice, thus reducing preference for free choice and/or increasing preference for the forced choice alternative.

**Choice Research in Applied Settings**

Research has indicated that providing choices to people with disabilities has a positive impact on their lives. Choice research has demonstrated that choices can reduce challenging behavior and/or increase participation in activities (Cole & Levinson, 2002; Graff et al., 1998; Killu et al., 1999). Applied research has demonstrated that individuals with disabilities can engage in choice making behavior and choice has led to the identification of preferred stimuli (DeLeon & Iwata, 1996; Fisher et al., 1992). In addition to identifying preferred stimuli, choice has been studied as an intervention.
Choice interventions have looked at choice as an antecedent intervention (e.g., selection of a task) or a consequence intervention (e.g., selection of a reinforcer).

Applied studies on choice have used both a single operant and concurrent operant designs. The type of design chosen for the study seems to influence the results of the study. In single operant research, demonstration of a preference for free choice or forced choice has been inconsistent. However, multiple studies examining choice using concurrent operant designs have demonstrated a more consistent preference for free choice conditions (Fisher et al., 1997; Geckeler, Libby, Graff, & Ahearn, 2000; Hanley, Piazza, Fisher, Contrucci, & Maglieri, 1997; Hanley, Piazza, Fisher, & Maglieri, 2005; Thompson, Fisher, & Contrucci, 1998; Tiger, Hanley, & Hernandez, 2006).

**Single operant research.** Single operant research is research that arranges one option for the target response to access the consequence. This method of research has been used to examine the effects of choice on task completion or the reduction of problem behavior. Responses are compared between free choice, forced choice, and/or a yoked forced choice condition. Under these arrangements, preference for free choice is assessed by higher responding for on-task behavior or lower occurrences of challenging behavior in one condition compared to responding in another condition.

Some researchers have studied the effects of a free choice and forced choice on the reduction of challenging behavior (Cole & Levinson, 2002; Romaniuk et al., 2002; Vaughn & Horner, 1997). Each of these studies used preferred items in the free choice condition and an experimenter-selected, less preferred item in the forced choice condition. The studies conducted by Cole and Levinson and Vaughn and Horner indicated that participants responded more favorably in the free choice condition as
compared to the forced choice condition. However, Romaniuk et al. found that 4 of the 7 participants responded better in the free choice condition than the forced choice condition. Romaniuk et al. suggested that free choice was more effective for participants whose challenging behavior was maintained by escape from a demand than by attention. This study indicated that the type of choice option presented influenced preference for free or forced choice conditions.

Other researchers using single operant designs have examined the effects of free choice, yoked forced choice, and forced choice conditions on on-task behavior, number of correct responses, and the reduction of challenging behavior for children and adults with disabilities. When single operant designs are used, researchers have demonstrated that responding is generally similar between the free choice condition and yoked forced choice condition when the same stimuli are used across conditions. (Bambara, Ager, & Koger, 1994; Killu et al., 1999; Mintz, Wallace, Najdowski, Atcheson, & Bosh, 2007; Parsons, Reid, Reynolds, & Bumgarner, 1990). Tasky, Rudrud, Schulze, and Rapp (2008) examined the effects of choice on task sequence in adults with traumatic brain injury. Interestingly, the results of this study were different from the studies mentioned previously, in that the yoked forced choice condition had lower levels of on-task behavior than the free choice condition. However, this study did not replicate the yoked forced choice or forced choice conditions; thus, the lack of experimental control makes it difficult to relate the results from this study to other studies.

This group of studies (Bambara et al., 1994; Killu et al., 1999; Mintz et al., 2007; Parsons et al., 1990) demonstrated that when a highly preferred item is used during the free choice and yoked forced choice conditions, responding is generally similar across
both conditions. These types of studies give the impression that in applied settings humans prefer both choice and forced choice arrangements when similar and preferred stimuli are provided. However, the use of a single operant design in these studies makes it difficult to identify if there is a preference for making a choice. It may be that the use of a of highly preferred items was responsible for the increase in responding rather than the ability to make a choice. In a single operant design arrangement, there is no direct comparison of the availability of making a choice versus not making a choice as in a concurrent arrangement design. Another possible explanation of the similar responding across both free choice and yoked forced choice conditions is that the use of highly preferred items produced a ceiling effect with regards to response output or reduction of challenging behavior. That is, the use of preferred items may confound the effects of preference for choice (Gaff et al., 1998; Lerman et al., 1997).

In addition, these studies did not directly assess if there was a preference for free or forced choice, but used collateral behaviors (on-task behavior) as an indication of preference for the free or forced choice alternative. These studies would state that responding was higher is a free choice arrangement when compared to forced choice (single operant design) or more responding was allocated toward the choice option (concurrent operant design). However, many of these studies were not designed to directly assess preference for making a choice, but to assess if choice was a variable the influenced responding. Looking at these studies does provide some indication that the use of single operant designs for assessing preference for choice may be less sensitive than a concurrent operant design, making it difficult to identify a difference in responding between a free choice and forced choice condition (Lerman et al., 1997). Single operant
designs do not allow the participant to express momentary changes in preference during a session. An alternative design that is more sensitive for assessing preference for choice would be the use of a concurrent operant design.

**Concurrent operant research.** Research in applied settings has examined choice behavior in concurrent operant arrangements (Fisher et al., 1997; Geckeler et al., 2000; Hanley et al., 1997; Hanley et al., 2005; Thompson et al., 1998; Tiger et al., 2006). These studies offer more evidence that there is a preference for engaging in choice making behavior.

A few researchers have compared participant responding under concurrent and single operant designs (Brigham & Sherman, 1973; Geckeler et al., 2000; Graff & Libby, 1999; Smeltzer, Graff, Ahearn, & Libby, 2009). Graff and Libby examined the effects of reinforcer choice on the responding of 4 children with disabilities under single and concurrent operant arrangements. The results of this study indicated that responding was similar across both free and forced conditions during the single operant arrangement. However, when a concurrent operant arrangement was used, participants allocated more responding toward the free choice option. These researchers suggested that it might be more difficult for participants to discriminate conditions when a single operant arrangement is used. This indicates that a single operant arrangement was not sensitive to momentary preference changes and that a concurrent operant arrangement was be a better design for examining preference for making a choice.

A number of researchers have examined participant preference for an intervention or reinforcer under concurrent operant arrangements (Fisher et al., 1997; Hanley et al., 1997; Hanley et al., 2005; Heal & Hanley, 2007; Tiger et al., 2006). Hanley et al. (1997),
Hanley et al. (2005), and Heal and Hanley (2007) examined children’s preference for different types of behavioral interventions in a concurrent operant two-link chain. In the initial link, children chose between different types of interventions. In the terminal link, the children received the chosen intervention. The results from these studies indicated that the researchers were able to determine participant preference for different interventions. The concurrent operant design allowed for multiple interventions to be tested effectively and efficiently, and the interventions chosen by the participants were effective in reducing participants’ challenging behavior.

Other researchers have used concurrent operant designs to look more closely at the effects of choice and preference for choice on responding. Thompson et al. (1998) examined the preference for choice in a 4-year-old child in a concurrent chain arrangement. During the initial link, a micro switch was used for the participant to make a selection. This study used either control, free choice, or forced choice conditions in the terminal link. During the control condition, no consequences were provided. During the forced choice condition, the experimenter selected a cup and gave the participant some soda. In the free choice condition, the participant was able to select the cup and if he wanted to use a straw to drink some soda. The results indicated that the participant preferred the free choice condition relative to the other conditions.

Tiger et al. (2006) examined 6 preschool children’s preference for making a choice in a series of studies. These studies used a concurrent operant arrangement to demonstrate how different arrangements of the reinforcer influenced preference for choice. In the first experiment, the free choice condition presented the participants with five identical reinforcers, the forced choice condition resulted in praise and access to one
reinforcer, and the control condition resulted in praise only. This study identified that 5 participants preferred the free choice condition. However, preference did not persist for 2 of the participants and 1 participant always preferred the forced choice condition. In the third experiment, Tiger et al. looked at preference for choice when the number of choice selections varied between 5, 10, and 15 reinforcers, while the forced choice option was always one reinforcer. This study demonstrated that selecting a reinforcer out of an array of five was no more preferred than selecting one item; yet, as the numbers of items to select increased, preference for the condition with the larger selection increased. The experiments conducted by Tiger et al. indicated that (a) free choice is not always preferred over a forced choice condition, and (b) the value of choice increased as more selection options were provided.

Studies in this section demonstrated that participants typically prefer a free choice alternative to a forced choice alternative. In addition, applied research can use procedures that are common in basic research to examine preference for choice (i.e., concurrent operant arrangements). Applied researchers should continue to use concurrent operant designs when assessing preference for choice. These designs can allow for a more systematic examination of the variables that influence a preference for choice.

**Conclusions about Choice Research**

Both basic and applied studies have repeatedly shown that organisms prefer making a choice. However, more research is needed to examine how additional variables influence the preference for free choice. The level of analysis on choice behavior has been different in basic and applied research. Applied research has shown that responding is influenced by choice but the process under which choice is influenced is not well
understood in the applied context. On the other hand, basic research has provided numerous studies that have examined the various influences on preference for choice under highly controlled settings. Basic researchers have demonstrated that non-human animals prefer free choice to forced choice when reinforcement is held constant. In addition, varying stimuli (i.e., number of keys, color, location, and informative value) does not influence preference for free choice. Although varying probability of reinforcement in a choice arrangement has yielded less consistent results across subjects, it needs further investigation. These types of variables should be extended to working with children with disabilities in applied settings. Choice research in applied settings has demonstrated that the type of design used will influence the results of the study. Concurrent operant arrangements should continue to be used in applied research to extend the work conducted in basic research on preference for choice.

In addition to the variables already mentioned, history effects could also influence preference for choice in educational contexts. The type of choice alternatives that have been previously presented may influence student’s preference for free or forced choice situations. This could also correspond to the level of on-task behavior and frequency of challenging behavior during an activity. Researchers have looked at how current contingencies affect preference for free choice in basic and applied settings. However, behavior exists on a continuum and historical influences could affect preference for making a choice.

**Behavioral History**

Behavioral history research has been occurring for over the past 50 years, but there has been relatively little interest in this area of research. Most operant research has
focused on examining how current contingencies in the environment influence responding. Researchers who examine current environmental arrangements are under the assumption that implementing the new environmental conditions long enough will override any effects of prior histories of responding (Salinger, 1996). It may be that researchers are more interested in studying behavior under current contingencies because many studies that have investigated operant conditioning have demonstrated that behavioral history effects are weak or occur for a short period of time.

Another reason why researchers may have expressed minimal interest in history effects may be due to limitations with single subject designs. In a single subject design, experimental control is demonstrated by changing behavior when and only when the independent variable is applied or removed. That is, experimental control is achieved by demonstrating steady state performance. Steady state performance occurs when there is little variability in the data path over time (Johnston & Pennypacker, 1993). If there is variability in the data when the independent variable is applied, this may indicate the presence of a confounding variable such as effects of behavioral history (Wanchisen, 1990). Thus, for researchers to demonstrate a convincing effect of the independent variable, the current contingencies must be highly effective at achieving steady state responding.

In a reversal design (ABAB), presence of an effect of the independent variable is examined by comparing the level of responding between conditions A and B. If the contingency arrangements in each condition are strong, it may be difficult for the experimenter to identify history effects of the previous condition. On the other hand, multiple baseline designs are commonly used for examining the relationship between a
contingency and behaviors, where once the behavior has been acquired, responding will continue if the contingency is removed. For example, if an intervention is designed to teach a child to read, once the intervention is removed, the child will still be able to perform the skill. The structure of a multiple baseline design is based on the researcher foreseeing the presence of history effects.

Though current contingencies can override the history effects of past contingencies, there are situations in operant conditioning that rely on the presence of history effects. When researchers or practitioners want to increase a particular response, shaping techniques are employed, such as increasing the response requirements in a ratio schedule (Tatham & Wanchisen, 1998). For example, a teacher wants to increase the number of math problems a student can independently complete during a work session. If the terminal goal is to complete 50 problems to access the reinforcer, the teacher first requires the student to complete 10 math problems, then 20 math problems, then 30 math problems, and so on before the reinforcer is delivered. The behavior pattern generated from the previous schedule (i.e., 10 math problems) carries over to the new schedule requirement (i.e., 20 problems). For the student to be successful on the new schedule requirement, behavior patterns from the previous schedule must still exert control over responding on the new schedule requirement. In this example, behavioral histories can be beneficial for student responding; however, other history effects can negatively influence student responding.

Each school year, teachers have new students in their classes. The students arrive to the classroom with individual behavioral repertoires that were developed in other settings. If a particular student arrives to a new class and engages in challenging
behavior, a behavior intervention plan is developed. However, there are times when challenging behavior persists after a function-based intervention has been implemented (assuming high treatment integrity). One possible explanation for the persistence of challenging behavior could be the effects of behavioral history. In this example, response patterns learned in the past negatively affect current responding in the classroom. These examples demonstrate how the presence of history effects may help or hinder development of new behavioral repertoires. Research on behavioral history effects is important and is needed to help develop a better understanding of the behavior of organisms.

Defining Behavioral History

A clear definition of behavioral history has not been achieved (Wanchisen, 1990), and a variety of definitions have been used to define behavioral history. Skinner (1953) stated that an organism’s present behavior could be explained by variables in the current and past environments. Most behavior analytic research has focused on examining how current environmental variables affect an organism’s responding. However, organisms are not behaviorally naïve; that is, the start of an experiment does not signify the start of an organism’s contact with operant conditioning; each organism has had prior experiences with operant principles. How long these experiences continue to influence responding is at the heart of behavioral history. Freeman and Lattal (1992) proposed a definition of behavioral history that has been cited more recently in the research literature. These researchers defined behavioral history effects as sources of control over current responding that have not been eliminated by current contingences, and confounds the obtained functional relations between responding and the current contingences. A
parsimonious definition of behavioral history may be difficult to achieve given that the definition may need to discuss proximal versus distal histories, extra-experimental versus experimental history, experimental design, and permanence of history effects.

**Proximal versus distal history.** Researchers typically have examined proximal as opposed to distal behavioral histories. Proximal histories would be a history of responding that was temporally close to the experimental conditions that test if history effects are present. Distal histories would be a history of responding that was established further away in time from the experimental conditions that test for the behavioral history effects. This then raises the question of how close is close? Does a proximal history reference a few hours, days, weeks, or months? These questions remain to be answered through research. Most studies investigating behavioral history effects have looked what could be classified as effects of proximal histories. That is, histories that have been developed days and weeks before a test of history effects occur. A reason that researchers have not investigated the effects of distal behavioral histories may be that longitudinal studies can be difficult due to the financial and time costs required to examine different lengths of history on current responding.

Ono and Iwabuchi (1997) examined the effects of proximal and distal behavioral histories on current contingencies in 3 pigeons. This study examined the difference between behavioral histories that were developed 15 days (i.e., proximal history) or 6 months (i.e., distal history) prior to testing the presence of behavioral history effects. The results indicated that effects of behavioral history were present with a lapse of 15 days and to a smaller degree with a lapse of 6 months. This study demonstrated that effects of behavioral history were present after a long period of time (i.e., 6 months) and that
contingencies that were more recent (i.e., 15 days) had a stronger influence over responding than older contingencies. In regards to a definition of behavioral history, a reference indicating a proximal or distal history is not mentioned. Though these terms are relative and decided upon by the researcher, it may be beneficial for researchers to indicate the type of behavioral history under investigation to build a more accurate account of behavioral history effects.

**Extra-experimental versus experimental history.** Basic non-human animal research uses naïve subjects for experiments (i.e., non-human animals with no programmed experience with contingencies from prior experiments). Using naïve subjects helps to minimize the effects of prior histories on experimental conditions. Nevertheless, no subject is completely naïve. Each subject will bring its experiences of being raised, transported, and housed in various laboratory settings (Wanchisen, 1990). These events can influence responding during experimental conditions. An inclusion of this type of history in a definition of behavioral history may be too large and would not be reliable for experimental use.

The issues raised about extra-experimental histories have led to some researchers questioning the utility of non-human animal research in relation to human research. Non-human animals will be referred to as animals. Some researchers question the use of procedures developed with animals as to how effective these procedures will be for humans. One of the main issues raised about the differences between human and animal research is the different types of the behavioral histories. People live in highly individualized living arrangements, and this may contribute to variations between extra
experimental histories in humans; however, animals live in more controlled settings and develop similar extra-experimental histories (Wanchisen & Tatham, 1991).

A difference between human and animal extra-experimental histories is that animals have less variation in their extra-experimental histories as compared to humans (Wanchisen & Tatham, 1991). These extra-experimental differences include genetics, living environments, diets, and medical histories, which are more controlled in animals. Basic studies with animals have used both naïve animals and animals that have participated in prior experiments (i.e., animals having experience with programmed consequences). The recycling of subjects appears to be a common practice among basic researchers using animals, especially researchers who have used pigeons (Wanchisen & Tatham, 1991). Whether a basic researcher uses naïve or experienced animals, the experimental arrangement typically produces desirable outcomes. Thus, the difference between extra-experimental histories may be due to the number of extra experimental experiences each organism brings to the study rather than the effect of similar versus non-similar experimental histories.

Humans arrive to a study with far more extra-experimental experiences than animals. In relation to human participants, extra-experimental histories are much more difficult to define due to the diversity of experiences each participant brings to the experimental setting. Each person has had a different upbringing, educational background, genetic background, and/or geographic location to name a few differences. These histories are vast and trying to define them would be beyond the scope of behavior analysis (Wanchisen, 1990). Over 20 years ago, Wanchisen suggested that because of the limited research conducted on behavioral history and the vast differences in extra-
experimental histories, the definition should be limited to a discussion of experimental histories. Thus, a behavioral history definition should relate a history that the researcher has programmed to be developed and subsequently tested.

**Experimental design.** Research studies need to be designed to build and test behavioral history effects. Thus, studies should include a history building condition and history testing condition. In the history building condition, the researcher exposes the participant to a particular set of contingencies until steady state responding is achieved. The purpose of this condition is for the participant’s responding to come under the control of the current contingencies; thus, establishing a history of responding under a new, experimenter arranged set of contingencies. For example, responding could be established under a fixed ratio (FR) schedule of reinforcement. On an FR schedule of reinforcement the organism must engage in a specified number of responses to gain access to the reinforcer. In a classroom, a student may be required to say five letter sounds before the teacher provides praise (i.e., FR 5). In the history testing condition, the researcher changes the contingencies and monitors how the participant’s behavior changes. Many studies have used fixed-interval (FI) schedules of reinforcement during the history-testing phase. On an FI schedule of reinforcement, a reinforcer is provided for the first response after a certain time period has passed. Responses made during the time period do not influence the delivery of a reinforcer. In the classroom example, the student was exposed to an FR 5 schedule of reinforcement for letter sounds under the history building condition, while the history testing condition examines how responding changes under a FI 10 s schedule of reinforcement for the number of letter sounds said by the student.
A single-subject design would test history effects in a reversal design (ABA). The A condition is used as a baseline to assess response levels under a particular contingency arrangement without prior history manipulations. The following B condition would be the history building condition. The purpose of this condition is to establish steady state responding under the contingency arrangement. The return to condition A is to test for the presence of history effects. Responding in the second presentation of condition A is compared to responding in the first presentation of condition A. If there were a difference between the first A condition and the second A condition, this would lead the researcher to identify the presence of a behavioral history effect (Tatham & Wanchisen, 1998). However, an ABA design has been used minimally in behavioral history research (Metzger & Lettal, 1998; Ono, 2004; Wanchisne, Sutphin, Balogh, 1998).

A more common design is a between group design (Freeman & Lattal, 1992; Lopez & Menez, 2005; Wanchisne, Tatham, Mooney, 1989; Weiner, 1969). In a between-group design, the experimental group would be exposed to the history building condition followed by exposure to the history testing condition. The control group would be exposed to only the contingency arrangements that are present in the history testing condition. Response patterns from the history testing conditions would be compared between the experimental and control groups to identify if there is a behavioral history effect.

**Permanence of history effects.** Behavioral history research should recognize that some history effects are short-term, causing a transition state, while other history effects are long-term and will permanently affect behavior. A transition state is defined as responding that changes from one steady state of performance to a different steady state
of performance (Johnston & Pennypacker, 1993). Many behavioral history effects can be
look at as a transition from previously arranged contingencies to the current
contingencies. An example of a transition state in a classroom situation is the
generalization of an intervention to other classroom staff. If a teacher has been using an
intervention with a student to increase on-task behavior during a writing activity, then the
teacher has other classroom staff use this intervention when working with the student.
The student may initially display similar levels of on-task behavior (i.e., behavior history
present) for the first few work sessions with the new staff members. As the new staff
members continue to work with the student, the new staff members may not provide the
same schedule of reinforcement and the history effects begin to dissipate as the current
contingencies control responding. This example suggests that some history effects may
be short lived.

Other history effects may have a long lasting effect on behavior under new
contingencies. For example, Wanchisen, Sutphin, Balogh, and Tatham (1998) examined
the effects of an FR and differential reinforcement for low rate behavior (DRL) schedule
on a subsequent FR contingency. On a DRL schedule, a certain amount of time must pass
without a response. The first response beyond this time period allows the participant to
gain access to the reinforcer. The results of this study demonstrated that in the history-
testing condition rats exposed to the DRL history building condition responded at a lower
rate under the FR contingency than rats that were exposed to the FR history building
condition. Continued exposure in the history testing condition demonstrated that
responding was maintained at the respective levels. This study demonstrated that some
history effects can have a long lasting influence on behavior under new contingencies.
Another issue related to defining behavioral history is the time spent training an organism to respond at a certain level. When schedules of reinforcement require either a high number of responses or longer interresponse intervals, these types of condition require that prior contingencies continue to influence current responding (e.g., shaping, chaining, etc; Tatham & Wanchisen, 1998). As mentioned earlier, many studies must establish a rate of responding prior to examining the experimental contingencies. For example, if a researcher were interested in looking at the effects of an FR 30 history building condition on following FI 30 s history testing condition, the researcher would first need to establish responding under the FR 30 condition. The amount of time and training necessary to have the animal engage in 30 responses could produce history effects in the following condition, rather than only experiences the FR 30 schedule of reinforcement. That is, it is hard to say that only the exposure to certain contingency requirements or the training needed to learn to complete the contingency requirements is responsible for the behavioral history effects.

**Behavioral History Effects on Schedules of Reinforcement**

Wanchisen (1990) stated that an examination of behavioral history should begin with examining history effects in relation to schedules of reinforcement. Research on schedules of reinforcement has been vast and has demonstrated that there is a predictable pattern of responding for the different types of schedule arrangements, particularly for animals. On the other hand, research on the use of schedules of reinforcement with humans does not always produce a predictable pattern of behavior. When an organism responds differently under similar schedules of reinforcement, factors other than or in addition to the schedule of reinforcement are influencing responding (Weiner, 1983). One
of these additional factors can be the presence of behavioral history. Using schedules of reinforcement as a manner to systematically analyze behavioral history effects can provide some insight as to how history effects influence and persist current contingency arrangements. The following section will discuss behavioral history research that has been examined under various schedules of reinforcement. For ease of discussion, research studies will be discussed in relation to the type of schedule that was used during the history testing condition.

**FI history testing condition.** FI schedules allow researchers to examine response patterns at various levels of responding without substantial influence on the number of reinforcers received. This means that behavior is free to vary in-between reinforcer deliveries. Behavioral histories have typically been examined in the context of an FR or a DRL schedule on the subsequent FI schedule of reinforcement.

A study by Weiner (1964) investigated the effects of an FR or a DRL history building condition on a subsequent FI history testing condition. Participants were divided into two groups. One group received the FR history building condition and the other group received the DRL history building condition. The effects of the history building conditions were examined under a similar FI schedule. The results of Weiner’s study yielded different performance levels between the groups of participants during the FI history testing condition. Participants who had received the FR history emitted higher rates of responding when compared to the participants who had received the DRL history under the FI testing condition.

In a similar but larger scale study, Weiner (1969) examined behavior history effects on FI performance in a series of five experiments. Weiner had noted that not all
human responses follow the typical pattern of responding under an FI schedule. On an FI schedule, animals tend to engage in post reinforcement pauses, followed by an acceleration of responding; producing a scalloped pattern of responding. Some humans engage in this pattern of responding, whereas some engage in high steady rates of responding (i.e., no post reinforcement pausing). In this series of experiments, participants sat in front of a micro switch button and were given instructions on how to earn points. The five experiments assessed the effects of different history building condition [i.e., FI, FR, DRL, differential reinforcement of other behavior (DRO), fixed time (FT), extinction, and/or use of a response cost] on the subsequent FI history testing condition.

The results of Weiner (1969) experiments demonstrated that responding during the FI schedule was affected by the preceding condition (i.e., FR, DRL, DRO, FT, or extinction). Weiner (1969) demonstrated that participants engaged in higher rates of responding when conditioned under an FR schedule and engaged in lower rates of responding when conditioned under a DRL, DRL then FR, DRO, or an FT schedule. The inclusion of a response cost component did have a systematic effect on low rate responding in the FI condition with a DRL, DRL then FR, DRO, or an FT history building condition. Another interesting result of these experiments was that if only a FR schedule was used in the history building condition, changing the FI schedule or including a response cost in the history testing condition did not systematically change the high rates of responding. Weiner speculated that FI schedules share important characteristic with FR schedules such as response-dependent reinforcement and that reinforcement is not contingent on inter-response time as in DRL schedules. Responding
on an FI schedule can vary within the interval yet still produce the same number of reinforcers. It may be that the participants had a difficult time discriminating the difference between the FR and FI conditions because the number of responses emitted could be similar and/or the number of reinforcers received could be similar.

A study by Wanchisen, Tatham, and Mooney (1989) assessed the effects of a variable ratio (VR) schedule on an FI schedule. In a VR schedule of reinforcement, the target response is reinforced on the average of a specified number of responses. Wanchisen et al. conducted a between-group study using rats. The experimental group received an ABAB expose to VR 20 and FI 30 s schedules. The control group received only the FI 30 s schedule. The results indicated that the control group of rats initially engaged in scalloped responding; with continued exposure to the FI 30 s schedule, low rates of responding or break and run patterns (i.e., post reinforcement pause followed by a high rate of responding until the delivery of the next reinforcer) were observed. The experimental group of rats emitted low and high rates of responding during the FI 30 s condition (i.e., history testing condition). An interesting result of this study was that for the experimental group, high rates of responding occurred for the first two thirds of the first FI 30 s condition, and the first third of the second FI 30s condition. These results indicated that the responding of the rats in the experimental group changed more quickly during the second exposure to the FI 30 s schedule than the first exposure. In addition, the responding of experimental group became similar to the terminal FI performance of the rats in the control group. That is, the response patterns between both groups became more similar toward the end of the experiment.
Baron and Leinenweber (1995) extended the work of Wanchisen et al. (1989). Baron and Leinenweber used a between group design to assess the effects of various VR schedules on a subsequent FI 30 s schedule of reinforcement. The experimental group of rats was exposed to different VR 30 s schedule arrangements. This was followed by exposure to an FI 30 s schedule. The control group was exposed to only an FI 30 s condition. Results indicated the different VR histories were not associated with systematic differences in responding during the FI 30 s condition. It should be noted that there were differences in responding on the FI 30 s schedule between the control and experimental group. The experimental group initially engaged in higher rates of responding during the FI 30 s condition, and with continued exposure to the FI 30 s condition, responses of the experimental group decreased to a similar level as the control group.

In a similar study, Lopez and Menez (2005) assessed the effects of three different history building conditions on the FI history testing condition for 30 rats. The emphasis of this study was to see the effects of an FR 1, FT, and random interval schedules in the history building condition on the history testing conditions with longer FI values (i.e., FI 30 s and FI 90 s). The results indicated that the different schedules in the history building conditions influenced the rats’ responding in the FI condition and these effects were transient. With continued exposure to the FI condition, responding from all history-building schedules converged to similar steady-state performances.

**Variable interval history testing condition.** Doughty et al. (2005) investigated behavioral history effects on resistance to change. The purpose of their study was not to directly assess the effects of prior schedules on subsequent schedules; however, their
study does provide an experimental demonstration of the effects of different schedules of reinforcement on a subsequent variable interval (VI) schedule. A VI schedule provides a reinforcer for the first response that occurs after a certain amount of time has passed, and the length of the interval revolves around some average amount of time. Doughty et al. developed behavioral histories under a VR and DRL schedule and tested the history effects on the following VI schedule. The history testing condition showed high and low response rates for the VR and DRL schedules, respectively. Both response rates eventually converged for 2 out of the 3 subjects. In Experiment 2, Doughty et al. examined the effects of an extinction only or a VI history on the following VI condition. The results indicated that high responding occurred during the VI schedule and minimal or no responding occurred when extinction was used during the history building condition. In the history testing condition, high rates continued from the former VI condition and responding from the former extinction condition quickly increased until similar to the VI history building condition. The rapid acquisition of responding in the history testing condition may have occurred because prior response patterns did not need to be altered. This indicated that changes from one schedule to another can happen more quickly if the prior schedule arrangements were weak when compared to the new schedule arrangement.

**Progressive ratio history testing condition.** A majority of the research examining the effects of behavioral history has used a time-based history testing condition (i.e., FI or VI). Cohen, Pedersen, Kinney, and Myers (1994) examined the history effects with progressive ratio (PR) schedules of reinforcement. A PR schedule is when a reinforcer is delivered after a fixed number of responses, and this number is
increased after each reinforcer delivery until some break point (i.e., responding stops) is reached. Cohen et al. trained groups of pigeons under a VR, FR, or DRL, followed by a PR schedule of reinforcement. The control group was trained under a PR schedule of reinforcement. Cohen et al. demonstrated that history effects were similar to other studies, that is, VR and FR schedules produced higher responding as compared to the DRL schedule on the PR schedule. However, these effects were short lived, only lasting a few sessions. These results are similar to some studies (Baron & Leinenweber, 1995; Wanchisen, et al., 1989) but dissimilar to other studies (Weiner, 1964; 1969). Cohen et al. speculated that FI schedules may be more sensitive to history effects than PR schedules. Under a FI schedule, a wide range of response rates can still produce similar reinforcement rates, whereas on a ratio schedule, the rate of reinforcement is directly tied to the number of responses. Thus, responding on a ratio schedule is more likely to come under control of the current contingencies and demonstrate minimal effects of behavioral history.

**Variable ratio history testing condition.** Chappell and Leibowitz (1982) evaluated the effects of behavioral history on lever pressing in 30 children. The children had to press a lever on a machine in accordance to a schedule of reinforcement to earn pieces of candy. The children were exposed to either a differential reinforcement of high rate behavior (DRH) or a DRL schedule of reinforcement. The subsequent VR condition tested the effects of the history building condition. Results indicated that children who had experienced the DRH condition responded higher during the VR history testing condition as compared to the children in the DRL history building condition. The transitory nature of responding during the history testing condition was not discussed.
That is, the researchers did not state if participants’ responding from either of the history building conditions fell under the control of the current contingencies as time spent in history testing condition increased.

**Conclusions on Behavioral History Effects on Schedules of Reinforcement**

These studies established behavioral histories and examined the effects of these histories on the following test condition. The results of these studies indicated that the schedule of reinforcement used during the history building condition did have an effect on the subsequent history testing condition. After an FR history building condition, responding on a following interval schedule was initially high, and then decreased to an intermediate level. When a DRL schedule was in place during a history building condition, responding on the following interval schedule was low, and then increased until it stabilizes at an intermediate level. The largest effect of the history building condition was likely to occur during the initial sessions of the history testing condition, rather than during sessions that occurred after extended exposure to the new schedule of reinforcement. Schedules with lower response rates (i.e., DRL) produce a greater resistance to change (Doughty et al., 2005). As a group, these studies provide evidence that behavioral history effects are generally transitory when studied under most schedules of reinforcement, particularly ratio schedules of reinforcement. More research on behavioral history and transition states could provide information on how to control transition states based on the type of schedule of reinforcement present in the history building condition (Metzger & Lattal, 1998).

Transition from the history building condition to the following history testing condition can be looked at as changes in reinforcer rate, reinforcer distribution, or both
rate and distribution (Lopez & Menez, 2005). These changes could influence how long responding is in transition. However, it may be difficult to determine when the transition state has ended and responding is under the control of current contingencies (Doughty et al., 2005). This could be due to experimental histories, lack a comparison condition without prior history effects, or motivating operations. Additionally, all studies discussed in this section used between group comparisons and it may be difficult to generalize across groups of participants. Finally, short-term effects of behavioral histories raise the issue of being able to reproduce the results when using a within-subject design (Okouchi, 2005).

Many of the studies noted that behavioral history effects were short lived. However, Weiner (1964; 1969) did not see transitory effects on responding in his experiments. There were two major differences between Weiner’s studies and the other studies mentioned in this section. First, Weiner used human participants, whereas the other studies used animals. It should be noted that Chappell and Leibowitz (1982) used children but did not discuss if transition states were observed. Behavioral history effects could be different in humans and animals due to extra-experimental histories. Second, in Weiner’s study the participants earned points according the schedule of reinforcement. However, the points were not tied to another back up reinforcer. That is, the participants were paid an hourly rate for their participation and not for the number of points earned. One possible explanation for the participants’ continued responding without a direct contingency in place for responding could be rule-governed behavior. That is, people engage in verbal behavior, which leads to verbal rules about contingencies and the behavior-environment relationship. On the other hand, animals engage in contingency-
governed behavior. Contingency-governed behavior is behavior acquired and maintained by the current contingencies in the environment. Researchers using humans should ensure that the responses used to build and test behavioral history are tied directly to the contingencies for earning primary or secondary reinforcers.

Behavioral history research could be used as an outlet to examine transition states of behavior. This area of research could be very important for treatments in the applied settings. A common problem associated with interventions in classroom settings is the issue of treatment integrity. Ensuring that teachers and other school staff are implementing the intervention procedures correctly is critical for the success of any school-based intervention. Behavioral history effects that present themselves as transitory effects could influence treatment integrity of an intervention. For example, if a student aggresses toward staff members in the classroom and a differential reinforcement of alternative behavior intervention (i.e., reinforcement is provided for an appropriate target behavior and not provided contingent on the problem behavior) was implemented, the effects of the past contingencies may still affect the current behavior for some time. School staff may interpret the persistence of behavior as a failure of the intervention and begin to deviate from the intervention procedures. In this example, behavioral history effects of the previous schedule of reinforcement for aggression were present under the new intervention arrangements. This may present a challenge for researcher and practitioner use data to interpret the effectiveness of an intervention. If behavior history effects generally produce a transition state, the data may seem to initially indicate that the intervention is not effective and a program change may occur. However, if a transition state is present, then the data falsely indicated that the intervention was ineffective. Thus,
it is important that researchers continue to examine behavioral history effects, particularly in the light of transition states because behavior that is in a transition state may negatively influence the perception of the effectiveness of intervention programs in school settings.

**Applied Implications of Behavioral History Research**

Studies on behavioral history have examined the effects of schedule changes on the same response. This has provided evidence that history effects are present for the same response across contingency changes. An issue related to behavioral history and problem behavior in the classroom is that teachers are concerned with reducing problem behavior and increasing an alternative appropriate behavior. It can be common for problem behavior to persist when reinforcement is withheld on the occurrence of problem and provided for an alternative appropriate behavior. More research is needed to examine how behavioral history influences responding when schedules of reinforcement concurrently change for two behaviors.

Problem behavior that is resistant to interventions for a short time may partly be a function of history effects from prior conditions (Martens et al., 2003). Individual differences in children’s responsiveness to intervention procedures are likely due in part to different reinforcement histories. Identifying schedules of reinforcement that are more persistent can provide some indication that resistance to new interventions may occur, or provide some indication that new interventions may need a longer time to take full effect. On the other hand, identifying schedules of reinforcement that are more persistent can aid in developing interventions that will be more resistant to treatment integrity failures and aid in generalization procedures. For example, if an FR schedule is used to increase the number of questions answered on a worksheet, when the intervention is transferred to the
classroom setting, failures in treatment integrity may occur. Treatment integrity failures may change the FR schedule of reinforcement to an FI schedule. Behavioral history research has shown that behavior may decrease somewhat but will eventually stabilize at an intermediate level.

PR schedules may be an ideal schedule to use when teachers want to see a quick transition to new intervention contingencies. The research by Cohen et al. (1994) provided some evidence that a change to a PR schedule reduces the transition state of responding. In classroom situations, executing quick behavior change is always ideal. This research has provided some evidence that the type of schedule, time-based versus ratio-based, can be a crucial component to the success of new interventions. The use of a ratio-based schedule of reinforcement is directly tied to the number of responses to access the reinforcer as compared to an interval schedule where the reinforcer is delivered based on the passage of time. Thus, to decrease transition states and the effects of behavioral history, teachers may want to initially implement a ratio-based schedule of reinforcement.

In the classroom, multiple stimuli in the environment can influence responding. Behavioral histories could be differentially influenced by the presence or absence of other environmental variables. Johnson, Brickel, Higgins, and Morris (1991) examined behavioral history effects of the presence or absence of water during the history testing condition. During the history building conditions (i.e., DRL or FR) and history testing condition (i.e., FI) rats had free access to water. As with other studies, rats with the FR history responded higher on the FI schedule and rats with the DRL history responded lower on the FI schedule, initially. Responding from both groups of rats then converged to similar levels. The experimenters then systematically allowed or withheld access to
water during the history testing condition. The results demonstrated that when water was withheld, the rats with the DRL history resorted back to response patterns that were similar to responding in the DRL history building condition. While the responding from the rats with an FR history, was not influenced by the presence or absence of water. This study provides evidence that behavioral history effects can be influenced by other variables in the environment other than just the schedule of reinforcement.

**Behavioral History Effects of Stimulus Control**

An organism learns to discriminate between stimuli in the environment that are associated with either reinforcement or punishment. It may be assumed that if behavior has been established under stimulus control in the past, can stimuli signal the availability of reinforcement or punishment, and also signal the schedule of reinforcement or punishment. Thus, the presence of a particular stimulus may alter current responding due to past schedules of performance (Lattal & Neef, 1996).

Freeman and Lattal (1992) examined the effects of distinct stimuli associated with particular history building conditions on a subsequent history testing condition. In addition, these authors were the first to use a parallel within-subject arrangement for assessing behavioral history. A parallel procedure is when each a subject is exposed to two history-building conditions at the same time. Freeman and Lattal conducted a series of three experiments to examine the effects of stimulus control on the effects of behavioral history.

In the first experiment, Freeman and Lattal (1992) examined the effects of a preceding parallel experience of an FR and a DRL schedule on the following FI schedule of reinforcement. Three naïve pigeons were used during this experiment. The stimulus
associated with the FR schedule was an operant chamber with black walls and the
stimulus associated with the DRL schedule was an operant chamber with white walls.
Reinforcement across all conditions in the history-building phase was yoked to the DRL
schedule. Each pigeon experienced the FR and DRL sessions daily with a 6 hr separation
between sessions. In the following FI condition (i.e., history testing condition), subjects
were exposed to two daily sessions; one session was in the white wall operant chamber
and the other session was in the black wall operant chamber. The same FI schedule of
reinforcement was in effect regardless of the chamber wall color. The results indicated
that the chamber associated with the FR schedule produced higher response rates on the
FI schedule as compared to the chamber associated with the DRL schedule. However,
with extended exposure to the FI schedule, response rates converged to similar levels in
both chambers.

In the second and third experiments, the procedures were similar to the first,
except during the history testing condition where a VI schedule (experiments 2 and 3)
and different discriminative stimuli were tested (experiment 3). The stimulus associated
with the FR or DRL schedule was a red or green light, respectively. The results from
these two experiments were similar to experiment 1. This study provided evidence that
the use of a parallel training procedure was effective in establishing separate behavioral
histories and these histories were influenced by stimulus control. This study also
demonstrated that the history of a DRL or an FR schedule of reinforcement was transitory
in nature.

Whereas, Freeman and Lattal (1992) assessed the effects of stimulus
discrimination on behavioral history, Okouchi (2005) examined the effects of stimulus
generalization on behavioral history in two experiments. In the first experiment, undergraduate students were trained to respond on either a VR or DRL schedule of reinforcement in the presence of a certain length of a line. An FI schedule was used during the history testing condition. Results indicated that participants engaged in VR responding to lines that were similar in length to the line used in the VR history building condition or engaged in DRL responding to lines that were similar in length to the line used in the DRL history building condition. In the second experiment, the effects of VR and DRL history building condition were assessed on an extinction history testing condition. Results from this experiment were similar to the first experiment; however, generalization gradients were flatter than generalization gradients in experiment 1. Both experiments indicated that with continued exposure to the history testing condition, responding became similar to the contingencies in history testing condition. These two experiments demonstrated that history effects could be generalized across stimuli and that the generalization of history effects was transitory.

Conclusions about Behavioral History Effects of Stimulus Control

These studies shed some light on factors that may contribute to persistence of behavior when contingencies have changed. Namely, if the same discriminative stimuli are present in the new contingency arrangement previous response patterns may continue to occur for a short period of time. In addition, stimuli that are close in resemblance to stimuli in the history building condition will also exert control over behavior for a short time period.

Applied Implications of Behavioral History Effects of Stimulus Control
Stimulus control is an important factor relating to behavioral history and problem behavior. In classroom situations, problem behavior can persist when function-based interventions are implemented. The results from Freeman and Lattal (1992) provide evidence that environmental stimuli exert control over current behavior under different contingencies. These results suggest that in classroom situations particular stimuli could produce behavioral history effects on student responding. Stimuli that are typically present in a classroom (e.g., adult figure, chairs, table, etc.) could exert control over behavior, even though these stimuli may not be the exact same stimuli that were present during the development of the behavioral history. For example, if a student is aggressive toward classroom staff, the staff may become a discriminative stimulus for reinforcement for problem behavior. Progar et al. (2001) had noted that an individual with developmental disabilities engaged in higher rates of aggression during treatment sessions with 2 staff members that had previously worked with this individual. In treatment sessions with staff who had not previously worked with this individual, levels of aggression were low. This study provides some correlational evidence that staff members can act as discriminative stimuli for past contingencies of reinforcement.

Classroom staff should be aware that when contingencies are changed (e.g., implementation of a function-based intervention), problem behavior may continue to persist for some time because the staff have become discriminative stimuli for past schedules of reinforcement. Given limited research in the area of stimulus control and behavioral history, researchers should begin to investigate these effects in the classroom.

Applied studies that have used discriminative stimuli to develop differential responding across different functional analysis (FA) conditions by associating each FA
condition with a different room color and a particular therapist (Conner et al., 2000). It is possible that researchers interested in pursuing stimulus control of behavioral histories could use similar techniques. That is, a researcher could conduct an intervention using particular room arrangements or experimenters to develop behavioral histories then change the environmental arrangements and observe if history effects are present. Researchers could also vary the color of stimuli used during a study. For example, if a student is to complete a worksheet, two different color worksheets can be used, each corresponding to a different schedule of reinforcement. The effects of behavioral history can be tested by changing the schedule of reinforcement but continuing to present the student with different color worksheets.

Generalization of behavioral history effects could provide more information as to how behavior patterns persist across people, settings, and responses. Baer, Wolf, and Risley (1968) defined generalization as behavior change that occurs across a variety of settings, people, behaviors, across time. Classroom management techniques that do not improve behavior in other settings, with other people, or develop new responding can be thought of as a failure to generalize. Researchers need to develop a better understanding of how behavioral history influences generalization strategies to reduce failures in generalization of classroom management techniques.

**Choice and Behavioral History**

The above discussion has presented the literature related to preference for choice and behavioral history effects separately. An analysis of the literature has indicated that these two areas of behavior analysis have been studied jointly in a few studies. The
studies in this section discuss basic and applied research that has looked at history effects on choice making behavior.

Researchers’ interests in behavioral histories have become more prevalent in the past 10 years. As the interest in behavioral history grows, some researchers have examined how preference and choice are influenced by behavioral history. In classroom settings, expression of preference and allowing children to choose has been shown to decrease challenging behaviors and increase engagement in a task (Carlson, Luiselli, Slyman, & Markowski, 2008; Cole & Levinson, 2002; Graff et al., 1998; Hanley et al., 1997; Hanley et al., 2005; Romaniuk, et al., 2002). The influence of history effects particularly on choice could help educators understand why preference changes and/or provide an idea of how environmental arrangements may influence future choice responding.

Martens et al. (2003) examined the influence of an FT schedule of reinforcement on student choice (i.e., easy or difficult) and accuracy of math problems. Two girls with developmental disabilities were given the choice to work on easy math problems on a lean schedule of reinforcement (FR 20) or difficult math problems on a richer schedule of reinforcement (FR 4; i.e., unequal reinforcement condition). In the following condition, the participants were again asked to choose between the easy and difficult math problems but the schedule of reinforcement was changed to FT 20 s for both types of math problems (i.e., equal reinforcement condition). Behavioral history effects were measured in an ABABA design, where A was the unequal reinforcement condition and B was the equal reinforcement condition. The results indicated that during the unequal reinforcement condition, both participants allocated more responding to the richer
schedule of reinforcement and made a minimal amount of errors. During the equal reinforcement condition, the participants made more errors and chose the easier math problems. On the subsequent return to the unequal reinforcement condition, participant preference was for easier math problems and more errors were present during the initial sessions of the condition. This study demonstrated that FT effects persisted briefly in the following unequal reinforcement condition and that FT history effects resulted in lower performance on an academic task. This study provided some initial evidence that behavioral history can affect choice making behavior when engaging in a socially valid response.

A study by Neef et al. (2004) examined the effects of instructions versus modeling on the choices between two different concurrent VI schedules of reinforcement for math problems. The results indicated that participants were able to respond more accurately when the contingencies were modeled versus when only instructions were given. Next, the researchers changed the schedules of reinforcement for each of the math problem options, without informing the participants. Participants that had previously experienced the modeled condition were able to quickly change their responding to reflect the new contingency arrangement (i.e., shorter transition state to the new schedule of reinforcement). Whereas, participants who experienced the instructions only condition had trouble identifying the new contingency arrangement until a model of the contingencies was given. Exposure to the model of the response requirements was able to better prepare the participants for reinforcement schedule changes than by providing only instructions. This study demonstrated that the type of antecedent intervention used can produced behavioral history effects.
To date, only one published study has investigated the effects of behavioral history on preference for making a choice. Ono (2004) examined preference between free versus forced choice arrangements in 3 pigeons. This study was interested in examining how different arrangements of behavioral history could influence a subject’s preference for a free or forced choice alternative. In the first experiment, three conditions (i.e., baseline, history building, and history testing) were arranged to examine the influence of behavioral history on choice responding. During the first baseline condition, preference for free or forced choice alternatives was assessed in a two-link current-chain design. In the history building condition, each pigeon was exposed to a different experimental arrangement in the terminal link of the chain. For the first pigeon, the initial link led to a forced choice terminal link. For the second pigeon, initial link led to a free choice terminal link. For the third pigeon, the initial link led to a terminal link, which alternated between free and forced choice alternatives. In the history testing condition, the procedures were the same as the baseline phase. The probability of reinforcement in the terminal link was 1 during all condition of this experiment.

The results of this experiment demonstrated that during baseline, all pigeons expressed a preference for the free choice condition. During the history building condition, pigeons continued to respond at rates similar to rates of responding that were present during the baseline condition. The results from the history testing condition were interesting. For the pigeon exposed to the forced choice history building condition, preference was clearly for the free choice option. During the initial sessions, preference was higher than the original baseline condition; however, toward the later sessions responding became similar to initial baseline levels. For the pigeon exposed the free
choice history-building condition, initial preference was for the force choice option, and with continued exposure to the contingencies preference shifted toward indifference between free and forced choice options. For the pigeon exposed to the mixture of both choice options, there was no change in preference for the free choice option relative to the baseline condition. These results demonstrated that preference for choice was influenced by behavioral history and that history effects were similar to the findings of other studies, in that history effects were transient in nature.

Ono (2004) conducted a second experiment using the same procedures but changing the probability of reinforcement to 0.5 (i.e., intermittent reinforcement). In addition, he examined only free and forced choice alternative in the history building condition. During the initial baseline, 3 out of the 4 pigeons preferred the free choice alternative, while 1 pigeon minimally preferred the forced choice alternative. The results were similar to the first experiment, that is, the pigeons exposed to the forced choice history building phase showed preference for the free choice option. Whereas, the pigeons exposed to the free choice history building condition showed preference for the forced choice option. However, these changes in preference did not emerge until the pigeons had been exposed to the testing phase for 7 to 14 sessions. This experiment demonstrated the emergence of delayed preference. This study demonstrated that preference could be influenced by prior environmental contingencies. Ono suggested that the change in preference was the related to a “novelty effect.” Where novelty was defined as the contingencies that had no immediate prior experience.

Research in behavioral history has demonstrated that history effects are subjective to stimulus discrimination, stimulus generalization, and the schedule of reinforcement. A
possible explanation for the occurrence of the results in the Ono (2004) study could be the influence of motivating operations. That is, preference for choice could be susceptible to motivating operations. In Ono’s study (experiment 1), pigeons had selected the free choice option during the initial baseline. In the history building condition, one pigeon was given forced exposure to the free choice option. The combination of free choice selection in baseline and the history building condition could have satiated the pigeon’s preference for a free choice. Thus, during the history testing condition, the pigeon’s initial preference for forced choice could be due to satiation of free choice.

**Summary and Purpose of this Study**

The number of studies on choice and the expression of preference make it clear that it is an important area of research. Choice has been examined in both basic and applied research to identify how preference is influenced and how this preference relates to response outputs. Researchers have shown that individuals prefer making a choice to not making a choice; however, the variables that influence the preference for choice have not been completely studied in the empirical literature. Research has shown that an increase in appropriate behavior and decrease in problem behavior has been a result of introducing choice into an individual’s environment. However, it is not always possible to always provide multiple choices in classroom settings. Developing an understanding of how behavioral history influences choice in the classroom may provide more insight as to why problem behavior persists in classroom settings and/or how to maintain appropriate behavior.

Studies on choice have mainly focused on influencing choice by changing the current environment and monitoring the effects. Less attention has been given on to how
a history of choice making influences a person’s preference for choice. Behavioral
history has been demonstrated in the basic literature to have a transitory effect on
behavior under new contingency arrangements. These history effects could affect
preference for choice in the same way. That is, preference for choice may have transitory
effect and this could indicate why preference for choice can be variable. Examining the
effects of behavioral history on preference for choice has occurred in a limited number of
studies. The purpose of the current investigation was to examine the effects of behavioral
history on preference for making a choice for children who are typically developing and
those with moderate disabilities. The specific research questions addressed were: (a) how
will past choice experiences affect preference for choosing academic tasks?, and (b) how
will behavioral history affect preference for selecting a reinforcer?
Chapter 3: Method Study 1

Participants

The participants were 6 children (2 male and 4 female) between the ages of 8 and 10-years-old from an elementary school in Columbus, Ohio. The school principal was contacted and a description of the study was provided. Two teachers from this school were asked to distribute and send home an informational letter (Appendix A) and consent form (Appendix B) to their entire class of students. Parents of the participants were contacted via the informational letter providing an explanation of the study followed by asking them to sign a consent form. After parental consent was obtained, a verbal assent script was read to the participants to obtain participant assent. To be included in this study, participants needed to complete three different levels of math problems at a 95% accuracy level and complete the training session for how to use the computer program. If the participants failed to meet any of these criteria, they would have been excluded from the study. No participant failed to meet these criteria.

Participant 01 was a 10-year-old African American male and was placed in a self-contained 3rd to 5th grade special education class for children with multiple disabilities. He had a diagnosis of multiple disabilities. Participant 02 was a 9-year-old African American male and was placed in a self-contained 3rd to 5th grade special education class for children with multiple disabilities. He had a diagnosis of ADHD and multiple
disabilities. Both participants 01 and 02 were in the same classroom. All students in the classroom had moderate disabilities and all were ambulatory. Participants 03 and 04 were 8-year-old typically developing African American females. Participant 05 was an 8-year-old typically developing Hispanic American female. Participant 06 was a 9-year-old typically developing African American female. Participants 03, 04, 05, and 06 were in the same 3rd grade general education classroom.

**Setting**

All sessions took place in a small conference room or a tutoring room. These rooms were equipped with a table, chairs, a small desk, and various tutoring materials (e.g., books, flash cards, etc).

**Materials**

Participants used a laptop computer with a mouse during the study. A computer program was designed for the study using Microsoft Visual Basic programming. Participants had a pencil and piece of paper or counting manipulatives to use during all conditions of the study in order to compute math problems by hand, if needed. Additionally, participants were given a choice of a reinforcer; these reinforcers varied between edible or tangible stimuli.

**Response Measurement**

The dependent variable was the participant’s selection of the math problem option. Selection of the math problem option was defined as the participant using an external mouse to click on one of two buttons, each associated with a different math problem presentation option, displayed on the computer screen. Data were collected as a count measure.
Preferences Assessment

Prior to the start of the experimental conditions, a multiple stimulus without replacement (MSWO; DeLeon & Iwata, 1996) was performed. Five stimuli were placed in a straight-line in front of the participant. Each stimulus was equal distance apart. The participant was told, Pick one. Participants was allowed to consume the edible item. Once an item was chosen, it was not replaced in the lineup. The remaining stimuli were represented and the participant was asked to pick another stimulus. This procedure continued until all stimuli were chosen. The termination criterion for this procedure was following 30 s of non-selection from the remaining array. The purpose of this preference assessment was to identify highly preferred items that the participant earned for participation in the sessions.

Math Assessment

Participants were given a math assessment to determine their current math skills. To identify the math level to be assessed, participants were asked what type of math problems they were working on in their classes. The type of math problems included addition, subtraction, and multiplication in either single or double digits. The participant began the math assessment at the level described by the participant. Each math assessment was 3 min. The participant took at least a 1 min break in between each assessment. A minimum of three different levels of math problems were assessed. If the participant completed 95% of the math problems correctly at each of the first three different levels of problems, these types of math problems were used for the study. Otherwise, the next easiest level of math problems was assessed. This procedure continued until the participant correctly performed 95% of the math problems for three
different types of math problems. A 95% accuracy level was selected because at this level student demonstrate fluency with material. This will help to control for the level of effort required to complete a math problem throughout the study. Effort could be a possible confounding variable; thus, demonstrating that the participants are fluent at a certain math level will help to minimize this confound on the participants’ preference for certain math problems. See Appendix C for a list of the level of math problems each student completed at 95% accuracy level.

Training Session

Each participant had one training session to become familiar with the computer program. First, the participant was shown how to use the external mouse to choose a math problem. Second, the participant was shown how to enter the answer to a math problem in the answer box. Third, a demonstration of each option arrangement was provided and then the participant was asked to pick each option arrangement. Finally, the participant had one practice session to demonstrate that he/she could operate the computer program. All participants demonstrated that they could operate the computer program on the first session. The training session and experimental sessions did not occur on the same day to prevent any history variables influencing the effects of the experimental conditions.

Experimental Conditions

Participants’ exposures to the experimental conditions were randomly assigned before the start of the sessions. Each session participants were exposed to the following conditions: baseline, followed by either one option, two options, or mixed schedule, and then to baseline again. The second baseline was used to test the effects of the recent
exposure to a particular experimental condition on participants’ preference for an option arrangement. The order of the exposure to the two options, one option, and mixed conditions varied across participants. There was at least a 1 min break between each session to help the participants discriminate the different conditions. Additionally, participant information was reentered into the computer program in between each condition. Each condition consisted of 30 math problems for 4 of the participants (03, 04, 05, and 06). Two of the participants (01 and 02) had conditions with 15 math problems each. This was due to the length of time it took participants 01 and 02 to complete a set of math problems. The type of math problems (addition or subtraction) used during the experimental conditions was randomly assigned to each session at the start of each session. This allowed the participant to work on a variety of different types of math problems over the course of the study. A problem counter was at the top of the computer screen. This was put in for the participants’ benefit to know how many problems they had completed. At the start of the session, the participant was asked to select a preferred edible out of a selection of three edible. This was done to ensure that the participant was working for a currently preferred item. Once the participant had completed all three conditions, s/he could choose a preferred item. Only one session was conducted per day to prevent any history effects carrying over and influencing preference for choice in the following session.

**Baseline.** This condition was designed to assess if the participant displayed a preference for a particular option arrangement. Participant preference was measured by the use of a concurrent operant design. In the initial link, the participant was presented with two buttons. One button read, “Two choices” and had a picture of two circles
underneath. This button was associated with the two options condition. While the other button read, “One choice” and had a picture of one circle underneath. This button was associated with the one option condition. Pictures and words of the option arrangements were used to increase the participants’ ability to discriminate between each option arrangement. If the participant chose the “Two Choices” button, the subsequent screen displayed two different math problems that were similar with respect to level of difficulty (i.e., terminal link). However, selection of the “One choice” button led to a screen with one math problem (i.e., terminal link). The participant had two tries to answer the math problem correctly. If the participant answered the math problem correctly, a phrase appeared reading, “Good Job!” then a “next” button appeared and the participant had to click on this button. This returned the participant to the initial screen with the two buttons displayed (i.e., initial link). If the participant entered the wrong answer, a phrase appeared reading, “Try again.” If the participant did not answer the math problem correctly within the two tries, the computer program presented the initial screen with the two buttons displayed (i.e., initial link).
Figure 2. Diagram of the computer screens of the initial and terminal links from the baseline condition.

**One option.** This condition was similar to the one option condition described in baseline. The initial computer screen displayed the “One Choice” button (i.e., initial link). The participant selected the “One Choice” button, and the subsequent screen displayed a math problem along with a box for the participant to enter the answer (i.e., terminal link). If the participant entered the wrong answer, a phrase appeared reading, “Try again.” If the participant entered the correct answer, a phrase appeared reading, “Good Job!” then a “next” button appeared and the participant clicked on this button. This returned the participant to the initial screen (i.e., initial link) with the “One Choice” button.
Two options. In this condition, the initial computer screen displayed the “Two Choices” button (i.e., initial link). The participant needed to click on the “Two Choices” button and the next computer screen displayed two math problems that were similar with respect to level of difficulty and a box for the participant to input the answer (i.e., terminal link). The participant had to complete only one of the two math problems. If the participant entered the wrong answer, a phrase appeared reading, “Try again.” If the participant entered the correct answer, a phrase appeared reading, “Good Job!” then a “next” button appeared and the participant clicked on the button. This returned the participant to the initial screen with the “Two Choices” button (i.e., initial link).
**Mixed schedule.** In this arrangement, the participant was exposed to both the one option and two options conditions with a probability of 0.5 of contacting each type of condition. The procedures were similar to those described above, except after the participant completed a math problem the computer program randomly chose to present either the one option or two options condition as the next type of option arrangement.

**Experimental Design**

This study used three different designs to demonstrate experimental control. The designs were a modified concurrent-chain procedure (Hanley et al., 1997), a within session reversal, and an across experimental conditions reversal.
**Modified concurrent chain procedure.** A modified concurrent-chain procedure (Hanley et al., 1997) was used for each condition. In the initial link, participants were exposed to an FR 1 schedule for button presses. This meant that in the initial link, the participant had to click on the button once to start the terminal link. In the terminal link, math problems were presented in the format selected in the initial link (i.e., one option, two options, or mixed). Participants completed one math problem in the terminal link. Completion of the math problem would reset the concurrent-chain design to display the initial link. If a participant answered the math problem incorrectly, he/she was given one more opportunity to enter the correct answer. If the participant failed to enter the correct answer the second time, the program would automatically return the participant to the initial link. The participants experienced either 30 or 15 trials of the concurrent-chain arrangement (depending the participant’s response requirement).

**Within session reversal.** The within session reversal (i.e., ABA, ACA, or ADA) consisted of the participant being exposed to baseline (condition A), an experimental condition (i.e., one option, two options, or mixed, condition B, C, or D, respectively), followed by the baseline condition (i.e., the history testing condition) during each session. A within session reversal was arranged to help control for any external confounding variables that could influence preference for an option arrangement.

**Across experimental conditions reversal.** A reversal across experimental conditions was conducted. Condition B was one option, condition C was two options, and condition D was mixed. The arrangement of the order of the experimental conditions was counter balanced across all participants to control for any carryover effects from a
previous condition. Participant 01 experienced a reversal in the following order BDCBDB. Participant 02 experienced a reversal in the following order DCBDCB.

Four of the participants (i.e., 03, 04, 05, and 06) were moved out of study 1 after exposure to one of each history building condition. Participant 03 experienced the conditions in the following order CBD. Participant 04 experienced the conditions in the following order CDB. Participant 05 experienced the conditions following order DBC. Participant 06 experienced conditions in the following order BCD. This occurred because these participants did not display any behavior that would have indicated a behavioral history effect. Thus, it was decided that these participants should be moved into study 2. Two of the participants (i.e., 01 and 02) remained in study 1 to complete one reversal of all three history building conditions.

In this arrangement, the same experimental condition was conducted for three sessions in a row. Three sessions were chosen to help to control for the exposure a participant had to a particular history building condition. This allowed for equal lengths of exposure to a history arrangement to facilitate comparisons between history conditions. However, as the study progressed, it became apparent that condition changes should be based on response patterns and not a predetermined number. Thus, after one exposure to the two option building conditions and two exposures of one option building condition for participants 01 and 02, the number of sessions per condition was based on the choice allocation displayed on a session-by-session basis.

**Procedural Integrity**

Independent observers collected procedural integrity on the implementation of the session procedures (i.e., baseline, experimental condition, and baseline). A checklist was
generated that described the procedures of each session (see Appendix D). The percentage of steps performed correctly was tallied and calculated across all sessions and participants. Procedural integrity was collected for 30.8%, 26.9%, 26.6%, 40%, 40%, and 40% of the sessions for participants 01, 02, 03, 04, 05, and 06, respectively. The total percentage of steps performed correctly averaged 99.7% (range, 98.3 - 100%).
Chapter 4: Results Study 1

Data from Study 1 are shown in Figures 5 through 10.

Participant 01

Overall, Participant 01 selected the one option terminal link most frequently for the first and second baseline during the first one option history building condition. Additionally, preference for the one option terminal link increased during this condition. In the mixed history building condition, Participant 01 selected the one option terminal link most frequently in the first baseline, and he selected the two options terminal link in the second baseline, for 2 out of the 3 sessions. In the first two options history building condition, he had a stronger preference for the one option terminal in the first baseline, and he had an exclusive preference for the two options terminal link in the second baseline. In the return to the one option history building condition, he frequently chose the two options terminal link in the first and second baseline. This response pattern was dissimilar to responding in the first one option history building condition. In the second mixed history building condition, he initially selected the one option terminal link in the first baseline while selecting the two options terminal link in the second baseline. However, the last three sessions of this condition he chose the two options terminal link for both the first and second baseline. In the third one option history condition, he chose
the two options terminal link for both the first and second baseline. In the second two options history building condition, he always chose the two options terminal link for both baselines. Overall, the strongest presence of history effects were observed in the mixed history building condition. However, as the study progressed, Participant 01 developed a preference for the two option terminal, regardless of the history condition.

Figure 5. These data represent the percentage of choice allocation in the initial link for Participant 01. The black bars are the first baseline and the grey bars are the second baseline conducted each session.
Participant 02

In first mixed history building condition, Participant 02 selected the one option link most frequently for the first and second baseline. In the first two options history building condition, he initially selected the two options terminal link most frequently in both baselines. As the condition continued, he chose the one option terminal link more frequently for both the first and second baseline. In the first one option history building condition, he chose the one option terminal link most frequently in both the first and second baseline. In the second mixed history condition, data were more variable as compared to the first mixed history building condition. For the initial baseline, Participant 02 selected the one option terminal link more frequently. However, the second baseline his selections varied between both the one option and two options terminal link. In the second two options history building condition, Participant 02’s choice allocation was more variable than the previous two options history building condition. Overall, it appears that initial preference was for the one option terminal link and this preference shifted toward two options terminal link at the end of this condition. In the second one option terminal link, his choice allocation was for the two options terminal link for both the first and second baseline. This preference was opposite than the previous one option history building condition.
Figure 6. These data represent the percentage of choice allocation in the initial link for Participant 02. The black bars are the first baseline and the grey bars are the second baseline conducted each session.

Participants 03 and 04

Participants 03 and 04 allocated there responding to the one option terminal link in both the first and second baselines across all three history building conditions.
Figure 7. These data represent the percentage of choice allocation in the initial link for Participant 03. The black bars are the first baseline and the grey bars are the second baseline conducted each session.
Figure 8. These data represent the percentage of choice allocation in the initial link for Participant 04. The black bars are the first baseline and the grey bars are the second baseline conducted each session.

Participant 05

In the mixed history building condition, Participant 05 allocated some of her responding to the one option terminal link but this preference decreased as the condition continued; resulting in most of her selections for the two options terminal link. In the one option history building condition, she allocated all of her responding to the two options terminal link in the first and second baseline. In the two options history building condition, she allocated some responding toward the one option terminal link in the second baseline but this pattern was not observed in the final session of this condition.
Figure 9. These data represent the percentage of choice allocation in the initial link for Participant 05. The black bars are the first baseline and the grey bars are the second baseline conducted each session.

Participant 06

Participant 06 allocated her responding to the two options terminal link in both the first and second baseline across all three history building conditions.
Figure 10. These data represent the percentage of choice allocation in the initial link for Participant 06. The black bars are the first baseline and the grey bars are the second baseline conducted each session.
Chapter 5: Discussion Study 1

The research question addressed in this study was how do past choice experiences affect preference for choosing academic tasks? The results of Study 1 indicated that behavioral history did not affect the preference for choice for 4 of the 6 participants. The 4 participants demonstrated a strong and solid preference for either one option (participants 03 and 04) or two options (participants 05 and 06). For participants 01 and 02, behavioral history effects were possible; however, responding was variable across sessions and across replication of the conditions.

Participant 01 displayed history effects in the mixed and two options history building conditions (see Figure 2). In the mixed history building condition, the first baseline preference was for the one option terminal link. After exposure to the mixed history building condition, his preference shifted to the two options terminal link in the second baseline. This pattern of responding was observed in the first and second applications of the mixed history building condition.

It should be noted that not all sessions conducted in this condition demonstrated the aforementioned pattern of responding. It is interesting to note that the prolonged exposure in the second mixed history building condition resulted in a preference for the two options terminal link in both the first and second baseline (see the last 3 sessions of the second mixed history building condition). This could indicate that the behavioral
history effects observed in the mixed history building condition were transient or possibly influenced by motivating operations.

The use of a within session reversal design makes it more difficult to say that the results for this participant were transient. The participant was re-exposed to the history building conditions each session; thus, history effects (if present) should be strengthened in each session. This would make it less likely that the current contingencies would control behavior across each session. However, the overall pattern of responding in the second mixed history building condition suggested that preference was in transition. This is similar to other studies of behavioral history that demonstrated most history effects were short-lived (Baron & Leinenweber, 1995; Doughty et al., 2005; Lopez & Menez, 2005; Wanchisen et al., 1989). It is hard to determine why preference in the first baseline shifted, but there could be an overall history effect of the condition or participation in the experiment resulted in the participant preferring the two options alternative.

The second explanation for the behavioral history effects observed could be an interaction between behavioral history and motivating operations. It could be viewed that the participant engaged in a number of one option responses during the first baseline and then received a number of forced exposures to additional one option alternatives in the mixed history building condition, thus resulting in satiation of the one option alternative. These experiences may have decreased the value of the one option alternative and subsequently increased the value of the two options alternative. Behavioral history effects on motivating operation may have been evident by the participant responding almost exclusively to the two options alternative in the second baseline. This explanation does
not address why preference in the first baseline shifted, but it may be that with more exposure to the one option arrangement the value of the two options alternative increased over the course of the study.

A second demonstration of behavioral history effects for participant 01 was observed in the first two options history building condition. In the first baseline, preference was generally for the two options alternative with some responding allocated to the one option alternative. After experience with the two options history building condition, an exclusive preference for the two options alternative emerged in the second baseline. Unfortunately, these results were not replicated in the second two options history building condition. The lack of replication makes it more difficult to conclude that the response patterns observed in the first two options history building conditions were due to behavioral history effects.

In general, Participant 01 typically preferred the one option alternative in the first baseline and the two options alternative in the second baseline, regardless of the type of history building condition experienced. Based on this overall picture of his responding, it seems that the type of history building condition did not result in differential preference. Previous studies have shown that history effects are different based on the schedule of reinforcement or discriminative stimulus used (Baron & Leinenweber, 1995; Doughty et al., 2005; Freeman & Lattal, 1992; Lopez & Menez, 2005; Okouchi, 2005; Wanchisen et al., 1989). It is interesting that the type of history condition did not result in differential preference for this participant. This pattern of preference was only observed with 1 of the 6 participants; thus, it could be that other variables were influencing preference.
Participant 02 displayed an overall general shift in preference from the one option alternative to the two options alternative (see Figure 3) across the course of Study 1. It is possible that participation in this study had an overall history effect. That is, ontogenic factors may have influenced Participant 02’s responding, and he may have developed a preference for two options through multiple experiences with the choice arrangement. Some reasons this preference may have developed through ontogenic factors could be that the levels of math problems used for Participant 02 were the three easiest levels. When he initially started the study, he took a long time to complete the required 15 math problems. As he progressed through the study, he became quicker at answering the math problems. It may be that as he became more proficient at answering the math problems, the value of choice increased. That is, because the math problems were easier to complete, choosing among the alternatives increased in value. At the start of the study, it is possible that all math problems were equally difficult for this participant; thus, the one option alternative may have been the less effortful alternative (e.g., did not require the extra time needed to select between the two options). However, as his math skills became more efficient, selecting between the two math problems became the preferred option because it could have allowed him to complete the math problem that he viewed as easier. This view suggests that a different variable (i.e., effort) was influencing preference for choice.

It is interesting to note that Participants 03, 04, 05, and 06 all had a stable preference for a particular option arrangement throughout this study. This indicated that their preference for an option arrangement was not influenced by exposure to a particular history building condition. In addition, participants 03 and 04 preferred the one option
condition, whereas, participants 05 and 06 preferred the two options condition. This provides evidence that preference for choice was idiosyncratic and that choice was not always the preferred option.
Chapter 6: Method Study 2

Participants and Setting

Participants 03, 04, 05, and 06 were selected from Study 1 to participate in Study 2. These participants were chosen because they had completed Study 1 and there was enough time remaining in the school year to allow for participation in Study 2. The same settings were used in Study 2 as in Study 1.

Materials

Participants used a laptop computer with a mouse during the study. A computer program was designed for Study 2 using Microsoft Visual Basic programming. Participants had a pencil and piece of paper to use during all conditions of the study in order to compute math problems by hand, if needed. Additionally, participants were given a choice of an edible reinforcer.

Response Measurement

There were two dependent variables in this study. The first dependent variable was the participant’s selection of the reinforcer selection alternatives in the initial link. Selection of the reinforcer selection alternative was defined as the participant using an external mouse to click on one of two buttons, each associated with a different way to select the reinforcer, displayed on the computer screen. The second dependent variable was the number of reinforcer selection alternatives completed in the terminal link. A
reinforcer selection alternative was defined as completing one math problem in the terminal link. In the experimenter selects terminal link, one math problem was displayed on the computer screen. Completion of this math problem always resulted in the experimenter selecting the reinforcer for the participant. In the participant selects terminal link, there were two math problems displayed on the computer screen, each associated with a different way to select the reinforcer (i.e., either the experimenter selects or the participant selects).

Preferences Assessment

A second MSWO preference assessment was conducted. The same procedures outlined in Study 1 were used to conduct the MSWO preference assessment in Study 2. The purpose of this preference assessment was to identify highly preferred items because history effects on preference for choice were directly related to the type of edible item the participant preferred. Research has indicated that preference can shift overtime (Hanley et al. 2003; Zhou, 2001), thus, it was appropriate to reassess preference for edible items in this study.

Math Assessment

The same math assessment used in Study 1 was used for Study 2. The participants mentioned that they had been working on multiplication in class and wanted to do work on multiple problems during the study. However, none of the participants met the 95% accuracy criteria on the multiplication problems.

Training Session

The same training procedures used as Study 1 were used to train the participants in study 2.
Experimental Conditions

Participants’ exposure to the experimental conditions was randomly assigned prior to the start of the sessions. Each session participants were exposed to baseline, followed by either participant selects, experimenter selects, or mixed condition, then baseline again. The second baseline was used to test the effects of the recent exposure to a particular experimental condition on participants’ responding. The order of the exposure to the participant selects, experimenter selects, and mixed condition varied across participants. As in Study 1, there was a 1 min break in between each experimental condition and participant information was reentered into the computer program to help the participants discriminate the different conditions. Each experimental condition consisted of 30 math problems. The type of math problems used during the experimental conditions was randomly assigned to each condition at the start of the session. This was done to allow the participant to work on a variety of different types of math problems over the course of the study. A problem counter was at the top of the computer screen. This was put in for the participants’ benefit to know how many problems they had completed. At the start of the session, the participant was asked to select a preferred edible out of a selection of three edible. This was done to ensure that the participant was working for a currently preferred item. At the end of each condition, the participant was given access to a preferred stimulus based on the participant’s selection of the reinforcer selection alternative during the session. That is, the participant was allowed to choose a reinforcer from an array of five identical reinforcers or the experimenter would choose a reinforcer out of an array of five identical reinforcers and give it to the participant. Only
one session was conducted per day to prevent any history effects carrying over and influencing preference for choice in the following session.

**Baseline.** This condition was designed to assess if the participant displayed a preference for a particular choice condition. The initial computer screen presented with two buttons (i.e., initial link). One button read, “Choice” and was associated with the participant selects condition, while the other button read, “No Choice” and was associated with the experimenter selects condition. If the participant chose the “Choice” button, the subsequent screen displayed the two different math problems of the same difficulty level (i.e., terminal link). Under the left math problem there was a label that read, “Teacher chooses the snack” and had a picture of the preferred reinforcer. Under the math problem on the right side, the label said, “You choose the snack” and had the same picture of the preferred reinforcer. However, if during the initial link the participant selected the “No Choice” button, the subsequent screen displayed one math problem in the center of the screen (i.e., terminal link). Under this math problem, the label read, “Teacher chooses the snack” and had a picture of the preferred reinforcer. Once the participant answered the math problem correctly, the computer screen returned to the initial screen with both choice buttons displayed (i.e., initial link). As in Study 1, the participant was given two opportunities to answer the math problem correctly or the computer program would automatically return the participant to the initial screen. After the participant completed 30 trials, a box appeared indicating how the participant allocated her responding. If the participant chose the participant select option and completed more problems with the label “You choose the snack” during the condition, then the participant was able to pick one reinforcer out of an array of five identical
reinforcers. If the participant chose the experimenter selects option more often or chose the participant selects option but completed problems with the label “Teacher chooses the snack,” then the experimenter picked one reinforcer out of an array of five identical reinforcers and gave it to the participant.

**Figure 11.** Diagram of the computer screens of the initial and terminal links from the baseline condition.

**Experimenter selects.** This condition was similar to the experimenter selects condition described in baseline. The initial computer screen displayed the “No Choice” button (i.e., initial link). The participant selected the “No Choice” button; the subsequent screen displayed one math problem along with a box for the participant to enter the
answer (i.e., terminal link). Under the math problem was the label, “Teacher chooses the snack” and a picture of the preferred reinforcer. If the participant entered the wrong answer, a phrase appeared reading, “Try again.” If the participant entered the correct answer, a phrase appeared reading, “Good Job!”; then a “next” button appeared, and the participant clicked on this button. This returned the participant to the initial screen (i.e., initial link) with the “No Choice” button. After the participant has completed 30 trials, the experimenter presented an array of five identical reinforcers, selected one, and gave it to the participant.

Figure 12. Diagram of the computer screens of the initial and terminal links from the baseline condition.
Participant selects. In this condition, the initial computer screen displayed the “Choice” button (i.e., initial link). The participant needed to click on the “Choice” button and the next computer screen displayed two math problems that were similar with respect to level of difficulty and a box for the participant to input the answer (i.e., terminal link). Under the math problem on the left side was a label that read, “Teacher chooses the snack” and a picture of the preferred reinforcer. Under the math problem on the right side was a label that read, “You choose the snack” and a picture of a highly preferred reinforcer. The participant had to select one of the two math problems to answer. If the participant entered the wrong answer, a phrase appeared reading, “Try again.” If the participant entered the correct answer, a phrase appeared reading, “Good Job!” then a “next” button appeared and the participant clicked on the button. This returned the participant to the initial screen with the “Choice” button (i.e., initial link). After the participant completed 30 trials, she was able to access the preferred reinforcer. If the participant completed more problems labeled, “You choose the snack” during the condition, the participant was able to pick one reinforcer out of an array of five identical reinforcers. If the participant completed more problems labeled “Teacher chooses the snack” during the condition, the experimenter picked one reinforcer out of an array of five identical reinforcers and gave it to the participant. If the participant completed an equal number of problems labeled “Teacher chooses the snack” and problems labeled “You choose the snack” then on the first occurrence the participant would select the reinforcer, on the second occurrence of equal distribution of responding the experimenter would select the snack and so on.
Mixed schedule. In this arrangement, the participant was exposed to both the participant selects and experimenter selects conditions with a probability of 0.5 of contacting each type of condition. The procedures were similar to those described above, except after the participant completed a math problem, the computer program randomly chose to present either the participant selects or experimenter selects condition as the next type condition. After the participant completed 30 math problems, she was able to access the preferred reinforcer based on her responding during the condition.

Change to the button labels. The labels of the buttons were changed after three sessions for participants 04, 05, and 06, and after one session for participant 05. This change occurred because the participants would state they had completed the wrong set
of math problems and did not understand which math problems to complete in order to choose the reinforcer. For example, a participant might choose the participant selects button in the initial link, and then completed math problems the resulted in the experimenter choosing the reinforcer; however, at the end the participant thought she would be able to choose the reinforcer. Originally, in the initial link, one button read “Teacher Choice” (later changed to “No Choice”) and the other button read, “Student Choice” (later changed to “Choice”). In the terminal link, the math problem associated with the participant selection of the reinforcer originally read, “Student Choice” (later changed to “You choose the snack”) and the math problem associated with the experimenter choosing the reinforcer read, “Teacher Choice” (later changed to “Teacher chooses the snack”). After the labels on the initial link buttons and the labels under the math problems in the terminal link were changed, the participants had another training session.

Experimental Design

The same experimental design used in Study 1 was used in Study 2. That is, a modified concurrent-chain arrangement, within session reversal (i.e., ABA, ACA, or ADA), and an across experimental conditions reversal. Condition A was baseline, condition B was experimenter selects, condition C was participant selects, and condition D was mixed. The order of the across experimental conditions reversal was BCDBC for participant 03, BDCB for participant 04, CDBCD for participant 05 and DCBDCB for participant 06.

Procedural Integrity
Independent observers collected procedural integrity on the implementation of the session procedures (i.e., baseline, experimental condition, and baseline). A checklist was generated that described the procedures of each experimental condition conducted per session (see Appendix E). The percentage of steps performed correctly was tallied and calculated across all sessions and all participants. Procedural integrity was collected for 23.2%, 23.1%, 19.2%, and 16% of the sessions for participants 03, 04, 05, and 06, respectively. The total percentage of steps performed correctly averaged 100%.
Chapter 7: Results Study 2

The data from Study 2 are shown in figures 14 through 17.

**Participant 03**

Participant 03 demonstrated a preference for selecting the reinforcer in the initial link across almost all sessions in all conditions of the study. In the participant selects terminal link, there was some initial variability in preference during the first experimenter selects history building condition. Initially, there was near equal responding toward both alternatives in the first and second baseline. As the condition progressed, preference for the participant picking the reinforcer became more frequent during the first and second baseline. During the first participant selects history building condition, she preferred participant selecting the reinforcer during the first and second baseline. During session 13, she allocated a small amount of her responding toward the experimenter choosing the reinforcer. In the first mixed history building condition, she demonstrated a strong preference for choosing the reinforcer herself, with the exception of one session, where she allocated about half of her responding toward the experimenter choosing the reinforcer. In the return to the experimenter selects history building condition, she responded in a similar fashion as the mixed history building condition, that is she typically allocated her responding to the option the resulted in her choosing the reinforcer.
except for one baseline session. In this one baseline, she equally split her responding between both alternatives. In the second participant selects history building condition, there was more variability in the data. Initially, she preferred to choose the reinforcer, then she would equally split her responding between both alternatives. At the end of the condition, she began to reallocate all of her responding to the option that allowed her to choose the reinforcer.
Figure 14. These data represent the percentage of choice allocation in the initial link and choice terminal link for Participant 03. The black bars are the first baseline and the grey bars are the second baseline conducted each session.
Participant 04

During the experimenter selects history building condition, preference in the initial link preference was for selecting the reinforcer herself in both baselines per session. During the mixed history building condition, preference for a particular terminal link became variable across the condition. The initial sessions demonstrate an increasing preference for the experimenter selects terminal link in the first and second baseline. However, distinct preference for a terminal link did not emerge. Responding was either equally or nearly equally split between both alternatives in sessions 9, 11, and 13. Whereas, responding on the first baseline was nearly equal between the two alternatives and responding on the second baseline was higher for the experimenter selects option on sessions 10, 12, 14, and 16. During the participant selects history building condition, responding in the initial link became more variable relative to the other conditions. There was an initial overall change in preference from experimenter selects to the participant selects option during the first three sessions of this condition. Then it seemed that her preference for a particular alternative would switch every other session. In the second experimenter selects history building condition, there was an initial preference for the participant selects terminal link during the first session; however, as the condition progressed preference for the experimenter selects terminal link became stronger. It should be noted that responding in the second experimenter selects history building condition was different than responding in the first experimenter selects history building condition.

In the participant selects terminal link during the first experimenter selects history building condition, Participant 04 demonstrated a strong preference for selecting the
reinforcer. In the mixed history building condition, when she entered the participant selects terminal link, she generally always preferred the option that allowed her to choose the reinforcer in both the first and second baseline. In the participant selects history building condition, she typically completed the math problem that allowed her to choose the reinforcer at the end of the session during first and second baseline. This pattern of responding was seen again in the second experimenter selects history building condition, where she generally allocated her responding to the math problem that let her select the reinforcer.
Figure 15. These data represent the percentage of choice allocation in the initial link and choice terminal for Participant 04. The black bars are the first baseline and the grey bars are the second baseline conducted each session.
Participant 05

In the initial link, Participant 05 allocated almost all of her responding toward the participant selects terminal link in all conditions of the study. In the participant selects terminal link during the participant selects history building condition, Participant 05 responded was variable during this condition, with most of the responding demonstrating indifference toward who choose the reinforcer. It should be noted that in some sessions Participant 05 responding more toward the experimenter selects option in the first baseline and responded more toward the participant selects option in the second baseline (sessions 2, 3, and 6). In the mixed history building condition, responding was again variable between the two alternatives. During the middle of this condition, there seemed to be an increasing preference for the experimenter choosing the reinforcer (sessions 10 - 12) but the remaining sessions in the condition indicated that preference was stronger for the participant choosing the reinforcer. In the experimenter selects history building condition, the first baselines demonstrated a stronger preference for the participant selecting the reinforcer. The second baselines demonstrated an increase in preference for the experimenter selecting the reinforcer in 3 out of 4 sessions. In the second participant selects history building condition, there was again higher preference for the experimenter choosing the reinforcer in the first baseline and a less of a preference observed in the second baseline for 3 out of 4 sessions. This is a similar pattern of responding as seen in the first participant selects history building condition. In the second mixed history building condition, responding was less variable between the first and second base as compared to the first mixed history building condition. Additionally, there seemed to be a
stronger overall preference for the participant selecting the reinforcer as compared to the first mixed history building condition.
Figure 16. These data represent the percentage of choice allocation in the initial link and choice terminal for Participant 05. The black bars are the first baseline and the grey bars are the second baseline conducted each session.
Participant 06

Participant 06 demonstrated a preference for the participant selects option in the initial link for almost all sessions in all conditions of the study. In the participant selects terminal link, there was some initial variability in preference during the first mixed history building condition. The participant has a stronger preference for selecting the reinforcer in the first and second baseline during the initial session. However, some responding was allocated toward the researcher selecting the reinforcer. As the condition progressed, she had an exclusive preference for selecting the reinforcer during the first and second baseline. During the first participant selects history building condition, she demonstrated a strong preference for her being able to choose the reinforcer during the first and second baseline. A few of the sessions, she allocated some responding toward the researcher choosing the reinforcer but this responding was variable. In the first experimenter selects history building condition, she demonstrated an almost exclusive preference for choosing the reinforcer herself in the first and second baseline. In the return to the mixed history building condition, she responding in a similar fashion as the previous mixed history building condition, that is she chose the math problems that lead to her selecting the reinforcer. In the second participant selects and experimenter selects history building conditions, responding was the same as the previous conditions, that is, almost exclusive preference for selecting the reinforcer herself in the first and second baseline.
Figure 17. These data represent the percentage of choice allocation in the initial link and choice terminal link for Participant 06. The black bars are the first baseline and the grey bars are the second baseline conducted each session.
Chapter 8: Discussion Study 2

The research question addressed in this study was how does behavioral history affect preference for selecting a reinforcer? The results of Study 2 indicated that each participant’s responding was highly individualized. Participant 06 displayed no effects of history on preference for selecting the reinforcer. This participant always preferred to select the reinforcer herself regardless of the history building condition. Participant 03 demonstrated a strong preference for selecting the reinforcer herself but her preference was not as stable as Participant 06’s preference for selecting the reinforcer. Participant 04 demonstrated indifference in her preference for who selected the reinforcer in the initial link. For Participant 05, she selected the participant selects alternative in the initial link and her responding resembled indifference for who would selected the reinforcer in the terminal link. Taken together these results indicate that preference for selection of the reinforcer was highly individualized and this study was not able to adequately control for confounding variables (e.g., food deprivation, reinforcement schedule, length of time in the study, or the presence of other participants) to identify if behavioral history affects preference for selection of a reinforcer.

Participant 03 demonstrated a strong preference for selecting the reinforcer throughout the conditions of Study 2. However, there were occasions in which she allocated some responding toward the experimenter selects alternative in the terminal
link. In particular, toward the end of the study (sessions, 20, 23, and 24) she would alternate her responding to result in an equal number of responses distributed to each selection alternative. The participant was asked why she performed in this manner and her response was that she had not “tied” before and wanted to see what would happen. In the event of a “tie” between reinforcer selection alternatives, the person who selected the reinforcer would alternate between the researcher and the participant. For example, on the first occurrence of a “tie” the participant selected the reinforcer, on the second occurrence of a “tie” the researcher selected the reinforcer, and so on. One interpretation is that the participant had become satiated with selecting the alternative that resulted in her choosing the reinforcer and thus, the value of engaging in a novel response pattern became the more preferred behavior.

Participant 04 demonstrated a different pattern of preference than the other participants in this study. Her preference was variable in the initial link of the concurrent chain arrangement. This is interesting because studies examining preference for choice have used the initial link as a measure of preference. In this study, however, the initial link was one of two ways to measure preference for choice. The participants had two ways to express a preference for choice--in the initial link and in the participant selects terminal link. This type of arrangement in a concurrent operant design (where the participant had two different opportunities to express a preference for choice) typically is not used in the preference for choice literature. In looking at preference for choice and using a concurrent operant design, researchers need to be aware of the options available in the initial and terminal links. Depending on the choice arrangements, these options could indicate different patterns of preference in the initial and terminal link. More
research is needed that uses a concurrent operant design where the choice terminal link has both one option and two options alternatives. This type of arrangement could provide more evidence as to the type of choice that is more valuable to the participant. In the initial link, participants were choosing to make a choice, whereas, in the terminal choice link, they were choosing to either select or not select the reinforcer. The choice in the terminal link could be influenced by other factors as demonstrated by the variable responding seen in participant 05 and to a lesser degree participant 03.

For Participant 04, possible history effects may have occurred in the mixed history building condition (sessions 7, 8, 10, 12, 14, and 16). In the first baseline, responding was typically equal or near equal for both terminal link options. After exposure to the mixed history building condition, she allocated more responding to the experimenter selects terminal link. This condition was not replicated due to the school year ending, so it is uncertain if these results could have been replicated.

The data from participant 04 also indicate that there was a lot of variability in preference, particularly in the participant selects history building condition. In the first experimenter selects history building condition, she allocated most of her responding to the participant selects terminal link. In the second experimenter selects building condition, she initially allocated responding to the participant selects terminal link then shifted her preference to the experimenter selects terminal link. These data indicate that there was a lack of experimental control and other variables were influencing preference for choice.

In the initial link, Participant 05 allocated most of her responding to the participant selects terminal link. This would indicate a strong preference for making a
choice. However, her responding in the participant selects terminal link was variable and appeared to be almost indifferent to selecting the reinforcer. That is, she would complete many responses on the math problems that led to the researcher selecting the reinforcer. This was mostly evident in the first two conditions (i.e., participant selects and mixed history building). A possible explanation for this type of responding was that there was motivation for the participant to select the participant selects alternative in the initial link; however, once that selection was made the value of choice immediately decreased and allowed responding to fluctuate between the two alternatives in the participant selects terminal link. This pattern of responding may suggest that the motivating operations were a large contributing factor to preference for choice. Additionally, motivating operations were easily influenced by a single response. This is one interpretation of the data from 1 participant of this study and more research is needed to provide support for this analysis.

Participant 05 did engage in some responding that could indicate influence of behavioral history effects. In the experimenter selects history building condition in the first baseline, she allocated most of her responding to selecting the reinforcer and some responding toward the experimenter selecting the reinforcer. After exposure to this one option history building condition, the majority of her responding was again allocated toward her selecting the reinforcer. Relative to the first baseline, however, more responding was allocated toward the researcher selecting the reinforcer. Unfortunately, the school year ended before the second experimenter selects history building condition could be implemented; thus, there was no replication of these results. In the participant selects history building condition, the opposite pattern of responding was observed. In the initial baseline, most responding was allocated toward the participant selecting the
reinforcer with about a quarter of the responding toward the researcher selecting the reinforcer. In the second baseline, less responding was allocated toward the researcher selecting the reinforcer relative to the first baseline. This pattern of responding was observed in some of the sessions in the first participant selects history building condition (sessions 2, 3, and 6) and in the second participant selects history building condition.

Participant 05 demonstrated different effects of behavioral history in two of the history building conditions. The different response patterns observed in these history building conditions provides some evidence that behavioral history influenced preference for selection of a reinforcer. Based on the results from Participant 05, the history effects seemed to increase the preference for the choice arrangement that the participant was exposed to during the history building condition (e.g., exposure to the experimenter selects history building condition resulted in a stronger preference for the experimenter selects alternative). It should be noted that the results from this study differed from the study conducted by Ono (2000). Ono’s study demonstrated that the history effects increased preference for the free choice arrangements when exposed to a forced choice arrangement and increased preference for forced choice when exposed to a free choice arrangement. However, it is hard to compare the results from this study to the study conducted by Ono because in the current study, most participants did not display clear effects of behavioral history or the presence of a history effect was minimal.
Chapter 9: General Discussion

The effects of behavioral history on preference for making a choice were evaluated in children with and without disabilities. First, the results from Study 1 and Study 2 indicated that most participants did not demonstrate an effect of behavioral history on preference for making a choice. Although some participants displayed possible behavioral history effects on preference for choice, these effects were minimal or were not replicated in the reversal back to that condition. Second, participants demonstrated variability in their preference between the choice alternatives. That is, a solid preference for making a choice was not observed in most participants.

This study contributes to the literature on choice and behavior history in at least three ways. First, this study is the first to specifically examine the effects of behavioral history on preference for making a choice in human participants. Second, this study demonstrated that choice is not always preferred and that preference may be related more to the type of choice consequence than originally demonstrated in previous research. Third, this study adds to the body of literature on the stability of preference across time.

Many studies have examined how behavioral history affects responding (Baron & Leinenweber, 1995; Chappell & Leibowitz, 1982; Doughty et al., 2005; Freeman & Lattal, 1992; Lopez & Menez, 2005; Okouchi, 2005; Wanchisen et al., 1989; Weiner, 1964; 1969). Few studies have examined how behavioral history influences choice behavior (Martens et al., 2003; Neef et al., 2004) and fewer studies have examined
behavioral history effects on preference for making a choice (Ono, 2004). Most of the studies on behavioral history have been conducted in basic research laboratories using animals or, if using humans, have had the human participants engage in an arbitrary response (e.g., button pushing). A strength of the current studies is that it adds to the limited research examining behavioral history effects in human participants engaging in a socially valid response.

The results of this study also demonstrate that choice is not always a preferred option. It seemed that the type of choice options (e.g., math problem choice vs. reinforcer choice) presented to the participants influenced preference for choice. That is, participants who participated in both Study 1 and Study 2 allowed for a comparison of the value of choice based on the type of options that were available. In Study 1, the choice was between selecting the math problem to complete, on the other hand in Study 2, the choice was between the participant or the researcher selecting the reinforcer. Participants 03 and 04 demonstrated a solid preference for one option in Study 1 (i.e., they did not prefer to make a choice). In Study 2, their preference for making a choice shifted to the participant selects terminal link (Participant 03) or indifference for a particular terminal link (Participant 04). The different pattern of responding can be attributed to the value of the item in the terminal link given that similar experimental procedures were used in both studies.

Many studies have looked at the effects of choice on response output when the individual was able to select the task (similar to Study 1) or when the individual was able to select the reinforcer (similar to Study 2). As mentioned earlier, different response patterns in applied studies can be attributed to the research design used. However, it may
be that the different results seen in these studies were partially attributed to the type of choice option presented in the terminal link. In Study 2, more participants (3 out of 4) preferred the choice terminal link when it resulted in access to the reinforcer; though in Study 1, only 2 of 4 participants preferred the choice terminal link. Comparing the results from these studies indicates that in Study 2 more participants preferred making a choice.

An interesting finding of this study was that preference for choice was not stable. Minimal attention has been given to the stability of preference in the research literature (Hanley, Iwata, Roscoe, 2006; Zhou, 2001). Previous research that has used concurrent arrangements in applied studies on choice has shown that preference for a particular terminal link is relatively stable when the selection is between different types of interventions (e.g., non-contingent reinforcement, punishment, extinction, etc.; Hanley et al., 1997; Hanley et al., 2005). In a study conducted by Tiger et al. (2006), preference for a reinforcer was examined in a choice and no choice alternatives and responding between the two alternatives was slightly variable for most participants. That is, participants generally selected the choice alternative but would occasionally select the no choice alternative. Applied research on choice should continue to investigate variables that influence preference for choice or no choice alternatives. This study and the study conducted by Tiger et al. demonstrated that preference for a choice arrangement is not always consistent across the study. The results from Study 1 and Study 2 may suggest that for some participants the type of choice presented (academic task or reinforcer) may influence the value of choice. Researchers should investigate if there is a difference in the value of choice between based on the type of choice options.
This study begins to illuminate the relationship between choice and motivating operations. Fisher et al. (1997) suggested that choice could be conceptualized as a conditioned reinforcer. This view relates nicely to thinking about choice as being influenced by motivating operations. Michael (2004) stated that a motivating operation is an environmental event or stimulus condition that has two functions: it alters the effectiveness of another event (e.g., reinforcement or punishment) and it alters the occurrence of behaviors associated with that event. Motivating operations could be conditioned and unconditioned. Choice would accurately be described as a conditioned motivating operation (CMO). Michael stated that a CMO acquires its value altering effects because of learning history. Michael discussed three different types of CMO: surrogate, reflexive, and transitive. It seems that choice could be conceptualized as a transitive CMO (CMO-T), which acquires it motivational effect through a relation with another stimulus that alters the value of the consequence. For example, in a concurrent arrangement for free choice or forced choice in the terminal link, the selection of the terminal link produces a stimulus change that could function as a conditioned reinforcer for all responses that result in entrance to the particular terminal link. If the reinforcer is the ability to make a choice in the terminal link, and completion of the terminal link results in access to food, then food deprivation functions as CMO-T for making a choice. That is, it has altered the value of choice (i.e., increased the value of choice) as a conditioned reinforcer for responding in the initial link and evoking responses that produce this conditioned reinforcer (i.e., selection of the choice terminal link). Looking at choice as influenced by CMO-T may indicate why preference for choice shifts over the
course of a study. Further investigations should examine if the ability to make a choice is influenced by motivating operations.

**Limitations**

One of the main limitations of this study was the lack of experimental control. The application of the independent variable did not systematically change the dependent variable, thus suggesting that there was a lack of experimental control. In Study 1, 2 of the 4 participants and in Study 2, 3 of 4 the participants demonstrated variable preference across the study. A clear and stable preference in the initial baseline is essential for demonstrating an effect of behavioral history. For some participants (01, 02, and 04), preference in the initial link was unstable or appeared to be in a transition state. The lack of a stable preference during the baseline indicated that other factors that were not programmed in the study were influencing participants’ preference. The lack of a stable initial baseline preference could account for the varied response patterns observed in the second baseline, thus, making it more difficult to identify if a behavioral history effect was present. Researchers should investigate the stability of preference for choice and try to identify other variables that influence preference for choice such as motivating operations.

One of the contributing factors to the lack of experimental control could be that the participants brought their own unique history of making a choice with them to the study. Each participant had a different history of the number and types of choices she/he made throughout the day. These choices could range from the clothes she/he wore in the morning, the food she/he ate for breakfast or lunch, or assignments to complete during class. The influence of a history of choice making is a large confound to this study. The
number of choices each participant made throughout the day or across days could have influenced their preference for making a choice during this study. It is important that readers are aware of this type of history of choice making and that this history could have had a large impact on the results of this study.

A second limitation of this study was that the history building condition was not long enough to develop a noticeable history effect in most participants. In study 1, participants were exposed to either 15 or 30 math problems and in Study 2 participants were exposed to 30 math problems. This is a relatively brief number of exposures to the history building condition. Most basic studies on behavioral history have stated that history building conditions were in place for a large number of sessions (e.g., 50) and these sessions lasted for a certain amount of time (e.g., 30 min). In the current study the history building condition was in place for a shorter period of time when compared to previous studies. It seems likely that for a behavioral history to be developed, the amount of time in the history building condition is in place is an important factor to consider. Researchers using human participants and examining behavioral history effects should use long history building conditions to increase the likelihood that a behavioral history effect will develop.

A third limitation was that the type of research design chosen for this study. Particularly, the use of a within session reversal design was not appropriate for a study examining behavioral history. This design was chosen to help to control for possible confounding variables that might influence history effects if history building sessions were conducted across multiple days. However, based on the lack of experimental control it is obvious that a different type of research design should be used when testing for the
effects of behavioral history. For example, it would be better to run a block of baseline sessions (e.g., 20), followed by a block of history building conditions (e.g., 30), then another block of baseline sessions (e.g., 20). This would allow the researcher to identify if there is or is not a stable baseline preference, and allow enough time to build a history of responding. The second baseline would then be able to measure history effects and if those history effects were transient.

A possible procedural limitation was that the options in the initial and terminal link did not alternate sides (Studies 1 & 2). This is a potential confounding variable because the participants could have a preference for responding on a particular side. If there was a side preference, then responding was not influenced by the availability of an option arrangement but by the preference for math problems on a particular side of the computer screen. However, given that there was variability in the data for many participants, it is unlikely that the participants had a side preference.

A fifth limitation was that the participants would occasionally talk to one another during the sessions. Typically, 2 participants were in the session room at a time. Participants would talk about subjects related to their friends in class, the type of math problems they were doing (e.g., subtraction or addition), the number of math problems completed, or they would ask the experimenter personal questions (e.g., does she have a boyfriend, etc.). When the participants asked a question or made a comment unrelated to the study, the experimenter would redirect the participants back to working on the math problems (e.g., “Ladies, please no chatting and focus on your math problems, you can talk to each other when you are done”). It is possible that the talking between participants influenced responding, particularly statements about how many math problems had been
completed; however, no comments were ever made about which option alternative the participant preferred. Additionally, in Study 2 the participants who were still working on math problems were able to see whom (i.e., either the experimenter or participant) selected the reinforcer for the other participant who had finished. Again, this might have influenced participant preference for selecting a particular option arrangement.

**Translational Issues**

The purpose of a translational study is to design an experiment that provides a connection between basic and applied research (Wacker, 2000). Translational studies examine basic mechanisms of behavior in conjunction with addressing problems that are of social importance. The techniques that are used in basic research are modified and examined to fit applied contexts. This type of research is useful in developing treatments that can be used in applied settings. For applied researchers, translational studies are important because these studies change the manner in which treatments are analyzed and provide a better understanding of behavior-environment interactions (Wacker, 2000).

This study is classified as a translations study and brought to light some issues that need to be addressed when planning and conducting translational research. First, there is a difference in the variation of similar procedures between basic studies and applied studies (Baron & Perone, 1982). Standardized procedures in basic operant laboratories allow for replication of the study. However, research with humans, there are many aspects of the procedures (e.g., deprivation levels, teaching the participant the response, discriminative stimuli, etc.) that are not directly stated (Barone, Perone, & Galizio, 1991). These variations could make it difficult for translational research to replicate results obtained in basic laboratories. A second issue is the difference in the
response requirement between basic and translational research. In basic research animals engage in a large number of responses per session and the type of response is typically arbitrary (i.e., lever presses). On the contrary, translational studies have participants engage in a socially valid response. The target response chosen can vary from challenging behaviors to academic tasks. Additionally, the number of response produced per session in basic research is greater than in translational research. A third issue is in basic research there is a large number of sessions conducted per condition. An advantage of conducting a large number of sessions is that steady state responding can be achieved. For example, Lopez and Menez (2005) ran the first condition of their study for 30 sessions and the second condition for 60 sessions. When compared to a basic study using human participants Weiner (1969) exposed participants to 10 sessions for each of the two conditions. This example demonstrates that there is a difference in the response requirements between animal and human studies. This difference is important because it relates to achieving steady state responding. Basic literature tends to demonstrate steady state responding more frequently than translational studies. This could be due to the time spent in each condition. A reason researchers using human participant does not conduct as many sessions could be due to ethical reasons (Barone & Perone, 1982). It may not be ethically sound to keep an individual in a particular condition for extended period of time, particularly if that condition is not designed to improve behavior. For example, many people may view extending a baseline condition to achieve steady state responding of challenging behavior as unethical.

The procedural difference between basic and translational research mentioned above could account for differences observed in the results from these two types of
studies. Researchers conducting translational research should be aware of these possible issues and try to plan their studies to address these differences.

Future Research

This study demonstrated some effects of behavioral history on preference for choice but has also elucidated many areas of that researchers should explore in relation to behavioral history and behavioral history on preference for choice. First, behavioral history research has demonstrated that history effects are transitory. Researchers should investigate how different lengths of a history building condition affect the transition state under the history testing condition. This would have relevance to applied researchers looking at how to prevent failures in treatment integrity or as a way to program for generalization. Research may examine how different lengths of training a particular skill (i.e., history building condition) maintain once the individual has completed training (i.e., history testing condition). This type of information is greatly relevant to applied researchers looking to prevent failures in treatment integrity once interventions are transferred to teachers/primary caregivers or to aid in the generalization of skills across people, behaviors, and settings.

Another area that researchers should investigate is the difference in the response output between antecedent choices and consequence choice. Researchers should investigate if the type of choice provided (e.g., academic activity or reinforcer) affects the value of choice. For example, in a classroom it may be easier for teachers to provide a variety of reinforcers for the students to selection from versus providing a variety of academic assignments for the students to select from. Academic assignments generally relate to IEP goals (for students with disabilities) or to yearly content standards. Teachers
may have less opportunities to provide students with choices of academic assignments because teachers need to ensure that students progress toward IEP goals and/or yearly content standards. If researchers further investigate how the value of choice differs for academic task selection than for reinforcer selection, this can better inform teachers to the type of choices (assignments or reinforcers) to provide more of during the school day, in order to get higher response output from the students.

A third area of research should investigate if individuals with profound to severe disabilities respond differently in studies looking at preference for choice and behavioral history. This group of individuals typically has a limited opportunity to make a choice during the day. It could be possible that the lack of choice making increases the value of choice and thus, this group may be more susceptible to history influences on preference for making a choice.

**Summary**

The current studies are part of a larger body of research examining variables that influence choice. The current studies investigated if behavioral history could influence an individual’s preference for making a choice. The results of these studies demonstrated that for most of the participants behavioral history did not influence preference for making a choice. However, these studies encountered a number of limitations that may have precluded the effects of behavioral history on preference for choice. Researchers should extend these findings and determine if and how behavioral history affects preference for choice.
References


Appendix A: Informational Letter
Dear Parent/Guardian,

My name is Alayna Haberlin, and I am a doctoral student in the Special Education department at The Ohio State University. This school year I am looking at students’ preference in the presentation style of math problems and how student like to select rewards. I will be conducting a two-part study. In the first part, I plan to assess how children’s preference for presentation styles change based on the student’s previous work on math problems. This will be accomplished by having your child work on 3 different sets of math problems (each set will contain 30 math problems each). With one set of math problems your child will be given the choice between two math problems to answer. With another set your child will be given one math problem to answer. A third set will be a combination between presenting one or two math problems to answer. By arranging different variations of the above example, we can assess differences in preference for presentation styles for children. In the second part of the study, I plan to assess how children’s preference for selecting a reward changes based on the student’s previous reward selection experiences. Your child will complete a set of 30 math problems. After completing the math problems your child will be able to pick one item out of an array of five items or the experimenter will pick the item for your child. By arranging different variations of who select the reward, we can assess differences in preference for reward selection.

Participation may benefit your child as s/he will receive extra practice with math. We will be working with your child for about 20-30 minutes per session and the number of sessions per week will vary. I will run between 1-5 sessions per week due to the availability of your child and myself. Given that scheduling sessions can be difficult, I have allow up to four months to complete the study. However, the more sessions that your child participates in each week will reduce the overall time spent in the study. During each session, your child will perform a series of math problems on a computer and s/he will receive feedback as to whether the problem was answered correctly.

If you agree to allow your son/daughter to participate in this project please:

- Sign and complete the attached consent form (white copy)
- Keep the second copy of the consent for yourself (green copy)
- Put the signed copy in the envelope marked “Return Envelope”
- Have your child take the “Return Envelope” to school and drop it off in the main office.

Thank you for your time and consideration. If you have any questions regarding this project or if you should want your child to stop participating in this study at any time, please do not hesitate to contact me at 614 –743-7745 or haberlin.1@buckeyemail.osu.edu. I would be more than happy to discuss the project with you.

Sincerely,
Alayna T Haberlin, MA, BCBA
Appendix B: Informed Consent
The Ohio State University Parental Permission
For Child’s Participation in Research

Study Title: Examination of Behavioral History on Participant Choice of Math Problems

Researcher: Nancy A. Neef and Alayna T. Haberlin

Sponsor: This is a parental permission form for research participation. It contains important information about this study and what to expect if you permit your child to participate.

Your child’s participation is voluntary.
Please consider the information carefully. Feel free to discuss the study with your friends and family and to ask questions before making your decision whether or not to permit your child to participate. If you permit your child to participate, you will be asked to sign this form and will receive a copy of the form.

Purpose:
The purpose of this study is (a) to look at students’ preference for different presentation styles of math problems and how these preferences change based on the most recent exposure to particular presentation styles. (b) To assess how children’s preference for selecting a reward changes based on the student’s previous reward selection experiences.

Procedures/Tasks:
First, a math assessment will be given to your child to determine her/his current math skills. The math assessment will be used to identify math problems that your child can answer with 95% accuracy. Second, your child will be given a short training on how to use the computer program that will be used for this study. Third, in the first part of the study, your child will be using a computer program designed to show math problems in different presentation styles. For example, your child may be given just one math problem to answer at a time or may be given a choice between two math problems to answer. We will be looking at which presentation style your child prefers to work on. In the second part of the study, your child will be using the same computer program; however, after completing a set of math problems your child will be able to pick one item out of an array of five items or the experimenter will pick the item for your child. By arranging different variations of who select the reward, we can assess differences in preference for reward selection.
Each visit your child attends, s/he will complete three different sets of 10 math problems each. All work will be completed on the computer, however, your child will have access to a paper and pencil to work out problems by hand if needed.

Duration:
Each session that we work with your child can be from 20-30 minutes. We would be working with your child up to five times per week. The number of sessions conducted per week will be variable due to our schedules and the availability of your child. Given this variability the study could take up to four months to complete. That is, if we can only meet with your child one time per week, you child will be in the study for a longer time period. Your child may leave the study at any time. If you or your child decides to stop participation in the study, there will be no penalty and neither you nor your child will lose any benefits to which you are otherwise entitled. Your decision will not affect your future relationship with The Ohio State University.

Risks and Benefits: Benefits that your child would receive from participating in this study would be more time spent working on mathematics. The extra practice in math skills during this study could help with math skills in your child’s classroom. There are more no risks than what would occur in your child's daily classroom activities.

Confidentiality: Efforts will be made to keep your child’s study-related information confidential. All material related to the study will be kept under password encrypted computer files or in locked file cabinets. In addition to maintaining secure files, your child will be assigned a number that will be used on all paperwork and data collected instead of using your child’s name. This will help to increase our ability to maintain your child’s confidentiality throughout this study. However, there may be circumstances where this information must be released. For example, personal information regarding your child’s participation in this study may be disclosed if required by state law. Also, your child’s records may be reviewed by the following groups (as applicable to the research):

- Office for Human Research Protections or other federal, state, or international regulatory agencies;
- The Ohio State University Institutional Review Board or Office of Responsible Research Practices;
- The sponsor, if any, or agency (including the Food and Drug Administration for FDA-regulated research) supporting the study.

Incentives: Your child will be receiving points for each math problem answered correctly. At the end of each session, your child can exchange the point for a small toy (e.g., pencil, sticker, ball, plane, bracelet, etc.) or a small snack (e.g., crackers, pretzels, cereal, fruit snacks, cookies, etc.).

Participant Rights: You or your child may refuse to participate in this study without penalty or loss of benefits to which you are otherwise entitled. If you or your child is a student or employee at Ohio State, your decision will not affect your grades or employment status.
If you and your child choose to participate in the study, you may discontinue participation at any time without penalty or loss of benefits. By signing this form, you do not give up any personal legal rights your child may have as a participant in this study. An Institutional Review Board responsible for human subjects research at The Ohio State University reviewed this research project and found it to be acceptable, according to applicable state and federal regulations and University policies designed to protect the rights and welfare of participants in research.

Contacts and Questions:
For questions, concerns, or complaints about the study you may contact Alayna Haberlin, 614-743-7745.
For questions about your child’s rights as a participant in this study or to discuss other study-related concerns or complaints with someone who is not part of the research team, you may contact Ms. Sandra Meadows in the Office of Responsible Research Practices at 1-800-678-6251.
If your child is injured as a result of participating in this study or for questions about a study-related injury, you may contact Alayna Haberlin, 614-743-7745.

Signing the parental permission form
I have read (or someone has read to me) this form and I am aware that I am being asked to provide permission for my child to participate in a research study. I have had the opportunity to ask questions and have had them answered to my satisfaction. I voluntarily agree to permit my child to participate in this study.
I am not giving up any legal rights by signing this form. I will be given a copy of this form.

Printed name of subject

Printed name of person authorized to provide permission for subject
Signature of person authorized to provide permission for subject

Relationship to the subject
Date and time
AM/PM

Investigator/Research Staff
I have explained the research to the participant or his/her representative before requesting the signature(s) above. There are no blanks in this document. A copy of this form has been given to the participant or his/her representative.

Printed name of person obtaining consent
Signature of person obtaining consent
Date and time
AM/PM
Appendix C: Participant Math Level
<table>
<thead>
<tr>
<th>Participant</th>
<th>Math Level</th>
</tr>
</thead>
</table>
| 06          | Addition: 0 – 5 + 0 – 5  
Addition: 0 – 5 + 0 – 10  
Addition: 0 – 10 + 0 – 10 |
| 07          | Addition: 0 – 5 + 0 – 5  
Addition: 0 – 5 + 0 – 10  
Addition: 0 – 10 + 0 – 10 |
| 08          | Addition: 0 – 10 + 0 – 10  
Subtraction: 0 – 10 – 0 – 5  
Subtraction: 0 – 10 – 0 – 10 |
| 09          | Addition: 0 – 10 + 0 – 10  
Subtraction: 0 – 10 – 0 – 5  
Subtraction: 0 – 10 – 0 – 10 |
| 10          | Addition: 0 – 15 + 0 – 15  
Subtraction: 0 – 10 – 0 – 10  
Subtraction: 0 – 15 – 0 – 10 |
| 11          | Addition: 0 – 10 + 0 – 15  
Addition: 0 – 15 + 0 – 15  
Subtraction: 0 – 10 – 0 – 10 |
Appendix D: Procedural Integrity Form, Study 1
Procedural Integrity Checklist

Participant number________________            Researcher__________________________
Date_____________________________            Session_________________________
Data Collector________________________________

Directions: Please put a plus mark “+” in the corresponding box when the task is completed. Put a negative mark “-” if a step is not completed. Put “N/A” if no opportunity to engage in the step occurred during the session. Steps should be completed in numerological order listed below.

### Pre-Session

<table>
<thead>
<tr>
<th>Blank paper and pencil next to the computer</th>
<th>Completed</th>
</tr>
</thead>
</table>

### Sessions

<table>
<thead>
<tr>
<th>Condition</th>
<th>Baseline 1</th>
<th>Experimental</th>
<th>Baseline 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Give student instructions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Tell student to begin</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. If student asks for help during session, tell them to, “Keep trying, you are doing fine” or any variation of that statement.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. While student is working on the computer, sit to the side or behind the student.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. When the participant has completed 30 math problems record the number of points earned</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Set up the next condition arrangement in the computer program.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. While doing this talk with the student about any topic you choose.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. A minimum of 1 min must past before the next session can begin.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### After Baseline 2

<table>
<thead>
<tr>
<th>Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Tell the student that they are finished working on math problems and can exchange their points for a prize.</td>
</tr>
<tr>
<td>2. Show/tell the student a choice of 3 items based on the MSWO</td>
</tr>
<tr>
<td>3. The student receives chosen item</td>
</tr>
</tbody>
</table>

Total number of plus marks ________________x 100%  =  ___________%
Appendix E: Procedural Integrity Form, Study 2
Procedural Integrity Checklist

Participant number_________________ Researcher___________________________
Date_____________________________ Sessions______________________________
Data Collector____________________________

**Directions:** Please put a plus mark “+” in the corresponding box when the task is completed. Put a negative mark “-” if a step is not completed. Put “N/A” if no opportunity to engage in the step occurred during the session. Steps should be completed in numerological order listed below.

### Pre-Session

<table>
<thead>
<tr>
<th>Step</th>
<th>Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blank paper and pencil or counting manipulatives next to the computer</td>
<td></td>
</tr>
</tbody>
</table>

### Sessions

<table>
<thead>
<tr>
<th>Condition</th>
<th>Baseline 1</th>
<th>History</th>
<th>Baseline 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>9. Give student instructions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Tell student to begin</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. If student asks for help during session, tell him/her to, “Keep trying, you are doing fine” or any variation of that statement.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. While student is working on the computer, sit to the side or behind the student.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. When the participant has completed 30 (or 15) math problems record choice selection</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. Researcher presents 5 identical reinforcers</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| This based on choice selections recorded in #5  
  a. Researcher selects one reinforcer and gives it to the participant OR  
  b. Participant selects one reinforcer | | | |
| 15. Set up the next condition arrangement in the computer program. Research can talk to participant | | | |
| 16. A minimum of 1 min must past before the next session can begin. | | | |

Total number of plus marks ______________ x 100% = _____________%