2016

Programmed Shifts in Reward Quality and Quantity: A Planned Positive and Negative Contrast Analysis

Michael Schafer
Louisiana State University and Agricultural and Mechanical College, michael.j.schafer@gmail.com

PROGRAMMED SHIFTS IN REWARD QUALITY AND QUANTITY: A PLANNED POSITIVE AND NEGATIVE CONTRAST ANALYSIS

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
In partial fulfillment of the
Requirements for the degree of
Doctor of Philosophy

in

The Department of Psychology

by
Michael John Schafer
B.A. Loyola University of New Orleans, 1995
M.S. Georgia State University, 2009
M.A. Louisiana State University, 2012
December 2016

TABLE OF CONTENTS

LIST OF FIGURES

FIGURE

ABSTRACT

Two experiments were conducted in an attempt to occasion both positive and negative contrast effects. The primary purpose was to occasion both decrements and increases in responding following planned shifts in quality or magnitude of reinforcement. Participants were children ages 7 to 16 years who were receiving therapy using Applied Behavior Analysis (ABA) and had a prior diagnosis of autism. In Experiment I, changes in responding were measured following manipulations of reinforcer quality. Results indicated response patterns consistent with negative contrast effects following shifts from high quality to low quality reinforcers, and positive contrast effects following shifts from low quality to high quality reinforcers. That is, responding in sessions following shifts from high to low magnitude reinforcers was lower than rates of responding in previous low quality conditions. Positive contrast was less consistently observed, but was seen as responding at higher rates during a second high-quality condition relative to the first following exposure to a low-quality condition. In Experiment II, responding was measured following shifts in reinforcer magnitude using a similar sequence of schedules as Experiment I. Both positive and negative contrast effects were observed, although less consistently than in Experiment I. Overall, the findings were consistent with the phenomena of positive and negative contrast effects in that one schedule of reinforcement produced changes in responding for a different schedule of reinforcement. Results were discussed in relation to the ideas of behavioral contrast and studies of intrinsic motivation.

CHAPTER I

INTRODUCTION

Overview

Positive reinforcement is widely used to increase or maintain rates of behavior relative to rates of the same behavior that have not received contingent reinforcement following their occurrence (Kazdin, 2005), but there have been many arguments against the use of positive reinforcement as being “best practice” (Eisenberger & Cameron, 1996; Koln, 1993). For example, it has been argued that the introduction of contingent rewards such as money or food following a certain behavior reduces the likelihood that this behavior will continue once the reward contingency is removed (Akin-Little & Little, 2004). That is, following a period of receiving a reward for engaging in a behavior, clients do not continue to engage in these behaviors when the reward contingency is discontinued.

The reduced value of an activity following the removal of a reward contingency can be considered as a behavioral contrast effect within the context of the operant perspective. Contrast effects occur when the value of rewards change from some previous reward contingency level experienced by the individual (Adamson, 1971). For example, an individual may be less willing to engage in an activity for a certain amount or quality of reward when they have a personal history of receiving higher level amounts or quality of reward. Abrupt shifts from high- to low-magnitude or low- to high-magnitude quality of reward can occasion contrast effects (Flaherty, 1996). For the most part, this research has been conducted in laboratories using non-human subjects (e.g., McSweeney, 1975).

In the current study, I will investigate whether shifts in the quality and amount of rewards would lead to responding in the direction away from generalization (Lind, 2008; Reynolds, 1961a; Zentall, 2005). I will provide a review of some potential negative side effects associated with the use of positive reinforcement, noting the negative effect that the removal of reinforcement contingences can have on rates of behaviors that had previously been rewarded, such that rates of behavior are reduced compared to baseline rates before the reward-contingency was introduced. Next I will describe the ongoing debate among researchers regarding this effect, including researchers working from the operant perspective. Finally, I define contrast as per the applied literature and outline the methodology for an examination of contrast effects so that our understanding of the effects of reward and withdrawal of reward may be better understood.

Positive reinforcement has been widely used in the scientific literature (e.g., Camp, Lerman, Contrucci, & Vorndran, 2000; DeLeon, Neidert, Anders, & Rodriguez-Catter, 2001; Kazdin, 2005; Lalli et al., 1999; Piazza et al., 1997). Reward and reinforcement procedures have been used successfully in a variety of settings with a variety of individuals across a range of behavior topographies for reduction or increase, and the data strongly suggests that these reward procedures are clinically useful (e.g., Camp, Lerman, Kelley, Contrucci, & Vorndran, 2000; Kazdin, 2005; Rodiguez, Fisher, & Kelley, 2012). These procedures are used in homes, schools, and other clinical settings where rewards can be earned by individuals and where consequences of undesirable behavior can most severely impact the environment (e.g., 2005). In the literature, the terms “reinforcer” and “reward” are often used interchangeably, but the terms do not technically mean the same thing. The term “reinforcer” is a technical term. It refers specifically to any event which, when it follows a response, increases the frequency of that response in the future (Kazdin, 2005). The term “reward” is a more general term that is used widely in colloquial speech. When used in this way, the term reward usually refers to a consequence for a behavior that it is assumed will function as a reinforcer (that is, is assumed to be a preferred item). The term “reinforcer,” therefore, is a specific term that refers to the effects of a consequence of future rates of behavior, where the term “reward” is less specific and refers more to the subjective experience of the recipient than specifically to the rates of future behavior. In this paper, the terms “reward” and ‘reinforcer” are used somewhat interchangeably, but distinctions will be made when the terms are being used specifically to their meaning (i.e., when a “reward” is specifically being discussed versus a “reinforcer”).

Other researchers have suggested that the benefits yielded by using reinforcement programs are often negated by inherent side-effects of using reinforcement programs (Deci & Ryan, 1985; Eisenberger & Cameron, 1996; Kohn, 1993). Programs featuring reinforcement may conflict with popular humanistic and cognitive theories of psychology (Deci & Ryan, 1985; Kohn, 1993). For example, the offering of rewards contingent on the individual engaging in some target behavior may be considered a form of bribery in that rewards are often provided in exchange for a specific behavior. Similarly, many parents and teachers may feel that this form of intervention may lead their child to develop materialistic dependence, which will in turn lead the child to begin expecting tangible rewards for tasks already under the control of natural reinforcement contingencies. Parents and teachers may also not want to reward appropriate behavior if the reward contingency was set up as a means of reducing problem behavior (i.e., the child engaged in problem behavior and now can earn edibles in class). These side effects may be the result of misuse of or misconception of rewards rather than inherent problems with the use of reward contingencies (O’Leary et al., 1972). For example, the term “bribe” does not accurately or appropriately describe the reinforcement process, or many adults would have to accept that their paycheck is a “bribe” for doing their job (O’Leary et al.). In addition, the negative side effects of using positive reinforcement can usually be abated through the careful fading of reinforcement contingencies such that natural reinforcing contingencies can take control once the skill or behavior is in the individual's repertoire (e.g., Kazdin, 2005; Kelley, Lerman, Fisher, Roane, & Zangrillo, 2011; Tiger & Hanley, 2006). Finally, although reinforcing a child who misbehaves may seem counterintuitive or contraindicated, reinforcement may be the most efficient and effective means of teaching replacement alternative behaviors to engaging in problematic behavior (Kelley, Lerman, Fisher, Roane, & Zangrillo, 20111; Thompson, Iwata, Conners, & Roscoe, 1999).

One frequently cited negative effect of reward contingencies is that when reinforcement is removed or reduced, an individual's engagement with the task will drop to levels below those observed in pre-reinforcement baseline. This effect has been widely debated in the literature (e.g., Akin-Little et al., 2004). There have been many published accounts of this effect occurring (e.g., Deci, 1971, 1972; Greene, Sternberg, & Lepper, 1976; Lepper, Corpus, & Iyengar, 2005), leading some to believe that this effect is guaranteed (Deci et al., 1999b). As a result, some would suggest that the use of contingent rewards should be avoided (Kohn, 1993, 1996). However, there have also been many failures to demonstrate this effect published in the literature (e.g., Akin-Little & Little, 2004; Davidson & Bucher, 1978; Flora & Flora, 1999; Reiss & Sushinsky, 1975; Vasta, Andrews, McLaughlin, Stirpe, & Comfort, 1978; Vasta & Stirpe, 1979). This has led others to conclude that this negative effect is inconsistent and avoidable (Balsam & Bondy, 1983; Tang & Hall, 1995; Vasta, 1981).

The existing literature relevant to behavioral contrast exhibits several methodological limitations which will be discussed in detail with reference to the most common models of investigation.. Perhaps the most common model used to explain the post-reward response decrements is that of over justification, which attributes decreases in responding to decreased intrinsic motivation (Lepper & Greene, 1976). In this model, the use of contingent rewards alter an individual's presumed motivation, resulting in his or her being motivated to engage in a behavior or activity only for extrinsic gain and not for the satisfaction or naturally-occurring reinforcement that results from completing the task itself (Deci & Ryan, 1985; Dickinson, 1989). In several studies where this model was examined (Deci, 1971, 1972; Lepper et al., 1973), subjects were provided with rewards contingent upon task engagement, and task interest following the removal of the contingency were compared with either the pre-reward task interest or with the interests of a control group that had no exposure to reward for task completion. The methodology used in these studies provided other researchers with a methodological paradigm for studying the effects of the use of contingent rewards on intrinsic motivation. Findings of this research suggest that tangible rewards offered contingent upon the engagement of a target activity lead to a reduced interest in that activity following the removal of the reward contingency (Cameron, Banko, & Pierce, 2001; Deci et al., 1999a).

According to reinforcement theory, the removal of the reward contingency should result in a decrease of responding compared to rates when reward contingencies are in place, but it should only decrease to levels equal to levels of responding during baseline (Dickinson, 1989). Post-reward response decrements *below* baseline levels are contrary to this expectation. Operant researchers have responded by offering explanations that are behavioral in nature. For example, satiation (Eisenberger & Cameron, 1996), distraction (Reiss & Sushinsky, 1975), and stimulus control (Flora) have been used to explain this effect using operant principles. In general, results of behavioral studies have failed to show post-reward response decrements (e.g., Akin-Little & Little, 2004; Fisher, 1979).

Social-cognitive research has examined this post-reward decrement phenomenon as a result of intrinsic motivation almost exclusively using a between-subjects group research designs in which test subjects experience just one trial of reward (Cameron & Pierce, 2001; Mawhinney, 1990). After having received a reward, subjects who spend less time on a task or rate a task as less interesting following having received the reward are said to have experienced a decrease in intrinsic motivation. These studies have been widely criticized for many reasons (e.g., single trial application), but, in general, the most notable concerns include that research protocols fail to take into account individual differences regarding task and reward preferences (Akin-Little & Little, 2004; Eisenberger & Cameron, 1996). By contrast, behavioral studies more commonly have used single-case research designs featuring repeated application of reinforcement during reinforcement contingency phases (e.g., Mynatt et al., 1978). Behavioral research results have proved inconsistent with the results of the social-cognitive studies. However, they have primarily served to undermine the reliability of the findings of the social-cognitive studies rather than suggest answers as to under what conditions this post-reward decrement is most likely to occur.

The operant literature contains very few applied investigations of the conditions under which response reductions below baseline levels are observed following the withdrawal of reward or reinforcement. There have been, however, several studies that have examined this phenomenon in non-human subjects, namely rats and pigeons. In this literature, post reward response deficits are known as contrast effects. The concept of contrast suggests that the value of a stimulus depends on reinforcement history, and the reinforcing effects of a stimulus are relative and transitory as opposed to absolute (Catania, 1998). In this literature, a contrast effect is observed when the organism is offered a moderate amount of reward following high levels of reward and response rate decreases to levels lower than previously observed under the moderate reward contingency (Bevan, 1966).

The general findings of contrast studies has been that suppression of responding can be elicited following specific shifts in reward. In these studies, for example, reward satiation/deprivation, inter-trial interval (i.e., the amount of time separating shifts in reward contingencies), and the sequence of reward shifts are all factors shown to influence the occurrence of contrast effects in non-human subjects (Flaherty, 1982, 1996). Shifts between disparate reward conditions may be particularly powerful in terms of producing contrast effects. That is, the larger the difference between reward magnitudes, the more likely one is to observe a contrast effect (e.g., Capaldi, 1972; Crespi, 1942). Similarly, contrast has been observed in subjects following disparate shifts in high- versus low-preferred rewards. Contrast effects have been seen when shifting both from lesser-to-greater and greater-to-lesser preference reward shifts (e.g., Flaherty & Checke, 1982; Kobre & Lipsett, 1972). When reward magnitude or preference are manipulated, the magnitude of the contrast effect is generally expected to mirror the magnitude of difference between the pre-shift and post-shift stimuli. In other words, when the difference in magnitude or preference is greater, the magnitude of the contrast effect is greater; when the difference between magnitudes is smaller, the expected contrast effect will be smaller.

Theories of contrast and the experimental approached used to produce these findings may account for some of the limitations of the intrinsic rewards in social cognitive studies. For example, contrast theory is a simpler theory, disregarding the unobservable complex thought processes used in intrinsic motivation studies to explain responding shifts (Adamson, 1971). Contrast studies also offer better experimental control.

Studies of contrast have rarely used human subjects. Among the relatively few contrast effect studies conducted with the human population (e.g.,] Kistner et al., 1982; Kobre & Lipsitt, 1972; Nicholson & Gray, 1971, 1972; Roane, Fisher, & McDonough, 2003; Weinstein, 1970, 1971a, 1972; Weinstein & Collucci, 1970), even fewer were planned examinations of contrast effects. Rather, unexpected findings were interpreted in light of contrast effects (e.g., Roane et al., 2003; Wahler, Vigilante, & Strand, 2004; Walker, Hops, & Johnson, 1975). One notable exception was a study by Lind (2008) in which children with developmental disabilities were exposed to shifts in reward quality or quantity.

Purpose of the Current Study

The purpose of the current study is to extend the literature on contrast effects by partially replicating and expanding upon an applied evaluation of responding following shifts in preference (Experiment I) and the magnitude (Experiment II) of contingently applied rewards (Lind, 2008). Similar to most basic studies of contrast, and unlike most previous applied behavioral studies, the primary objective is to occasion decrements in responding following the removal of or shifts in reward, and to occasion increases in responding following upshifts in reward quality or quantity. I hypothesize that contrast effects will be observed in children's responding following repeated shifts between conditions in which low- and high-preferred rewards are shifted or low- and high-magnitude of reward is shifted. Reductions in responding following high-reward conditions lower than the responding observed in lesser reward conditions will indicate negative contrast effects, or changes in the relative value of stimuli due to the context in which they are experienced; increases in responding following shifts from low quality or quantity of rewards to high quality or quantity rewards will indicate positive contrast effects.

In the current study, as in the study by Lind (2008), some of the main features of previous investigations of reward on intrinsic motivation were combined with some key features used in previous investigations of contrast effects. As in many studies of the effects of reward on intrinsic motivation, participants were children (e.g., Leppet et al., 1973; Vasta et al., 1978; Vasta & Stirpe, 1979), and the value of a task was indicated by a participant's level of responding on a given task both before reward was introduced (baseline) and after. Sessions sequences will be manipulated such that the first and third sessions of a four-session-sequence will be low quality or magnitude reward, while the second and fourth sessions will be of high quality or magnitude. Negative contrast effects will be demonstrated when responding in the third session falls below levels of responding in the first session, and positive contrast effects will be demonstrated when responding in the fourth session exceeds responding in the second session. This rationale is consistent with the notion of contrast and the idea that stimulus value is influenced by shifts in dimensions of reward and that low-value stimuli will actually decrease further in value following experience with high-level stimuli.

A primary variable of interest in this study will be participants' levels of responding following changes in quantity and quality of reinforcement. The current study will use, as its primary dependent variable, the number of responses completed, and will be measured through progressive-ratio analysis. Progressive-ratio analysis refers to a methodology in which the "price" of reward (what must be done to gain access to that stimulus) increases until the participant reaches a point where the cost of receiving the reward (i.e., number of responses required) outweighs the drive to receive the reward, and responding stops. This methodology has been used successfully across a wide number of applied studies to assess stimulus value (e.g., DeLeon et al., 2001; Roane, Lerman, & Vorndran, 2001). For example, a participant may be willing to work for 1 minute for a reinforcer, but as the amount of work time required increases gradually, the participant will eventually stop working because the amount of time required to work outweighs the reinforcing value of the reinforcer. In this example, the participant may be willing to work for up to 5 minutes for 1 reinforcer, but when the requirement is increased to 10 minutes, the participant stops responding. Because of its ability to accurately assess stimulus value via the technological process of the procedure, the progressive ratio analysis will be used in the current study.

In summary, the major purpose of this investigation is to add to conduct an investigation into the effects of shifts in quality and magnitude of reinforcement on children's responding. In this case, methodologies devised by Lind (2008) will be partially replicated and expanded upon. I want to determine if shifts between extremes of quality and magnitude of reinforcers will occasion predictable contrast effects in the form of relative changes in stimulus value following the application and removal of contingent rewards. The results of this study will also add to the applied literature on contrast effects as well as intrinsic motivation literature.

CHAPTER II

REVIEW OF THE LITERATURE

Introduction

The phenomenon by which rates of responding drop below baseline levels following the application and removal of a reward stimulus is sometimes referred to as a negative contrast effect (Flaherty, 1996; Garland & Staff, 1979; Levine, Broderick, & Bruckhart, 1983; Williams, 1992; Zentall, 2005), and while it has been observed in various studies, it is by no means a reliable phenomenon in humans or the applied literature. The conditions which give rise to contrast effects are, therefore, not fully understood.

The applied literature on post reward response decrements is described by both social-cognitive and behavioral reserach. In the social-cognitive literature, these post reward shifts are explained as the result of decreased intrinsic motivation (Lepper & Green, 1976; Ryan & Deci, 2000). These studies generally use single-trial measures conducted within between-group designs. In many of these studies, subjects are provided with rewards following activity engagement. Their ratings of the activity are compared to their ratings before receiving a reward (or are compared to a control group that did not receive a reward at any point for engaging in the activity (Akin-Little & Little, 2004; Cameron et al., 2001). In general, results for these studies have indicated post-reward reductions in task interest (Cameron et al., 2001; Deci et al., 1999).

Behavioral reserachers offer different explanations of this post reward decrease in responding (e.g., Eisenberger & Cameron, 1996; Garland & Staff, 1979; Reiss & Sushinsky, 1975; Williams, 1980) and have demonstrated that this effect is by no means a consistent, replicable, or reliable phenomenon (e.g., Akin-Little & Little, 2004; Davidson & Bucher, 1978;

Mawhinney et al., 1990; Vasta & Stirpe, 1978; Vasta et al., 1975). Participants in these studies are often provided multiple trials of one or two activities during baseline. The amount of time participants spend on each activity indicates activity preference (i.e., the activity in which they allocated more time is consider more-highly-preferred than the activity they spent less time with). The higher-preferred activity, as indicated by time allocation, is externally rewarded with tangible reinforcers for several sessions. During the last phase the external reward is removed and performance during this post reward phase is compared to baseline rates (Dickinson, 1989). Results of these studies have shown that post reward rates of responding do not consistently fall below initial rates of responding during baseline (Akin-Little et al., 2004; Flora, 1990).

Rather than attributing post-reward response decrements, when or if it occurs, to decreased intrinsic motivation, several behavioral researchers have explained this observed shift in responding as contrast effects (Garland & Staff, 1979; Levine et al., 1983; Zentall, 2005). These effects are occasioned by sudden shifts in reward conditions. This phenomenon has been repeatedly observed in the basic literature using such non-human subjects as pigeons and rats (e.g., Flaherty & Largen, 1975; Flagherty & Rowan, 1986; Reynolds, 1961a, 1961b,; Padilla, 1971; Williams, 1992; Zeaman, 1949).

The current review describes the existing models and explanations for shifts in responding following shifts in reward quantity and quality. It begins with studies investigating the effects of reward on intrinsic motivation. It then focuses on alternative explanations of these effects from a behavioral perspective, namely of contrast effects resulting from abrupt shifts in quality or magnitude of reward. The review concludes by decsribing applied studies that have evaluated contrast effects, including a description of methodologies employed that are common to studies from each of the paradigms described.

The following section is a review of social-cognitive studies describing post reward response decrements as a result of decreased intrinsic motivation. It begins with a review of seminal studies that have contributed to these theories, followed by a general description of their methodologies. Notable results from these studies will be presented, with emphasis on how abrupt shifts in magnitude or quality of reinforcement may affect participants' subsequent reports of task interest. The section ends with a review of the limitations of this research approach.

Social-Cognitive Theories

Social-cognitive theories describe much of human behavior as controlled by either intrinsic or extrinsic motivation. Intrinsic motivation refers to the idea that one engages in an activity because one likes that activity, presumably due to naturally occurring reinforcement effects of the activity itself. Extrinsic motivation refers to behaviors that are motivated by external reward; that is, one engages in a behavior because of what one hopes to gain from the environment (Deci, 1972, 1975). By providing external rewards contingent upon engaging in an activity, these theorists predict that a subject will shift the motivation to engage in that activity from intrinsic to extrinsic. Upon removal of the reward contingency, the intrinsic motivation is said to have decreased, resulting in the individual engaging less with the activity than individuals who have no history of receiving a reward for the same activity.

The first studies that investigated the effects of rewards on intrinsic motivation were done by Deci (1971, 1972). In one Deci (1971) study, 24 college students were separated into an experimental and control group and were presented with a problem-solving task (Soma puzzle). The study used three 1-hr periods over the course of 3 days. Researchers recorded time spent engaged in puzzle solving each day. For each session, participants were given 13 min to solve as many as four puzzles. Session 2 consisted of the experimental group receiving an additional reward (i.e., money) for each puzzle solved, while the control group received no external reward for puzzle solving. After several minutes into the session, the researchers left the room and instructed the participants to do as they pleased (Session 3). The amount of time spent engaged in the task during this free time was used as the measure of intrinsic motivation. Results supported Deci's hypothesis that subjects in the experimental group exhibited less task engagement in the third session following reward than they did in the first session (pre reward).

This article, which first described the negative effects of external reward on intrinsic motivation, also provided social-cognitive scientists a methodology for studying motivation and reward. The results of this and related studies led to a belief that extrinsically motivated behaviors are detrimental to an individual because they are not performed out of one's own interest in the activity itself (self-determined) but rather for what the environment will deliver for engaging in the activity, which are not self-determined (Deci et al., 1991).

Another important study that contributed to the social-cognitive theory was done by Lepper et al. (1973). In this study, preschool children who were promised a reward drawing spent less time drawing during a post-reward follow-up session than children who were neither promised nor received a reward. In addition, children who were promised and also received a reward for engaging in the drawing task also spent less time drawing during the post-reward observation than during their own pre-reward baseline.

Lepper et al. attributed the decrease in post-reward drawing to a decreased in intrinsic motivation caused directly by the use of rewards. They explained this by describing the overjustification hypothesis (Lepper et al., 1973; Lepper & Greene, 1976). This hypothesis states that one initially performs a task due to intrinsic motivation. Following the introduction of external rewards, the individual now has multiple reasons to enjoy the task, and the initial reason (internal motivation) is discounted in the face of numerous external reasons.to perform the task (Eisenberger & Cameron, 1996). In other words, when reinforcement is introduced from outside of the task, those naturally occurring reinforcers are often discounted.

Intrinsic motivation studies have exclusively used between-subject research designs (Cameron & Pierce, 1994). In general, one of two methods have been employed. In one, the measure of intrinsic motivation, task engagement, is measured by direct observation before any reward is tied to the activity, or they use an indirect measure of intrinsic motivation in the form of self-reports of interest in the activity (Cameron et al., 2001; Deci et al., 1999). Participants are assigned to experimental or control groups; subjects in the experimental or reward group receive extrinsic rewards during the second part of this methodology while control group members do not receive extrinsic rewards for engaging in the activity. Finally the reward is withdrawn and the intrinsic motivation to engage in the task with no external reward offered for either group is measured. The mean differences in the measure of intrinsic motivation between pre- and post-reward phases are compared statistically for each group. Statistically significant differences between the groups or within the group across time are considered evidence of the effects of reward withdrawal (Cameron & Pierce, 1994).

The second approach to the study of intrinsic motivation is the after-only between-groups experimental design (Cameron & Pierce, 1994). This differs from the previously described methodology in that in this design there is no baseline measure of intrinsic motivation. Typically participants are allowed to engage in a task that the researchers presume they will enjoy doing (i.e., puzzles, word games). Subjects in the control group receive no reward. Experimental subjects receive a reward based on either performing at a certain level or merely participating in an activity. After rewards are provided, the participants are again allowed to engage in the activity during a free play period, and researchers record and compare rewarded participants' engagement with the activity with the engagement of the non-rewarded participants. A decrease in intrinsic motivation is said to have occurred if the rewarded groups shows less interest in the activity than the non-rewarded group during the follow-up observation.

Over 100 studies have been conducted investigating the effects of reward on intrinsic motivation (Cameron & Pierce, 2001; Dickinson, 1989). In general, meta-analytic findings have indicated that expectations for tangible rewards provided contingent upon task engagement or performance (Cameron et al., 2001; Cameron & Pierce; Deci et al., 1999).

Relatively few studies have examined the effects of the amount and quality of rewards, and thus the findings in meta-analyses have been limited and less consistent with respect to the interaction of these variables with levels of intrinsic motivation. Enzle and Ross (1978) provided 78 college students with either high magnitude ($1.50) or low magnitude ($0.45) rewards for working a series of puzzles. They found that participants who were offered the high level reward reported less interest in the task than those who were given the reward unexpectedly (not told they would receive the reward). Similar results were reported by Freedman, Cunnigham, and Krismer (1992). The authors found that the higher the reward offered for performing a task, the more negatively it was rated following removal of the reward contingency.

Studies examining the effects of children's reward preferences have generated mixed support for the overjustification hypothesis. McLloyd (1974) prompted 54 second- and third-graders to read either high- or low-interest books to receive high- low- or no-level reward.

Results indicated that any level of reward results in decreased interest in reading during subsequent free choice periods.

Williams (1980) found, however, conflicting results. Here “attractive” and “unattractive” rewards for engagement with relatively preferred games were offered to 48 fourth- and fifth-graders. Rewards were rated by students. Results indicated response decrement following reward removal only for those who received “unattractive” rewards. Those who received attractive rewards experienced no decrease. These data suggest that highly potent rewards may actually lead to post-reward performance increases, while less reinforcing or non-reinforcing rewards lead to post-reinforcement decreases. These findings directly contradict theories of intrinsic motivation described above.

The overjustification effect has been questioned in part due to inconsistent findings (Dickinson 1989; Flora, 1990). Some studies using the paradigm have obtained results inconsistent with the hypothesized overjustification effect (e.g., Flora & Flora, 1999; Scott & Miller, 2001). Other critics point out that while some findings have been statistically significant, the differences are small (Mawhinney, 1989). Deci’s (1971) findings were significant at the $p<.10$ level, not the $p<.05$ level.

Critics (e.g., Mawhinney, 1990) have also suggested that the measurement phases are too brief to yield complete understanding of the phenomena being studied (Cameron & Pierce, 1994). For example, most studies have just a single reward trial, and post-reward behavior is measured just once. The few studies that have employed multiple trials have failed to find evidence of detrimental effects of reward (Mynatt et al., 1978; Reiss & Sushinsky, 1975). Mynatt et al. observed 10 first-graders for 9 days in baseline, 11 days of reward phase, and 9 days of post-reward observations. A second control group were observed for 29 consecutive days. Researchers found no statistical difference between the task engagement during post-reward phase, suggesting that extended observations do not support the previous intrinsic motivation findings.

Previous researchers have referred to their study of rewards as a study of reinforcement (e.g., Deci, 1972; Greene et al., 1976). However, to function as reinforcement, the consequence must, increase the frequency of a behavior it follows (Skinner, 1957). In most studies, no demonstration of this reinforcement effect is found in that no subsequent increase in the behavior is demonstrated. Rather, the term reward is used to describe any presumed pleasant consequence given, whether or not it changes behavior (Bernstein, 1990). Thus researchers (e.g., Flora, 1990) point out that it is rash to denounce reinforcement procedures for undermining intrinsic motivation when no actual reinforcement contingencies have been demonstrated.

Another issue with this line of research is the use of between-group research designs that may not reflect the actual behavior patterns of individuals. Conclusions based on statistically significant differences between groups may yield generalizable results, but the findings may lack internal validity. For example, Mawhinney (1989) analyzed Deci's (1971) study, examining each individual participant's pattern of behavior. He found that the reported average decrement appeared to be the result very large difference for 3 individuals. Actual data indicated that the individual decrements, if they existed at all, were typically small and influenced relatively few participants. These results indicate that researchers must examine what factors influence idiosyncratic responding before generalizing to larger populations.

Response Reductions from a Behavioral Perspective

From a behavioral perspective, the removal of contingent reinforcement can have several results on responding. Responding may, for example, return to levels observed prior to the reinforcement phase, as would be predicted by reinforcement theory, which assumes that when contingencies change from no reward to reward then back to no reward, rates of behavior should shift to match those contingencies (Skinner, 1969). Another possibility is that behavior will remain at an elevated state relative to pre-reinforcement levels during post-reinforcement phases due to naturally reinforcing consequences being paired with external reinforcers. Also, rates of responding may increase as in an extinction burst; during extinction bursts, previously reinforced behaviors are no longer reinforced, and a temporary increase or burst in responding is observed (Lerman & Iwata, 1995).

Williams (1980) suggests that external expectations may account for apparent decrease in intrinsic motivation following reward removal rather than removal of the reward itself. In this study, subjects received either attractive or unattractive rewards, while those in a control group were only requested to engage in the activity. Response decrements were seen in both the control group and the unattractive reward group. This explanation relates to an optimal duration model of reinforcement, which suggests that organisms optimize the duration of engagement when free of any constraints. The request and the unattractive reward functioned to upset this freedom to behave optimally, resulting in response decrement (Mawhinney, 1990). This explanation also fits with the disequilibrium theory (Timberlake, 1980) which generally states that any activity can function as a reinforcer if the contingency schedule is arranged in such a way that the organism can't access this activity at baseline levels (and will therefore respond accordingly so that the organism can access the activity at baseline levels).

Flora (1990) suggested that social-cognitive studies are actually utilizing salient discriminative stimuli to signal to participants that they are participating in a training program. In these studies, participants received verbal cues that rewards would be made available and under what conditions they are earned. Operant theory predicts that organisms will begin to respond in the presence of these signal stimuli for reinforcement but not in the presence of no discriminative stimuli (Skinner, 1953). Thus decrements in post-reward responding may in fact be explained as discrimination training, and that removal of the instructions informing participants of the reward contingency should result in removal of post-reward decrements. They tested this by testing the effects of monetary rewards for college students based on finding words in a word search grid. At the end of the reinforcement phase, 66 subjects were or were not told they would no longer earn money for finding words. Between-group and within-group analysis indicated that only those who were told they would no longer receive rewards exhibited post-reward decrements below initial baseline levels. These results supported the discrimination training hypothesis.

Another effect of reward that may be interpreted as a change in intrinsic motivation is satiation. Satiation involves a decline in desire to continue engaging in an activity after repeated performance of the activity (Dickinson, 1989). Repeated contact with that reinforcement from a reinforcing task may result in satiation and thus decreased motivation to continue engaging in that activity. Contingent reward may expedite this process because this increases frequency of engagement and thus contact with automatic reinforcers. It follows, then that interest should return following sufficient periods of deprivation between task engagements. This is supported by several studies reporting a failure to maintain post-reward decrements following multiple post-reward trials (e.g., Vasta & Stirpe, 1979).

Adamson (1970) stated that contrast effects can be predicted "whenever there is a pronounced change from an established history of reinforcement," (p. 160). In contrast theory, each additional encounter with a stimulus provides a value that relates to its expectations through relative comparison between results of the encounters (Adamson, 1971). Thus, the reinforcing value of a stimulus is not fixed, but is always changing following each encounter with the stimulus. With each encounter, the effects of previously encountered stimuli are reduced. If the potency of a reinforcer exceeds the norm, it will be perceived as more intense, while the opposite is true in that if the potency of a reinforcer falls below the norm, it is perceived as less intense. Thus, the greater the difference between the perceived value relative to the perceived norm, the more exaggerated the response (Adamson, 1971).

` In the baseline phase of typical social-cognitive research of intrinsic motivation, a norm is established for expected levels of reward with no external rewards offered. During the second phase, the addition of extrinsic rewards may exceed the established norm, and responses are strengthened based on favorable contrast following the comparison to baseline. When the reward is withdrawn, the return to baseline levels of reward. Now, however, the baseline levels produce greater negative contrast relative to the reward phase, which in effect lowers the potency of engaging in the task with no external rewards linked to the behavior. This lowered potency results in lower response rates relative to baseline. When such a negative change occurs and responding decreases, this is called a negative contrast effect (Adamson, 1971). Thus, the overjustification effect may also be described as a negative contrast effect (Zentall, 2005).

Garland and Staff (1979) reasoned that if this same pattern of responding could be elicited in non-human animals, the overjustification hypothesis would be disproven in that it is unlikely that lower order species would engage in thought processes required to justify choices based on multiple sources of reinforcement. In this study, 16 rats were observed for 1-hr periods across days. After five baseline sessions with no reward, a five-session reward phase was introduced in which rats were rewarded for running at or above their baseline pace. Upon returning to the baseline condition where reward was unavailable, rates of running dropped to below baseline rates and remained below baseline rates for 9 days. The authors interpreted these findings as support of contrast effects rather than overjustification to explain the post-reward decrease.

Contrast effects can be defined as changes in rates of responding in one condition that are opposite from those in the second condition (Catania, 1998). Several different forms have been identified.

Incentive Contrast of occurs when an organism overreacts to an increase or decrease in level of reward relative to the control condition or control group that did not experience the change in reward levels (Zentall, 2005). In studies using the successive paradigm, only one level of reinforcer is available per trial. In simultaneous contrast paradigm studies, different stimulus levels are simultaneously available during a trial, and each is associated with a different response (Flaherty, 1982).

In studies using the successive contrast procedure, a subject is given training with one level of reward and then shifted to a different level of reward using the same or similar response (Flaherty, 1996). Typically the magnitude of reward (i.e., number of food pellets) is manipulated. Some studies also examine the quality of a reward by training the subjects to engage in a consuming behavior such as licking or sucking solution while the quality of reward is manipulated (e.g., Flaherty, Becker, & Pohorecky, 1983).

Studies by Crespi (1942) and Zeaman (1949) used the successive contrast procedure. Crespi measured the running speed of 22 rats. One trial per day was conducted in which he trained the rats to run through runways to reach either high or low levels of reward. One group was trained to run for a 16-unit incentive. This was shifted to either 1 or 4 units and then shifted back to 16 units. Their running speeds were compared to an unshifted 16-unit control group, and the shifted rats' running speeds were reliably higher than the unshifted rats. In another experiment, rats were shifted from 256 or 64 units to 16 units. Their speed was compared to a control group unshifted from 16 units of reward. In this case, downshifted rats ran reliably slower, and the larger the downshift, the stronger the reactive behavior was.

Zeaman (1949) conducted a study evaluating rats' latency to obtain reward. Zeaman varied magnitude, giving one group 0.05 g of cheese and another group 2.4 g of cheese. After several trials, the groups were shifted to the other reward level. The response latencies were compared to rates during acquisition trials. Zeaman found both the depression effect as well as the elation effect (Crespi, 1942), which is an increase in responding following an upshift in reward. Zeaman (1949) referred to this depression effect as a "negative contrast effect" (p. 481) and the elation effect as a "positive contrast effect" (p. 481).

This methodology has also been used to evaluate behavior changes following shifts in reward quality. Vogel et al. (1968) exposed rats to either a high or low sucrose solution for before downshifting the high quality group to a low sucrose solution. These rats demonstrated less licking behavior than the rats that had the low sucrose solution throughout.

In most studies of this nature, negative contrast effects are demonstrated much more reliably than positive contrast effects (Flaherty, 1982; Flaherty, 1996). This may be due the control group having already maximized rates of responding. For example, after experiencing an upshift and increasing performance accordingly, there is not much room for increasing performance when returning to high-reinforcement phases (to elicit positive behavioral contrast).

Simultaneous conrast differs from successive contrast in that two or more responses are concurrently available during phases, each associated with a different level of reward. As in successive contrast studies, reward magnitude is most commonly manipulated and typical dependent variables are running speed for ramps. Bower (1961) conducted a study with 30 rats using a simultaneous contrast design. In this study, one experimental group of rats received eight pellets in one alley and one pellet in another. One control group received one pellet in both ramps while another control group received only eight pellets in both ramps. While no simultaneous positive contrast was found, simultaneous negative contrast was demonstrated. That is, experimental group rats ran more slowly in the one pellet ramp than the control group that had only one pellet ramps. The experimental group rats did not run faster in the eight pellet ramp than the control rats that only had eight pellet ramps.

Behavioral contrast, as is referred to in the behavior analysis literature, has been defined by Catania (1998) as "a change in the rate of one response that occurs when either the rate of a second response or the reinforcement rate produced by that response changes in the opposite direction," (p. 384). A contrast effect occurs when the change in rate of one behavior during the presentation of one stimulus is in a direction away from rate of responding during the presentation of the other stimulus. Behavioral contrast is a product of a change in the schedule of reinforcement, unlike incentive contrast which is a product of quantity or quality of a reward. In basic studies of behavioral contrast, researchers typically use single-case rather than between-group designs, and typically use pigeons rather than rats or mice. In this case, rates of responding during preshift baselines serve as the basis for comparison.

Reynolds (1961a) studied behavioral contrast using pigeon key peck rate as the dependent variable. Using multiple schedules, pigeons first experienced two variable interval (VI) schedules. When the schedules were the same, pecking allocation was equal to both sides. When one side was changed to extinction (EXT) not only did responding decrease for that side, but responding increased on the side not under EXT schedule. Reynolds therefore found that altering one schedule changed rates of responding for both. Rate of responding in the altered side changed, and rate of responding in the unaltered side changed as well, in the opposite direction. Positive and negative behavioral contrast, in this case, can be defined in terms of the effect on the unaltered component. That is, when the altered component side's responding decreases and the unaltered side's rate of responding increases, this is defined as positive behavioral contrast. The opposite is true in that when the unaletered side responding decreases as the altered side responding increases, this is defined as negative behavioral contrast (McSweeney & Weatherly, 1998).

Although there are many differences between incentive and behavioral contrast, these procedures do share some common components which leads to an identification of several factors that reliably lead to their occurrence (Flaherty, 1996). Capaldi (1972) found larger effects when trials were separated by 3 to 5 minutes versus a day. In behavioral contrast studies, the inter-trial interval is nearly zero (Flaherty, 1996; Padilla, 1971), with greater magnitudes associated with shorter inter-trial intervals (Lerman & Iwata, 1996).

Another factor that affects contrast effects is deprivation prior to running trials. More specifically, when operating under greater deprivation, contrast effects were more pronounced (Flaherty, 1982, 1996). Ehrenfruend and Badia (1962) observed greater negative contrast effects for running speed in rats that were highly deprived. Similar results have been found when manipulating quality of reward. Rogers (1985) found that when rats were returned to nonpreferred foods from a temporary preferred food diet, their food intake fell below levels of a nonpreferred diet only control group.

Another factor affecting contrast effects is the amount of difference between the two reward contingencies (magnitude or quality)(Flaherty, 1982, 1996). In incentive studies, the greater the difference between magnitude or quality of schedules, the greater the contrast effect (Crespi, 1942; Flaherty, 1996).

In behavioral contrast studies, the sequence of conditions and the durations of those components play a large role in the strength of contrast effects seen. Shorter durations of conditions presumably result in more frequent comparison between rewards, which in turn produced larger degrees of both positive and negative behavioral contrast as a result of greater fluency with schedules and rewards (Flaherty, 1996; McSweeney, 1982).

Applied studies of contrast effects share many similarities to the non-human animal literature, although there have been relatively few of these studies performed with humans. Many of these studies report contrast effects as unexpected outcomes due to stimulus conditions that differed greatly (e.g., Johnson et al., 1976; Kelly & Drabman, 1977; Roane et al., 2003). This often demonstrates itself in the literature through changes in behavior as a result of behavioral programming changes in one setting leading to unexpected changes in behavior (in the opposite direction) in another setting where this change did not take place (Gross & Drabman, 1981).

Lovaas and Simmons (1969) examined the effects of removal of social attention and application of electric shock on self-injurious behaviors exhibited by children with mental retardation. Results showed moderate decrease following the removal of attention and powerful decrease following the application of shock. Results also indicated increased rates of self-injurious behaviors in environments where treatment was not being implemented. In a sense, contrast effects represent a failure to generalize across settings.

Of the few planned applied evaluations of contrast effects, most have involved responding using artificial activities (such as lever pressing). Ditkoff and Ley (1974) and Waite and Osborne (1972) observed negative contrast effects and both positive and negative contrast effects, respectively, in rates of human lever pressing. Obrien (1968) found positive behavioral contrast for lever pressing when one lever's schedule was changed to extinction.

Levine et al. (1983) asked 92 college students to rate their preferences for high-preferred (money) and low-preferred (jigsaw puzzle) stimulus. They were asked to rate how much they would enjoy receiving money or how much they would enjoy a jigsaw puzzle. The other group received the same question but in reverse order. Results indicated that the low-preferred stimulus was rated even lower when it followed the question about money. Similarly, the high-preferred stimulus was rated as even higher when it followed the low-preferred question. These results were described as contrast effects.

Roane et al. (2003) conducted an analysis of sorting response of a 14-year-old boy with developmental disabilities. In this study, multiple shifts between baseline and reward conditions were carried out. During baseline, the subject was told to sort every 6o seconds with no other contingencies in place. During reward phases, the subject was given 20-s access to two preferred stimuli contingent upon successful sorting. During the first baseline, responding was variable. In the first contingent reward phase, the rate of sorting unexpectedly decreased. Upon returning to baseline, sorting rates increased to above baseline levels while rates in the reward conditions continued to decrease. This phenomenon was interpreted as a contrast effect due to unfavorable contrast between the baseline and contingent reward condition.

In a study by Fisher (1979), rewards were varied for inpatients contingent upon the amount of time spent brushing their teeth. Rewards varied from 0, 1, or 5 tokens per week. The schedules were varied over ten weeks, and followed the pattern: 0, 0, 5, 0, 1, 0, 5, 0, 1, 0. A small negative contrast effect was found following the first downshift at week 4. This reduction was not repeated for the second downshift at that magnitude, and smaller downshifts (e.g., 1 to 0) did not produce a negative contrast effect. This may have been due to repeated exposure to the varying schedules creating satiation effects.

One applied study that looked directly at occasioning contrast effects in human subjects was conducted by Lind (2008). In this study, 4 children diagnosed with developmental disabilities were exposed to shifts in quality or quantity of rewards. In both experiments, a progressive-ratio (PR) schedule was used to find a break point for responding, and the schedule increased by one trial. For example, participants had to perform a task at certain levels to gain access to reward. At first, one response produced reward. This was increased by one as per the PR1 schedule, and the participant had to perform two actions to gain access to reinforcers. This increased until participants stopped responding, thus noting the break point in the PR schedule. Lower post shift breakpoints following a downshift in reinforcer quality or quantity were indicate negative contrast effects, and increased break points following return to high-quality or quantity reinforcers indicated positive behavioral contrast. Experiment I, in which reward quality was compared, exposed participants to alternating triads of conditions per day, alternating between nonpreferred, low-preferred, or high-preferred stimuli. In each case, the shift was made from a lower preferred stimulus to a high-preferred stimulus, then back to low-preferred or nonpreferred stimulus (such that the same quality of stimulus was experienced for the first and third conditions of the triad). For one participant, Lind added a fourth condition in which a return to the high-preferred stimulus was introduced. Results indicated that negative contrast effects did occur for all participants. Positive contrast effects did not reliably or predictably occur. The most reliable and potent negative contrast effects were observed when shifts were between the most disparate levels of reward quality; that is, when shifting between nonpreferred and high-preferred stimuli. Experiment II, which examined contrast effects with shifting reinforcer magnitude, did not produce negative contrast effects as reliably as in Experiment I. Also, no fourth (return to high magnitude) conditions were run, and thus no positive contrast effects were observed.

Summary

The post reward response decrement phenomenon has been explained in the social-cognitive literature as a decline in intrinsic motivation (Deci et al., 1999; Kohn, 1993). These declines are considered contrast effects from the behavioral perspective (Garland & Staff, 1979). Contrast effects have been demonstrated in non-humans following manipulations of reward quality (e.g., Flaherty & Rowan, 1982), quantity (e.g., Crespi, 1942), or schedule (e.g., Reynolds, 1961a). While few studies with humans have intentionally elicited contrast effects, the results from applied studies have generally agreed with results of basic research in that changes in reward levels for humans can result in changes of behavior in other conditions, away from generalization (Fisher, 1979). Most applied studies have explained results in light of behavioral contrast or have measured responses with no social significance. Further research is needed, therefore, to understand under what conditions contrast effects occur, and to what magnitude based on disparate reinforcement contingencies in place.

The purpose of the current study is to partially replicate and extend research performed by Lind (2008) by replicating both experiments regarding manipulation of reinforcer quality and magnitude to occasion negative contrast effects. The current study will replicate Lind's general methodology. Unlike the study by Lind, however, the PR schedule will be increased at a faster rate (from PR1 to PR3), such that participants will need to perform more work more quickly to gain access to reward. This will reduce potential satiation effects that may have affected both experiments, especially the quantity of reward condition, as this potentially decreases the amount of exposure to reinforcers. Another change between the current study and Lind (2008) is that a fourth condition will be added to both experiments so that potential positive contrast effects can reliably be captured. Another change in the current study relative to the study by Lind (2008) will be the inclusion of only nonpreferred and high-preferred stimuli for the quality shift analysis, and the inclusion of only low- and high-magnitude reinforcers for the quantity shift analysis. This change will again reduce the number of exposures to reinforcers for participants, and it should also produce more robust contrast effects. This change will also reduce satiation with the instrumental task by reducing the number of times overall that a participant must perform the task.

CHAPTER III

METHODOLOGY

Experiment 1

Participants

Participants were 4 children with a diagnosis of autism. All participants were receiving behavioral services in the New Orleans, Louisiana (and surrounding) area at the time of their participation. All participants were able to communicate through vocal communication and were ambulatory. While participants did vary in range of cognitive ability, all participants could complete simple, 2-step demands and complete simple physical tasks as a prerequisite for inclusion in the study. Names provided below are pseudonyms.

Walt was a 14-year-old boy with a diagnosis of autism and anxiety disorder. Walt could communicate in 3 to 4 word utterances, either spontaneously or when prompted. He lived at home with his parents and older brother. Walt was referred for services to decrease problem behavior and increase communication and social skills. Walt engaged in hand-biting and disruption, however he did not engage in challenging behaviors throughout the duration of the study.

Charles was a 7-year-old boy with a diagnosis of autism. Charles communicated in full sentences. He lived at home with his parents and younger sister. Charles was referred for services to increase social communication skills and to provide shadow services at his school to help aid him in completion of class activities.

Adam was an 8-year-old boy with a diagnosis of autism and attention deficit hyperactivity disorder (ADHD). Adam communicated in full sentences, both spontaneously and when prompted. Adam would engage in frequent bursts of echolalia, however this did not disrupt sessions. Adam was referred for services to decrease problem behaviors in the form of aggression and disruption. Adam lived at home with his parents and older sister.

David was a 16-year-old boy with a diagnosis of autism. David communicated in 2 to 3 word utterances, often repeating a single word. David was referred to increase communication and social skills as well as compliance with demands.

Setting

All sessions took place in the participants' homes. All sessions were conducted in a room separate from others, with only the participant and data collector(s) present during instruction and trials. For all participants, sessions were conducted in the same area where typical behavioral therapy sessions were conducted at the home.

Materials

Phase 1

The purpose of Phase 1 was to identify relative preferences for tangible and edible stimuli by conducting a paired-stimulus (PS) preference assessment. Materials included all stimuli being compared in the preference assessment as well as 4 in. square picture cards for all stimuli being used in the assessment.

Stimuli were identified by reports from parents and caregivers, as well as direct observation. Based on parent reports of preference as well as potential dietary restrictions, edibles, tangibles, or a combination were compared in the preference assessment. Each stimulus to be used was paired once with every other stimulus such that choice between each pair of items, and thus a preference hierarchy, could be established.

Phase 2

The purpose of Phase 2 was to identify tasks for the participants to complete during the analysis. Tasks were those in which participants initially responded at moderate levels with no programmed reinforcement, thus allowing for increases or decreases in rate of responding when variables are manipulated. Materials included items specific to the tasks being analyzed (e.g., beads and string for stringing bead tasks; container and blocks for putting blocks in container task).

Walt's task was to pick up rubber bears from the table and place them in the container next to the table. Materials included rubber bears and the plastic container.

Charles's task was to match color cards. Materials included a deck of cards where matches were based on similar colors versus 1:1 correspondence.

Adam's task was to complete math problems using a calculator. Materials included a worksheet with triple digit addition and subtraction problems, a pen or pencil, and a calculator.

David's task was to string beads on a string. Materials included the container of wooden beads and long piece of string.

Phase 3

Phase 3 consisted of the actual contrast analysis in which participants gained access to stimuli upon completing a certain number of task requirements (e.g., beads strung). Materials included items required for the task as identified in Phase 2, nonpreferred (NP) and high-preferred (HP) reward stimuli as identified in Phase 1, picture cards corresponding for stimuli functioning as rewards, and a data sheet. The picture cards for the reward stimulus were placed in view of the participant during task completion. For all participants, the NP stimulus functioned as the control stimulus.

Walt's contrast analysis consisted of shifts between the NP condition (nothing) and the HP condition. The HP stimulus for Walt was access to his iPad. For meeting schedule requirements during the NP sessions, Walt had work stimuli removed from the table for 30 s. When meeting schedule requirements during HP sessions, the work stimuli were removed and Walt was given access to his iPad for 30 s.

Charles's contrast analysis sessions consisted of shifts between NP and HP sessions. During HP sessions, Charles earned access to 5 potato chips or Skittles candy, depending on the choice Charles made for reinforcers at the beginning of the sequence. Once his choice was made, however, these reinforces remained constant for the duration of the sequence. During both NP and HP sessions, work stimuli were removed for 30 s upon completion of a schedule requirement.

Adam's HP contrast analysis sessions consisted of his earning his iPad upon completing a schedule requirement while he earned nothing during the NP sessions. Work stimuli were removed upon completing a schedule requirement in both NP and HP sessions. Additionally, during HP sessions, Adam earned access to his iPad for 30 s.

David's HP contrast analysis sessions consisted of his working for access to Skittles, Goldfish Crackers, or Fruit Snacks, depending on his choice at the beginning of the sequence.

Once a choice was made, however, this remained the reinforce for the duration of the sequence. Work stimuli were removed for 30 s during HP and NP sessions following completion of the schedule requirement.

Independent Variables

The purpose of Phase 3 was to determine whether shifts in preference for reward stimuli would occasion contrast effects. During the analysis, preference conditions were sequenced such that shifts between conditions were distinct (e.g., NP-HP). The first session of the sequence was a NP session. This was shifted to a HP reward for session 2, then back to a NP session for session 3. By focusing on disparate shifts in reinforcer quality, it was hypothesized that this shift would elicit negative contrast effects. A fourth session was conducted with a return to the HP condition. This upshift, it was hypothesized, would result in positive contrast effects. This final HP session also tested for responding due to contrast effects rather than satiation with the task; if satiation is responsible for changes in rates of responding, then rates shouldn't increase when HP reward contingencies return in the last session of the 4-session sequence.

Dependent Variables

The dependent variable was reward stimulus value as indicated by levels of responding on the task under differing reward conditions. Like the study by Lind (2008), stimulus value was measured with a progressive ratio (PR) analysis in which the value of reward increases within each session until the participant ceased responding for a specific duration, yielding a breaking point (Roane, 2008). In this case, the dependent variable included the highest PR schedule where reward was earned (i.e., the break point). Data for each session was graphed separately and visually inspected for contrast effects. Contrast effects were recognized when the break point increased or decreased in relation to previous levels following a reward shift in a previous condition. Decreases from initial values were considered negative contrast effects, and increases were seen as positive contrast effects.

Response Definitions and Measurement

Phase 1

During the PS preference assessment, two stimuli were simultaneously presented and choice between the two was noted on the data sheet. Choice consisted of either touching the stimulus or picture card or verbally stating which one is preferred. At the conclusion, preferences were assessed by dividing the number of times chosen by the total number of times presented for each stimulus. NP stimuli (picture of empty desk) were chosen 0% of presentations, while HP stimuli were selected between 80 to 100% of trials.

Phase 2

Responding during this phase was measured by completion of a distinct behavior that is particular to that task. For Walt's bear sorting, one unit of task completion was defined as placing 5 bears, one at a time, into the canister next to the table after picking up the bear from the table. So, for example, to complete an FR1 schedule, Walt had to place five bears in the container. To complete FR3 schedule, Walt had to place 15 bears in the container.

For Charles's color matching task, one response was defined as matching one complete set of 4 cards. Thus to complete an FR1 schedule, Charles had to match 4 cards. To complete an FR3 requirement, Charles had to match 12 cards.

For Adam's math problem task, one unit of responding was defined as completing one math problem. Thus to complete an FR9 schedule, Adam had to complete 9 math problems.

For David's bead stringing task, one unit of responding was defined as stringing 5 beads. Thus to complete an FR1 schedule, David had to string 5 beads. To complete an FR3 schedule, David had to string 15 beads.

Phase 3

In this phase, accurate responding was defined the same way as in Phase 2. All sessions began with the participant being required to complete one unit of work (i.e., FR1) to gain access to a reward. This schedule was increased using a PR2 schedule. That is, the schedule was increased by two upon completion, such that following successful completion of the FR1 schedule, participants were required to complete 3 units of work to gain access to reinforcement (FR3). This then increased to a requirement of 5 units to access reinforcement. The breaking point was graphed and inspected for contrast effects. Negative contrast effects consisted of decreases in the break point in the NP condition following a HP condition or in the second HP condition following the reintroduction of the NP condition; positive contrast effects were seen as increases in the break point in HP conditions following NP conditions or in the second NP condition reative to the first, following the first introduction of the HP condition.

Interobserver Agreement

Interobserver agreement (IOA) was calculated for at least 30% of all trials in all phases. Agreement was calculated by having a second observer independently record data simultaneously with another observer. Their results were then compared. The number of agreements was then divided by the number of agreements plus disagreements and multiplied by

100, yielding a percentage of exact agreement. IOA was calculated for 33% of sessions for Walt, 50% of sessions for Charles, 33% of sessions for Adam, and 40% of sessions for David. Percent agreements were 100, 100, 85, and 100% for Walt, Charles, Adam, and David, respectively.

The contrast analysis consisted of a single-case multi-element design featuring repeated shifts, or reversals, between disparate levels of reward. This design allowed for the evaluation of carryover effects in which responding in the postshift condition is influenced by recent reward experiences in the previous condition. Unlike most studies of intrinsic motivation and incentive contrast (Cameron & Pierce, 1994), this study will use a within-subjects design.

In addition, several key elements from other research paradigms were included in the current design. By arranging sessions in sequences of four in which the first and third are NP and the second and fourth are HP, there is a similarity with the before-after design used in social-cognitive studies (Cameron & Pierce, 1994). As in incentive contrast studies (e.g., Boyer et al., 1979; Flaherty et al., 1983; Flaherty & Largen, 1975), the current study evaluated response changes resulting from shifts in reward quality. Like studies of behavioral contrast (e.g., Reynolds, 1961a; 1961b), a single-case design is used. Sessions were conducted in groups of four each day, with no more than 40 minutes between parts of the group. This theoretically will increase the likelihood that effects from one session will carry over into another session.

Data was analyzed using visual inspection of graphed data points of break points for each condition. This approach has been used widely in the behavior analysis literature, including those using PR schedules (e.g., DeLeon, Iwata, Goh, & Worsdell, 1997; Glover et al., 2008; Roane et al., 2001).

Procedures

Parent and participant consent was first attained before beginning participation in the study. Interviews regarding preference were conducted with caregivers, behavioral therapists, and participants to identify preferred stimuli and tasks.

Phase 1

Lists of 9 tangible or edible reinforcers were generated based on results of the parent and caregiver interviews. Each of these items was photographed and placed on a 4 in square card. Next, a PS preference assessment was conducted using procedures described by Fisher et al. (1992). Participants were presented with each stimulus and its card and allowed 30 s access to the item (or to consume one item if it is an edible). The stimuli and their pictures were paired once with every other stimulus and card. The two were simultaneously presented and the participant told to "pick one." Once chosen, the participant was allowed to consume the item for 30 s. Observers noted which stimulus was chosen for each presentation. If no choice is made, the participant was prompted to try each stimulus again, then the pair will be represented. Trials continued until all pairings were presented. A hierarchy was established by dividing, for each stimulus, the number of times chosen by the total number of times that stimulus was presented. The control stimulus was included along with the 9 stimuli to provide data that the control stimulus is in fact a NP stimulus. In this case, the NP stimulus was a card with a picture of the participant's empty desk.

Phase 2

Tasks were identified based on interview results and direct observation of the participants. Each task was required to lend itself to measurable units of responses, and participants must engage in the task to a moderate degree without external reinforcement being offered contingent upon engaging in the task. For all participants, tasks were chosen that were already part of their therapy repertoire and were considered near or at mastery level.

Phase 3

Prior to the start of Phase 3, units of task completion were identified for each participant based on their baseline rate of responding in the absence of reinforcement contingencies. Upon completing that schedule requirement, the schedule was increased by units of two. Thus the PR schedule was PR1, PR3, PR5, PR7, etc. until the participant stopped responding for 1 minute. During each session, the experimenter only explained contingencies, delivered rewards, or arranged materials for the task. The picture card corresponding to reward for that condition was placed within sight of the participant, on the wall, table or floor. Immediately upon completing a schedule requirement, work stimuli were removed and they gained access to preferred stimuli (HP sessions).

At the start NP sessions, the experimenter showed the picture card for the control stimulus and said, “If you want to earn this, which is nothing, you have to complete the task ___ number of times. You don’t have to do anything if you don’t want to.” No further prompts were provided to complete the task. Following 30 s, the experimenter then stated the new schedule requirement. This process was repeated until the participant stopped responding for 1 minute.

HP sessions were similarly conducted, except in this case the reward stimulus and corresponding picture cards were the HP stimulus. At the start of session, the experimenter said, “You have to do [amount of work required for schedule] to get [HP reward]. But you don’t have to if you don’t want to.”

For all conditions, no prompting was provided to engage in the task. In addition, no praise was delivered for responding. There were no programmed consequences for problem behavior other than blocking (if necessary) and ignoring. In general, problem behavior occurred only once during Adam's sessions and it did not interfere with responding.

Experiment II

Experiment II was similar procedurally to Experiment I, however while Experiment I attempted to occasion contrast effects through manipulation of reinforcer quality, Experiment II attempted to occasion contrast effects by manipulating quantity of reinforcement.

Participants

The same participants (Walt, Charles, Adam, and David) participated in Experiment II as in Experiment I. In addition, sessions were run in the same space as session for Experiment I.

Materials

Phase 1

The goal of Phase I was to identify a HP stimulus to use in the contrast analysis. Because all of the participants were the same as in Experiment I, the same results from the previous PS assessment were used for Experiment II.

Phase 2

As in Experiment I, the goal of Phase 2 was to identify tasks to be used in the contrast analysis. Again, because the same participants were sued in Experiment II as in Experiment I, the same tasks were used during the contrast analysis.

Phase 3

Phase 3 consisted of the contrast analysis. In this case, magnitude of reinforcement was compared using PR schedules in a similar process as Experiment I. In this case, picture cards were developed showing high magnitude (HM) and low magnitude (LM) rewards. For example, for access to the iPad for Walt and Adam, LM sessions showed a small picture of the iPad with "15s" written below. During HM sessions, the card depicted a larger picture of the iPad with "90s" written underneath. For edibles, the LM session cards depicted a single edible (e.g., one chip or Skittle), while the HM sessions showed six chips or Skittles).

Independent Variables

Phase 3 attempted to determine if shifts in magnitude of reinforcement would elicit contrast effects. Thus the primary independent variables were stimulus magnitude and shifts between conditions in which low or high magnitudes of reinforcement are available. For edible stimuli, magnitude was the number of stimuli received for completing the PR schedule requirement. For tangible stimuli, the magnitude was the amount of access time given with the stimulus. In both cases, LH and HM differed by a factor of 6. For example, for a tangible reward LM was 15 s and HM was 90 s. For edible stimuli, LM was 1 piece and HM was 8 pieces.

As in Experiment I, conditions shifted from LM to HM to LM (producing possible negative contrast effects) to HM (producing possible positive contrast effects).

Dependent Variables

\ As in Experiment I, the dependent variable is the stimulus value as indicated by responding under low- and high-magnitude reward contingencies. PR analysis was used in this experiment as well, noting break point of responding. Lower break points in the second LM condition would constitute a negative contrast effect, while increased break point in the second HM condition constituted a positive contrast effect. Similarly, a higher break point in the second LM session constituted a positive contrast effect, while a lower break point in the second HM condition constituted a negative contrast effect.

Response Definitions and Measurement

Phase 1

Results from previous PS assessments from Experiment I were used during Experiment II.

Phase 2

Response definitions for Phase 2 of Experiment II were identical to those used in Phase 2 of Experiment I.

Phase 3

Response definitions were the same as in Experiment I. Again, sessions started with PR1 schedule and were increased by 2 as schedule requirements were met and rewards were delivered.

Interobserver Agreement

Interobserver agreement was collected for at least 30% of sessions. The process for collecting agreement data and calculating agreement percentages was identical to those used in Experiment I. Exact IOA was calculated for 35, 33, 33, and 40% of sessions for Walt, Charles, Adam, and David, respectively. Exact agreement was 100%, 100%, 100% and 95% for Walt, Charles, Adam, and David, respectively.

\ As in Experiment I, a single-case multi-element design will be sued for the contrast analysis. As in Experiment I, break points for responding during the PR schedules will be graphed and visually inspected to assess in negative and/or positive contrast effects occurred within a given 4-session sequence.

Procedures

Phase 1

Results from Phase 1 of Experiment were used for Experiment II.

Phase 2

Tasks used in Experiment I were used in Experiment II.

Phase 3

Procedures during this phase matched those of Phase 3 of Experiment I, with a few key exceptions. Prior to the start of session, the picture card associated with the magnitude of reward to be earned was presented and placed within sight of the participant. For all sessions, the experimenter stated exactly how much of the reinforcer will be earned and exactly what the schedule requirement to earn that level of reinforcer was. As schedule requirements were met, the researcher immediately delivered the amount of reward appropriate for that condition. Again, there was no prompting to engage in the task outside of initial instructions and no praise was delivered for task engagement.

CHAPTER IV

RESULTS

Experiment I

Results of Experiment I indicate both negative and positive contrast occurred within 4-session sequences. When break points were lower for the second NP session of a NP-HP-NP sequence, a negative contrast effect was said to be observed. When NP break points were the same across NP-HP-NP sessions, no change was said to be observed. When break points increased for the second NP session of the sequence, an increase was said to be observed. Similarly, an increase in break points for the second HP session was observed in a HP-NP-HP sequence, a positive contrast effect was said to be observed. Similar interpretations for no change and decreasing patterns were used as for NP-HP-NP sessions.

For all graphs of results of contrast analyses, the open circle data path represents the break point for sessions where the non-preferred item was made contingently available, and the closed square data path represents the break point during sessions where the highly-preferred stimulus was delivered following participants meting the specific criteria. Each group of four sessions (e.g., NP-HP-NP-HP) is separated by a dashed line to group these sessions together as one unit. Within each group of four sessions, two triads can be assessed (i.e., NP-HP-NP and HP-NP-HP). The first triad of each four-session group can be assessed for contrast effects for the NP condition (i.e., NP-HP-NP) and the last three sessions of each group of four can be assessed for contrast effects for the HP condition (i.e., HP-NP-HP). Negative contrast effects are defined here as a decrease in responding between the first and third session. For example, if the second NP session of the NP-HP-NP triad has a lower break point than the first NP session, a negative contrast effect has been observed. Positive contrast effects are defined here as an increase in break point between the first and third session of a triad (e.g., HP-NP-HP). For example, if the break point is higher for the last HP session compared to the first HP session, a positive contrast effect has been observed.

Generally speaking, within each four-session group, if session 3 has a lower break point than session 1, a negative contrast effect has been observed. If session 4 has a higher break point than session 2, a positive contrast effect has been observed. In addition, it is expected that break points will generally be higher in the HP conditions relative to the NP conditions. The tird 4-session sequence of Walt's data demonstrates these anticipated results. While these are the anticipated results, it is possible that positive contrast effects can be displayed between session 1 and 3 and that negative contrast can occur for the second triad (between sessions 2 and 4).

Across all participants, negative contrast between NP-HP-NP sessions were observed in 14 of 18 sequences (78%). Positive contrast was observed for 12 of 18 HP-NP-HP sequences (67%). For NP-HP-NP sequences, 2 of 18 sequences were observed with no change (11%) and 2 of 18 sequences were observed with increases (11%). For the HP-NP-HP sequences, decreasing patterns were observed for 6 of 18 sequences (33%).

While both negative and positive behavioral contrast effects were observed for all participants, idiosyncratic responding patterns prevented reliable prediction of when negative or positive behavioral contrast effects would be observed.

The results of Walt's preference assessment are presented in Figure 1. The control stimulus was selected for 0% of occasions and functioned as the NP stimulus. The iPad was

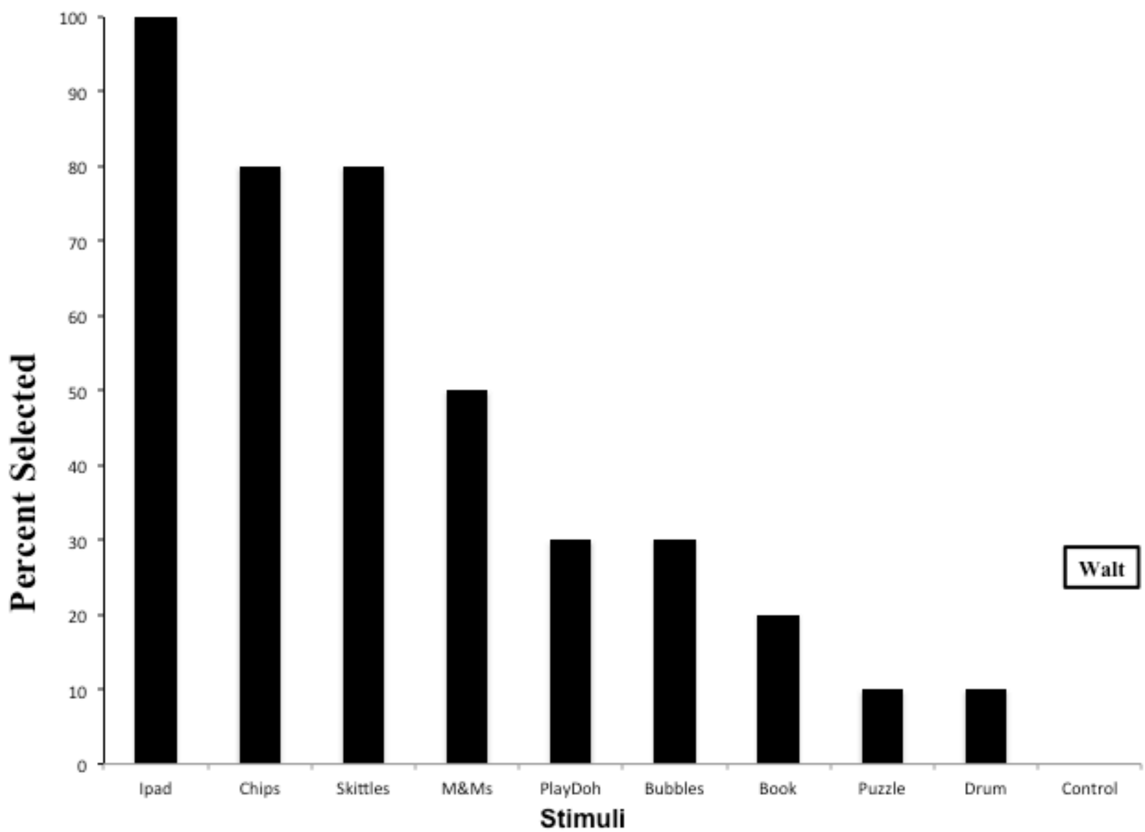

Figure 1. Results of Walt's PS preference assessment.

selected for 100% of trials. It along with Potato Chips (80%) and Skittles (80%) met criteria to function as HP stimuli. Walt chose the iPad consistently as his reinforce throughout sessions.

Results of Walt's contrast analysis are presented in Figure 2. Negative contrast effects were observed across all four NP-HP-NP-HP sequences (100%). Additionally, positive contrast effects were observed for 50% of sequences. Walt showed the pattern of seeing no positive contrast during the first two sequences, then demonstrating positive contrast across the latter two sequences. On average, Walt had a breaking point of 4.25 for NP sessions and 6.26 for HP sessions. In addition, the average size of the negative contrast effect across all sequences where a negative contrast effect was demonstrated was 4. This was calculated by subtracting the smaller breaking point from the larger breaking point, then averaging the differences across sequences. The average size of the positive contrast effects across all sequences where a positive contrast effect were demonstrated was 5. This was calculated by averaging the differences between the first and second HP sessions.

Results of Charles's PS preference assessment are presented in Figure 3. Charles chose the control stimulus 0% of trials, thus it functioned as the NP stimulus. Potato chips (100%), Skittle (90%) and M&Ms (80%) all met criteria to function as HP stimuli. Charles was given a choice at the beginning of a sequence as to which stimulus he wanted to receive upon completing a schedule requirement.

Results of Charles's contrast analysis are presented in Figure 4. Negative contrast effects were observed in 100% of NP-HP-NP sequences. Positive contrast effects, as defined as higher responding in the second HP session relative to responding during the first HP session of an

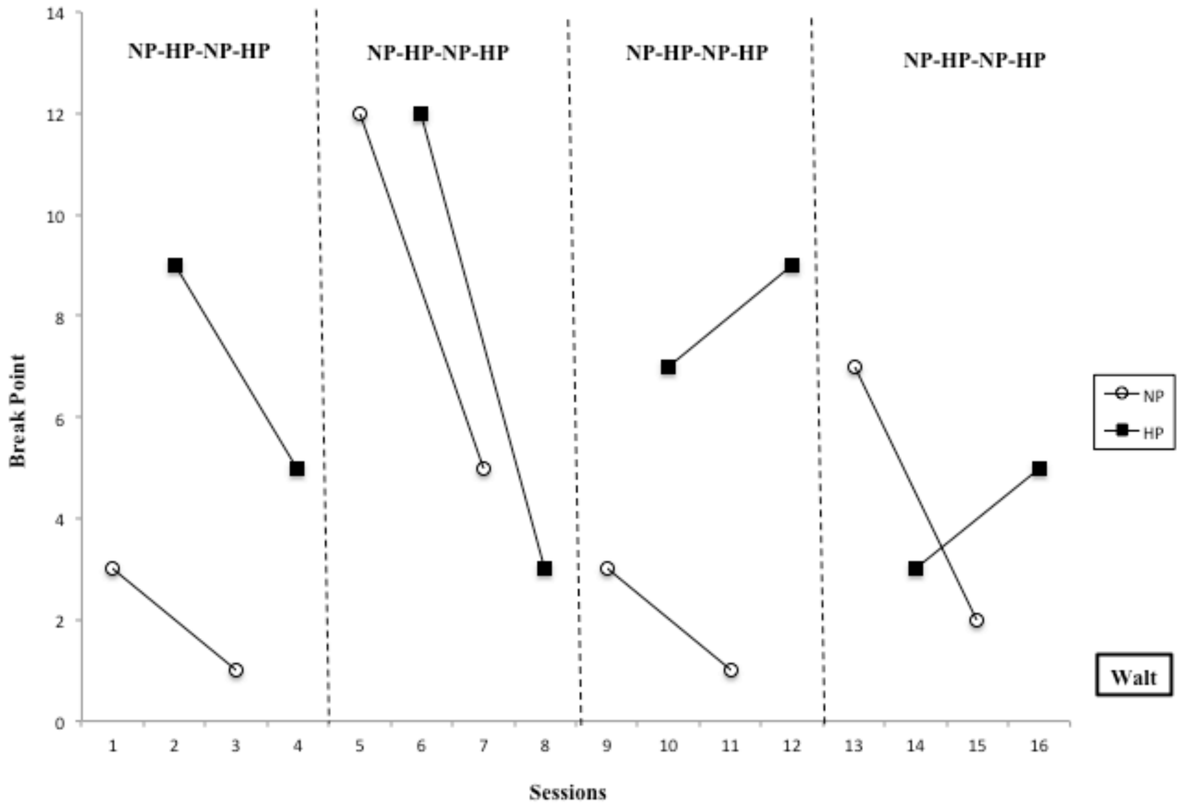

Figure 2. Results of Walt's contrast analysis from Experiment I showing break point.

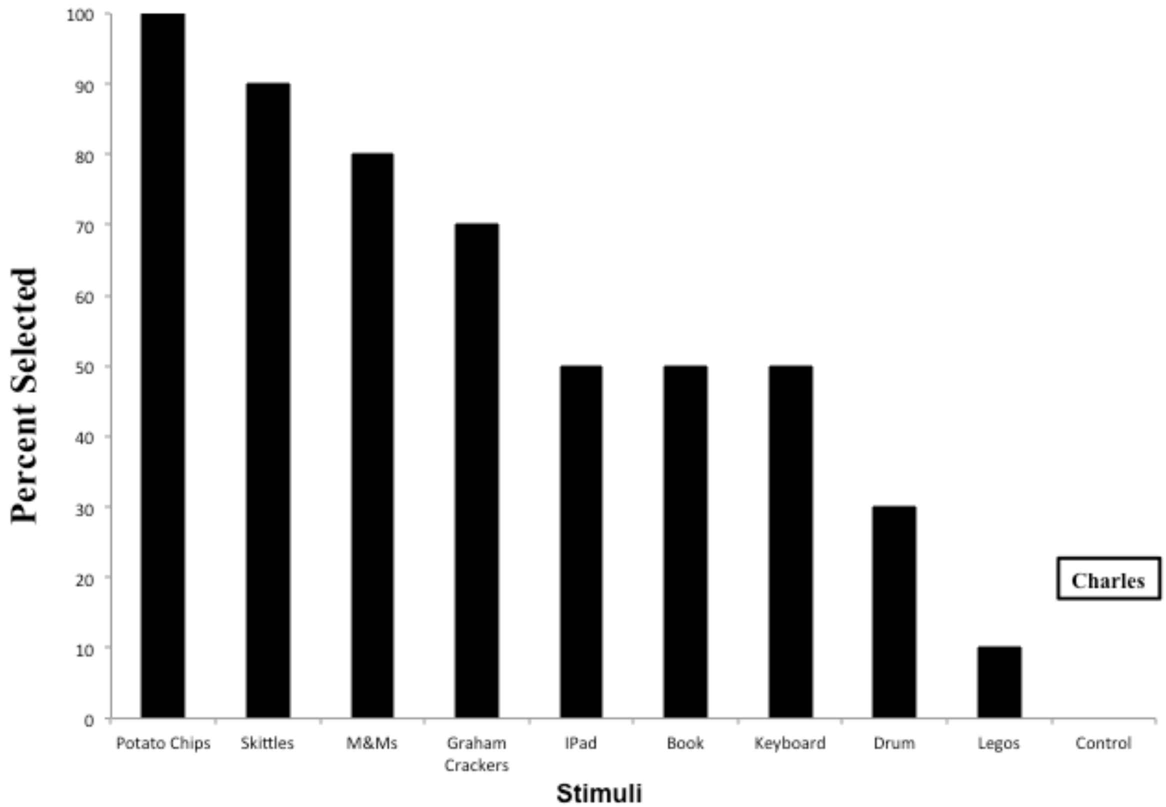

Figure 3. Results of Charles's PS preference assessment.

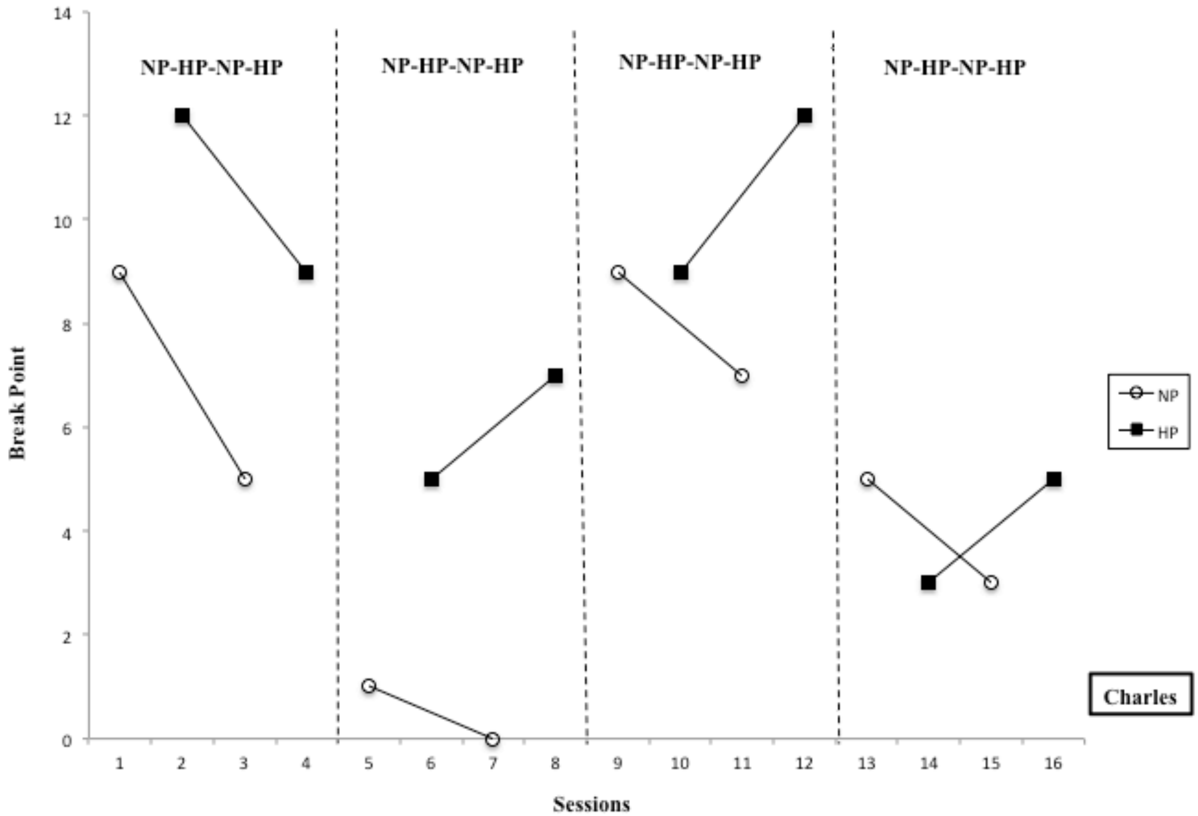

Figure 4. Results of Charles's contrast analysis from Experiment I showing break point.

HP-NP-HP sequence, were observed in 3 of 4 sequences (75%). Similarly to Walt, Charles's responding did not produce a positive contrast effect for the first session but did demonstrate this effect for the final 3 sequences. On average, Charles had a breaking point of 4.9 for NP sessions and 7.75 for HP sessions. Charles had an average negative contrast effect size of 2.25, while there was an average positive contrast effect size of 2.33.

Results of Adam's preference assessment are shown in Figure 5. He chose his iPad 100% of trials, and chose cookies and Skittles for 80% of opportunities, thus all 3 met criteria to function as HP stimuli. The control stimulus was chosen 0% of trials and functioned as the NP stimulus.

Results of Adams's contrast analysis are shown in Figure 6. Adam demonstrated negative contrast in 3 of 5 sequences (60%) and positive behavioral contrast in 3 of 5 sequences (60%). No change was observed for 1 of 5 (20%) NP-HP-NP sequences, and increasing responding was seen in 1 of 5 (20%) of NP-HP-NP sequences. Adam's responding did not follow the same general pattern as Walt and Charles, with failure to demonstrate positive and negative contrast effects occurring after the first sequence. On average, Adam had a breaking point of 2.3 for NP sessions and 5.6 for HP sessions. Adam had an average negative contrast effect size of 5, while there was an average positive contrast effect size of 4.

Results of David's preference assessment are demonstrated in Figure 7. Skittles (100%), Goldfish Crackers (80%) and Fruit Snacks (80%) all met criteria and could function as HP stimuli. The control stimulus was selected 0% of trials and functioned as the NP stimulus.

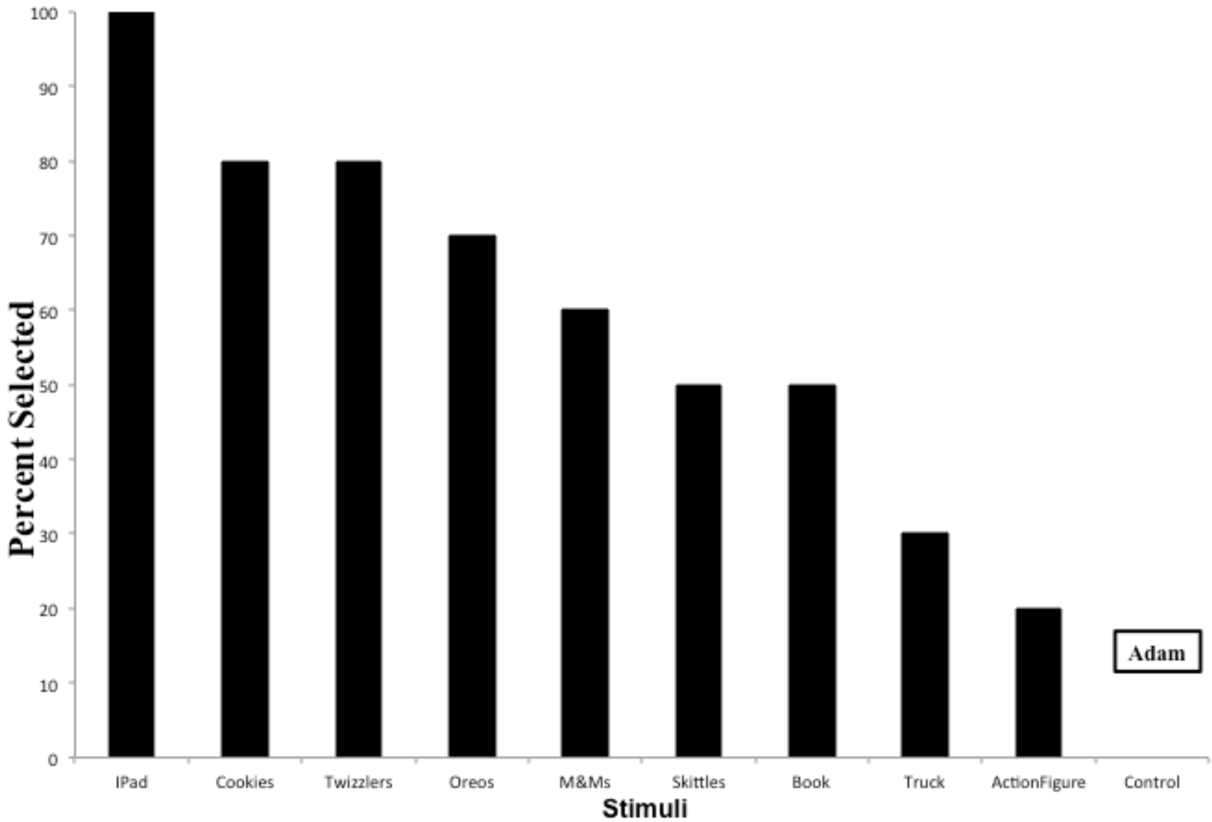

Figure 5. Results of Adam's PS preference assessment.

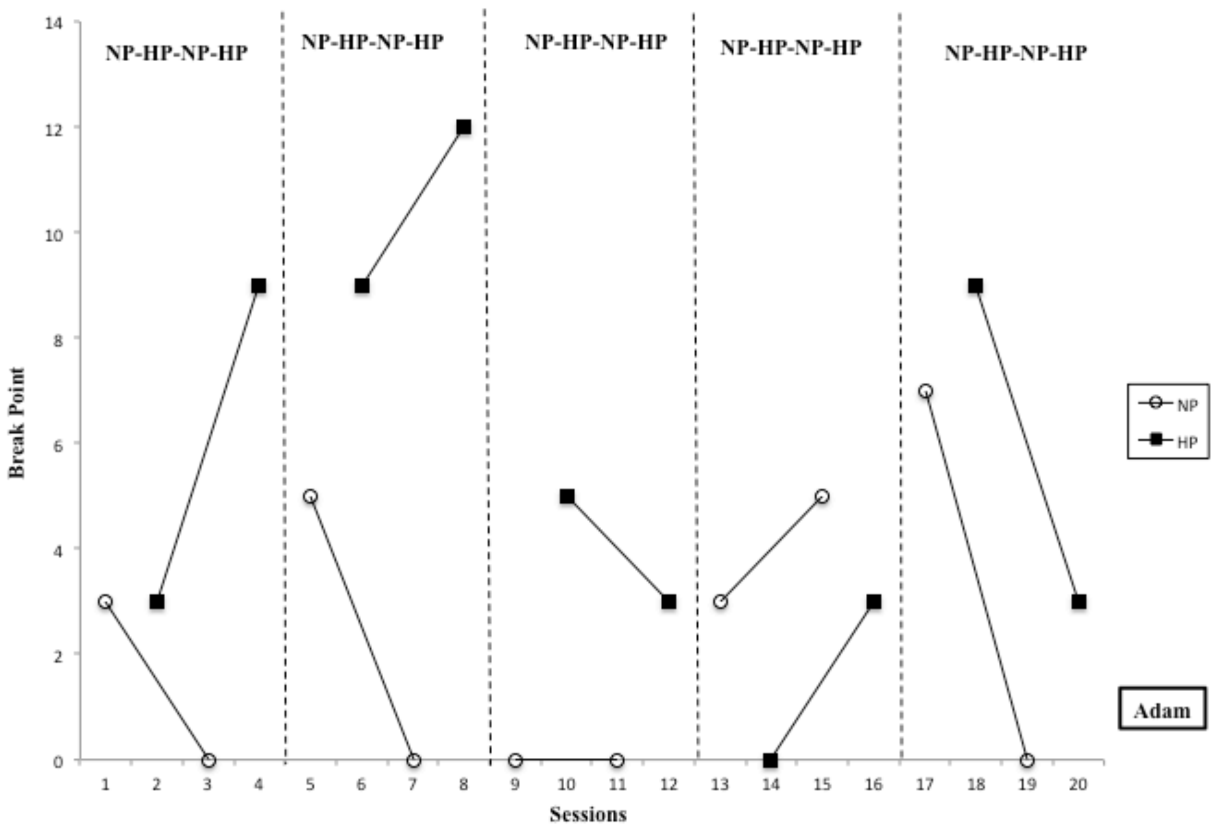

Figure 6. Results of Adam's contrast analysis from Experiment 1 showing break point.

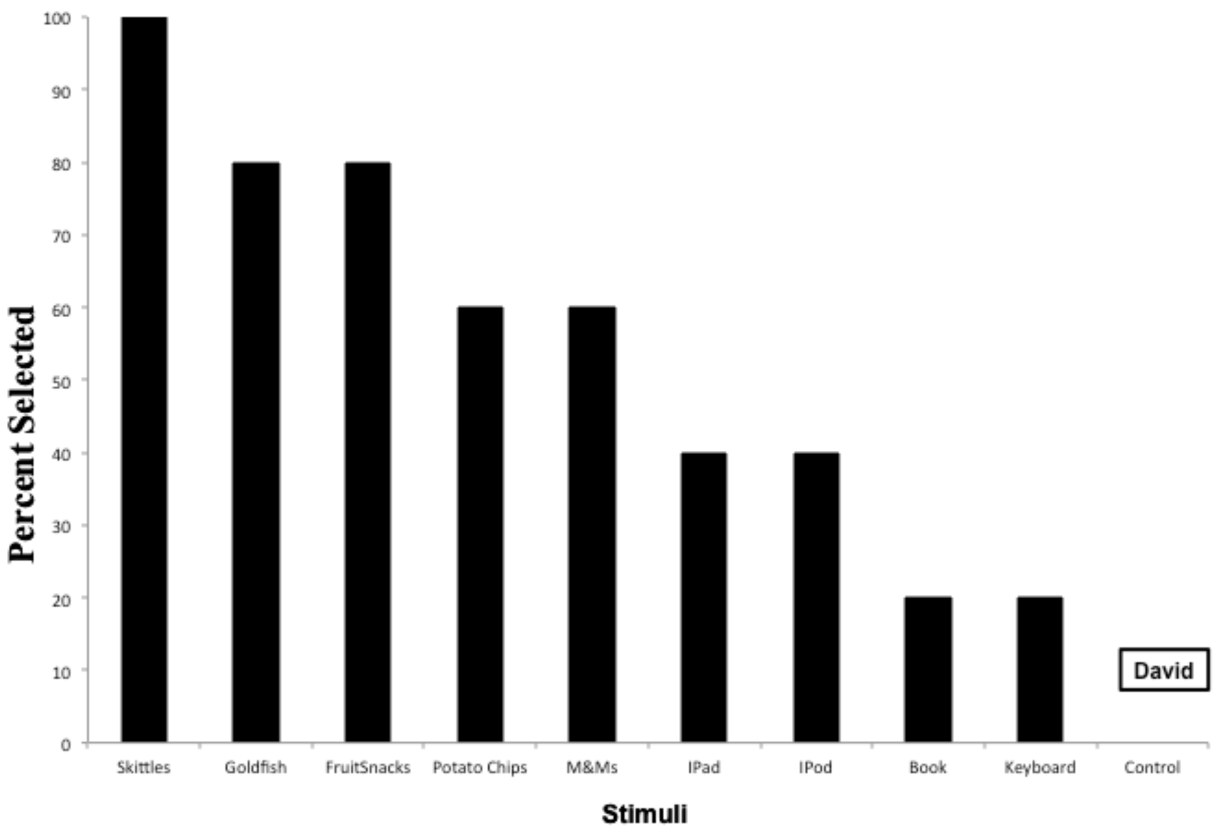

Figure 7. Results of David's PS preference assessment.

Results of David's contrast analysis are shown in Figure 8. Negative contrast effects were observed in 3 of 5 sequences (60%). No change was observed in 1 of 5 sequences (20%), and increasing responding was seen in 1 of 5 (20%) of sequences. Positive contrast effects were observed for 4 of 5 sequences (80%). David's general pattern of responding was similar to Adam for negative contrast effect in that it was demonstrated in the first sequence. The pattern of responding for positive contrast effects was similar to that of Walt and Charles in that the first sequence did not demonstrate the positive contrast effect. On average, David had a breaking point of 4.6 for NP sessions and 7.2 for HP sessions. David had an average negative contrast effect size of 3.33, while there was an average positive contrast effect size of 2.25.

Experiment II

Results from Experiment II were roughly comparable to those found in Experiment I. Negative contrast effects occurred more frequently than positive contrast effects. Also, similar to results in Experiment I, no clear pattern of responding was found across participants, but rather seemed somewhat idiosyncratic in nature.

Across all participants, negative contrast effects were demonstrated from LM-HM-LM sequences for 14 out of 20 sequences (70%). Positive contrast effects as defined by increased responding in the second HM session relative to the first following the introduction of a LM session between, were seen in 10 out of 20 sequences (50%). No change in responding was observed in 2 of 20 sequences (10%), both of which occurrence with the LM-HM-LM sequence.

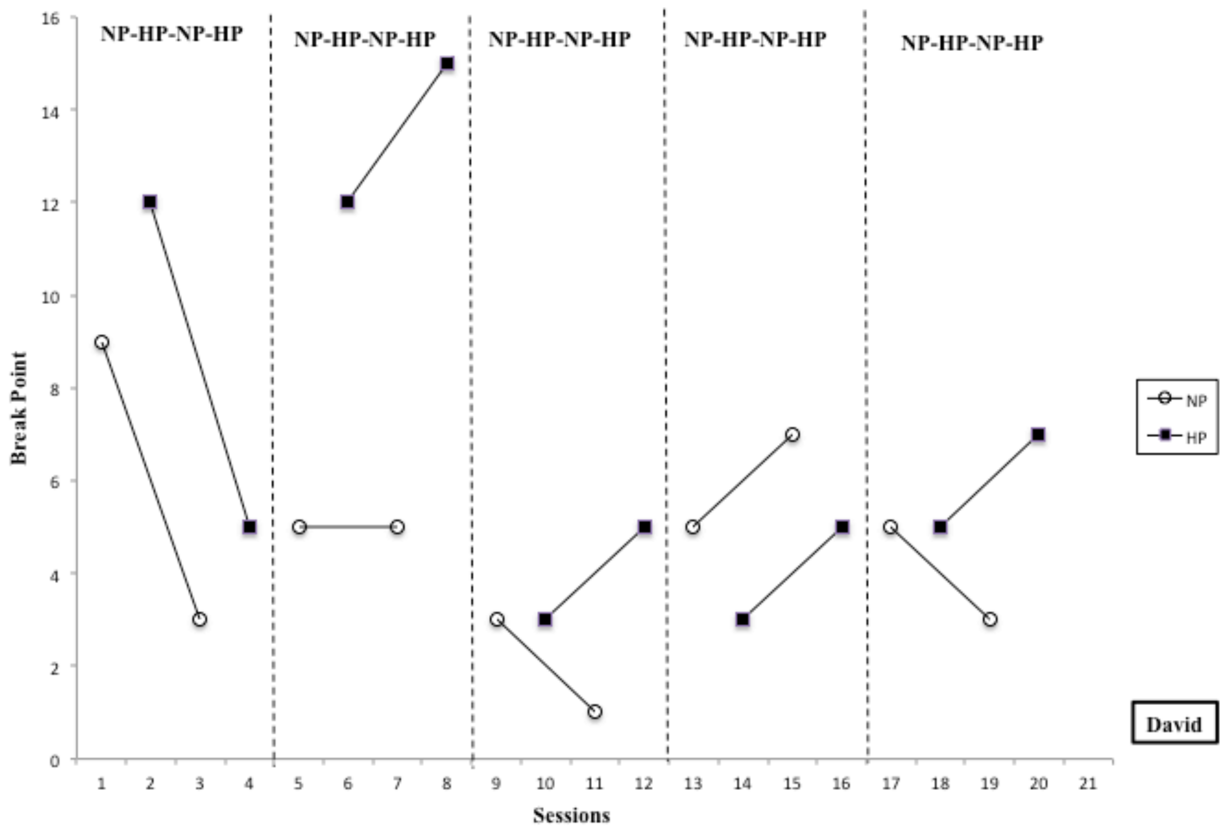

Figure 8. Results of David's contrast analysis from Experiment I showing break point.

Results of Walt's contrast analysis for Experiment II are presented in Figure 9. Negative contrast effects were observed across 4 of 5 LM-HM-LM-HM sequences (80%). Additionally, positive contrast effects were observed for 3 of 5 sequences (60%). Walt showed a somewhat similar pattern of responding as in Experiment I, with no demonstration of positive contrast during the first sequence. On average, Walt had a breaking point of 2.7 for LM sessions and 5.6 for HM sessions. The average size of the negative contrast effect across all sequences where a negative contrast effect was demonstrated was 2.75. The average size of the positive contrast effects across all sequences where a positive contrast effect were demonstrated was 3.67. This was calculated by averaging the differences between the first and second HM sessions from sessions where positive contrast effects were demonstrated.

Results of Charles's contrast analysis are presented in Figure 10. Negative contrast effects were observed in 60% of LM-HM-LM sequences. Positive contrast effects, as defined as higher responding in the second HM session relative to responding during the first HM session of a sequence, were observed in 2 of 5 sequences (40%). On average, Charles had a breaking point of 2.4 for LM sessions and 4.3 for HM sessions. Charles had an average negative contrast effect size of 2.0, while there was an average positive contrast effect size of 3.0.

Results of Adams's contrast analysis are shown in Figure 11. Adam demonstrated negative contrast in 2 of 5 sequences (40%) and positive behavioral contrast in 3 of 5 sequences (60%). No change was observed for 1 of 5 (20%) LM-HM-LM sequences, and increasing responding was seen in 1 of 5 (20%) of LM-HM-LM sequences. On average, Adam had a breaking point of 4.6 for NP sessions and 6.9 for HP sessions. Adam had an average negative contrast effect size of 3.33, while there was an average positive contrast effect size of 2.

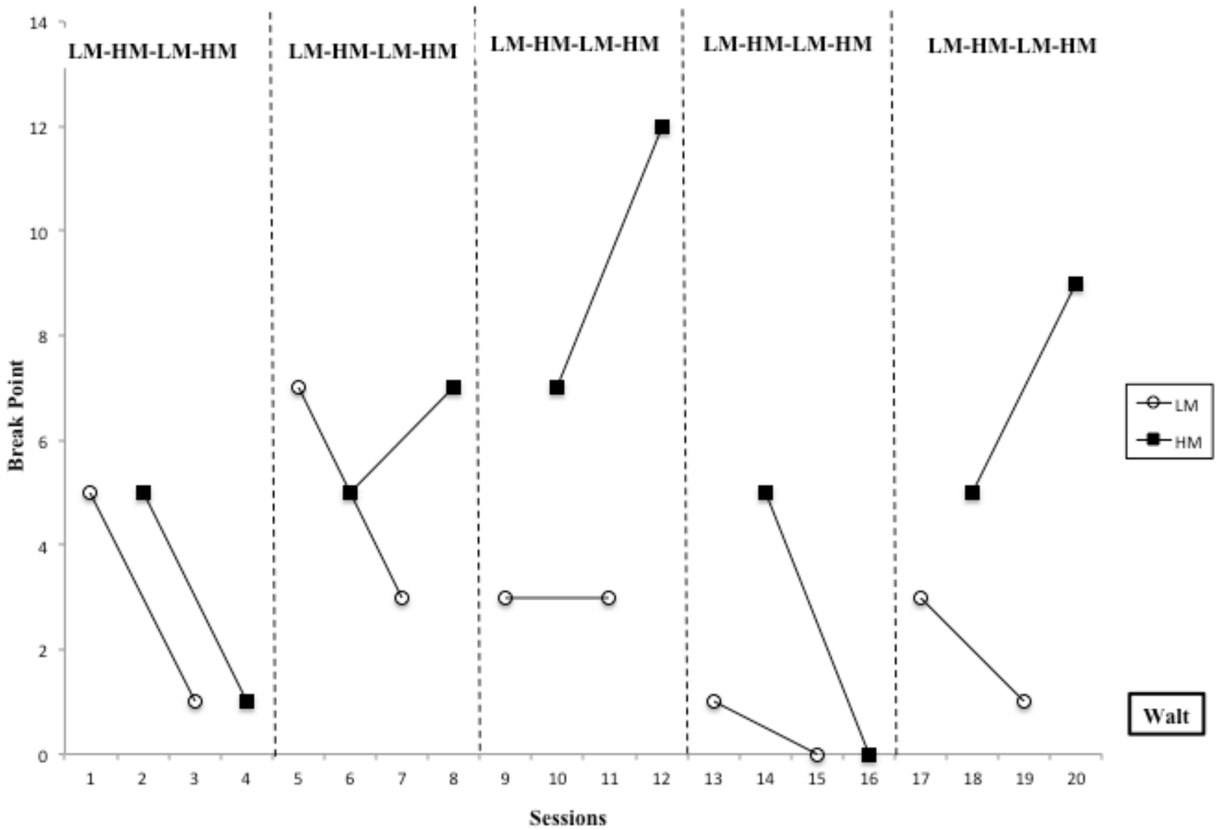

Figure 9. Results of Walt's contrast analysis from Experiment II showing break point.

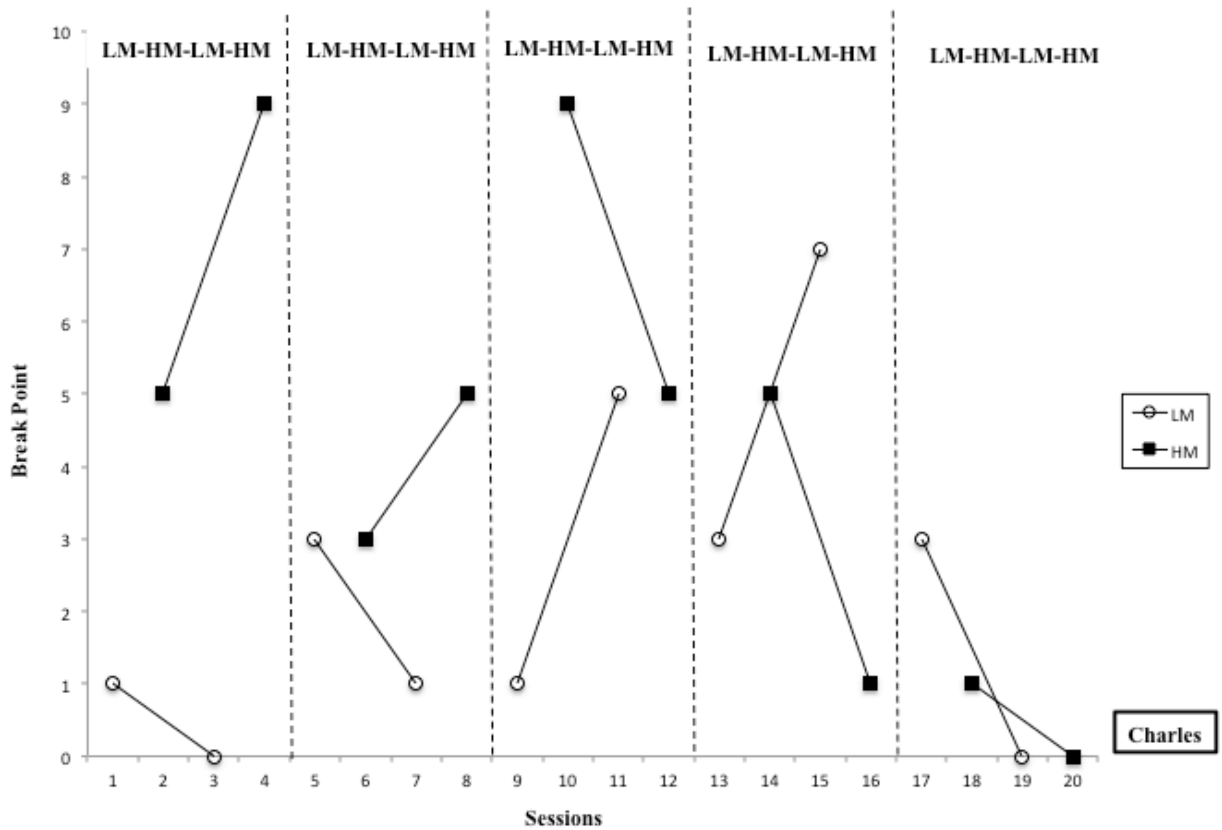

Figure 10. Results of Charles's contrast analysis from Experiment II showing break point.

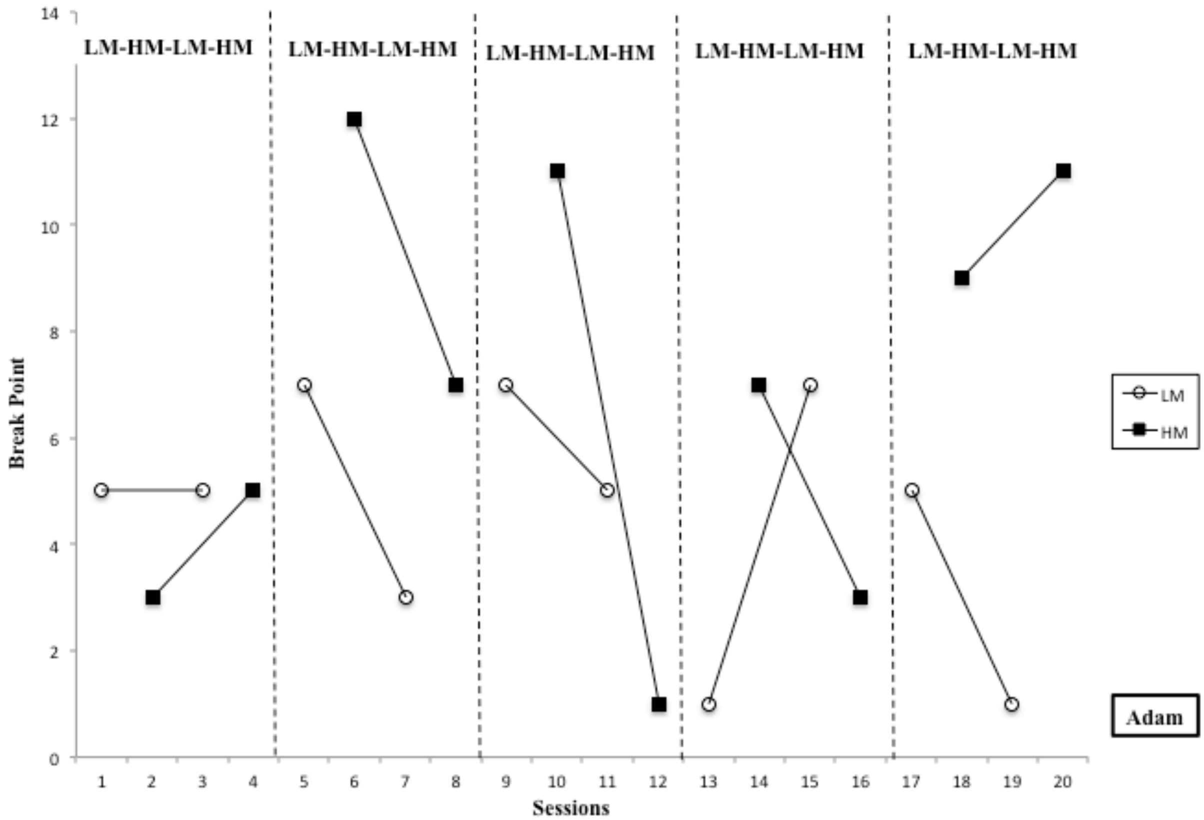

Figure 11. Results of Adam's contrast analysis from Experiment II showing break point.

Results of David's contrast analysis are shown in Figure 12. Negative contrast effects were observed in 4 of 5 sequences (80%). Increasing responding was seen in 1 of 5 (20%) of LM-HM-LM sequences. Positive contrast effects were observed for 3 of 5 sequences (60%). Decreasing responding patterns were seen in 2 of 5 sequences (40%). The pattern of responding for positive contrast effects was similar to that of Walt, Charles, and David during Experiment I in that the first sequence did not demonstrate the positive contrast effect. On average, David had a breaking point of 6.3 for NP sessions and 6.9 for HP sessions. David had an average negative contrast effect size of 4.75, while there was an average positive contrast effect size of 4.25.

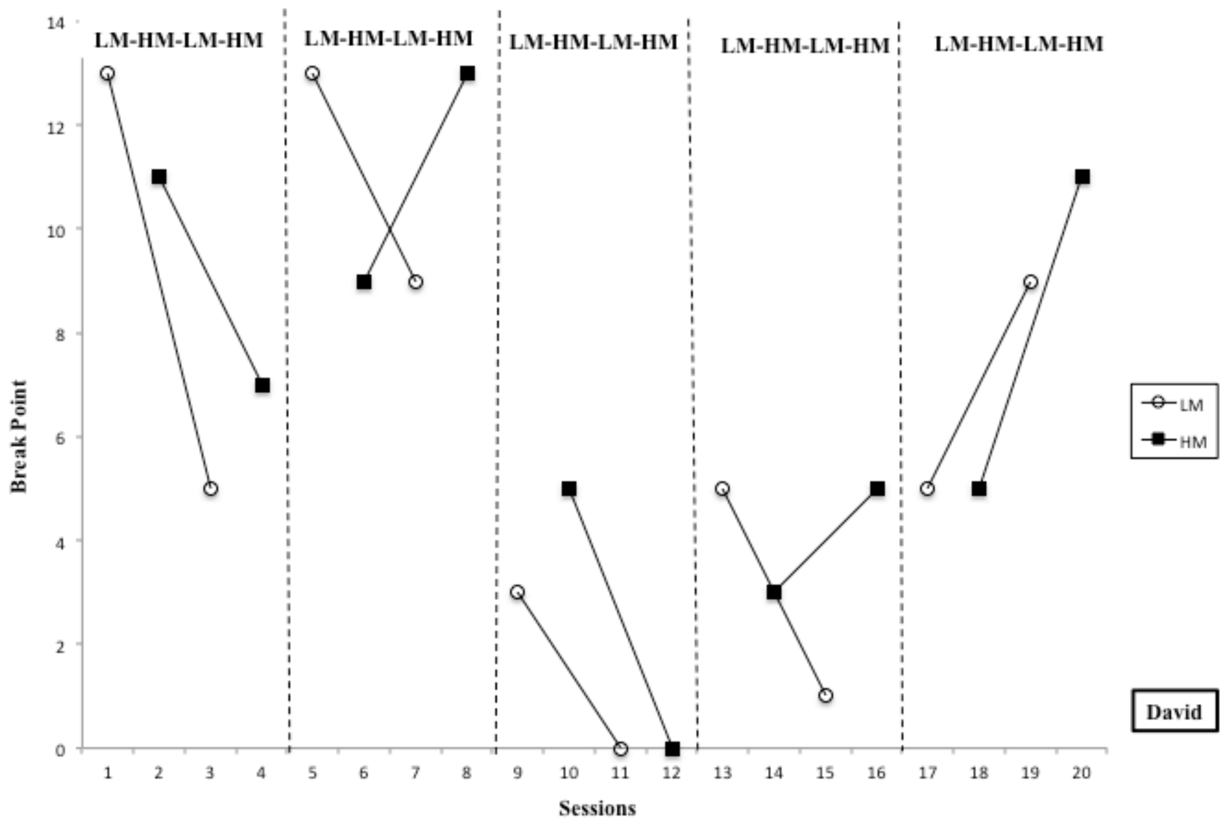

Figure 12. Results of David's contrast analysis from Experiment II showing break point.

CHAPTER V

DISCUSSION

From one perspective, reduced responding in a condition following the introduction of a reward contingency relative to responding for the same reinforcement schedule before the introduction of a HP reward may be considered the result of the individual finding the consequence (in this case, no reward) less appealing than receiving a reward for completing the same task (Adamson, 1971). Similarly, responding that increases in a HP reward contingency relative to a NP reward contingency can be seen as the result of behavior changing to match the more-appealing schedule of HP sessions. This effect can be considered contrast effects. The existence of negative and positive contrast effects have been repeatedly demonstrated in the basic literature, with negative contrast effects being most commonly demonstrated following a downshift in reward quality or magnitude and positive contrast effects following an upshift in reward quality or magnitude (e.g., Crespi, 1942; Flaherty & Checke, 1982). This idea has not been thoroughly examined in human participants, resulting in the present studies in which these effects were demonstrated among human participants.

The current study combined aspects of research methodologies from the basic literature as well as methodologies in previous examples of applied testing for contrast effects (Lind, 2008). Specifically, disparate reward contingencies were directly compared in an alternating fashion, with HP and NP stimuli being compared in Experiment I and HM and LM reward contingencies compared in Experiment II. In all cases, rewards were held constant in that only items selected and consumed for at least 80% of trials were used as HP or HM stimuli, and only items chose 0 % of trials were used as NP stimuli. Sessions were arranged in a specific order to first compare responding from NP to HP to NP sequences (negative contrast effects) and HP to NP to HP sequences (positive contrast effects) for Experiment I. Similarly, for Experiment II, sequences were arranged such that the first three sessions of LM-HM-LM occasioned potential negative contrast effects while the last three sessions of HM-LM-HM sequences occasioned opportunities to demonstrate positive contrast. Negative contrast effects were defined as responding in the second NP (Experiment I) or LM (Experiment II) conditions had lower breaking points than responding in the first NP or JM condition. Similarly, positive contrast effects were defined as higher responding in the second HP (Experiment I) or HM (Experiment II) conditions relative to the first HP or HM sessions.

In the following sections, I discuss response patterns for Experiment I and Experiment II with possible explanations for response patterns. I then discuss how these findings relate to current literature on contrast effects and responding following the withdrawal of reward contingencies. Finally I discuss potential limitations of the current study and directions for future research.

Experiment I

Experiment I examined patterns of responding when the same task produced different qualities of reinforcement. Results indicated that negative and positive contrast effects, as defined for the purposes of this study, were elicited for the majority of NP-HP-NP-HP sequences. That is, the most common result of shifting from a NP to a HP condition was a decrease in responding during the second NP condition relative to the first. Similarly, the most common result of shifting from a NP to a HP condition was an increase in responding for the second HP condition relative to the first HP condition. Other response patterns included no change in break point between the first and second NP conditions as well as an increase in responding for the second NP condition relative to the first. These results were far less common, though. As previously stated, No change was only observed for 11% of NP-HP-NP sequences and increases were seen only for 11% of these sequences as well. While a slightly higher percentage of HP-NP-HP sequences resulted in a decrease in responding for the second HP session (33%), 67% of sequences did demonstrate positive contrast. These results are overall consistent with basic studies of contrast effects (e.g., Flaherty, 1996) as well as intrinsic-motivation studies (e.g., Deci, 1971).

In general, responding patterns followed the degree of reward available during a session. That is, responding was generally higher during sessions when reward quality was higher. This is to be expected based on reinforcement theory (Fisher et al., 1992). The clearest examples of behavioral contrast were the cases where responding not only showed positive and negative contrast effects, but also response levels that coincided with the relative quality of reinforcers (i.e., higher levels of responding for HP versus NP sessions, overall). Several sequences, though, did not demonstrate this phenomenon. For example, 2 of 4 of Walt's and Charles's sequences show initial responding for the first NP sessions higher than those of the subsequent NP and HP sessions. For 1of 5 sequences for Adam and David, responding was higher across all NP sessions than HP sessions. While the majority of sequences met the definition for negative and positive contrast effects, it is less convincing that behavioral contrast alone was responsible for these shifts for sequences in which NP responding was not lower than HP responding. One possible explanation for this pattern of responding is that each first NP session was the first session of the sequence for the day, thus responding may have been slightly elevated relative to the other sessions due to the relative novelty of the task compared to later sessions in the sequence for the day. Another possible explanation is that satiation with the HP stimulus may have resulted in decreased responding during HP sessions. More specifically, encountering the HP stimulus several times may have initially resulted in an increase in responding to gain access to the item, but reinforcing effectiveness of the stimuli decreased over time resulting in responding lower than if the task alone were being performed, due possibly to a combination of fatigue with the task and satiation with the reward.

Another pattern of responding that occurred in several sequences was a general decrease in responding across all 4 sessions in the sequence. In these cases, responding may not have been entirely the result of behavioral contrast, but rather may have been the result of satiation with reinforcers or the task (Dickenson, 1989). This explanation seems most pertinent to those cases where positive contrast effects were not observed. This makes sense when considering that the last HP sessions occurred following multiple completions of the same task and coming into contact multiple times with the HP reinforcer.

Another potential explanation for the sequences where negative and/or positive contrast effects were not observed (22% and 33%, respectively) is that the single session methodology may have affected results. More specifically, negative contrast effects and positive contrast effects may have been more pronounced if participants had received multiple experiences with the reward contingency such that the quality of reward may have been more frequently experienced and (presumably) internalized, resulting in responding that may have better matched contrast theory. While the single session shifts were conducted in this study to potentially decrease satiation and practice effects for the task by decreasing the total number of times a task had to be performed per sequence, as well as to allow all 4 sessions of a sequence to be run in one day, repeated exposure to each condition prior to a shift may have produced more predictable results.

Across sequences, patterns of responding were also not predictable for 2 or 4 participants. That is, for Walt and Charles, response patterns across sequences was somewhat predictable in that negative contrast effects were observed for all sequences and positive contrast effects were observed following the first sequence. These patterns of responding did not hold true for Adam and David, however, in which failures to demonstrate negative and/or positive contrast occurred in the middle or end of the series of sequences. One explanation for this idiosyncratic responding among series of sequences is that with each sequence being run on a different day, responding may have been affected by external factors specific to that day. For example, one failure to demonstrate negative and positive contrast occurred for Adam on a day when responding was low across all sessions, possibly due to his having not slept on the previous night. That is, other factors such as general fatigue, medications, family issues may have influenced how willing a participant was to work on a given day, thus resulting in a potential failure to demonstrate positive or negative contrast effects.

Another potential explanation for unexpected patterns of responding in Experiment I was that reinforcer effectiveness decreased over time. That is, satiation emerge within a sequence but could also carry over to sequences run of separate days if the break between sequences was not great enough. While this holds true theoretically, it is unlikely that this affected response patterns too greatly because participants were allowed to pick among HP stimuli before a sequence was begun and responding did not ever completely drop out across sequences.

Another potential explanation for unexpected patterns of responding is that the tasks chosen may have been too familiar to the participants. As all participants had experience with completing the tasks on multiple occasions for varying amounts of reward, past history with the task may have reduced the ability to predict responding on the tasks.

Experiment II

Experiment II attempted to evaluate changes in responding across shifting magnitudes of reward such that decreases in responding between the first and second LM sessions were defined as negative contrast effects and increases in responding between the first and second HM sessions were defined as positive contrast effects. All sessions were run with the LM-HM-LM-HM sequence. As in Experiment I, both negative and positive contrast effects were observed for the majority of sequences (70% and 50%, respectively). No change in responding or an increase in responding following the LM-HM-LM sequences were observed for 10% and 20% of sessions, respectively. A decrease in responding for the final HM session was observed for 50% of sequences. This pattern of responding was unexpected compared to basic studies and the effect of reinforcer magnitude on behavioral contrast (e.g., Capaldi, 1974). This was not, however, very different from results found by Lind and colleagues (2008).

Similar to results of Experiment I, not all instances of contrast effects that met the definitions of the study were explicable by contrast theory alone. As in Experiment I, initial responding during the LM condition was often higher than responding in subsequent HP conditions, such that responding did not necessarily match predictions based on reinforcement theory (Fisher et al., 1991). In other words, while negative and positive contrast effects may have been obtained, levels of responding were not necessarily predictable based on the schedule of reinforcement in effect.

Explanations for the unexpected patterns of responding include several factors that were described in the discussion of results for Experiment I. Satiation with the reinforcer may have affected responding, especially in light of the increased number of reinforcers experienced by participants relative to Experiment I. That is, the difference between occasions of positive contrast between the two experiments (67% versus 50%) may have been the direct result of Participants receiving up to 6 times the amount of HP reinforcers in Experiment II relative to Experiment I. While this explanation may be true for sessions where responding dropped off dramatically across sequences (e.g., sequences 1 and 3 for Walt and sequence 5 for Charles), many other sequences did not demonstrate this overall decrease in responding across sessions within a sequence.

As in Experiment I, participants generally responded at higher rates for tasks associated with “better” rewards (i.e., greater magnitude in Experiment II and more-highly-preferred in Experiment I). That is, as in Experiment I, responding was generally higher when participants were working for a “better” reward (in this case, greater magnitude versus greater quality in Experiment I).

Explanations for unpredictable responding in other conditions may include outside environmental factors as discussed for Experiment I. That is, patterns of responding across all participants varied across days. While participants were allowed to pick which reinforcer they would receive for completing schedule requirements, it may be that desire to engage in either the task activity or to enjoy the reinforcers delivered were being influenced by idiosyncratic mood.

As discussed earlier, satiation with the task may have been a factor as well. This is supported by those sequences that saw a general decline in responding, similar to those where satiation with the reinforcers were used to explain unexpected patterns of responding. Idiosyncratic responding based on type of task were not manipulated in these experiments, but it is possible that different tasks (e.g., easier or perhaps more difficult) would produce more predictable results.

General Discussion

Results of the two experiments were generally in agreement with the idea of negative and positive behavioral contrast. Reductions in responding following the introduction of a reward contingency were frequently observed by comparing break points in responding from pre- and post-shift sessions. Similarly, increases in responding were frequently observed following a shift from no reward or small amounts of reward to HP rewards or HM of HP stimuli delivered for completing schedule requirements. These shifts in responding constituted negative and positive contrast effects (Flaherty, 1996). Again, negative contrast effects were seen in the majority of sequences for both experiments, and positive contrast effects were seen for the majority of sequences during Experiment I and 50% of sequences for Experiment II.

These results supported many findings of basic and applied investigations of contrast and intrinsic motivation (e.g., Flaherty, 1982). As in previous studies, contrast effects were seen following disparate changes in reward quality or magnitude. Also, negative contrast effects were seen more frequently than positive contrast effects (Lind, 2008). Also, as in the basic and applied literature, contrast effects were not necessarily predictable. For some participants, contrast effects (especially negative contrast effects) were predictable across all phases. For other participants, contrast effects were not predictable. For others, the opposite effect was seen than was expected. In general, these findings are in agreement with the disparate results reported in the literature (e.g., Cox, 1975).

Some results were not in agreement with current contrast and adaption-level theory. Specifically, in the basic literature it is generally observed that reward magnitude produced greater negative and positive contrast that reward quality (Flaherty, 1996). In this case, however, reward quality produced more predictable results (especially for positive contrast) than shifting reward magnitude. While sessions were arranged in the current studies such that disparate reward contingencies were in place in the hopes of producing reliable contrast effects, the use of this sequence alone did not adequately predict the occurrence of negative and positive contrast effects and occasions under which they will occur. This suggests that other factors were involved in affecting levels of responding to the different conditions.

Results of the current studies were in general agreement with findings of intrinsic motivation studies (e.g., Akin-Little, 2004). Specifically, the NP-HP-NP and LM-HM-LM sequences were similar to baseline-reward-baseline methodologies employed by basic researchers. In general, responding did decrease following the introduction of reward. While the positive contrast effect sequences were not specifically designed to replicate this methodology, it stands to reason that if someone will only work for external reinforcement following its introduction, responding should increase relative to a return to no reward baseline. The current findings, however, are not completely congruent with the intrinsic-motivation interpretation of results in that intrinsic motivation studies suggest a long term, pervasive negative effect on responding in the absence of reward following the introduction of reward (Deci & Ryan, 1985). In this case, however, responding during NP or LM returned to initial levels following a break of at least one day between sequences. Thus no pervasive decrease in baseline responding was observed.

Satiation with either the task or the reinforcer may have affected responding for some participants in some sequences, Specifically, when positive contrast effects were not observed and/or a general decreasing trend in responding across sessions regardless of condition, a general tiring of completing the task or decreased reinforcing effectiveness of the reward stimuli may be responsible. This is supported by the general trend of returns to typical responding following a break of at least one day, and may have been more easily detected had a more rapidly increasing PR schedule been used. That is, had participants come into contact with the task and reinforcers less frequently, decreasing patterns across sessions may not have been observed as frequently. This confound was addressed not only through the use of the PR schedule, but through pre-sequence choice of HP reinforcer. Alternative tasks and choice for tasks may have also decreased this potential satiation effect. By increasing schedule requirements by a factor of 2 responses per completion, more negative and positive contrast effects were potentially elicited. In the study by Lind, 2008, for example, the PR schedule increased by 1, and fewer positive contrast effects were observed than in the current study.

Overall, findings of the current study suggest that response reductions and increases following the addition and removal of reward contingencies can be somewhat predicted. All participants exhibited negative and positive contrast effects to some degree. Results also suggest that responding will change somewhat predictably following predictable shifts in reward contingencies. The results also suggest that these shifts are temporary, and that the role of repeated exposure to the same trial or multiple deliveries of a reinforcer will make prediction of responding more difficult.

Limitations and Directions for Future Research

The current study contained many limitations. First, because all participants were male and had similar diagnoses, results can not be generalized to a larger population. Future studies may wish to compare results from other populations such as an adult population or the typically developing population. It may be, for example, that typically developing people show contrast effects more or less reliably due to rule-governed behavior. Another issue is that because participants were so similar (all male, all with autism diagnosis), yet had different cognitive abilities, results may have been less predictable. That is, future studies should compare individuals equated in other ways to determine if qualities such as cognitive ability produce consistent patterns of responding and contrast effects.

Another limitation is that there was no evaluation of how long contrast effects remained in effect. That is, if more sessions had been run per schedule requirement, information could have been gathered on the durability of the contrast effect. While the return to initial responding rates was observed following a break of at least 1 day between sequences, and while this return argues against the findings of intrinsic motivation studies, a more definite distinction may have been made had multiple post-shift sessions been run. Future studies might, therefore, include multiple post-shift sessions to determine longevity of effect.

Another limitation of the current study was the use of only one task during sessions. While no individuals demonstrated clear satiation with the task, it is not beyond consideration that participants may have tired of the task, which in turn affected responding. Future studies should identify multiple tasks to be used during session, and these tasks could be randomly assigned to sequences to control for potential satiation effect.

Another potential limitation of the study was the PR schedule employed may have been too dense to avoid satiation effects. Future studies should consider using a PR schedule that increases more rapidly such that interactions with the task and with reinforcers are further minimized.

Overall, results of the two experiments indicated that contrast effects in humans can be observed under the appropriate conditions. In addition, relative to previous research, this study did find that positive contrast can be demonstrated best when satiation effects are minimized. In addition, no evidence was found to support the assertion that extrinsic reward contingencies decrease responding in non-reward conditions. For example, several positive contrast effects were found between NP or LM sessions (i.e., responding in the NP or LM sessions actually increased following the addition of an extrinsic reward contingency). In general, contrast effects were shown to occur in human participants under the right contingencies, and these effects offer an arguably better explanation for post-reinforcement response decrements than simply a decrease in intrinsic motivation.

REFERENCES

Adamson, R. (1971). Contrast effects and reinforcement. In M.H. Appley (Ed.), *Adaption-level theory: A symposium* (pp. 159-168). New York: Academic Press.

Akin-Little, K.A., Eckert, T.L., Lovett, B.J., & Little, S.G. (2004). Extrinsic reinforcement in the classroom: Bribery or best practice. *School Psychology Review, 33*(3), 344-362.

Akin-Little, K.A., & Little, S.G. (2004) Re-examining the overjustification effect. *Journal of Behavioral Education, 13*(3), 179-192.

Balsam, P.D., & Bondy, A.S. (1983). The negative side effects of reward. *Journal of Applied Behavior Analysis, 16,* 283-296.

Bernstein, D.J. (1990). Of carrots and sticks: A review of Deci and Ryan's intrinsic motivation and self-determination in human behavior. *Journal of the Experimental Analysis of Behavior, 54,* 323-332.

Bevan, W. (1966). An adaption-level interpretation of reinforcement. *Perceptual and Motor Skills, 23,* 511-531.

Bower, G.H. (1961). A contrast effect in differential conditioning. *Journal of Experimental Psychology, 62,* 196-199.

Boyer, W.N., Boyer, S.L., & McCloy, T.M. (1979) Extinction: Effects of qualitative reard and reinforcement schedule. *The Journal of General Psychology, 101,* 155-156.

Cameron, J., Banko, K.M., & Pierce,W.D. (2001). Pervasive negative effects on intrinsic motivation: The myth continues. *The Behavior Analyst, 24,* 1-44.

Cameron, J., & Pierce, W.D. (1994). Reinforcement, reward and intrinsic motivation: A meta-analysis. *Review of Educational research, 64*(3), 363-423.

Cameron, J., Pierce, W.D., Banko, K.M., & Gear, A. (2005). Achievement-based rewards and intrinsic motivation: A test of cognitive mediators. *Journal of Educational Psychology, 97*(4), 641-655.

Camp, C.M., Lerman, D.C., Kelley, M.E., Contrucci, S.A., & Vorndran, C.M. (2000). Variable-time reinforcement schedules in the treatment of socially maintained problem behavior. *Journl of Applied Behavior Analysis,* 33(4), 545-557.

Capaldi, E.J. (1972). Successive negative contrast effect: Intertrial interval, type of shift, and four sources of generalization decrement. *Journal of Experimental Psychology, 96*(2), 433-438.

Capaldi, E.J. (1974). Partial reward either following or preceding consistent reward: A case of reinforcement level. *Journal of Experimental Psychology, 102*(6), 954-962.

Catania, A.C. (1998). *Learning* (4^{th} ed.). Upper Saddle River, NJ: Prentice Hall.

Crespi, L.P. (1942). Quantitative variation and incentive and performance of the white rat. *The American Journal of Psychology, 40,* 467-517.

Davidson, P., & Bucher, B. (1978). Intrinsic interest and extrinsic reward: The effects of a continuing token program on continuing nonconstrained preference. *Behavior Therapy, 9,* 222-234.

Deci, E.L. (1971). Effects of externally mediated rewards on intrinsic motivation. *Journal of Personality and Social Psychology, 18*(1), 105-115.

Deci, E.L. (1972). Intrinsic motivation, extrinsic reinforcement, and inequity. *Journal of Personality and Social Psychology, 22*(1), 113-120.

Deci, E.L., Koestner, R., & Ryan, R.M. (1999a). A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation. *Psychological Bulletin,125*(6), 627-668.

Deci, E.L., Koestner, R., & Ryan, R.M. (1999b). The undermining effect is a reality after all – Extrinsic rewards, task interest, and self-determination: Reply to Eisenberger, Pierce, and Cameron (1999) and Lepper, Henderlong, and Gringas (1999). *Psychological Bulletin, 125*(6), 692-700.

Deci, E.L., & Ryan, R. (1985). *Intrinsic motivation and self-determination in human behavior.* New York: Plenum.

DeLeon, I.G., Iwata, B.A., Goh, H., & Worsdell, A.S. (1997). Emergence of reinforcer preference as a function os schedule requirements and stimulus similarity. *Journal of Applied Behavior Analysis, 30,* 439-449.

DeLeon, I.G., Neidert, P.L., Anders, B.M., & Rodriguez-Catter, V. (2001). Choices between positive and negative reinforcement during treatment for escape-maintained problem behavior. *Journal of Applied Behavior Analysis, 34,* 521-525.

Dickinson, A.M. (1989). The detrimental effects of extrinsic reinforcement on "intrinsic motivation." *The Behavior Analyst, 12,* 1-15.

Ehrenfreund, D., & Badia, P. (1962). Response strength as a function of drive level and pre- and postshift incentive magnitude. *Journal of Experimental Psychology, 63* (5), 468-471.

Eisenberger, R., & Cameron, J. (1996). Detrimental effects of reward: Reality or myth? *American Psychologist, 51*(11), 1153-1166.

Fisher, E.B. (1979). Overjustification effects in token economies. *Journal of Appled behavior Analysis, 12,* 407-415.

Fisher, W.W., Piazza, C.C., Bowman, L.G., Hagopian, L.P., Owens, J.C., & Slevin, I. (1992). A comparison of two approaches for identifying reinforcers for persons with severe and profound disabilities. *Journal of Applied Behavior Analysis, 25,* 491-498.

Flaherty, C.F. (1982). Incentive contrast: A review of behavioral changes following shifts in reward. *Animal Learning & Behavior, 10*(4), 409-440.

Flaherty, C.F. (1996). *Incentive relativity.* New York: Cambridge University Press.

Flaherty, C.F., & Checke, S. (1982). Anticipation of incentive gain. *Animal Learning and Behavior, 10,* 177-182.

Flaherty, C.F., & Grigson, P.S. (1988). From contrast to reinforcement: Role of response contingency in anticipatory contrast. *Journal of Experimental Psychology: Animal Behavior Precesses, 14,* 165-176.

Flaherty, C.F., & Largen, J. (1975). Within-subjects positive and negative contrast effects. *Journal of Comparative and Physiological Psychology, 88,* 653-664.

Flaherty, C.F. & Rowan, G.A. (1985). Anticipatory contrast: Within-subject analysis. *Animal Learning & Behavior, 16,* 47-52.

Flora, S.R. (1990). Undermining intrinsic interest from the standpoint of a behaviorist. *Psychological Record, 40*(3), 323-347.

Flora, S.R., & Flora, D.B. (1999). Effects of extrinsic reinforcement for reading during childhood on reported reading habits of college students. *The Psychological Record, 49,* 3-14.

Garland, H., & Staff, P.E. (1979). The overjustification effect: Reward contrast or reattirubution in rats? *Motivation and Emotion, 3*(1), 35-49.

Glover, A.C., Roane, H.S., Kady, H.J., & Grow, L.L. (2008). Preference for reinforcers under progressive- and fixed-ratio schedules: A comparison of single and concurrent arrangements. *Journal of Applied Behavior Analysis, 41,* 163-176.

Greene, D., Sternberg, B., & Lepper, M.R. (1976). Overjustification in a token economy. *Journal of Personality and Social Psychology, 34*(6), 1219-1234.

Gross, A.M., & Drabman, R.S. (1981). Behavioral contrast and behavior therapy. *Behavior Therapy, 12*(2), 231-246.

Kazdin, A.E. (2005). *Parent management training: Treatment of oppositional, aggressive, and antisocial behavior in children and adolescents.* New York: Oxford University Press.

Kelley, M.E., Lerman, D.C., Fisher, W.W., Roane, H.S., & Zangrillo, A. N. (2011). Reinforcement delay fading during differential reinforcement of communication: The effects of signals on response maintenance. *Journal of the Experimental Analysis of Behavior,* 96(1), 96-107.

Kistner, J., Hammer, D., Wolfe, D., Rothblum, E., & Drabman, R.S. (1982). Teacher popularity and contrast effects in a classroom token economy. *Journal of Applied Behavior Analysis, 15,* 85-96.

Kobre, K.R., & Lipsitt, L.P. (1972). A negative contrast effect in newborns. *Journal of Experimental Child Psychology, 14,* 81-91.

Kohn, A. (1993). *Punished by rewards.* Boston: Houghton Mifflin.

Kohn, A. (1996). By all available means: Cameron and Pierce's defense of extrinsic motivators.

Lalli, J.S., Vollmer, T.R., Progar, P.R., Wright, C., Borrero, J., Daniel, D., et al. (1999). Competition between positive and negative reinforcement in the treatment of escape behavior. *Journal of Applied Behavior Analysis, 32,* 285-296.

Lepper, M.R., Corpus, J.H., & Iyengar, S.S. (2005). Intirnsic and extrinsic motivational orientations in the classroom: Age differences and academic correlates. *Journal of Educational Psychology, 97*(2), 184-196.

Lepper, M.R., & Greene, D. (1976). On understanding "overjustification": A reply to Reiss and Sushinsky. *Journal of Personality and Social Psychology, 1,* 25-35.

Lepper, M.R., Greene, D.,& Nisbett, R.E. (1973). Undermining children's intrinsic interest with extrinsic reward. *Journal of Personality and Social Psychology, 28*(1), 129-137.

Lerman, D.C., & Iwata, B.A. (1995). Prevalence of the extinction burst and its attenuation during treatment. *Journal of Applied Behavior Analysis, 28,* 93-94.

Lerman, D.C., & Iwata, B.A. (1996). Developing a technology for the use of operant extinction in clinical settings: An examination of basic and applied research. *Journal of Applied Behavior Analysis, 29,* 345-382.

Levine, F.M., Broderick, J.E., & Burkart, M. (1983). Attritnution and contrast: Two explanations for the effects of external rewards on intrinsic motivation. *British Journal of Psychology, 74,* 461-466.

Lind, M.A. (2008). *Response reductions following shifts in the quality and magnitude of contingent reward: An evaluation of contrast effects in children.* Unpublished doctoral dissertation, University of Iowa, Iowa City.

Mawhinney, T.C. (1990). Decreasing intrinsic "motivation" with extrinsic rewards: Easier said than done. *Journal of Organizational Behavior Management, 11,* 175-191.

Mawhinney, T.C., Dickinson, A.M., & Taylor, L.A. (1989). The use of concurrent schedules to evaluate the effects of extrinsic rewards on "intrinsic motivation." *Journal of Organizational Behavior Management, 10*(1), 109-129.

McSweeney, F.K. (1975). Matching and contrast on several concurrent-press schedules. *Journal of the Experimental Analysis of Behavior, 23,* 193-198.

McSweeney, F.K. (1982). Positive and negative contrast as a function of component duration for keypecking and treadle pressing. *Journal of the Experimental Analysis of Behavior, 37,* 281-293.

McSweeney, F.K., & Weatherly, J.N. (1998). Habituation to the reinforcer may contribute to multiple-schedule behavioral contrast. *Journal of the Experimental Analysis of Behavior, 69,* 199-221.

Mynatt, C., Oakley, T., Arkkelin, D., Piccione, A., Margolis, R., & Arkkelin, J. (1978). An examination of overjustification under conditions of extended observation and multiple reinforcement: Overjustification or boredom? *Cognitive Therapy and Research, 2*(2), 171-177.

Nicholson, J.N., & Gray, J.A. (1971). Behavioural contrast and peak shift in children. *British Journal of Psychology, 62*(3), 367-373.

Nicholson, J.N., & Gray, J.A. (1972). Peak shift, behavioural contrast and stimulus generalization as related to personality and development in children. *British Journal of Psychology, 63*(1), 47-62.

O'Leary, K.D., Poulos, R.W., & Devine, V.T. (1972). Tangible reinforcers: Bonuses or bribes? *Journal of Consulting Clinical Psychology, 38*(1), 1-8.

Padilla, A.M. (1971). Analysis of incentive and behavioral contrast in the rat. *Journal of Comparative and Physiological Psychology, 75*(3), 464-470.

Piazza, C.C., Fisher, W.W., Han ley, G.P.,Remick, M.L., Contrucci, S.A., & Aitken, T.L. (1997). The use of positive and negative reinforcement in the treatment of escape-maintained destructive behavior. *Journal of Applied Behavior Analysis, 30,* 279-298.

Reiss, S., & Sushinsky, L.W. (1975). Overjustification, competing responses, and the acquisition of intrinsic interest. *Journal of Personality and Social Psychology, 31*(6), 1116-1125.

Reynolds, G.S. (1961a). Behavioral contrast. *Journal of the Experimental Analysis of Behavior, 4,* 57-71.

Reynolds, G.S. (1961b). An analysis of interactions in a multiple schedule. *Journal of the Experimental Analysis of Behavior, 4,* 107-117.

Roane, H.S. (2008). On the applied use of progressive-ratio schedules of reinforcement. *Journal of Applied Behavior Analysis, 41,* 155-162.

Roane, H.S., Fisher, W.W., & McDonough, E.M. (2003). Progressing from programmatic to discovery research: A case example with the overjustification effect. *Journal of Applied Behavior Analysis, 36,* 35-46.

Roane, H.S., Lerman, D.C., & Vorndran, C.M. (2001). Assessing reinforcers under progressive schedule requirements. *Journal of Applied Behavior Analysis, 34,* 145-167.

Ryan, R.M., & Deci, E.L. (2000). Self-determination theory and the facilitation of intrinsic motivation. *American Psychologist, 55*(1), 68-78.

Scott, J.R., & Miller, L.K. (2001). Intrinsic motivation and the overjustification effect: A failure to replicate. *Journal of Genetic Psychology, 146*(4), 469-476.

Tang, S., & Hall, V.C. (1995). The overjustification effect: A meta-analysis. *Applied Cognitive Psychology, 9,* 365-404.

Thompson, R.H., Iwata, B.A., Conners, J., & Roscoe, E. (1999). Effects of reinforcement for alternative behavior during punishment for self-injury. *Journal of Applied Behavior Analysis, 32,* 317-328.

Tiger, J.H., & Hanley, G.P. (2006). Using reinforcer pairing and fading to increase the mild consumption of a preschool child. *Journal of Applied Behavior Analysis, 39*(3), 399-404.

Timberlake, W. (1980). A molar equilibrium theory of learned performance. In G.H. Bower (Ed.), *The psychology of learning and motivation* (Vol. 14, pp. 1-58). San Diego, CA: Academic Press.

Vasta, R. (1981). On token rewards and real dangers. *Behavior Modification, 5*(1), 129-140.

Vasta, R., Andrews, D.E., McLaughlin, A.M., Stirpe, L.A., & Comfort, C. (1978). Reinforcement effects of intrinsic interest: A classroom analog. *Journal of School Psychology, 16*(2), 161-166.

Vasta, R., & Stirpe, L.A. (1979). Reinforcement effects on three measures of children's interest in math. *Behavior Modification, 3*(2), 223-244.

Vogel, J.E., Mikulka, P.J., & Spear, N.E. (1968). Effects of shifts in sucrose and saccharine concentration on licking behavior in the rat. *Journal of Comparative and Physiological Psychology, 66,* 661-666.

Wahler, R.G., Vigilante, V.A., & Strand, P.S. (2004). Generalization in a child's oppositional behavior across home and school settings. *Journal of Applied Behavior Analysis, 37,* 43-51.

Waite, W.W., & Osborne, J.G. (1972). Sustained behavioral contrast in children. *Journal of the Experimental Analysis of Behavior, 18,* 113-117.

Walker, H.M., Hops, H., & Johnson, S.M. (1975). Generalization and maintenance of classroom treatment effects. *Behavior Therapy, 6,* 188-200.

Weinstein, L. (1970). Magnitude of incentive contrast as a function of amount of verbal reward change. *Psychonomic Science, 21*(2), 65-66.

Weinstein, L. & Colucci, V.M. (1970). Negative incentive contrast effects with verbal reinforcement. *Psychonomic Science, 18* (6), 318.

Williams, B.A. (1992). Inverse relations between preference and contrast. *Journal of the Experimental Analysis of Behavior, 58,* 303-312.

Williams, B.W. (1980). Reinforcement, behavior constraint, and the overjustification effect. *Journal of Personality and Social Psychology, 39*(4), 599-614.

Zeaman, D. (1949). Response latency as a function of the amount of reinforcement. *Journal of Experimental Psychology, 39,* 466-483.

Zentall, T.R. (2005). A within-trial contrast effect and its implications for several social psychological phenomena. *International Journal of Comparative Psychology, 16,* 273-297.

APPENDIX A

IRB Approval

ACTION ON EXEMPTION APPROVAL REQUEST

Institutional Review Board
Dr. Dennis Landin, Chair
130 David Boyd Hall
Baton Rouge, LA 70803
P: 225.578.8692
F: 225.578.5983
irb@lsu.edu | lsu.edu/irb

TO: Michael Schafer
Psychology

FROM: Dennis Landin
Chair, Institutional Review Board

DATE: December 11, 2015

RE: IRB# E9694

TITLE: Programmed Shifts in Reward Quality and Quantity: A Planned Positive and Negative Contrast Analysis

New Protocol/Modification/Continuation: New Protocol

Review Date: 12/3/2015

Approved X **Disapproved** ______

Approval Date: 12/11/2015 **Approval Expiration Date:** 12/10/2018

Exemption Category/Paragraph: 1

Signed Consent Waived?: No

Re-review frequency: (three years unless otherwise stated)

LSU Proposal Number (if applicable):

Protocol Matches Scope of Work in Grant proposal: (if applicable)

By: Dennis Landin, Chairman ______

PRINCIPAL INVESTIGATOR: PLEASE READ THE FOLLOWING –
Continuing approval is CONDITIONAL on:

1. Adherence to the approved protocol, familiarity with, and adherence to the ethical standards of the Belmont Report, and LSU's Assurance of Compliance with DHHS regulations for the protection of human subjects*
2. Prior approval of a change in protocol, including revision of the consent documents or an increase in the number of subjects over that approved.
3. Obtaining renewed approval (or submittal of a termination report), prior to the approval expiration date, upon request by the IRB office (irrespective of when the project actually begins); notification of project termination.
4. Retention of documentation of informed consent and study records for at least 3 years after the study ends.
5. Continuing attention to the physical and psychological well-being and informed consent of the individual participants, including notification of new information that might affect consent.
6. A prompt report to the IRB of any adverse event affecting a participant potentially arising from the study.
7. Notification of the IRB of a serious compliance failure.
8. **SPECIAL NOTE:**

**All investigators and support staff have access to copies of the Belmont Report, LSU's Assurance with DHHS, DHHS (45 CFR 46) and FDA regulations governing use of human subjects, and other relevant documents in print in this office or on our World Wide Web site at http://www.lsu.edu/irb*

VITA

Michael Schafer began working with children with developmental disabilities in 2002, working with the Marcus Autism Center in Atlanta, Georgia. While attending Georgia State University, Michael was accepted to the School Psychology program at Louisiana State University. Michael received a Master of Science degree in Educational Psychology from Georgia State University in 2009, and his Master of Arts degree in School Psychology from Louisiana State University in 2012.

Michael became a Board Certified Behavior Analyst (BCBA) in 2013 and completed his pre-doctoral internship in 2014 while working at the Shabani Institute in California. Michael currently works with children diagnosed with autism, specializing in case management for children who engage in severe problem behavior, who display significant social and living-skills deficits. Michael lives in New Orleans, Louisiana, with his wife and three children.