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An Examination of the Influence of the Behavior Altering Effect of the Motivating Operation on the Discriminative Stimulus

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Dedication

For Amma & Thatha

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The purpose of this research was to identify the behavior altering effect of the motivating operation (MO) on the discriminative stimulus (S^D). Two studies were conducted to systematically evaluate this effect. Study 1 examined the behavior altering effect of the MO on the S^D with two participants whose target behavior was identified as challenging behavior. Study 2 examined the behavior altering effect of the MO on the S^D with two participants whose target behavior was the use of a Voice Output Communication Aid (VOCA).

Both Study 1 and Study 2 had four phases. The conceptual logic and methodology for both studies were the same. Phase 1 of each study identified the consequence maintaining the operant. In Study 1, a functional analysis identified the consequence maintaining the target behavior (challenging behavior) for two participants. In Study 2, a preference assessment was conducted to identify preferred

stimuli that the target behavior (pressing a VOCA device) accessed for two additional participants. In Phase II, for both studies stimulus discrimination was trained. In Phase III, for both studies presession MOs were manipulated to verify the influence of the MO on the target behavior. Finally in Phase IV, for both studies, as in Phase III presession MOs were manipulated and the behavior altering effects of the MO was examined by placing the target behavior on extinction when the S^D was both present and absent (S^Δ). In this way the direct effect of the MO on the S^D was examined in both Study 1 and Study 2, for a total of four participants. Results of Study 1 and Study 2 were similar in all phases across target behaviors for all four participants. Results indicated that, during extinction responding was higher in both the S^D and S^Δ conditions, when the MO was present than when the MO was absent. These results indicated that in the context of extinction the MO has a behavior altering effect on the S^D.

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CHAPTER 1

INTRODUCTION

> Behavior is a difficult subject matter, not because it is inaccessible, but because it is extremely complex. Since it is a process, rather than a thing, it cannot easily be held still for observation. It is changing, fluid and evanescent, and for this reason it makes great demands on the ingenuity and the energy of the scientist. (Skinner, 1953, p.15)

In the current vernacular, the terms *cause* and *effect* are no longer widely used in natural science. Instead, scientists endeavor to find functional relationships, a "change in the independent variable" *effecting* a "change in the dependent variable" (Skinner, 1953, p. 16). The idea of functional relationships then is not confined to mathematics or physics from super string theory to the theory of the structure of scientific revolutions[1] but extends to animate subject matter such as psychology and biology. Science is a study of one variable affecting the other. While human behavior is amid complexity from severe challenging behavior, to verbal behavior, to the dance of social behavior between the sexes, the study of the basic processes of behavior is not necessarily different to that of any other science.

In behavior analysis, the term operant (the three-term contingency) is used to describe a class of responses. B. F. Skinner used the term both as an adjective (operant behavior) and as a noun to designate a behavior defined by a noun. He stated, "the term [operant] emphasizes on the fact that behavior *operates* on the environment to generate consequences" (Skinner, 1953, p. 65). A multitude of

variables influence the occurrence and the consequences maintaining operant behavior. Some of these variables, such as reinforcing stimuli, contingencies of reinforcement, discriminative stimuli, etc., have been studied and isolated at laboratories in basic research, as well as in applied settings. The assessment and manipulation of these behavioral processes help determine under what contexts a particular behavior is evoked and sustained.

Since behavior analysis was used by scientists as a method of scientific approach to analyze and understand behavior, its potential for the remediation of severe problem behavior in persons with severe developmental disabilities has long been recognized (Durand, 1990). Unfortunately, aversive approaches (for example, electric shock, water mist, etc.) used in the past by behavior analysts to manage severe problem behavior stigmatized the approach of behavior modification in the eyes of many (Van Houten, 1996). Fortunately, behavior analysis is not dependent on the charismatic appeal of one, or a few scientists, but rather on the tenets of science. The principles of behavior analysis are based on scientific experimentation and data-based evidence, rather than superstition or clinical intuition, as is apparent in several alternative approaches to the study of severe problem behavior (Sinason, 1992).

Reinforcement is perhaps one of the most basic tools of behavior analysis (Vollmer & Iwata, 1991). It is not surprising then, that operant reinforcement would be used to teach individuals with severe disabilities, to improve their quality of life and to decrease challenging behaviors. Fuller (1949) conducted one of the first

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[1] Borrowed from Thomas Kuhn's *The Structure of Scientific Revolutions*.

studies in operant reinforcement. He did so by increasing arm movements through reinforcement in a young boy who had severe disabilities who was considered "vegetative" and unable to learn. Fuller accomplished this by giving the boy access to a warm sugar-milk solution via a syringe contingent on arm movement. This study demonstrated that principles of reinforcement could be applied beyond the laboratory to individuals with severe disabilities and has had significant impact on current practices in behavior analysis.

Challenging behaviors such as self-injury are common among individuals with severe developmental disabilities. Such behaviors can place the individual at physical risk and can limit participation in educational and community activities (Sigafoos, Arthur, & O'Reilly, 2003). These individuals typically require intensive assessment and rigorous behavioral support plans to ameliorate such behaviors. During the past twenty years, an increasing number of researchers have adopted methodologies derived from the basic study of operant behavior in an attempt to identify the environmental variables (i.e., reinforcing functions) that maintain behavior (Neef & Iwata, 1994). The practice of identifying the consequences that maintain behavior and designing interventions that address these same consequences have been considered *best practice* in the field of applied behavior analysis (Carr, 1994; Iwata et al., 1994; Duker, Didden, & Sigafoos 2004; Leslie & O'Reilly, 1999). Identifying the contingencies that maintain challenging behavior have thereby resulted in the development and refinement of a wide variety of intervention strategies, such as functional communication training, noncontingent reinforcement,

fixed-time interval reinforcement, differential reinforcement, sensory intervention strategies, etc (Durand, 1990; Hanley, Iwata, & Goh, 2003).

And yet, even with the abundance of effective intervention studies published in the literature, there have been studies that have failed. One possible theory that has been proposed in the literature to explain why interventions fail is, reinforcement effects with a given stimulus vary across individuals, and are idiosyncratic. And that there is, therefore, variability in the occurrence of challenging behavior both within and across individuals (Vollmer & Iwata, 1991). This vacillation of behavior could be due to a plethora of reasons, for example, the past histories of reinforcement, and other antecedent events that can alter the value of reinforcing stimuli, psychological factors, ecological variables, bio-behavioral interactions, and health issues. It is also possible that such antecedent events might alter the consequences maintaining behavior. This interaction between the behavioral processes and antecedent events suggests a complex interaction between antecedents and consequences of operant behavior (Vollmer & Iwata, 1991). When these conditions converge, the result can be increased levels of challenging behavior, for example, aggression, destructive behavior, self-injury, etc. (see O'Reilly, 1995, 1997; Kenned & Meyer, 1996; Carr, Smith, Giacin, Whelan, & Pancari, 2003, for examples). Interventions designed incorporating a better understanding of antecedent and consequence interactions might not only reduce challenging behavior by eliminating the motivation to access consequences, but also influence other functional behaviors such as communication.

In recent years, there has been an increased interest in the application of antecedent variables to enhance instructional strategies and behavior management approaches with individuals with severe developmental disabilities (Kennedy & O'Reilly, in press; Wilder & Carr, 1998). One class of antecedent variables that may have such an effect on challenging behavior is motivating operations (Michael, 1982, 1993). Motivating operations influence operant responding by: (a) altering the effectiveness of a consequence as a reinforcer/punisher, (b) altering the probability of behavior previously associated with that consequence, and (c) modifying the evocative effects of discriminative stimuli (Laraway, Snycerski, Michael, & Poling 2003).

However, all intervention research to date has focused on the reinforcer altering effects of antecedent operations. In other words, researchers have examined how antecedents influence the consequences maintaining responding. However, antecedents may also influence operant responding when consequences (reinforcement) are not available, and the behavior is under extinction (Michael, 2000). Such research may have important implications for the assessment and treatment of challenging behavior in people with severe developmental disabilities (McGill, 1999). However, an understanding of behavior under different antecedent conditions (that is motivational operations), and their momentary behavior-altering effects, requires a more complex examination of behavior (Michael, 1993a, 1993b).

This dissertation has attempted to go beyond a presentation of a philosophy of human behavior or a descriptive analysis of the same. In this dissertation the basic

tenets of behavior analysis, the three term contingency (stimulus-response-reinforcement) were examined in the context of antecedent operations. Specifically, the influence of the behavior altering effect of the motivating operation (MO) on the discriminative stimulus (S^D) was conducted. The following chapter will present a literature review that has driven the conceptual framework for this dissertation. The next chapters will present the methods, results, and discussion for this dissertation.

CHAPTER 2

LITERATURE REVIEW

> In the vernacular we should say that the organism eats only when it is hungry. What we observe is that the strengths of these reflexes vary, and we must set about finding the operations of which they are a function. (Skinner, 1938, p. 23)

This research examined the influence of the behavior altering effect of motivating operations (MO) on the discriminative stimulus (S^D). The following chapter will discuss in detail the history of motivating operations including terminology and properties, the discriminative stimulus, the relationship between the two, applied implications of identifying the MO and the S^D, and methodologies to identify them.

The History of the "Motivating Operation"

The term "Motivating Operation" (MO) has received a considerable amount of conceptual and empirical attention within the applied operant literature in recent years (e.g., Laraway, Snycerski, Michael, & Poling, 2003; Berg et al., 2000; Michael, 2000; McGill, 1999; Smith & Iwata, 1997; Wacker et al., 1996). MO is an omnibus term used to describe antecedent variables that alter, (a) the effectiveness of reinforcers or punishers (value altering), and (b) the frequency of operant response classes previously associated with those consequences (behavior altering). As the MO and its various permutations (e.g., third variables, motivation, drive,

establishing/abolishing operation, etc.) influence the probability of operant responding, this recent emphasis should not be considered unusual within a field whose primary goal is the prediction and control of behavior (cf. Baer, Wolf, & Risley, 1968). While this focus is relatively new to applied operant psychology it has a long history in the field of behaviorism (e.g., Keller & Schoenfeld, 1950; Millenson, 1967; Skinner, 1938).

B. F. Skinner's "Third Variable"

Behaviorism is concerned with not only the observation of a response but also the identification of functional relationships. As early as 1938, B. F. Skinner stated that "we need to establish laws by virtue of which we may predict behavior, and we may do this only by finding variables of which behavior is a function (Skinner, 1938, p. 8)[2]. In 1931, Skinner described the primary law of the reflex[3] as an "observed correlation of two events, a stimulus and a response" (p. 445). This relationship between the stimulus and the response was noted with the equation R = f(S) where R is a response measure and S is the quantified characteristic of the stimulus such as its "intensity" (p. 451). The letter *f* denotes function.

The primary laws of reflex described the correlations of a stimulus and a response. Yet, Skinner (1931) noted that, "these must be supplemented by other laws describing the exact conditions of a correlation" (p. 452). Therefore, the secondary

[2] See Coleman, 1984 for a detailed discussion of Skinner's early conceptualization of third variables.

laws of reflex (p. 451-454) specified quantitatively the dependence of the primary reflex relationship on values of other environmental variation that altered the stimulus-response (S- -R) correlation. For Skinner (1938) variability reflected the effectiveness of the functional relationship between eliciting stimuli and other *third variables (c.f.* Tolman, 1932)[4]. Skinner wrote that these variations do not challenge the relationship expressed in the R= f(S) equation but that "they do require that in the description of a reflex, account be taken of *third variables* [italics added] (p. 452)*."* The mathematical expression of the secondary law of reflex is simple yet elegant. It is R= f(S, A), where A is the *third variable,* that "accounts for any change in the value of R given no change in S (p. 452)" and F is the function. Among third variables that Skinner examined over the years were, response conditioning and extinction (Skinner 1933a, 1933b, 1934, 1936a, 1936b), deprivation and satiation (Heron & Skinner, 1937; Skinner, 1932a, 1932b, 1936a, 1953;), emotion (Skinner & Heron, 1937), and conditioned anxiety (Estes & Skinner, 1941). Utilizing the primary laws of reflex, it is possible to isolate a response and identify its correlated stimulus, and together with the secondary laws of reflex, it is possible to analyze spontaneity and variability in the study of the behavior of an organism.

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[3] The dependent measure of a reflex is sampled at different levels e.g., the intensity of the eliciting stimulus, latency, duration amplitude etc. For a detailed discussion of the properties of the reflex, see Skinner, 1931 and Skinner, 1938.

[4] For a discussion on Tolman's *"intervening variables (B= f (E, I) "* see Morris, 1998).

Drive/Motivation as a Third Variable

The word *drive* is used in psychology to describe a motivational process within an organism. Such processes cannot be directly observed, and even if such processes do occur, only their manifestations can be observed. Furthermore, since manifestations of *drive* for example, *sex drive, hunger drive, drive to excel, pursue an advanced degree,* and so on, are outcomes of many concatenating variables, one cannot be certain of the "presence and strength of any single factor…both within and without the organism" (Murray, 1937, p. 27). *Drive,* therefore is a hypothetical construct and not an accurate description or an operational definition of the mechanisms of the process(es) taking place when one uses the term *drive*.

Skinner discussed this same process *drive* as a third variable. In 1938, Skinner points out that when we say we are measuring the strength of the *drive* we are in fact only measuring the strength of the behavior that is associated with the word *drive* (p. 368). *Drive* then is a word used to denote a hypothetical state but the concept however is useful as a "device for expressing the complex relation that obtains between various similarly effective operations and a group of co-varying forms of behavior (p. 368)." When the operations that affect the *drive* may be reduced to a single form, for example, thirst (the desire or need to drink liquid), *drive* may be misinterpreted as a simple mechanism when it is in fact a complex mechanism.

To illustrate this complex mechanism, Skinner gave the example of the *hunger drive*. At any moment in the life of the organism different foods will be eaten at different rates. Conditioned reflexes reinforced by different foods will also differ in

strength[5] (c.f. Michael, 1982; Michael, 1993a) and not only will one type of food be eaten when another not, but two foods will be eaten at different rates [6]. When two food items are presented as stimuli at the same time, the stronger reflex takes propensity (preference) as the organism chooses one stimulus over the other (Skinner, 1938).

Later he described the effects of deprivation and satiation to food and aversive stimulation. He conceptualized the effects of deprivation and satiation as motivational variables (Skinner, 1957, pp. 31-33). *Motivation,* was described by Skinner (1938) as *a third variable* that leads to variability in the response evoked by the eliciting stimuli. This effect of *drive/motivation* influencing variability, was demonstrated in a study wherein he examined changes in responding during deprivation (Heron & Skinner, 1937). In this study food was withheld from the organism and the state of the *hunger drive/motivation* was measured by measuring the number of responses made per hour. Thirteen rats were used for this study. Forty-eight hours prior to the commencement of the experiment the rats were allowed continuous free access to food for 24-hours. At the end of the 24-hours of free access to food a 24-hour period of deprivation (no access), to food was initiated. Water was made available at all times. The response measured was a lever press made by each rat. A response was reinforced every four minutes with a single pellet. The amount of total food ingested was less than one gram a day and was insufficient to have an effect upon the results

[5] This difference in the strength of the reinforcer is later conceptualized as the evocative effect of the EO (Michael, 1982; Michael, 1993a)

[6] Conceptualized as the reinforcer altering effects of the EO (Michael, 1982; 1993a).

of the study. Results indicated that the change in the mean rate of responding increased rapidly during the first 24-hours and continued more slowly in a linear fashion until a peak was reached on the fifth day. On the sixth day the group was no longer intact. The typical curve for a single rat indicated an evocative effect in the frequency of responding in that it showed a steady rise throughout the greater part of the period immediately prior to demise. Whilst not explicitly described as an *evocative effect* the *frequency increasing* effects observed in the study do however, meet the current definition of an evocative effect. To summarize, this early study demonstrated the evocative effect that *a third variable* (hunger drive), may have on behavior when deprivation to food was in effect.

Establishing Operation (EO)

The use of the term "*third variables*" however and the interest in examining third variables waned in the literature and did not re-emerge until Keller and Schoenfield in 1950, first used the term "*establishing operation*" to refer to "operations…of deprivation or...stimulations…that establish *drives"* (p. 274). Nevertheless, by the late l960s the subject of motivation was no longer given the same consideration in behavior analysis (Michael, 1982). Michael (1993a) pointed out that failure to deal with the topic left a gap in our understanding of operant functional relations. He proposed that a general term was needed as the traditional terms "motive" and *drive* have a number of disadvantages. For example, the word *drive* implies an understanding of "inner state" (Michael, 1982). However, *inner state*

cannot be ascertained by observation and the term serves little use as a descriptor for a behaviorist. As a partial solution he revived the term "*Establishing Operation*" introduced in the 1950s by Keller and Schoenfeld but acknowledged that changes "occur in both directions (Michael, 1982)," i.e. establishing and abolishing, and that it is "probably safer to refer simply to establishing and abolishing operations (Michael, 2000)". Michael continued to refine this construct over several papers. He described an EO as an operation that refers to an environmental event, operation, or stimulus that affects an organism, and has two independent yet simultaneous functions, (a) reinforcer altering and (b) evocative (Michael 1982; Michael 1983; Michael, 1993a; Michael 2000).

Thus, EOs establish the current reinforcing effectiveness of a stimulus, object, or event (*establish* includes the effect in the opposite direction, *abolish*), as well as evoke any behavior that has been reinforced by the same (*evoke* includes an effect in the opposite direction, *abate*). For example, when the person is deprived of food (EO present), then food becomes a more powerful reinforcer (reinforcer altering). Additionally, food deprivation will also momentarily increase the frequency of behaviors that have been previously reinforced with food such as foraging, going into a restaurant, cooking, purchasing grocery items etc., (evocative effect). Again, these two effects of the EO (reinforcer altering and evocative) occur simultaneously but are independent of one another (Michael, 2000).

Another example would be water deprivation (EO present). When an organism is deprived of water then, (a) the effectiveness of water as a form of

reinforcement is increased (reinforcer altering) and, (b) all behavior previously reinforced with water would increase in frequency (evocative) (Michael, 1993a).

The effects of such conditions may occur in the opposite direction. For example, with the repeated presentation, the effectiveness of water as a type of reinforcement may decrease, and behaviors that have previously been associated with this consequence may abate. Satiation (EO absent), then, is an abolishing operation that momentarily decreases the ability of the stimulus (water) to serve as a reinforcer and has a behavior altering effect in that the behaviors previously associated with gaining access to water decrease (McGill, 1999; McSweeney, Kowal, Murphy, & Wiediger, 2005). For example, when water satiation is in effect behaviors such as, going to the water fountain to drink water, purchasing water bottles at the store etc., are behaviors that will decrease as long as water satiation is in effect.

Motivating Operation (MO)

A possible limitation of using the term EO as an omnibus term, to include all operations that have motivational effects, stems from the fact that it *implies* only an increase in the effectiveness of a consequence as a reinforcer. Michael acknowledged this when he suggested that "establishing" should be understood as *establishing* and *abolishing* (Michael, 1982). In practice however, using the same term to refer to events that both increase or decrease in behavior is confusing and may lead behavior analysts to neglect operations with abolishing and abative effects (Laraway et al., 2003; Poling, 2001). To address this problem Laraway et al., in 2003 introduced the

term “Motivating Operations (MO).” MOs are antecedent operations that have two defining effects a) value altering and b) behavior altering. MOs can be unconditioned (UMO) or conditioned (CMO).

As this research will examine the behavior altering effect of the MO on the S^D an effort is made in the following sections to describe the properties of MOs, properties of the S^D, the relationship between the MO and the S^D, and finally address MOs in terms of unlearned (UMO) and learned (CMO) behavior in greater detail.

Properties of MOs

Similar to EOs, MOs have two defining effects, a value altering and a behavior altering effect. Value altering in that the MO alters the current reinforcing effectiveness of some stimulus, object, or an event. Behavior altering in that it alters the probability of any behavior that has been previously reinforced by the same stimulus, object, or event that is altered in value by the same MO. *Value altering* effects comprised of, (a) reinforcer-establishing, (b) reinforcer-abolishing, (c) punisher establishing, and (d) punisher abolishing (p. 411). The *behavior altering effect* of the MO subsumes two effects, (a) an evocative (increase) effect and, (b) an abative (decrease) effect (Laraway et al., 2003). Michael pointed out that “‘Behavior Altering’ replaced “Frequency Altering” [in the EO] to include other dependent variable effects, such as changes in S-R latency, relative frequency (number of responses in a given time period divided by the number of response opportunities), resistance to change (as with Nevin's behavioral momentum) and others (J. Michael,

personal communication, November 8, 2005).” With the current conceptualization of MOs we can study behavioral processes that did not fit as neatly with the definitions of the EO (reinforcer altering and evocative).

1. Value altering effect. For example it is more precise to conceptualize sleep deprivation (Kennedy & Meyer, 1996; O’Reilly, 1995;) as a value altering effect rather than a reinforcer altering effect. The term “*value altering*” conveys the effects of sleep deprivation more precisely than describing it is as “*reinforcer altering*.” This makes senses if one considers that sleep deprivation does not increase the frequency (evocative) of behaviors that are associated with sleep. For example, if a person usually brushes their teeth before getting ready to go to sleep, when they are sleep deprived, it is not likely that they will increase the frequency of brushing their teeth in the middle of the day. However, it does make sense to think of sleep deprivation, as punisher establishing in that behaviors that were previously associated with sleep deprivation will decrease in frequency. For example, if a young lad had spent the previous consecutive nights at the local bar and was sleep deprived then it is likely that the behavior “spending the night at the bar” will momentarily decrease until his sleep levels are restored. In the same manner, it does not make sense to think of satiation to sleep having abative effects but it does make sense to think of satiation to sleep as a punisher abolishing effect (e.g. the young lad had 12-hours of sleep on two consecutive days). Therefore, the process sleep deprivation/satiation can be more precisely described as value altering as value altering accounts for both punisher abolishing, and punisher establishing effects of sleep under satiation and deprivation.

2. Behavior altering effect. Similarly, the process behavioral momentum[7] (Lattal, 1998; Mace et al., 1998; Nevin, 1974; Nevin, 1984; Nevin, 1988; Nevin, 1996; Nevin, 2002; Zarcone, Iwata, Mazaleski, & Smith; 1994) is better described as a behavior altering effect rather than an evocative effect as it exerts both abative and evocative influences. To illustrate, behavioral momentum refers to the procedure in which presentation of high probability demands are made on the organism immediately prior to the presentation of low probability demands (Nevin, 1974). For example, consider that a parent asks a teenager to pick up a pizza order at the local pizza chain (high probability of compliance) and on the way back pick up some milk at the corner store (low probability demand). It is possible that if the parent asked the teenager to pick up milk at the corner store that the request would be met with noncompliance. But because picking up pizza has a high probability of compliance, and because the low probability demand (picking up milk) followed this high probability demand, it is more likely that the teenager would comply with both requests. Thus, behavioral momentum is the tendency for the behavior, once initiated and reinforced, to persist in conditions whereby it may otherwise not be expected to. Conceptualizing this influence of behavioral momentum on response rate and its persistence when those conditions are altered as behavior altering conveys its properties more readily rather than describing it as an operation that has both evocative and abative properties.

[7] Behavioral momentum is the product of response rate and resistance to change.

3. Modifying the evocative effects of discriminative stimuli. A third effect of MOs is that "they modify the evocative effects of discriminative stimuli (Laraway et al., 2003).[8]" Laraway points out that "MOs influence discriminative stimuli by, (a) making reinforcement and punishment possible, and by (b) changing the control over behavior exerted by previously established discriminative stimuli" (p. 411). Once stimulus discrimination has been established the behavior altering effects of that stimulus can be seen "only when an MO is in effect" (p. 412). Therefore the behavior altering effects of the MO "may depend on the presence of the relevant discriminative stimuli (Laraway, 2003)" and the ability of the discriminative stimuli to control behavior (Michael, 1993b). Michael referred to this effect as a Conditioned Motivating Operation-Reflexive (CMO-R)[9] (J. Michael, personal communication, November 7, 2005).

To summarize, EOs *evoke* behavior while MO's *alter* behavior. This is an important distinction between EOs and MOs. MOs have three distinct effects, (1) a value altering effect comprising of, (a) a reinforcer-establishing, (b) a reinforcer-abolishing, (c) punisher establishing, and (d) a punisher abolishing, and (2) a behavior altering effect which subsumes two effects, (a) an evocative effect and (b) an abative effect, and finally (3) they modify the evocative effects of discriminative stimuli.

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[8] c.f. Michael, 1993a, 1993b & 2000 wherein Michael discusses the properties of the Conditioned Establishing Operation-Transitive (CEO-T). (See McGill 1999 for a detailed review of CEOs.)

[9] c.f. Michael (1993a) and Laraway et al., (2003) to compare properties of CEO-R with CMO-R

Discriminative Stimulus (S^D)

A Discriminative Stimulus (S^D) is a stimulus that does not elicit responding but in its presence responses are emitted and reinforced either continuously or intermittently (Skinner, 1938). Skinner (1938) says that an S^D is "best described as 'setting the occasion' for a response. Whether or not the response is to occur does not depend on the S^D once it is present" (p. 241). Additionally an S^D has a history of correlation associated with the differential availability of an effective form of reinforcement given to a particular type of behavior (Michael, 1993a). Differential availability implies that the relevant reinforcement has been more available in the presence than in the absence of the S^D. For example, consider that the music (S^D) emitted from an ice-cream van signals the availability of ice cream (reinforcement for those who like ice cream) for purchase. Because "ice cream van music" (S^D) has a long history of correlation with the availability of ice cream (reinforcement) and ice cream has been more available for purchase in the presence of "ice cream van music" than in the absence of it, a young child, may in hearing the music run towards the van (particular type of behavior) in order to purchase ice cream (reinforcement). Therefore, the child's responding to the "ice cream van music" (the S^D) is not elicited by the sound of the "ice cream van music" but rather the music sets the occasion for the behavior to be evoked due to its history of reinforcement.

For a stimulus to function as an S^D, there must also be a negative discriminative stimulus or absence of S^D. This condition is referred to as S^Δ (S-

Delta). The reinforcement that is available in S^D is unavailable in S^Δ but were it available it would be effective as reinforcement (Catania, 1979; Michael, 2000; Skinner, 1938). For example, the absence of "ice cream van music" (S^Δ) would signal to the child that ice cream is unavailable for purchase. But were it available, it would still be effective as reinforcement as unavailability of the reinforcement (ice cream) does not alter its effectiveness as a reinforcer.

Additionally, the organism may come to respond differentially when the S^D is absent (S^Δ) than when it is present (Millenson, 1967). For example, the child may not run towards the ice cream van if s/he does not hear the "ice cream van music" (S^Δ). If s/he ignores the absence of music (S^Δ) as a signal for the unavailability of ice cream, and does run towards the van, this behavior (response) will not be reinforced, as s/he will not be able to purchase ice cream (reinforcer unavailable). With repeated disappointments (unavailability of the reinforcer) the child will learn that "ice cream van music" signals the availability of ice cream and the absence of "ice cream van music" (S^Δ) signals unavailability of ice cream (reinforcer). This behavioral process (i.e., learning to discriminate between S^D and S^Δ is called discrimination (Skinner, 1938).

In order, for an organism to discriminate between S^D and S^Δ conditions, and behave differentially, the behavior needs to be under stimulus control (Catania,

1979). Several factors influence stimulus control. One such factor is discriminability of the stimulus. For responding to depend on the presence of the S^D verses the presence of the S^Δ, the stimulus must be detectable and discernable (Catania & Bringham, 1978). For example if the child in the previous example had a hearing impairment, then the presence of the S^D (ice cream van music) would not be detectable and the behavior of the child would not be under the stimulus control of the S^D (ice cream van music).

For a true discriminative relation, the reinforcement that is available in the S^D condition must be unavailable in the S^Δ (Michael, 2000). Therefore, for the child to be able to discriminate between the S^D and the S^Δ conditions ice cream must be unavailable in the absence of the ice cream van music (S^Δ).

Just as stimulus discrimination is a learned due to a past reinforcement history motivating operations too can be learned. As mentioned previously there are two types of MOs a) Unconditioned motivating operations (UMOs) and, b) Conditioned motivating operations (CMOs). The following sections will review MOs in greater detail.

Unconditioned Motivating Operation (UMO)

As mentioned previously MOs can be conditioned or unconditioned. Unconditioned MOs (UMOs) are events, operations, or stimulus conditions that are

unconditioned with unlearned value altering effects. This behavior is unlearned and is therefore unconditioned. For example, most biological organisms have a capacity to be reinforced by food. They do not need to *learn* to be reinforced by food. For example, even if *glucose* (a food) is artificially injected into the blood stream of a Rufus hummingbird it has the capacity to survive due to the nutrition that the glucose provides. It does not need to learn to be reinforced by glucose, or even recognize that glucose is a type of food. In the above example, the Rufus hummingbird, does not even need to be aware that glucose has been injected into its bloodstream. The value altering effects of glucose is unlearned and is unconditioned.

Conditioned Motivating Operation (CMO)

Conditioned motivating operations (CMOs) are MOs with learned value altering effects. For example, a person who typically purchases precut pineapple in a can or container, at the local grocery store may not recognize an uncut pineapple, as the same reinforcing food, and hence may not purchase it. The person needs to learn that an uncut pineapple can be cut open and consumed. Once this behavior is learned however, when the person next sees an uncut pineapple, it will have a value altering effect and the person may chose to purchase the pineapple. This learned effect is a conditioned motivating operation. The distinction depends solely on the value altering effect; an MO's behavior altering (evocative/abative) effect e.g. grocery shopping,

foraging, hunting etc., is always learned[10]. There are three types of CMOs: (a) surrogate (CMO-S), (b) reflexive (CMO-R) and, (c) transitive (CMO-T).

Conditioned Motivating Operation-Surrogate (CMO-S)

A surrogate CMO involves "a pairing of a previously neutral stimulus with a UMO, with the former developing the motivative effects of the latter (McGill, 1999, p. 396)." The pairing of stimuli develops the respondent conditioned stimulus, and the operant reinforcer (S^{+}), and possibly the S^{D} (Michael, 1993). Such a CMO is called a surrogate CMO, a CMO-S. It would have the same reinforcer-establishing effect and the same evocative effect as that of the MO it had been paired with. Adelinis, Piazza, Fisher, and Hanley (1997) examined the establishing effects of a client's location on self-injurious behavior. Their results indicated that the clients' location might have been correlated with attention maintained challenging behavior. McGill (1999) asserts that although this study reported that they examined an establishing stimulus that the location (wheelchair) meets the definition of a CMO-S (CEO-S) as it involved a pairing of the wheelchair, a neutral stimulus, with a deprivation from attention (CMO).

For a more applied example, consider a woman (S^{D}) wearing a certain perfume (a Neutral Stimulus) arousing desire[11] (UMO) in a man. When the NS

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[10] Personal communication, J. Michael, October 13th, 2005

[11] The word 'desire' is used here in the same manner that Skinner (1936) used the term 'drive', realizing it is an useless term but that the concept is however useful. Michael pointed out that evoking desire was somewhat vague and that it would be more precise to say, that, "the behavior had been reinforced by sexual contact before" (J. Michael, personal communication, April 11, 2006)."

(perfume) and the UMO (desire) are paired the perfume takes on the surrogate properties of the UMO (desire) and becomes CMO-S. The next time the man smells the perfume (CMO-S) even in the absence of the woman it would evoke desire due to the past pairing of the NS with the UMO. Examples for other CMO-S that one may encounter in everyday situations are emotional MOs, sexual motivations, and psychological MOs. From a practical standpoint, it makes sense to consider these types of CMO-S when trying to understand behavior that is often considered irrational. While CMO-S makes sense on a conceptual level, however, to date no research has specifically examined the role of CMO-S (McGill, 1999).

Conditioned Motivating Operation-Reflexive (CMO-R)

A reflexive CMO, is a previously neutral event that alters its own function, that the termination of which becomes reinforcing or punishing (McGill, 1999). Both Michael and McGill give examples of warning stimuli that establish its' termination as reinforcing (McGill, 1999; Michael, 1993; Michael 2000). CMO-Rs occur frequently in everyday social situations. Consider for example, that you are a senior faculty member at a faculty social. A junior faculty member inquires about your area of research. This is a simple non-threatening question and the appropriate social response would be to give an answer. The reinforcement could be that the junior member congratulates you on your research, you will be reinforced that you have helped orient the junior faculty member to the research currently conducted in the department, you will get an opportunity to interact with another person, etc. The

request may appear to be a S^D but it is in fact a CMO-R. The request initiates a brief period that Michael refers to as "a warning stimulus" (Michael, 1993), and if a response is not made soon, some form of social descent will occur. The junior faculty may repeat the question more clearly or vociferously, may even think you have a hearing impediment or worse that you are eccentric or even down right rude. You, yourself, would consider your behavior socially inappropriate or feel awkward if you did not respond quickly. The longer the latency, the more aversive, the situation becomes even with no clear threat implied for not responding. Social history however, dictates that some form of aversive situation (embarrassment, loss of face, being cast as a rude person, etc.) would occur for continued inappropriate behavior. Therefore, the request is a CMO-R and not an S^D.

Conversely, "promise CMOs" establish motivation to prevent their termination and suppress behaviors associated with their termination (McGill, 1999). McGill uses the classic example of being tired to illustrate this effect. He says that stimuli whose onset is correlated with "falling asleep (reinforcement) may suppress behaviors (such as drinking coffee) associated with their termination" and that in the absence of the stimuli the response is more likely to occur, "not because it no longer produces punishment (avoidance of falling asleep) but because there is no punishment to produce (not falling asleep is only punishing if I am tired" (p. 396).

Conditioned Motivating Operation-Transitive (CMO-T)

Transitive CMOs are stimuli in "whose presence the reinforcing or punishing effectiveness of existing conditioned reinforcers or punishers are altered. (McGill, 1999, p. 396-397)." The term transitive is frequently used in mathematics to denote a relationship between variables (a=b=c). The same logic applies here. Michael (1982) proposed in his electrician and the slotted screw example, that when the electrician sees a slotted screw, he turns to his assistant and asks for a *Philips*® screwdriver, that the slotted screw functions as a CMO-T. In another example, he proposed that flashlights are available in most home settings, but are not accessed until existent lighting becomes inadequate, as with a power failure. Sudden darkness, as a CMO-T, thus evokes getting a flashlight. The sudden darkness is usually interpreted as an S^D for looking for a flashlight. But he pointed out that flashlights are not more available in the dark, only that they are more valuable (Michael, 1993).

Further Teasing the S^D and the Conditioned Motivating Operation (CMO) Apart

Since, the first conceptual paper on MOs (EOs) was written by Michael in 1982, he and others after him (Laraway et al., 2003; McGill, 1999; etc.,) have tried to differentiate S^Ds from MOs. In 2000, Michael tried to further clarify the role that conditioned MOs play and to differentiate them from the S^Ds that signal reinforcement. In this example, Michael argued that the slotted screw is not a S^D that evokes the behavior (asking for a *Phillips*® screwdriver) but rather that it functioned

as a CMO-T. That the slotted screw prompted the electrician to ask his assistant for a screwdriver due to the *prior history* that the electrician had asking his assistant for screwdrivers (Michael, 1983). The presence of the assistant may function as an S^D for asking behavior but the presence of the slotted screw (CMO) evoked the request for the screwdriver as a transitive conditioned MO, just as lever pressing by a pigeon for food in a discrimination procedure, is jointly evoked by food deprivation, the CMO, and by the onset of the exteroceptive S^D as in the presence of the lever (Michael, 2000).

While Michael's slotted screw example and pigeons pressing levers are not part of every day encounters CMOs nevertheless prevail in real world settings. Consider a frequent request that a parent makes to a teenager "turn the TV off." In the real world the teenager's compliance will not get reinforced ("that's great, you turned the TV off", or "here's a cookie"). The teenager's compliance behavior however can be understood in terms of an escape contingency. It can be argued that the teenager complies with the request in order to escape from a potential aversive situation. Inherent in the parents' request to "turn the TV off" is a conditional stimulus and a learning history that when the request was not honored in the past it was followed by the parent engaging in a number of aversive consequences, for example, screaming, grounding, smacking, shouting etc. The behavior to comply when requested to "turn the TV off" is a learned behavior due to the aversive conditions noncompliance was associated with in the past. Therefore, this conditional stimulus i.e. the request to "turn the TV off" when not honored (noncompliance), is a learned aversive condition

because it has been paired with some sort of aversive condition. Not honoring the parents' request by itself is not an aversive condition. Only the combination of the two stimuli "turn the TV off" and the parent engaging in "screaming etc.," is aversive. Through a history of learning the onset of the aversive stimulus i.e. the request" "turn the TV off" establishes its own removal as an effective type of reinforcement and evokes behavior associated with the removal of this request in the past. Therefore, the request "turn the TV off" and other similar requests made by parents, teachers, caregivers etc., function as warning stimuli or reflexive conditional MOs and not S^Ds.

The Relationship Between the MO and the S^D

The operant (the three-term contingency) is described as S^D, response, and reinforcement. But "such a relation is not in effect unless the relevant EO [MO] is at an appropriate level (Michael, 1988)." For example, if a child has had access to tubs of ice cream and is satiated, then hearing the "ice cream van music" will not evoke a response that has previously been reinforced by access to ice cream. In this example the S^D signaling reinforcement is present, but as satiation (MO absent) is in effect, the reinforcer (ice cream) is currently ineffective as a form of reinforcement. If however, the child has been deprived of ice cream (MO present) a response previously reinforced in the presence of the S^D would be more likely to occur. Thus, for

responding to occur in the presence of the S^D, the MO must be at an appropriate level. Thus the MO functionally influences the S^D.

Conversely, when the MO is in effect for responding to occur and be reinforced the S^D also needs to be present. For example, the child's response (running) towards the ice cream van in the absence of the "ice cream van music" (S^D) or running towards other vans or other motorized vehicles will not be reinforced (unavailability of ice cream) and thus the response (running) will typically undergo extinction. Therefore, even if the child has been deprived of ice cream for months, the MO by itself will not evoke responding. Thus, the MO influences or enters into a functional relationship with the S^D.

To summarize, MOs and S^Ds are both antecedent variables that alter the current frequency of some particular type of behavior. Additionally, they are both operant (rather than respondent) variables in that they control response frequency because of their relation to reinforcing or punishing consequences. Both MOs and S^Ds are learned and have evocative (or abative) characteristics (Michael, 2000). S^Ds evoke while S^Δs abate behavior because of the differential *past* availability of a reinforcer. MOs evoke or abate behavior because of the differential *current* effectiveness of a reinforcer (Michael, 1993b). MOs can be unconditioned or conditioned. Conditioned MOs can be either surrogate (CMO-S), reflexive (CMO-R) or transitive (CMO-T). For responding to occur in the presence of the S^D, (as in the ice cream van music

example) the MO for that particular S^D must be at an appropriate level, Thus the S^D and the MO are inextricably linked.

These next sections will describe ways in which to conceptualize MOs for social positive and social negative reinforced behavior.

Conceptualizing the MO for Social-Positive Reinforced Behavior

A reinforcement contingency is a relationship between a response and a stimulus change (presentation or removal) that follows the response thereby increasing the probability of the same response reoccurring. The reinforcement contingency is correlated with the response being reinforced in the presence of the S^D versus the S^Δ (Catania, 1992; Lattal & Shahan, 1997, Thompson & Iwata, 2005).

An S^D is not constrained to the inanimate environment and can stem from other organisms. Social behavior can be described as a "behavior for which the reinforcing or discriminative stimuli are or have been mediated by the behavior of another organism (Millenson, 1967)." Therefore, even if the response is maintained by a presentation of a stimulus that is tangible (food, toys etc.,) the contingency remains a social-positive contingency because reinforcement is mediated through another persons' action (Iwata, et al., 1994a). While numerous terms (edible, material, social, tangible) have been utilized to describe this broad contingency the common feature to all these terms is that the behavior is maintained by social interaction (Iwata, et al., 1994a).

In 1982, Iwata, et al., developed the procedures for conducting an analogue functional analysis to identify behavior maintained by social-positive reinforcement, social negative reinforcement and automatic reinforcement. Test conditions for behavior maintained by social positive reinforcement comprised of attention and tangible[12] conditions (Iwata et al., 1994a). In each of the conditions social-positive reinforcement was delivered contingent on the occurrence of the target behavior and all other forms of behavior were ignored.

Once the reinforcing contingency for social-positive reinforced behavior is identified (attention or tangible) then by identifying and manipulating the MO for the same behavior one can examine the effect of the MO on the target behavior (see Smith & Iwata, 1997 for a discussion). For example, if the target behavior is maintained by access to ice cream (S^D) then by withholding access to the same tangible (ice cream) for a period of time it is possible to examine the effects of deprivation (MO present) on the target behavior.

Conceptualizing the MO for Social-Negative Reinforced Behavior

The S^D for negatively reinforced behavior is correlated with the availability of an escape contingency in the presence of an aversive stimulus (Smith & Iwata, 1997). However, Michael makes the point that the aversive stimulus is analogous to deprivation in the social-positive reinforcement situation, and that it's only because of its proximal location to the behavior does it seem like an S^D (Michael 1993a; 2000).

[12] These social positive reinforcement conditions (attention and tangible) and social negative

Thus the complexity in operationally conceptualizing the MO for negatively reinforced behavior (escape) is that it is difficult to differentiate the MO from the S^D (see previous section on a discussion on teasing the S^D and the MO apart). Moreover, in the ordinary escape condition, (escape from a demand condition) there is not an S^Δ situation, which can signal the unavailability of the reinforcer (escape). A possible solution would then be to contrive the S^D. An example of a contrived S^D in an applied setting for negatively reinforced behavior could be conceptualized in the following manner. A demand is made by experimenter A & B under two conditions. Both conditions start with a demand situation and pre-session MO's (in this case escape/no demands are made) are manipulated for both conditions. At the onset of the target behavior, Experimenter B does not remove the demand task (reinforce the behavior). Whereas, in the second condition Experimenter A does. If the target behavior increases in frequency[13] in the presence of Experimenter A, then Experimenter A, would be a true S^D. This effect can be explained by the fact that the S^D (Experimenter A) and the S^Δ (Experimenter B) elicit the behavior because of the differential *past* availability of the reinforcer whereas when the presession condition[14] is manipulated the MO, will elicit the behavior due to the *current* effectiveness of the reinforcer granted of course stimulus discrimination is achieved (c.f. Michael, 1993b).

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reinforcement conditions (escape from demand) will be discussed later in the methodology section.

[13] Michael pointed out that only if the behavior increases in the presence of Experimenter A, will Experimenter A function as a true S^D (J. Michael, personal communication, November 7th 2005).

Implications of Examining the MO in Developing Interventions

Applied researchers have, for example, determined the influence of a variety of MOs on the probability of challenging behavior for persons with developmental disabilities. For example, a variety of biological conditions such as sleep deprivation, allergies, menses, and ear infections seem to influence negatively reinforced challenging behavior (Carr, Smith, Giacin, Whelan, & Pancari, 2003; Horner, Day, & Day, 1997; Kennedy, & Meyer, 1996; O'Reilly, 1997; 1995). Researchers have also looked specifically at the influence of MOs in designing interventions.

Preference Assessments

In a recent study, Gottschalk, Libby, & Graff (2000) suggested that MOs influence the reinforcement effects of a previously identified preferred stimulus, and thus alter the results of preference assessments accordingly. McCadam et al., (2005) replicated and extended this study to include an examination of putative MOs; satiation and deprivation on preference assessments for leisure items and toys. North & Iwata (2005) examined the motivational influence of performance maintained by food reinforcement. They did so by evaluating the independent effects of reinforcer consumption during sessions and meal consumption prior to sessions on performance. Additionally they evaluated the effects of (a) participants' presession choice of reinforcers, (b) increased break between reinforcement sessions, (c) varied presentation of reinforcers, and (d) intermittent schedules of reinforcement in

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[14] See methods section for a description of how to manipulate pre-session MO conditions.

mitigating MO effects on decreased performance. Their results indicated that for 7 of the 9 participants repeated consumption of the reinforcer prior to commencement of the experimental session had an abative effect, as did consumption of lunch for 3 of the 9 participants.

Together, these results indicate that it might be useful to be aware of pre-session conditions and monitor access to stimuli prior to conducting preference assessments (McCadam et al., 2005; North & Iwata, 2005; Gottschalk et al., 2000; Vollmer & Iwata, 1991). If not, inadequate control of presession MOs could lead to powerful reinforcers being incorrectly identified as low-preference items during assessments. Vollmer & Iwata (1991) further, pointed out that in some cases when access to high-preferred stimuli were restricted then low preferred stimuli served as effective reinforcers.

Basic Research

In an earlier study, Gerwirtz & Baer (1958) found that social deprivation functioned as an MO and enhanced the effectiveness of social approval as a reinforcer with children. Vollmer & Iwata (1991) showed that response rates during reinforcement conditions varied as a function of manipulating pre-session MOs of deprivation (MO present) and satiation (MO absent). Their findings implied that the effectiveness of social reinforcement might be enhanced by deprivation, as in the case of reinforcers of primary appetitive drives like hunger and thirst.

Vollmer and Iwata (1991) examined MOs that may influence the effectiveness of reinforcers. Two motor tasks were assessed during conditions of baseline, satiation, and deprivation with three classes of arbitrary consequences: food, social praise and music. The satiation condition consisted of presession access to the reinforcer while the deprivation condition consisted of presession deprivation to the reinforcer. However, there were some limitations in their study. For example, the experimenters found that the response rates in the experimental condition were higher than baseline for one participant (Sam) during food reinforcement sessions. The experimenters then changed the presession conditions mid intervention by conducting the sessions within 15 minutes following lunch and adding an additional 10 minute period of free access to the food.

Furthermore, session duration was not held constant across sessions or across participants; therefore, it is difficult to generalize or directly replicate their findings. This may be a further threat to the internal validity of their study. Finally, in the social interaction condition, which involved a demand situation (block placement task) the participant (Donny) displayed escape behaviors from moving across the room to aggression towards the experimenter during the satiation condition. These data indicate that perhaps the social interaction condition may have been confounded by demand placement. Therefore, while the experimenters had manipulated putative MOs the behavior altering effects of the MO were not specifically isolated, as they did not analyze the MO under extinction. Thus their findings are limited to the value altering effects of the MO.

Challenging Behavior

O'Reilly (1999) examined the effect of pre-session attention with a participant whose challenging behavior was attention maintained. He did so by systematically manipulating pre-session levels of attention and examined its influence on rates of yelling and head hitting. Results indicated that pre-session attention reduced the frequency of attention-maintained behavior. In another study, Berg et al., (2000) examined the effects of pre-session exposure to attention on the results of assessments that used attention as a reinforcer. Their results indicated that events occurring immediately prior to an assessment condition influenced behavior within the assessment.

Wilder, Carr & Gaunt (2000) examined noncontingent reinforcement (NCR). NCR is an empirically validated procedure effective in the treatment of challenging behavior among individuals with developmental disabilities and typically involves the delivery of reinforcers that have been demonstrated to maintain challenging behavior (O'Reilly et al., 2005). Wilder et al., examined conditions of satiation (MO absent) and deprivation (MO present) operating in the use of the procedure on NCR schedules. Their results suggested that the presence of the MO may have a behavior altering effect on NCR procedures. These findings by Wilder et al., may provide additional information that may help practitioners decide under which conditions to best use NCR. For example, providing non-contingent access to preferred foods as an intervention for challenging behavior maintained by access to food may be most

effective when NCR is implemented post lunch when the MO for food is absent. (Wilder, et al, 2000)

Together these studies suggest that it is: (a) possible to identify MOs via manipulation of antecedent variables (McCadam et al., 2005; North & Iwata, 2005; Carr, Smith, Giacin, Whelan, & Pancari, 2003; Gotschalk et al., 2000; Horner, Day, & Day, 1997; Kennedy & Meyer, 1996; O'Reilly, 1997; 1995; Vollmer & Iwata, 1991; Gerwirtz & Baer 1958); (b) performance during training/teaching sessions may be enhanced by scheduling "deprivation" of the reinforcer (Wilder, 2000); (c) constant access to the reinforcer may diminish its effectiveness, so that its true value to function as a reinforcer may not be optimized (McCadam et al., 2005; North & Iwata, 2005; Gotschalk et al, 2000); and (d) prior levels of reinforcement can influence positively reinforced challenging behavior (Berg et al., 2000; O'Reilly, 1999).

Methodologies Used to Identify the S^D and the MO

A methodology to identify the S^D has been perfected in basic research and employed by applied researchers. The typical methodology utilized has been to train stimulus discrimination (Skinner, 1938). Given that there is one response class and, two stimulus conditions (S^D & S^{Δ}) discriminability of the stimulus can be achieved by reinforcing the response in the S^D condition and withholding reinforcement (extinguishing the response) in the S^{Δ} condition. As a result the organism will learn

to respond in S^D and not in S^Δ (Millenson, 1967). Skinner demonstrated this effect with a pigeon, a light, a lever press, and food pellets. In the presence of the light (S^D), lever pressing (response) was reinforced with a food pellet. In the absence of the light S^Δ, lever pressing was not reinforced with a food pellet. With extinction taking place in S^Δ, discrimination to the stimulus was achieved and the pigeon subsequently pressed the lever only in the S^D condition.

The typical methodology employed by applied researchers to examine the influence of the MO has included a two-step process. The first step is to isolate the contingencies maintaining the behavior (often using the analogue functional analysis methodology developed by Iwata, et al. 1982,1994). The second step is to hold the operant constant while systematically examining the influence of the MO on operant responding. Researchers are therefore able to determine the existence of an MO by examining the influence of the MO on the probability of operant responding.

Aside from examining the influence of the MO on the discriminated operant, applied researchers have rarely attempted to empirically clarify additional functional properties of the MO. For example, it would seem timely to begin to examine the value altering and behavior altering effects of the MO. Such research may shed further light on the functional properties of the MO, MO and S^D interaction effects, and possibly identify new applications of the MO in applied settings.

In a recent study, O'Reilly, et al., (in press, a) attempted to isolate the behavior altering effects of the MO for tangible-maintained and attention-maintained

challenging behavior. They employed a three-phase methodology. In Phase I, the operant function of challenging behavior was identified using the analogue functional analysis methodology developed by Iwata, et al., 1982, 1994. In Phase II, putative MOs were isolated for the discriminated operant identified in the first phase of the study. This was accomplished by systematically controlling the levels of pre-session access to reinforcement under two conditions a) presession access (MO absent) and b) presession no access (MO present) (c.f. Vollmer & Iwata, 1991). Finally, in Phase III, the MO was systematically controlled as in Phase II while tangible-maintained and attention-maintained behaviors were placed on extinction. In this final phase the MO and S^D were both present but reinforcement never occurred.

Although, the authors demonstrated differential control over challenging behavior by the antecedent/consequence arrangements in Phase I, no specific S^D were either identified or manipulated in a way that clearly demonstrated their effects. Rather, contingencies that maintained challenging behavior were identified and manipulated in presession conditions.

In Phase II, it was demonstrated that presession access to those stimuli functioned as MOs (i.e., with a reinforcement contingency intact, response measures differentiated according to levels of presession exposure). In Phase III, when presession access to the identified maintaining stimuli were manipulated in the absence of a reinforcement contingency, response measures differentiated according to levels of pre-session access. Further, no manipulation was conducted that

supported an account of the effects of presession access on the behavior altering effect of any other antecedent stimulus.

However, their analysis for the first time examined the behavior altering effects of the MO on operant behavior. No other study had previously conceptualized a method to isolate the behavior altering effect of the MO on operant behavior.

In a second study, O'Reilly et al., (in press, b) replicated the first study with a person with autism and developmental disabilities whose challenging behavior was maintained by access to attention. As in the previous study, this study consisted of three phases. First, an analogue functional analysis identified attention as maintaining challenging behavior. Second, access to attention was systematically controlled (continuous access versus no access) immediately prior to functional analysis sessions in which the participant received attention on a fixed ratio interval 1 (FR1) schedule. Results of this phase indicated that challenging behavior occurred at higher levels during the functional analysis sessions when access to attention was restricted immediately prior to sessions (i.e., no access functioned as an MO). In the third phase, prior access to attention was again controlled as in the second phase of the study, however the participant was then placed on extinction. Results of this final phase of the study indicated that challenging behavior occurred at higher levels during extinction sessions when the participant did not have access to the reinforcer prior to these sessions. The results of this final phase seem to indicate that no access to the reinforcer prior to extinction had a behavior altering effect (produced higher levels of responding) during extinction sessions.

In another study, O'Reilly, et al., (in review) examined the behavior altering effects of a motivating operation on challenging behavior during classroom instruction for a student with severe disabilities. The method was similar to the previous two studies. A prior functional analysis indicated that challenging behavior was maintained exclusively by access to tangible (savory food) items. During classroom instructional sessions these food items were visible but not available to the student. Thus challenging behavior was placed on extinction during instruction. Immediately prior to instructional sessions the student received either access to the savory food items or did not receive access to food. Access versus no access to food prior to instruction was systematically controlled using a multielement treatments design. Their results demonstrated higher levels of challenging behavior during instruction when the student did not have access to food prior to instruction. Very little challenging behavior occurred during instruction when the student had prior access to food.

These results seem to have important implications for using operant extinction in applied settings. For example, it may be prudent to combine operant extinction with some manipulation of MOs (e.g., prior satiation with the consequences) in order to reduce the negative side effects of extinction during intervention.

The first two O'Reilly et al., (in press, a & b) and O'Reilly et al., (in review) studies examined a three-phase methodology to identify the behavior altering effects of the motivating operation. The third, O'Reilly et al., (in review) study, in addition, examined the relevance of the behavior altering effects of the motivating operation in

an applied setting (i.e. in a classroom). In particular, this study showed one way in which an assessment methodology can identify an antecedent condition, that can then be used in an educational setting, to address behaviors as complex as challenging behavior. Together, these three studies support a beginning trend in examining the behavior altering effects of motivating operations.

Purpose and Rational for the Study

To sum, no known research to date has demonstrated the relationship between the MO and the S^D. In order to demonstrate that the MO has a behavior altering effect on S^D, the S^D in question must be clearly identified and systematically manipulated. An appropriate conceptual model to identify the behavior altering effect of the MO is to examine the direct relation between deprivation levels and the initial rate of responding or the total number of responses emitted during extinction (Michael, 2000). Klatt & Morris (2001) further state that the behavior altering effect should be demonstrated when "other contingencies are not in effect during extinction or before the onset of the first delivery of the reinforcer" (p. 177).

In order, to evaluate the behavior altering effects of a MO on the S^D, it would be necessary to first demonstrate or establish a discriminative relationship, and then compare response measures from conditions during which no reinforcement is presented contingent on the target response and in which, (a) both the S^D and the MO are present, (b) both the S^D and the MO are absent, (c) the S^D is present and the MO

is absent, and (d) the S^D is absent and the MO is present. These manipulations (a-d) need to be conducted in the context of extinction.

Results of such a manipulation would then examine a direct effect of the MO on the S^D. If the data were to indicate that the putative S^D did, in fact, function as such (as evidenced by the directly established history of correlation with reinforcement for challenging behavior as well as differentiation in response measures in the presence versus absence of the S^D), one may then be able to extrapolate that the behavior altering effects the S^D was a function of the presence of the MO (as evidenced by the differentiation in response measures in the presence versus absence of the MO when the S^D was held constant). In effect such a study may then verify one way in which the MO enters into a functional relationship with the discriminated operant.

The purpose of the current study is to identify the behavior altering effect of the MO on the S^D and verify how the MO enters into a functional relationship with the discriminated operant.

CHAPTER 3

METHOD

> Implicit in a functional analysis is the notion of control…Proving the validity of a functional relation by an actual demonstration of the effect of one variable upon another is the heart of experimental science. The practice enables us to dispense with many troublesome statistical techniques in testing the importance of variables. (Skinner, 1953, p. 227)

At the heart of experimental science is the demonstration of functional relationships, that is, the effect of one variable upon another (Skinner, 1953). This rings true from the cellular to the environmental level, from biology to behavior analysis. The purpose of this research was to identify the behavior altering effect of the MO (variable A) on the S^D (variable B). Two studies were conducted to systematically evaluate this effect. Study 1 examined the behavior altering effect of the MO on the S^D with two participants whose target behavior was identified as challenging behavior. Study 2, examined the behavior altering effect of the MO on the S^D with two participants whose target behavior was the use of a Voice Output Communication Aid (VOCA).

Both Study 1, and Study 2, had four phases. The conceptual logic and methodology for both studies were similar. Phase 1, of each study identified the consequence maintaining the target behavior (operant). In Study 1, an FA identified the consequence maintaining the target behavior (challenging behavior) for two participants. In Study 2, a preference assessment was conducted to identify preferred stimuli that the target behavior (pressing a VOCA device) accessed for two additional

participants. In Phase II, for both studies, stimulus discrimination was trained. In Phase III, for both studies, presession MOs were manipulated to verify the influence of the MO on the target behavior. Finally, in Phase IV for both studies, as in Phase III, presession MOs were manipulated and the behavior altering effects of the MO was examined by placing the target behavior on extinction when the S^D was both present and absent (S^Δ). This systematic manipulation of the MO when under extinction allowed for an analysis of the functional influence of the MO on the discriminated operant. In this way the direct effect of the MO on the S^D was examined in both Study 1 and Study 2 for a total of four participants.

Participants

A total of four participants with a diagnosis of autism were selected from a residential treatment facility for persons with developmental disabilities to participate in this research. All four participants were ambulatory, and followed instruction. All four were Caucasian. All four were toilet trained and were able to dress themselves independently. Participants at this facility either worked at a sheltered workshop and engaged in activities like sanding, cleaning and stuffing envelopes or spent time at a school facility. Two of these participants had been involved with several previous studies conducted by the experimenter and others at the University of Texas at Austin.

Alex was 16 years old. He was diagnosed with pervasive developmental disability not otherwise specified (PDD/NOS) and severe mental retardation. He was

functioning at a 2-year-old level on the daily living skills domain of the Vineland Adaptive Behavior Scales – Interview Edition (Sparrow, Balla, & Cicchetti, 1984) and scored in the severe range on the Gilliam Autism Rating Scale (Gilliam, 1995). He was nonverbal and communicated mainly through facial expressions, gestures, a few manual signs (i.e., more, cracker, cookie), screaming, and by guiding an adult's hand to objects. He had limited social skills and displayed aggression, self-injury, and property destruction. His challenging behaviors consisted of frequent tantrums that included screaming, dropping to the floor, head-butting, occasionally hitting others, while self injury included head hitting, head banging, hand biting, and stomping. While Alex was reported to display severe forms of the above self injurious (SIB) behaviors, they occurred however almost exclusively during transition times and in the context of his classroom. Only mild forms of the above topographies were observed during experimental sessions with him. Therefore, all forms of SIB observed during sessions could be characterized more aptly as precursor SIB and more reflective of stereotypic behaviors consistent with the autism population. Session lengths for all sessions for him were restricted to 5-minutes in duration in order to prevent possible acceleration effects of precursor SIB. In addition, to the above described behaviors, Alex would occasionally hit, and head-butt others, sniff the hair of strangers, smell lotion, and the soles of his shoes. Alex attended the school program at the residential treatment facility. He spent most mornings in a self-contained classroom with eight other students.

Josh was 37 years old and worked at the sheltered workshop at the residential treatment facility. He was diagnosed with Autism and severe mental retardation. He functioned at a 3-year old level on the Vineland Adaptive Behavior Scales – Interview Edition (Sparrow, Balla, & Cicchetti, 1984) and scored in the moderate to severe range on the Gilliam Autism Rating Scale (Gilliam, 1995). He engaged in bizarre speech, shouting, and throwing himself against walls and other stationary objects while making special comic book sound effects with his mouth, e.g., "KaaPow." He would frequently take on the persona of certain comic book characters e.g., Batman, and World Wrestling Federation wrestling characters, e.g., Hulk Hogan. Occasionally he would display aggressive behaviors (slamming and hitting) towards others. He would almost always say, "I'm sorry" soon after he had either slammed or hit someone with his fist.

Bret was 35 years old and worked at the sheltered workshop. He was diagnosed with Autism and severe mental retardation. He was non-verbal. He did not make any proximal sounds. He functioned at a 2-year old level on the Vineland Adaptive Behavior Scales – Interview Edition (Sparrow, Balla, & Cicchetti, 1984) and scored in the moderate range on the Gilliam Autism Rating Scale (Gilliam, 1995). He used his hands to gesture and had a number of self made signs in his repertoire. He made moaning sounds when his attempts at communicating with gestures went unnoticed. His mother was German and he occasionally responded to a few German words like "Kommen Sie hier" (come here), "Sitzen Sie" (sit down), etc. He was a mild mannered man and was always neatly dressed.

Morgan was 37 years old and worked at the sheltered workshop. He was diagnosed with Autism and severe mental retardation. He functioned at a 1-year old level on the Vineland Adaptive Behavior Scales – Interview Edition (Sparrow, Balla, & Cicchetti, 1984) and scored in the severe range on the Gilliam Autism Rating Scale (Gilliam, 1995). He was non-verbal. He made a few proximal sounds like "bleuoo," and "yella." He could say "beer" and used the Spanish term "Si" to say yes even though he was Caucasian and his family spoke English at home. Morgan went home every weekend. On Fridays, he had no interest in engaging in any social activities, having lunch or consuming any preferred edibles. According to staff reports this was due to his anticipation of his visit home. No data were collected for Morgan on Fridays. Morgan engaged in stereotypic behaviors, for example, body swaying, hand flapping, humming, and clapping with one hand. Alex and Josh participated in Study 1 while Bret and Morgan participated in Study 2.

Setting and Materials

All sessions were conducted at room at the treatment facility that was equipped with a round table, chairs, and other session materials. Session materials included, color pens, paper, identified tangibles (for example, cheese crackers for Alex, popcorn, M & M® s, and marshmallow for Bret, and cookie, M & M® s and popcorn for Morgan), one red and one green bowl, and two VOCA devices (one blue

and one yellow BIGMack® [15]switch) and three five-digit re-settable mechanical counters. Sessions were conducted two to ten times a day, one to three days a week.

Implementation, Procedural Integrity and Data Coding

Three advanced graduate students in Special Education, including the experimenter implemented the procedures (i.e., conducted the functional analysis, conducted the preference assessment, discrimination trials, the MO manipulations and extinction trials.) Two additional advanced graduate students trained by the experimenter conducted data coding. All sessions during Study 1 were videotaped. A fifth advanced graduate student who was blind to the mechanisms of the study independently scored a third of the videotapes in Study 1. All sessions during Study 2 were coded using real time recording. A sixth advanced graduate student who was blind to the mechanisms of Study 2 independently coded a third of the sessions using real time recording. Mechanical counters were used to take frequency counts during real time recording. Real time recording dictated that observers be present during all sessions to record real time data.

In order to compare session trends in the occurrence and non-occurrence of behavior standardized observation times were utilized. Standardized observation times require that conditions be consistent from one observation session to the next and provide equal opportunities for the occurrence and non-occurrence of behavior

[15] The BIGMack® VOCA device will be discussed in greater detail in Study 2.

(Cooper, Heron, & Heward, 1987). Therefore, two examples for Alex are (a) all sessions were 5 minutes in length and, (b) in Phase II, during the pre-session MO absent condition he had free access to tangibles for 15 minutes. Session order was randomized according to a multi-element treatment design format to control for sequencing effects.

Data coders were given definitions of target behaviors, coding sheets and were trained on identifying the occurrence of the target behavior on mock trials until they reached above 90% reliability before coding the sessions for 3 consecutive trials. If the coders had any questions in respect to the coding, the experimenter answered them, until concurrence was reached.

The experimenter trained the advanced graduate students who participated in implementing the sessions until they performed the procedures exactly and according to protocol. Session order was predetermined, by the experimenter (by random assignment), and data sheets were provided. Procedural checks were implemented frequently. If any sessions were not implemented correctly due to the session been interrupted or not following protocol then that session was not included in the study. The dissertation chair visited the site frequently and conducted checks on procedural implementation. The dissertation chair also watched a portion of the video recordings in Study 1 and made site visits to observe real time data recording for Study 2 in order to check for procedural integrity. All data were graphed on a weekly basis and any anomaly, decisions to continue a phase, terminate a phase etc., were discussed with the dissertation chair.

In Study 1, an examination of the influence of the MO on the behavior altering effect of the S^D was undertaken. Challenging behavior was selected as the target behavior for Study 1. Two participants, Alex and Josh took part in Study 1. Study 1 comprised of four phases. In Phase 1, an FA was conducted to identify the contingency maintaining the target behavior. In Phase II, discrimination training was conducted under two conditions a) S^D and b) S^Δ for the contingency identified in Phase 1. In Phase III, the MO for the contingency identified in Phase 1 was manipulated whilst target behavior was reinforced on a fixed ratio 1 schedule. In Phase IV, the MO for the contingency identified in Phase 1 was manipulated in the presence of both S^D and S^Δ but the target behavior was not reinforced and was placed on extinction. The following sections describe in detail each of the phases in Study 1. The response measurement and target behaviors for all phases were the same.

Dependent Variables

The target behaviors for Alex were pre-cursor self-injurious behavior and aggression. Alex displayed four forms of pre-cursor self-injurious behaviors, (a) head hitting, (b) head banging, (c) hand biting, and (d) stomping and two forms of aggression, (a) hitting others, and (b) hair pulling. These target behaviors were scored independently and data were collapsed to form the composite challenging behavior (see below for operational definitions). The target behavior for Josh was bizarre speech.

Operational Definitions of Target Behavior

Operational definitions of target behavior are as follows: (a) Head hitting was defined as forceful contact to head with an open or closed fist; (b) Head banging was defined as forceful contact of the head with a stationary object or person; (c) Hand biting was defined as any part of the hand passing the pane of the lips between the upper and lower teeth; (d) Stomping was defined as forcefully and repeatedly placing the soles of the feet on the ground; (e) Hitting others was defined as using any part of the hand to make forceful contact with another person; (f) Hair pulling was defined as forcefully dragging or tugging another persons' hair with hand or hands; (g) Bizarre speech was defined generally as references to objects or persons that were nonsensical or irrelevant to the current topic of conversation, the task at hand or the stimuli in the environment. For example, taking on the persona of Batman, Hulk Hogan, making grunting or growling sounds.

Data Collection and Interobserver Agreement

Target behavior was measured using a 10-second partial interval recording procedure for all sessions and phases of Study 1. All sessions were video taped using a Sony DV digital camera. A second observer independently coded target behavior during 78% of sessions, and a third observer who was blind to the mechanisms of the study independently coded 40% of the sessions. Interobserver agreement was calculated according to the Interval-by-Interval method (Hawkins & Dotson, 1979). In this method, all intervals (occurrence plus non occurrence) in which both observers

scored the occurrence of the target behavior or the non-occurrence of the target behavior were counted as an agreement. Interobserver agreement was thus calculated by dividing the number of agreements of occurrence (for each 10-second interval during each session) by the number of agreements plus disagreements (i.e. total number of intervals for that session) and multiplying by 100%. For example, if there were ten 10-second intervals in a session and the record showed that observers were in agreement in intervals 1, 2, 3, 4, 5, and 6 and in disagreement in intervals 7, 8, and 9, then by dividing the number of agreement intervals (7) by the number of agreements plus disagreements (7+3) and by multiplying that score by 100 an interobserver agreement score of 70% is reached for that session. Interobserver agreement data for each phase of Study 1 is presented in Table 1 in the results section of this document.

In addition Cohen's kappa coefficient was used. This is a statistical measure of interobserver reliability. Kappa statistics are appropriate for testing whether agreement exceeds chance levels for binary and nominal ratings (Carpenter, 2005). Cohen's kappa measures the agreement between two raters who each classify N into mutually exclusive categories. It is generally thought to be a more robust measure than simple percent agreement calculation since kappa takes into account the agreement occurring by chance (McGinn, Wyer, Newman, Keitz, Leipzig, & Guyatt; 2004). Kappa statistic was only used to calculate reliability between the primary observer and the secondary observer.

Kappa was calculated by hand by using the formula k = (Oa - Ea)/(N - Ea), where Oa is the observed count of agreement, Ea is the expected count of agreement, and N (1 pair) is the total number of respondent pairs.

For example, in a given session if observer A reported that target behavior occurred during 9 intervals and did not occur during 2 (total 11) intervals and observer B reported that the behavior occurred during 13 intervals and did not occur during 1 (total 14) interval. The observed agreement (Oa) between observer A and B is 0.88 (9+13)/25. The probability of chance for observer A to report the occurrence of behavior is 0.44 (11/25), and the probability of observer A to report the nonoccurrence is 0.40 (10/25). For observer B the probability of chance to report the occurrence of behavior is 0.56 (14/25) while the probability to report nonoccurrence is 0.60 (15/25). The expectant agreement (Ea) or probability for the two observers reporting that they observed that the behavior occurred or did not occur is probability agreement of occurrence plus the probability agreement of non-occurrence of the target behavior. The probability that both observers agreed that the behavior occurred is 0.176 (0.44x 0.40). The probability that both observers agreed that the target behavior did not occur is 0.336 (0.56x0.60). The expected agreement (Ea) by chance alone for the two observers is therefore 0.512 (0.176+0.336). The kappa formula is k = (Oa - Ea)/(N - Ea). Therefore for the two observers the kappa is 0.75 (0.88-0.512)/(0.368/0.488).

Kappa is always less than or equal to 1. A value of 1 implies perfect agreement and values less than 1 imply less than perfect agreement (Cohen, 1960). In

the above example 0.75 could be interpreted as good agreement between the two observers.

While, it is possible to calculate interobserver reliability between more than three observers using a modified kappa (Fleiss's kappa) calculation this was not done due to time constraints. Therefore, the third interobserver ratings, between the observer who was blind to the mechanisms of the study and the primary and secondary observers were not calculated using kappa.

Experimental Design

Individual participant multielement designs were used to demonstrate experimental control in each of the four experimental phases with both Study 1 and Study 2 (Kazdin, 1982). However, the data are presented in either session by session format or cumulative frequency format in different phases of the study to facilitate interpretation of the results.

Study 1

Phase I: Identifying the Contingencies Maintaining the Operant Response

Alex and Josh participated in Study 1. In Phase I, the operant function of the target behavior was identified using an analogue functional analysis (FA) based on the procedures described by Iwata et al., (1982/1994). Participants were exposed to attention, alone, play, tangible and demand conditions within the functional analysis. Sessions of each of the functional analysis conditions was 5 minutes in length for Alex and 10 minutes in length for Josh. Session length was shorter for Alex due to severity of his challenging behavior (see section on operational definitions of target behavior).

In the attention condition the participant and the experimenter was present in a room that contained a table and four chairs. Preferred items such as books, paper and pens for coloring were made available on the table. Sessions began with the experimenter attending exclusively to reading materials. Contingent upon target behavior the experimenter briefly interacted for 10 s, providing comments such as "Don't do that. You might hurt yourself", on a frequency ratio 1 (FR-I) schedule. No attention was provided contingently for any other behavior.

In the demand condition the experimenter taught matching words, and correspondence tasks that staff reported were of moderate difficulty for Alex. Josh was instructed on vocational tasks that he had difficulty completing (e.g., stuffing

envelopes). Instruction was delivered using a least-to-most hierarchy of prompts (i.e., verbal prompt, model response, light physical guidance). Contingent upon target behavior the task was removed for 10 s on a frequency ratio 1 schedule and then reintroduced.

During the play condition the experimenter delivered positive statements on a fixed time 10s schedule (e.g. good sitting, what a lovely day) and were not contingent on any response by the participant. Preferred items as in the attention condition were made available and no demands were placed on the participant.

In the alone condition the participant remained by himself in the room. Preferred items were made available on the table during this condition. No social consequences for target behavior were delivered, as the experimenter was absent from the room.

In the tangible condition 3-5 different food items (cracker, cookie, popcorn, granola bar, raisin) that the staff identified as preferred food were available during the tangible condition. At the beginning of a session during the tangible condition a small sample of the tangible food item was given to the participant. The food item was placed in a small green bowl. The session commenced once the participant had consumed the sample and the green bowl was refilled with another small potion of the tangible items and placed on the table within 2 feet of the participant. Each time the participant engaged in the target behavior he was given access to the food in the bowl. Each time the participant consumed the item it was replaced with a similar portion.

Phase II: Discrimination Training

In Phase II, a demonstration of differential stimulus control was conducted. Discrimination training was based on the results of Phase I. The FA results for Alex indicated that his behavior was maintained exclusively by access to food items[16]. Functional analysis results for Josh indicated that his behavior occurred almost exclusively during the attention condition and was maintained by access to social attention (Results are discussed in greater detail in the results section). Discrimination was trained in Phase II under two conditions a) S^D and b) S^Δ for the social-positive reinforced behavior (tangible for Alex and attention for Josh). Only the FA conditions that were identified in Phase I as the maintaining contingency for the target behaviors that was examined in Phase II (i.e. tangible for Alex or attention for Josh) were included in the discrimination training phase. The functional analysis conditions under which the challenging behavior occurred (i.e. tangible for Alex and attention for Josh) were included in this discrimination training phase. All other conditions of the FA described in the previous section were excluded.

Figure 3.1 illustrates the process of discrimination training for tangible and attention conditions). As can be noted in the diagram reinforcement is available (S^+) when the S^D is present but unavailable (S^-) when the S^Δ is present.

[16] Alex almost exclusively consumed cheese crackers although he had access to all items included in the FA Tangible condition.

S^{Δ}	S^{D}	S^{+}
absent	present	present
present	absent	absent

Figure 3.1. Conceptual diagram to illustrate sessions in Phase II, Study 1.

S^{D} and S^{Δ} Training for Tangibly-Maintained Target Behavior

The tangible FA condition for Alex was identical to the tangible FA condition in Phase I with the exception of discrimination training. In order to train discrimination a green bowl functioned as the S^{D} and a red bowl functioned to signal the S^{Δ} condition. Both bowls were equipped with similar quantities of food. When the green bowl (S^{D}) was present and the participant engaged in the target behavior reinforcement was provided on a fixed ratio I FR-1 schedule by giving the participant access to a small portion of food in the bowl. Each time the participant consumed the food the bowl was refilled with a similar portion. When the red bowl (S^{Δ}) was present and the participant engaged in the target behavior reinforcement was not provided (i.e., he was not given access to food contingent on challenging behavior). If the participant tried to grab the food item response blocking was used to restrict access to the food item.

The experimenter conducted all discrimination sessions during both conditions. Therefore the stimulus to signal discrimination was restricted to the presence of either the green or the red bowl. Sessions were terminated when the

response strengths in S^D and S^Δ gradually drew apart, with prolonged extinction taking place in S^Δ (Millenson, 1967).

S^D and S^Δ Training Attention Maintained Target Behavior

The attention FA condition for Josh was identical to the attention FA condition in Phase I with the exception of discrimination training. Two female experimenters conducted all training sessions and they alternated serving as S^D and S^Δ. This was done so that the stimulus for discrimination was restricted to the diverted attention (S^Δ) condition or the expectant attention (S^D) condition and not possible experimenter preference by Josh. In order to train discrimination, in the S^D condition the experimenter turned facing toward the participant and looked at him expectantly. In the S^Δ condition, the experimenter pretending to read a book so that the experimenter's attention was diverted. In the presence of the S^D if the participant engaged in the target behavior, reinforcement was provided as in Phase I, in the form of praise delivered on a fixed ratio 1 schedule. When S^Δ was present and the participant engaged in the target behavior reinforcement was not provided. A diverted attention condition was selected as the S^Δ condition rather than a designated experimenter to rule out possible MO interactions effects (e.g., prior associations with the experimenter (CMO-R), preference of one experimenter over the other (CMO-T)

etc.,). Sessions were terminated when the response strengths in S^D and S^Δ gradually drew apart, with prolonged extinction taking place in S^Δ (Millenson, 1967).

Phase III: Identifying the Motivating Operation

In Phase III, by manipulating the presession conditions for each FA (tangible condition only for Alex, Attention condition only for Josh) session, MOs for the target behaviors were isolated. This phase was conducted to empirically determine an MO for the target behavior for each participant. For tangible-maintained and attention-maintained target behavior, tangible and attention conditions prior to the commencement of Phase III, FA sessions were systematically controlled for satiation (MO present) and deprivation (MO absent) to that MO. For example, for attention-maintained challenging behavior the satiation (MO absent) to the MO was conducted by giving continuous attention every 10 seconds to the participant for 15-minutes prior to the commencement of the session.

The tangible condition for Alex, and the attention condition for Josh were used in Phase III. For example each tangible session was 5 minutes while each attention session was 10 minutes in duration. Contingent upon target behavior, tangibles (for Alex) or attention (for Josh) was delivered on a fixed ratio 1 schedule. As in Phase II, other FA conditions (i.e., alone, demand, play) were not included in this phase of the experiment. Each participant was exposed only to the condition identified in Phase I as the consequence maintaining his target behavior. Restricting access (MO present) or providing access (MO absent) to the reinforcer immediately

prior to the tangible or attention FA sessions acted as an MO for that operant. By conducting the Phase III sessions immediately after MO present and MO absent conditions, effects of each session when the MO is present verses when the MO is absent was examined experimentally for both tangible maintained and attention maintained behaviors. The conceptual diagram in Figure 3.2 illustrates the process of MO manipulations. As can be noted in both MO present and MO absent conditions if the target behavior occurs reinforcement was presented. Reinforcement was presented on an FR1 schedule.

MO	S^+
present	present
absent	present

Figure 3.2. Conceptual diagram to illustrate sessions in Phase III, Study 1.

Controlling for Presession MOs (Present and Absent) for Tangibly Maintained Target Behavior

In order to take advantage of natural levels of deprivation MO present tangible sessions were conducted 30 minutes prior to lunch. It was presumed that the participant was hungry at this point in time during the day. This period, that is, 30 minutes prior to lunch served as the presession MO present condition wherein the MO (as the participant is deprived of food) is present prior to the commencement of the session.

The presession MO absent condition was conducted immediately after lunch to take advantage of natural satiation levels. Additionally, the participant was given

free access to food for 15 minutes after lunch. The FA sessions were conducted immediately following the 15-minute free access to food condition.

Controlling for Presession MOs (Present and Absent) for Attention Maintained Target Behavior

Results from the Phase I, FA indicated that Josh's target behavior was attention maintained. In Phase III, the level of social interaction prior to the FA attention sessions was systematically controlled for Josh. The presession MO present condition consisted of placing the participant alone in a room with preferred items for 15 minutes prior to the commencement of the attention session. Therefore Josh was deprived of any social attention for 15 minutes prior to the session. Presession MO absent sessions consisted of engaging the participant in continuous social interaction (every 5 seconds) for 15 minutes immediately prior to the commencement of the attention session.

Phase IV: Isolating the Behavior Altering Effects of the Motivating Operation on the Discriminative Stimulus

In Phase I, an FA identified the contingencies maintaining the target behavior for the participants. In Phase II, discrimination training was demonstrated. In Phase III, an assessment of the effects on responding of manipulating the MO (i.e. MO present & absent) was conducted. In Phase IV, of the study the behavior altering effects of the MO on the S^D for tangible-maintained and attention-maintained behavior was isolated. This was done by examining differentiation in response

measures in the presence versus absence of the MO and the presence versus absence of the S^D in the context of extinction.

Thus, Phase IV had four different conditions whereas Phase III had only two conditions (i.e. presence or absence of the MO). The methodology used in Phase IV was identical to Phase III with two exceptions, 1) no consequences were delivered during the tangible and attention conditions (extinction was in effect), and 2) sessions were held in both in S^D and S^Δ conditions. Thus, responding in both the S^D and S^Δ conditions were placed on extinction, as reinforcement was not available.

As in Phase III, the presession MOs were manipulated in the same manner. For example, for attention maintained behavior the presession MO present condition consisted of placing the participant alone in a room with preferred items for 15 minutes prior to the FA session. The presession MO absent condition consisted of engaging the participant in continuous social interaction (every 5 seconds) for 15 minutes immediately prior to the FA session.

By designing the study in this manner a direct comparison of the behavior altering effect of the MO on the S^D was examined. Figure 3.3 illustrates the process of each of the conditions. As can be noted in the diagram both when the S^D was present and absent (S^Δ) and the MO was present and absent reinforcement was absent (S^-). In fact, in all conditions reinforcement was absent. See Figure 3.3 for a conceptual diagram.

S^{Δ}	S^{D}	MO	S^{+}
absent	present	present	absent
absent	present	absent	absent
present	absent	present	absent
present	absent	absent	absent

Figure 3.3. Conceptual diagram to illustrate sessions in Phase IV, Study 1.

Study 2

The same logic for the conceptualization in Study 1 applied to Study 2. In Study 2, as in Study 1, an examination of the influence of the MO on the behavior altering effect of the S^D was undertaken. Use of a Voice Output Communication Aid (VOCA) to access identified tangible items was selected as the target behavior for Study 2. Two participants, Bret and Morgan participated in Study 2. Study 2 comprised of four phases. In Phase 1, a preference assessment was conducted to identify 3 highly preferred items. In Phase II, two VOCA devices (BIGMack® switch) that differed only in color were used to train discrimination. Discrimination was trained under two conditions, (a) S^D, and (b) S^Δ to indicate availability and unavailability to the preferred tangible items identified in the preference assessment in Phase 1. In Phase III, the motivating operation for the preferred tangible items in Phase 1, was identified by providing presession access or withholding presession access to the items prior to the commencement of sessions. Phase IV, was identical to Phase III in that presession access was manipulated prior to the commencement of each experimental session. Phase IV differed in that firstly the experimental sessions were conducted in the presence of both S^D and S^Δ and secondly the target behavior was not reinforced. In fact, similar to Phase IV in Study 1, target behavior was placed on extinction. The following sub-sections describe in detail each of the phases in Study 2.

Dependent Variables

In Phase 1, a multiple-stimulus without replacement (MSWO) format was used to assess preference (DeLeon & Iwata, 1996). For both participants a selection response was recorded when the participant made physical contact with one of the items. If the participant made contact with more than one item then the first item that was made contact with was recorded as the selection. Participants had 30 seconds to respond. If no item was selected within the 30 seconds or if the participant pushed the tray away on which the items were placed then the trial was terminated. Each session consisted of 6 trials and participants had a total of 72 opportunities to respond.

Interobserver Agreement

For most of the sessions of Phase 1, the experimenter also served as the observer. A second observer independently recorded selections for 91.66% of the sessions. As described above for study 1 agreement was scored when both observers independently recorded the same selection or no selection on the same trial. Interobserver agreement was computed by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100%.

In Phases II to IV, two independent observers recorded the target behavior. The target behavior for Phases II to IV was VOCA use. A third observer who was blind to the mechanisms of Study 2 independently recorded 30% of the sessions. Observers used four digit mechanical counters to independently collect frequency of

the participants engaging in the target behavior. They each recorded the total number of times the participants engaged in the target behavior on data sheets. Interobserver agreement was computed by dividing the smaller number recorded for each session by the larger number recorded for that session and multiplying by 100%. For example, if observer A recorded that the target behavior 30 times and observer B recorded 40 times then the smaller number 30 would be divided by 40 and multiplied by 100% to yield and an interobserver agreement score of 75% or a coefficent of .75. Interobserver agreement data for each phase of Study 2 is presented in Table 1. Each session in Study 2 with the exception of Phase 1 lasted for 5 minutes.

Operational Definitions of Target Behavior

Selection of Preference items (Phase I) was defined as the participant reaching out and selecting an item (one of six items) on the tray.

VOCA use was defined as pressing a BIGMack® switch with sufficient force to activate the prerecorded voice output that said, *"I want to choose please."*

Materials Specific to Study 2

The VOCA device used for this study were two BIGMack® switches. BIGMack® is VOCA device manufactured by AbleNet and is a single button switch. A single message of up to 20 seconds can be prerecorded and replayed with a single press. The button is five inches in diameter 2 1/4 high at tallest point, had a volume

control and can be operated with a 9-volt battery. This VOCA device was chosen for the study, as it was easy to operate as it had a large surface area. A yellow button was used as the S^D and a blue button was used as the S^Δ. A same age typical peer was recruited to say *"I want to choose please"* and this prerecorded message was activated each time the device was pressed.

Phase I: Identifying the Reinforcers Maintaining the Operant Response

Preference Assessment

For the preference assessment in Phase 1, a multiple-stimulus without replacement (MSWO) format was used (DeLeon & Iwata, 1996). In the MSWO multiple stimuli are presented concurrently as in the MS method with the exception that if a stimulus was chosen from the array it was not replaced in the next presentation. This method enables the participant to make a preference among stimuli that are less preferred allowing for a distinct hierarchy of preference.

Preference for six items was assessed for each participant. Preference items were selected in consultation with staff to ensure that a participant's food allergies or dietary restrictions were not compromised. Three staff members were independently asked to identify ten highly preferred items for each participant. Six items that were identified in common by all three staff members for each participant were chosen for the preference assessment. The six items identified for Bret were soda, popcorn,

granola bar, M & M® s, marshmallow, and cookie. The six items identified for Morgan were water, music[17], M & M® s, cookie, popcorn, and granola bar.

For each participant these six stimuli were presented concurrently without replacement for a total of 12 sessions. Each session comprised of 6 trials. Each session began with all items sequenced randomly in two rows of 3 approximately 5 cm apart and placed on a rectangular tray. The participant was seated at the table approximately two feet from the stimulus array. A trial consisted of moving the tray within reach of the participant. The experimenter instructed the participant to make a selection by saying, *"choose one"* and waited up to 30 seconds until the participant made a selection. The item selected was recorded after each trial. After a selection was made it was either removed out of sight (portable CD player, see footnote) or not replaced.

If the participant tried to select more than one item the response was blocked and the first item selected was scored. At the end of each trial the sequencing of the remaining items for the next trial was randomized. . This procedure was then repeated until all items were selected or the participant refused selection. The tray was replenished with all six items after every sixth trial. Thus a total of 12 sessions comprised of 6 trials resulting in 72 opportunities for each participant. After each session, a hierarchy of preference was determined by using the formula: Number of times the item was selected/Number of times the item was offered x100%.

[17] A portable CD player was used to play Tijuana music or Bob Marley for 30 seconds.

The three most highly preferred items identified for each participant were made available in Phases II-IV. For Bret the three highly preferred items were marshmallow, M & M® s and popcorn. For Morgan the three highly preferred items were cookie, M & M® s and popcorn. Results of Phase 1 are presented in Figure 4.7 in the results section.

Phase II: Discrimination Training

In Phase I, a preference assessment identified three highly preferred items for both Bret and Morgan. In Phase II, a demonstration of differential stimulus control was conducted. Discrimination was trained in Phase II under two conditions (a) S^D and (b) S^Δ. A yellow BIGMack® switch was used as the S^D and a blue BIGMack® switch was used as the S^Δ. The three highly preferred items were placed on a tray. When the yellow BIGMack® (S^D) was present and the participant engaged in the target behavior (i.e., pressing the VOCA) reinforcement was provided on a fixed ratio I schedule by moving the tray with the preferred items within reach of the participant. Each time the participant consumed the item the tray was replenished with the same item. When the blue BIGMack® (S^Δ) was present and the participant engaged in the target behavior reinforcement was not provided. If the participant tried to grab the food item response blocking was used to restrict access to the food item. Sessions

were terminated when the response strengths in S^D and S^Δ gradually drew apart, with prolonged extinction taking place in S^Δ (Millenson, 1967).

Figure 3.4 illustrates the process of discrimination training for VOCA use. As can be noted in the diagram reinforcement is available (S^+) when the S^D is present but unavailable (S^-) when the S^Δ is present.

S^Δ	S^D	S^+
absent	present	present
present	absent	absent

Figure 3.4. Conceptual diagram to illustrate sessions in Phase II, Study 2.

Phase III: Identifying the Motivating Operation

In Phase II, discrimination was trained so that the participant learned to respond in the presence of the S^D but not in the presence of S^Δ. In Phase III by manipulating the pre-session conditions prior to the commencement of each session, MOs for the target behavior were isolated. Thus in Phase III, sessions were systematically controlled for satiation (MO present) and deprivation (MO absent) to the preferred tangible item for both Bret and Morgan prior to the commencement of each session.

Each session lasted for 5 minutes. Only the yellow BIGMack® switch was used in Phase III as the focus of this phase was to verify a MO. As in Phase II, the

three highly preferred items were placed on a tray (e.g. popcorn, marshmallow, M & M for Bret). When the participant engaged in the target behavior (i.e., pressing the VOCA) reinforcement was provided on a fixed ratio I schedule by moving the tray with the preferred items within reach of the participant. Each time the participant consumed the item the tray was replenished with the same item.

The conceptual logic of Phase III in Study 2 was identical to Phase III in Study 1. By conducting the Phase III sessions immediately after MO present and MO absent conditions, effects of each session when the MO was present verses when the MO was absent was examined systematically. Figure 3.5 illustrates the process of MO manipulations. As can be noted in both MO present and MO absent conditions if the target behavior occurs reinforcement was presented.

MO	S^+
present	present
absent	present

Figure 3.5. Conceptual diagram to illustrate sessions in Phase III, Study 2.

Controlling for Presession MOs (Present and Absent) for VOCA use

In order to take advantage of natural levels of deprivation MO present sessions were conducted 30 minutes prior to lunch. It was presumed that the participant was hungry at this point in time during the day. This period, that is, 30 minutes prior to lunch served as the pre-session MO present condition wherein the

MO (as the participant is deprived of food) is present prior to the commencement of the session.

The presession MO absent condition was conducted immediately after lunch to take advantage of natural satiation levels. Additionally, the participant was given free access to the highly preferred tangibles for 15-minutes after lunch or till he refused further acceptance of the tangible item. Sessions were conducted immediately following the 15-minute free access condition. In this way the MO was systematically controlled for both deprivation (MO present) and satiation (MO absent) to the preferred tangibles.

Phase IV: Isolating the Behavior Altering Effects of the Motivating Operation on the Discriminative Stimulus

In Phase I, a preference assessment identified the three highly preferred tangibles for both Bret and Morgan. In Phase II, with discrimination training a direct history of correlation with reinforcement for the target behavior (VOCA use) as well as differentiation in response measures in the presence of S^D and S^Δ was demonstrated. In Phase III, an assessment was conducted of response differentiation in the presence versus absence of the MO when the S^D was held constant. In Phase IV, of the study the behavior altering effects of the MO on the S^D was demonstrated for VOCA use. This was achieved by examining differentiation in response measures in the presence versus absence of the MO and the presence versus absence of the S^D in the context of extinction.

Thus, Phase IV had four different conditions whereas Phase III had only two conditions (i.e. presence or absence of the MO). The methodology used in Phase IV in Study 2 was identical to the methodology used in Phase IV in Study 1. Phase IV was identical to Phase III with two exceptions, (1) no consequences were delivered during the sessions, and (2) sessions were held in both the S^D and S^Δ conditions. Thus, responding in both the S^D and S^Δ conditions were placed on extinction, as reinforcement not available.

As in Phase III, the presession MOs for Phase IV were manipulated in the same manner. For example, the presession MO absent condition consisted of giving the participant free access to the three highly preferred items continuously for 15-minutes or. By designing the study in this manner a direct analysis of the behavior altering effect of the MO on the S^D could be achieved. Figure 3.6 illustrates the process of each of the conditions. As can be noted in the diagram both when the S^D was present and absent (S^Δ) and the MO was present and absent reinforcement was absent (S^-). In fact, in all conditions reinforcement was absent. See Figure 3.6 for a conceptual diagram.

S^{Δ}	S^{D}	MO	S^{+}
absent	present	present	absent
absent	present	absent	absent
present	absent	present	absent
present	absent	absent	absent

Figure 3.6. Conceptual diagram to illustrate sessions in Phase IV, Study 2.

Summary of Methods

To summarize, in this research two studies each with four phases were conducted systematically to evaluate the behavior altering effect of the MO on the S^{D}. In Study 1, the behavior altering effect of the MO on the S^{D} with two participants whose target behavior was identified as challenging behavior was examined. In Study 2, the behavior altering effect of the MO on the S^{D} with two participants whose target behavior was the use of a VOCA device was examined. The next chapter will discuss the results for each phase of the two studies for each participant.

CHAPTER 4

RESULTS

> Unlike hypotheses, theories, and models, together with the statistical manipulations of data which support them, a smooth curve showing a change in probability of response as a function of a controlled variable is a fact in the bag, and there is no need to worry about it as one goes in search of others. (Skinner, 1969, p. 94)

This chapter presents the results of this dissertation. Results of Study 1 and Study 2 will be presented separately. Each study had four phases. Each Phase, of Study 1 is presented individually for each participant but discussed together to draw comparisons between subjects.

Study 1

In Phase 1, an FA was conducted to identify the contingency maintaining the target behavior. In Phase II, discrimination training was conducted under two conditions a) S^D and b) S^Δ for the contingency identified in Phase 1. For Alex, a green bowl functioned as the S^D and a red bowl functioned to signal the S^Δ condition. Both bowls were equipped with similar quantities of food. When the S^D was present and the participant engaged in the target behavior reinforcement was provided on a fixed ratio I (FR-1) schedule. When the S^Δ was present and the participant engaged in the target behavior reinforcement was not provided. For Josh, in the S^D condition the experimenter turned faced toward the participant and looked at him expectantly. In

the S^{Δ} condition, the experimenter pretended to read a book so that the experimenter's attention was diverted. In the presence of the S^{D} if the participant engaged in the target behavior, reinforcement was provided in the form of praise delivered on a FR-1 schedule. When S^{Δ} was present and the participant engaged in the target behavior reinforcement was not provided. In Phase III, the motivating operation for the contingency identified in Phase 1 was manipulated. During sessions if the participant engaged in the target behavior reinforcement was provided on FR1 schedule in both MO present and MO absent conditions. In Phase IV, the motivating operation for the contingency identified in Phase 1 was manipulated in the presence of both S^{D} and S^{Δ} but the target behavior was not reinforced and was placed on extinction.

Phase I Results for Alex

Phase I, consisted of a FA, with five conditions i.e. attention, demand, tangible and play. Results of Phase 1 for Alex are presented in Figure 4.1. In the attention condition, challenging behavior occurred during one session from a total of six sessions. However, the percentage of intervals with the occurrence of challenging behavior during the attention condition was irrelevant (range 0.00% -3.33%). In the demand condition, challenging behavior did not occur (range 0.00%-0.00%) in any of the five sessions. In the play condition, challenging behavior did not occur in any of the four sessions (range 0.00%-0.00%). In the tangible condition, the percentage of

intervals with challenging behavior occurred during 10 of the 14 sessions (range 0.00%-40.00%) in which all ten sessions had challenging behavior occurring ≥ 10.00% of intervals for that session.

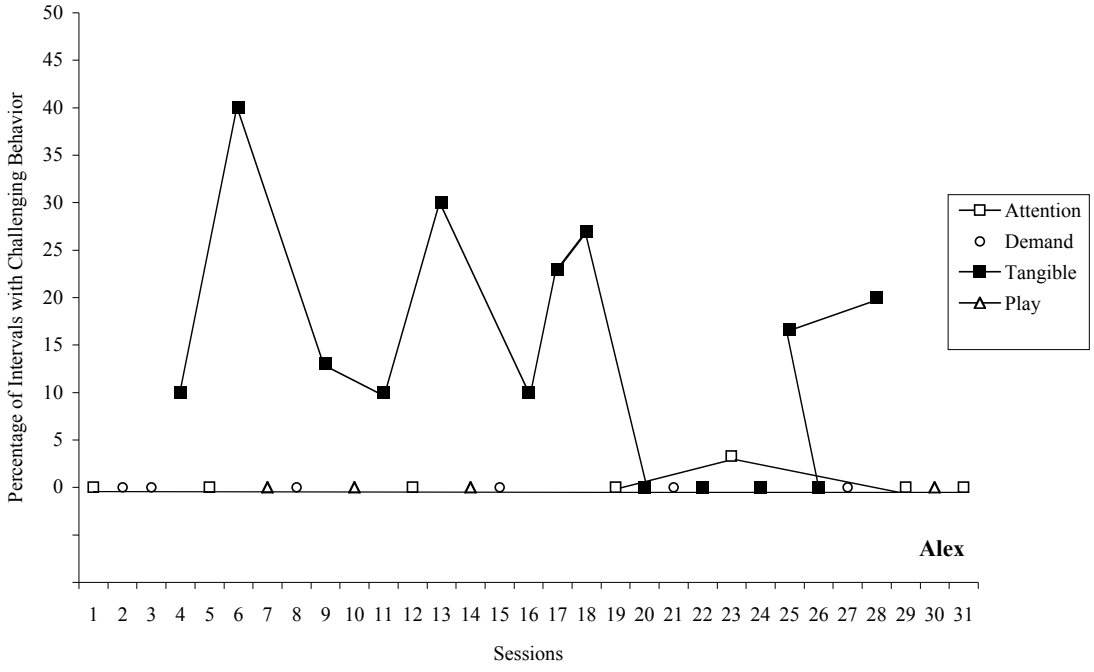


Figure 4.1. Functional analysis percentage of intervals with challenging behavior: Study 1, Alex. The values on the abscissa indicate the number of sessions conducted while the values on the ordinate represent the percentage of intervals with the occurrence of challenging behavior (see Methods section for operational definitions of target behavior).

As can be noted challenging behavior occurred almost exclusively in the tangible condition of the FA for Alex. Therefore it can be ascertained that challenging behavior for Alex was maintained by access to tangible items.

Phase I Results for Josh

Results of Phase 1 for Josh are presented in Figure 4.2. The FA for Josh was identical to Alex as there were five FA conditions. In the tangible condition, challenging behavior (bizarre speech) occurred during one session from a total of four sessions. However, the percentage of intervals with the occurrence of challenging behavior during the tangible condition was negligible (range 0.00% -3.33%) for Josh. In the demand condition, challenging behavior did not occur (range 0.00%-0.00%) in any of the five sessions. In the play condition, challenging behavior did not occur in any of the four sessions. In the attention condition, the percentage of intervals with challenging behavior occurred during all of the eight sessions (range 26.66%-60.00%) in which all ten sessions had challenging behavior occurring $\geq$ 26.66%of intervals for that session. Therefore, results of the FA for Josh indicated that challenging behavior for him (bizarre speech) occurred almost exclusively in the attention condition.

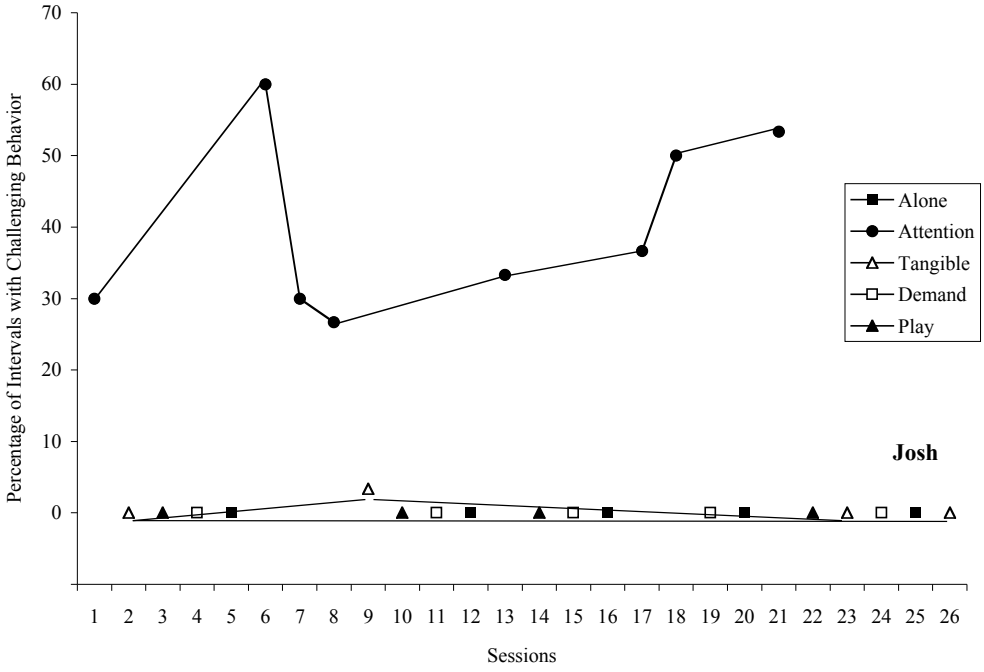


Figure 4.2. Functional analysis percentage of intervals with challenging behavior (bizarre speech): Study 1, Josh, Phase I. The values on the abscissa indicate the number of sessions conducted while the values on the ordinate represent the percentage of intervals with the occurrence of challenging behavior (see Methods section for operational definitions of bizarre speech).

In conclusion, the FA results for Alex indicated that his challenging behavior was maintained by access to tangibles and the FA results for Josh indicated that his challenging behavior was maintained by access to attention. In Phase II of the study discrimination was trained for both Alex and Josh. Phase II results are presented next.

Phase II Results for Alex

The following Figure 4.3, presents the results of Phase II discrimination training (see methods section for a detailed description on how sessions were conducted) for Alex.

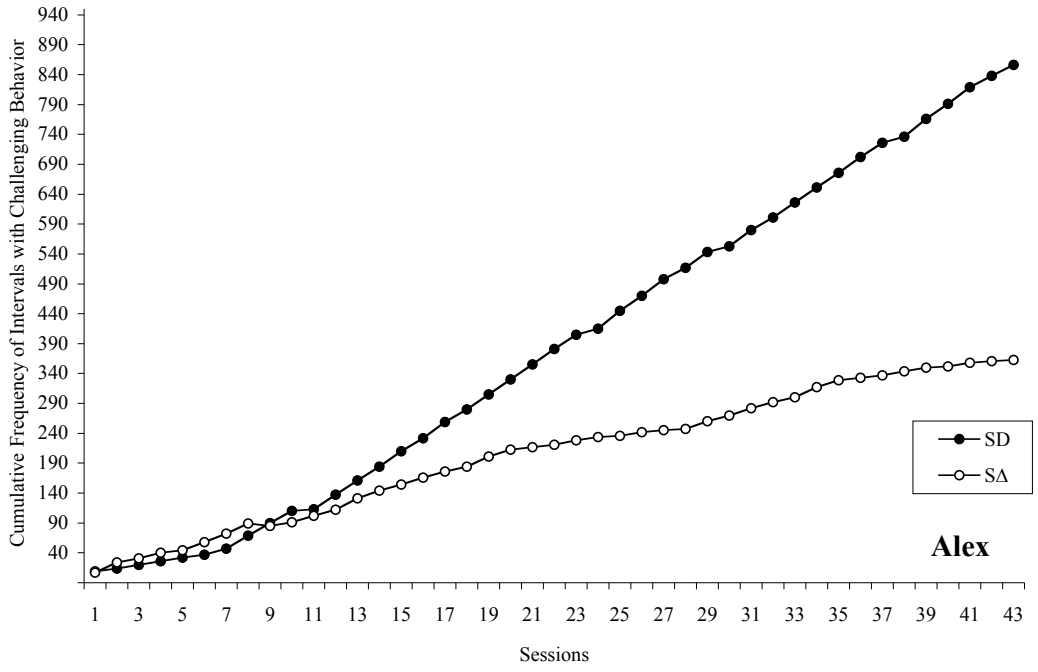


Figure 4.3. Cumulative frequency of intervals with target behavior: Study 1, Alex, Phase II. The values on the abscissa indicate the number of sessions conducted while the values on the ordinate represent the cumulative frequency of intervals with the occurrence of target behavior.

As is illustrated in Figure 4.3, by the overlapping values for both S^D and S^Δ the target behavior is initially not under stimulus discrimination. In fact responding is

slightly higher in the S^{Δ} condition when target behavior was not reinforced and all attempts were placed on extinction. During session 10, responding in the S^{D} is higher than the S^{Δ} condition. As sessions continue the target behavior is gradually under stimulus discrimination. For Alex, stimulus discrimination is reached at session 27 when responding in S^{D} is greater than 2/3[18] of the responding in S^{Δ}. Complete stimulus discrimination for Alex is reached at session 43 when responding occurred in S^{D} and not in S^{Δ}.

Phase II Results for Josh

Figure 4.4 presents the Phase II results for Josh. Unlike Alex, Josh showed differentiation in responding in session 1 (see methods section for a detailed description on how sessions were conducted). Results indicate that Josh had reached discrimination in session 3, when his responding in S^{D} was greater than 2/3 the responding in S^{Δ}. As sessions continued Josh's data indicated greater discrimination, with total discrimination resulting in session 8, when responding occurred in S^{D} and not in S^{Δ}.

[18] Skinner (1938) asserts that if the organism has reached discrimination when responding in S^{D} is greater than 2/3 responding in S^{Δ}.

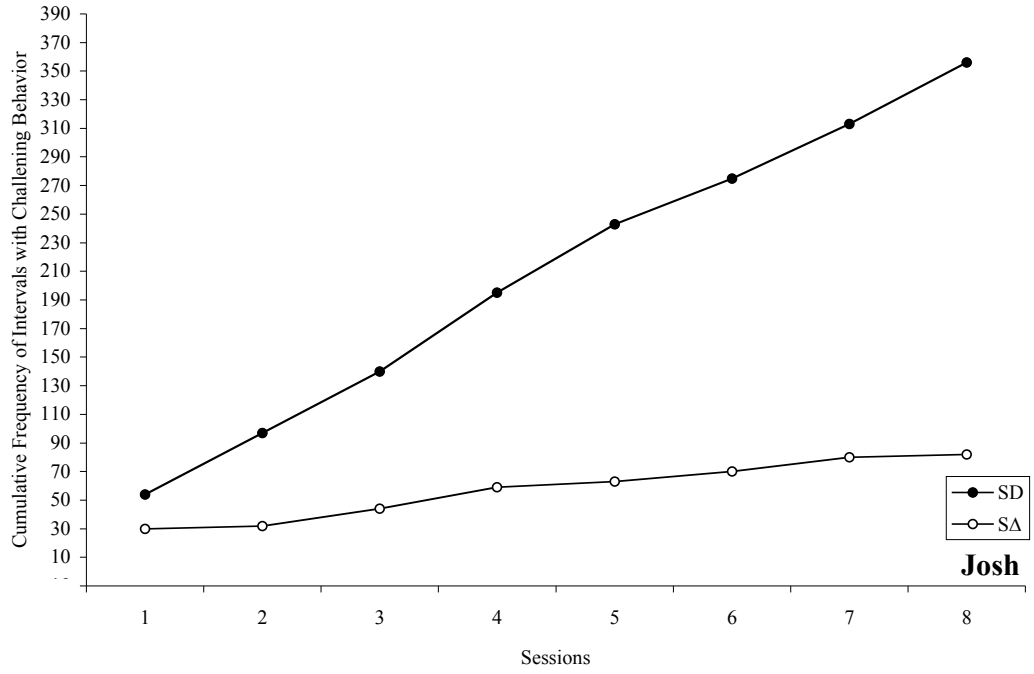


Figure 4.4. Cumulative frequency of intervals with target behavior: Study 1, Josh, Phase II. The values on the abscissa indicate the number of sessions conducted while the values on the ordinate represent the cumulative frequency of intervals with the occurrence of target behavior.

To summarize, Phase II results for both Alex and Josh indicated that they both reached stimulus discrimination under both in S^D and S^Δ. Phase III results will be discussed next.

Phase III Results for Alex

In Phase III, the consequence maintaining the operant behavior identified in Phase I, in the FA (tangibles for Alex) was manipulated by either providing pre-

session access (MO Absent) to the same or by withholding presession access (MO present) prior to the commencement of each session (see Methods section for a detailed description). The results for Alex are presented in Figure 4.5. Results indicate that when the MO was absent he had lower rates of challenging behavior during the sessions. When the MO was present he had higher rates of challenging behavior occurring during each session.

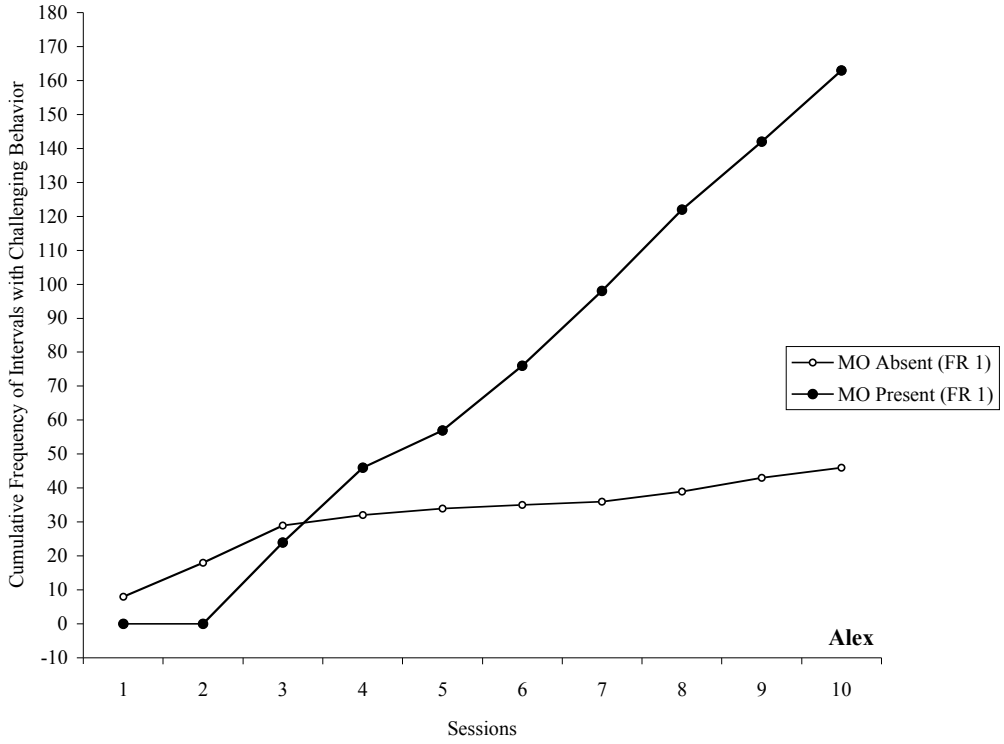


Figure 4.5. Cumulative frequency of intervals with target behavior: Study 1, Alex, Phase III. The values on the abscissa indicate the number of sessions conducted while the values on the ordinate represent the cumulative frequency of intervals with the occurrence of target behavior. Reinforcement was provided on a fixed ratio of 1 (FR-1).

Phase III Results for Josh

In Phase III, the consequence maintaining the operant behavior identified in Phase I, in the FA (attention for Josh) was manipulated by either providing pre-session access (MO Absent) to the same or by withholding pre-session access (MO present) prior to the commencement of each session (see Methods section for a detailed description). The results for Josh are presented in Figure 4.6. Results indicate that when the MO was absent he had lower rates of challenging behavior during the sessions. When the MO was present he had higher rates of challenging behavior occurring during each session.

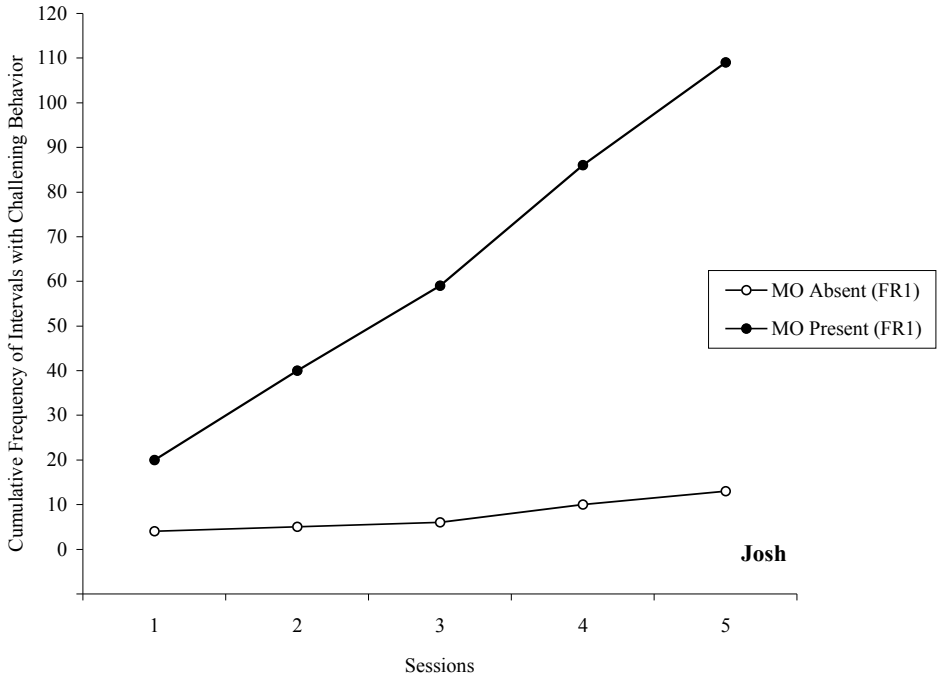


Figure 4.6. Cumulative frequency of intervals with target behavior: Study 1, Josh, Phase III. The values on the abscissa indicate the number of sessions conducted while the values on the ordinate represent the cumulative frequency of intervals with the occurrence of target behavior. Reinforcement was provided on a fixed ratio of 1 (FR-1).

To summarize, results of Phase III for both Alex and Josh indicated that when the MO for the consequence maintaining the target behavior was manipulated prior to each session that they both had lower rates of challenging behavior in the MO Absent condition and higher rates of challenging behavior in the MO Present condition. Phase IV results will be presented next.

Phase IV Results for Alex

Results of Phase IV for Alex is presented in Figure 4.7. Results in Phase IV indicate that when extinction was in effect that responding occurred at high rates when the MO was present both in S^D and S^Δ. In session 1, the frequency of intervals with target behavior under S^D when the MO was present, was 25 while the frequency of responding in S^Δ was, 5. This differentiation in responding in S^D and S^Δ continued till session 8. However, in session 8 for a brief period (session 8 & session 9) responding S^Δ was higher than responding in S^D. However, as sessions continued responding in S^D and S^Δ, differentiated yet again. The cumulative frequency of responding in S^D was 105 and S^Δ was 89. However, for both conditions (S^D and S^Δ) responding was higher when the MO was present when compared to when the MO was absent. When the MO was absent, responding in both S^D and S^Δ were at near zero levels with responding in slightly higher in S^Δ. The cumulative frequency of responding in S^D was 3 and S^Δ was 4.

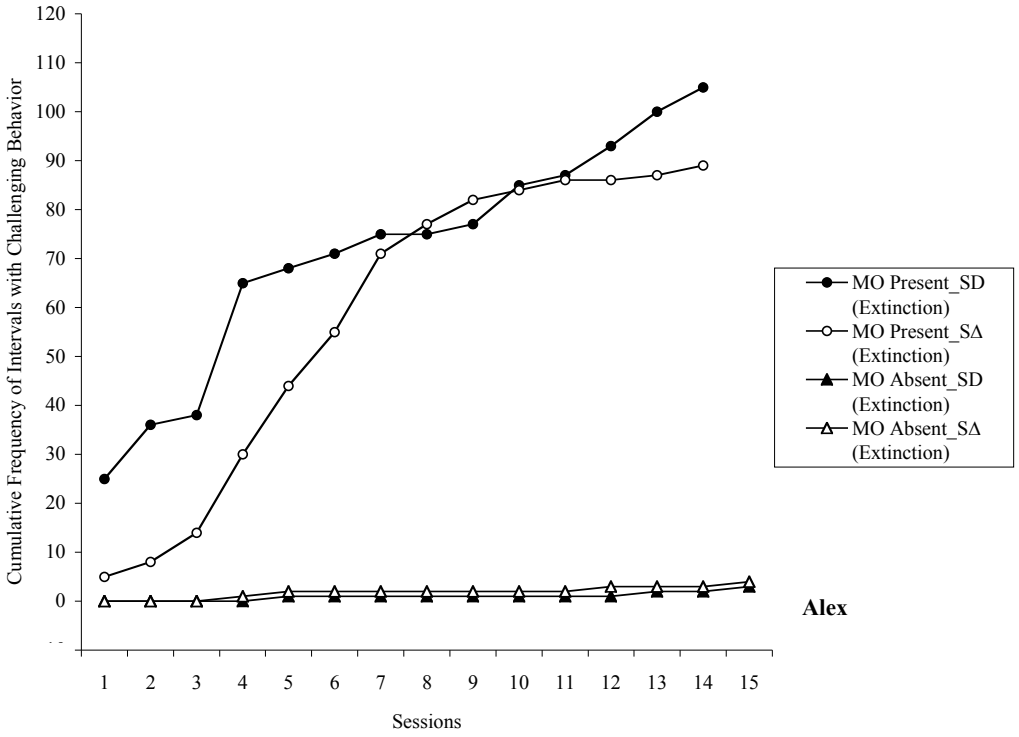


Figure 4.7. Cumulative frequency of intervals with target behavior: Study 1, Alex, Phase IV. The values on the abscissa indicate the number of sessions conducted while the values on the ordinate represent the cumulative frequency of intervals with the occurrence of target behavior. Reinforcement was not provided.

Phase IV Results for Josh

Results for Josh are presented in Figure 4.8. Results in Phase IV indicate that when extinction was in effect that responding occurred at high rates when the MO was present both in S^D and S^Δ. In session 1, the frequency of intervals with target behavior under S^D when the MO was present was 6 while the frequency of responding in S^Δ was 9. However, in session 8 for a brief period (session 8 & session 9) responding S^Δ was higher than responding in S^D. However, in session 2,

responding in S^D was 19, and S^Δ was 15. This differentiation continued till the cumulative frequency of responding in S^D was 190, and S^Δ was, 114. Thus, for both conditions (S^D and S^Δ) responding was higher when the MO was present when compared to when the MO was absent.

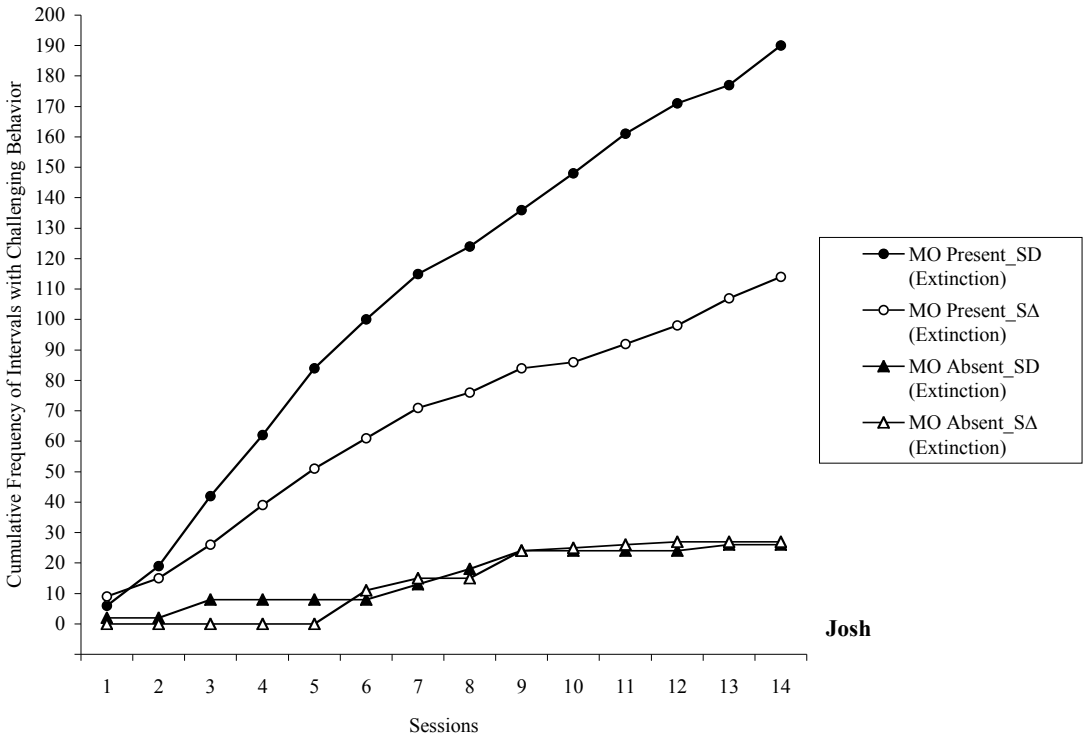


Figure 4.8. Cumulative frequency of intervals with target behavior: Study 1, Josh, Phase IV. The values on the abscissa indicate the number of sessions conducted while the values on the ordinate represent the cumulative frequency of intervals with the occurrence of target behavior. Reinforcement was not provided.

When the MO was absent responding in both S^D and S^Δ were both at much lower levels than when with not much differentiation between S^D and S^Δ. The cumulative frequency of responding in S^D was 26 and S^Δ was 27.

Summary of Results for Study 1

In Study 1, Phase I, results for Alex indicated that his challenging behavior was maintained by access to tangibles and for Josh, results indicated that his challenging behavior (bizarre speech) was maintained by access to attention. Phase II, results indicated that both Alex and Josh were able to discriminate between S^D and S^Δ conditions when reinforcement was available in the presence of S^D and unavailable in the presence of S^Δ. Phase III, results indicated that when controlled for pre-session access for MO present and MO absent conditions that responding was lower when the MO was absent and higher when the MO was present for both Alex and Josh. Phase IV, results indicated that when the MO was present rates of responding were higher in both the S^D and S^Δ for both Alex and Josh even when all attempts at responding were placed on extinction. Phase IV results indicated that when the MO was absent responding was lower in both S^D and S^Δ.

Study 2

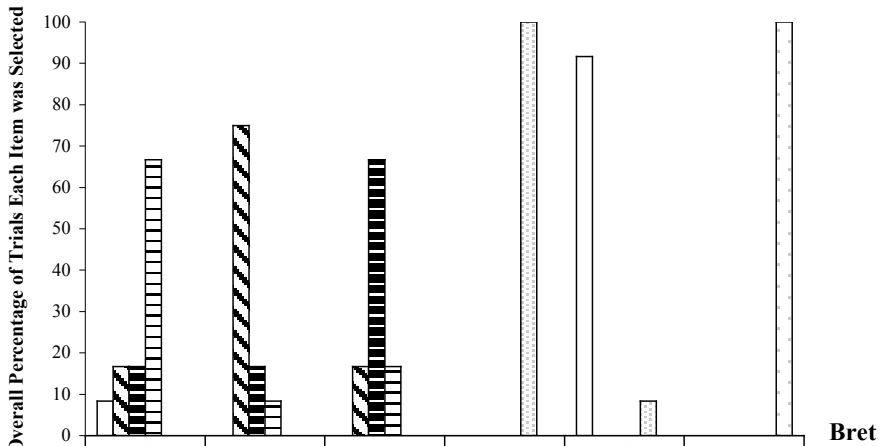
In Study 2, as in Study 1, an examination of the influence of the MO on the behavior altering effect of the S^D was undertaken. Use of a Voice Output Communication Aid (VOCA) to access identified tangible items was selected as the target behavior for Study 2.

In Phase 1, a preference assessment was conducted to identify 3 highly preferred items. In Phase II, two VOCA devices (BIGMack® switch) that differed only in color were used to train discrimination. Discrimination was trained under two conditions, a) S^D and b) S^Δ to indicate availability and unavailability to the preferred tangible items identified in the preference assessment in Phase 1. In Phase III, the MO for the preferred tangible items in Phase 1, was identified by providing pre-session access or withholding pre-session access to the items prior to the commencement of sessions. Target behavior was reinforced on a fixed ratio 1 (FR-1) schedule. In Phase IV experimental sessions were conducted in the presence of both S^D and S^Δ in MO present and MO absent conditions (see Methods section for a conceptual diagram). The target behavior was placed on extinction and not reinforced. Study 2, as in Study 1 had four phases. Results of each phase for each participant will be presented next.

Phase I Results for Bret

Phase I, preference assessment results for Bret are presented in Figure 4.9. Preference assessment results indicated that the 1st choice of preference for Bret was marshmallow. He chose marshmallow 66.67% of the time as his first choice, while he chose popcorn, and M & M, only 16.67%, and soda, 8.33% of the time as his first choice.

Results indicate that he chose popcorn, 75% of the time as his second choice. M & M was chosen 16.67%, and marshmallow was chosen 8.33% as his second choice. His third choice of preference was M & M as he chose them 66.67% of the time as his third choice. He chose popcorn and marshmallow 16.67% of time as his third choice. Bret chose cookie as his 4th choice 100% of the time. His fifth choice was soda, which he chose 91.67% of the time. Finally, he chose music as his sixth choice.



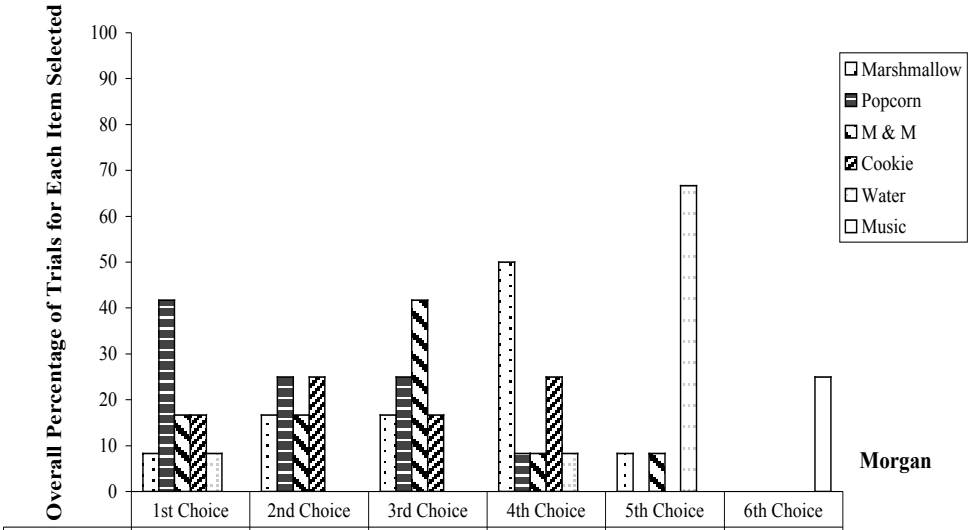
	1st Choice	2nd Choice	3rd Choice	4th Choice	5th Choice	6th Choice
Soda	8.33	0.00	0.00	0.00	91.67	0.00
Popcorn	16.67	75.00	16.67	0.00	0.00	0.00
M & M	16.67	16.67	66.67	0.00	0.00	0.00
Marshmallow	66.67	8.33	16.67	0.00	0.00	0.00
Cookie	0.00	0.00	0.00	100.00	8.33	0.00
Music	0.00	0.00	0.00	0.00	0.00	100.00

Figure 4.9. Preference assessment data for Bret. The values on the abscissa indicate the choice of preference item selected in rank order while the values on the ordinate represent the overall percentage of trials each item was selected.

To summarize, results indicated that Bret's first choice was marshmallow, second choice was popcorn, third choice was M & M, fourth choice was cookie, fifth choice was soda, and sixth choice was music when presented with an array of six items to choose from in a total of 72 trials. Highly preferred items (i.e. 1st, 2nd and 3rd choice), for Bret, which were used in Phases II-IV are shaded with darker lines.

Phase I Results for Morgan

Phase I, preference assessment results for Morgan are presented in Figure 4.10. Preference assessment results indicated that the 1st choice of preference for Morgan was popcorn. He chose popcorn 41.67% of the time as his first choice, while he chose cookie, and M & M, only 16.67%, and water and marshmallow, 8.33% of the time as his first choice.



	1st Choice	2nd Choice	3rd Choice	4th Choice	5th Choice	6th Choice
Marshmallow	8.33	16.67	16.67	50.00	8.33	0.00
Popcorn	41.67	25.00	25.00	8.33	0.00	0.00
M & M	16.67	16.67	41.67	8.33	8.33	0.00
Cookie	16.67	25.00	16.67	25.00	0.00	0.00
Water	8.33	0.00	0.00	8.33	66.67	0.00
Music	0.00	0.00	0.00	0.00	0.00	25.00

Figure 4.10. Preference assessment data for Morgan. The values on the abscissa indicate the choice of preference item selected in rank order while the values on the ordinate represent the overall percentage of trials each item was selected.

Results indicate that he chose popcorn, 25% and cookie 25% of the time as his second choice while, M & M and marshmallow were chosen only 16.67% of the time. His third choice of preference was M & M as he chose them 41.67% of the time. Popcorn was chosen 25% of the time, while cookie and marshmallow were chosen 16.67%, of time as his third choice. He chose marshmallow 50% of the time as his 4th choice and cookie, 25% of the time, while M & M, popcorn, and water were chosen 8.33% of the time as his fourth choice. His fifth choice, was water, which he chose 66.67% of the time, while M & M and marshmallow were chosen 8.33% of the time. Finally, he chose music as his 25% of the time as his sixth choice. Highly preferred items (i.e. 1st, 2nd and 3rd choice), for Morgan, which were used in Phases II-IV are shaded with darker lines.

Phase II Results for Bret

Results of Phase II for Bret are presented in Figure 4.11. As is illustrated in Figure 4.10, the target behavior is initially higher in the S^{Δ} condition than in the S^{D} condition even when in the S^{Δ} condition when target behavior was not reinforced and all attempts were placed on extinction. However, during session 7, responding S^{Δ} condition stabilizes 10 sessions and responding continues to decrease till cumulative responding in session 35 is at 647. Responding in S^{D} continues to increase at a steady pace for 40 sessions with cumulative frequency of responding at session 40 at 1280. For Bret, stimulus discrimination is reached at session 14 when differentiation in

responding in S^D is greater than 2/3[19] of the responding in S^Δ. However, as responding during S^Δ, was at much higher rates during the first 6 sessions, visually the results may appear not to be under stimulus discrimination until session 37. Complete stimulus discrimination for Bret was reached at session 25, when responding occurred in S^D and not in S^Δ.

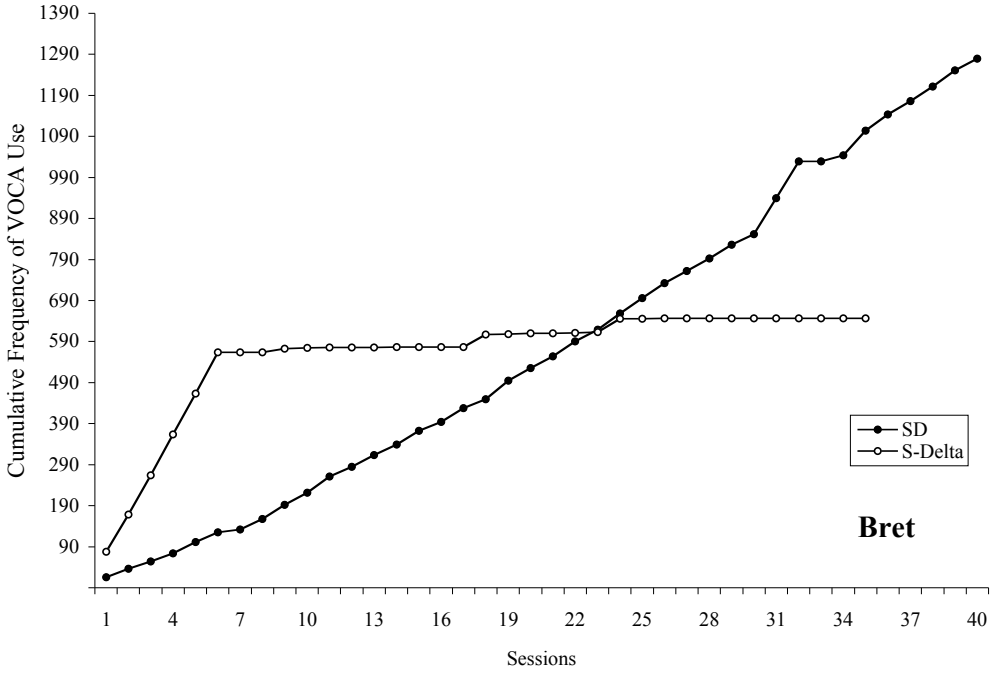


Figure 4.11. Cumulative frequency of intervals with target behavior: Study 2, Bret, Phase I. The values on the abscissa indicate the number of sessions conducted while

[19] Skinner (1938) asserts that if the organism has reached discrimination when responding in S^D is greater than 2/3 responding in S^Δ.

the values on the ordinate represent the cumulative frequency of intervals with the occurrence of target behavior.

Phase II Results for Morgan

Phase II, results for Morgan are presented in Figure 4.12. As is illustrated in Figure 4.11, the target behavior is initially at similar rates of responding in both S^{Δ} and S^{D} conditions even when in the S^{Δ} condition when target behavior was not reinforced and all attempts were placed on extinction.

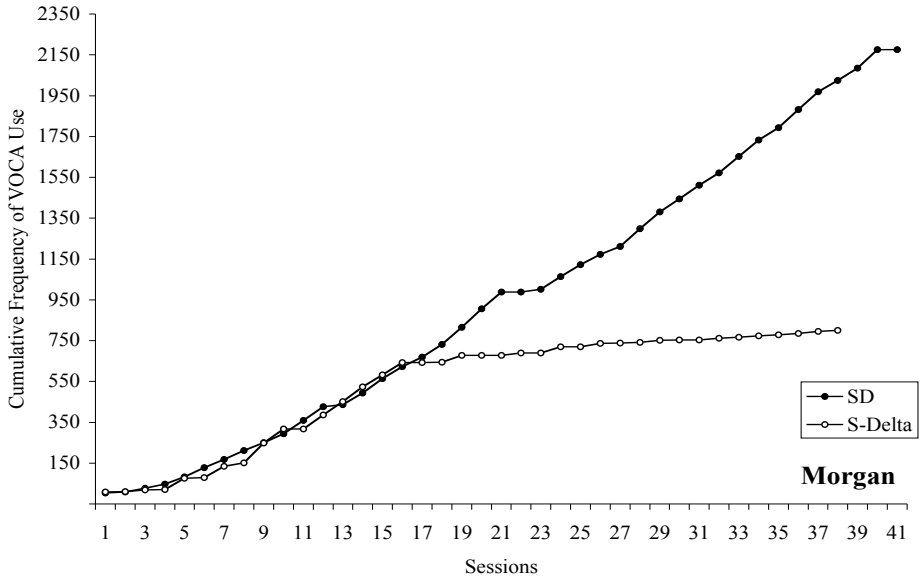


Figure 4.12. Cumulative frequency of intervals with target behavior: Study 2, Morgan, Phase II. The values on the abscissa indicate the number of sessions conducted while the values on the ordinate represent the cumulative frequency of intervals with the occurrence of target behavior.

However, during session 17, responding in the S^{Δ} condition stabilizes and responding continues to decrease till cumulative responding in session 39 is at 801. Responding in S^{D} continues to increase at a steady pace for 41 sessions with cumulative frequency of responding at session 41 at 1275. For Morgan, stimulus discrimination is reached at session 21 when differentiation in responding in S^{D} is greater than 2/3[20] of the responding in S^{Δ}. Complete stimulus discrimination for Morgan was reached at session 27, when responding occurred in S^{D} and not in S^{Δ}.

Phase III Results for Bret

In Phase III, pre-session access to the highly preferred items identified in the Phase I were manipulated by either providing pre-session access (MO Absent) to the same or by withholding pre-session access (MO present) prior to the commencement of each session (see Methods section for a detailed description).

Phase III, results for Bret are presented in Figure 4.13. The results for Bret indicate that when the MO was absent he had lower rates of responding (VOCA use) during the sessions. When the MO was present he had higher rates of responding during each session even when reinforcement for both MO present and MO absent conditions were presented on a fixed ratio schedule of 1.

[20] Skinner (1938) asserts that if the organism has reached discrimination when responding in S^{D} is greater than 2/3 responding in S^{Δ}.

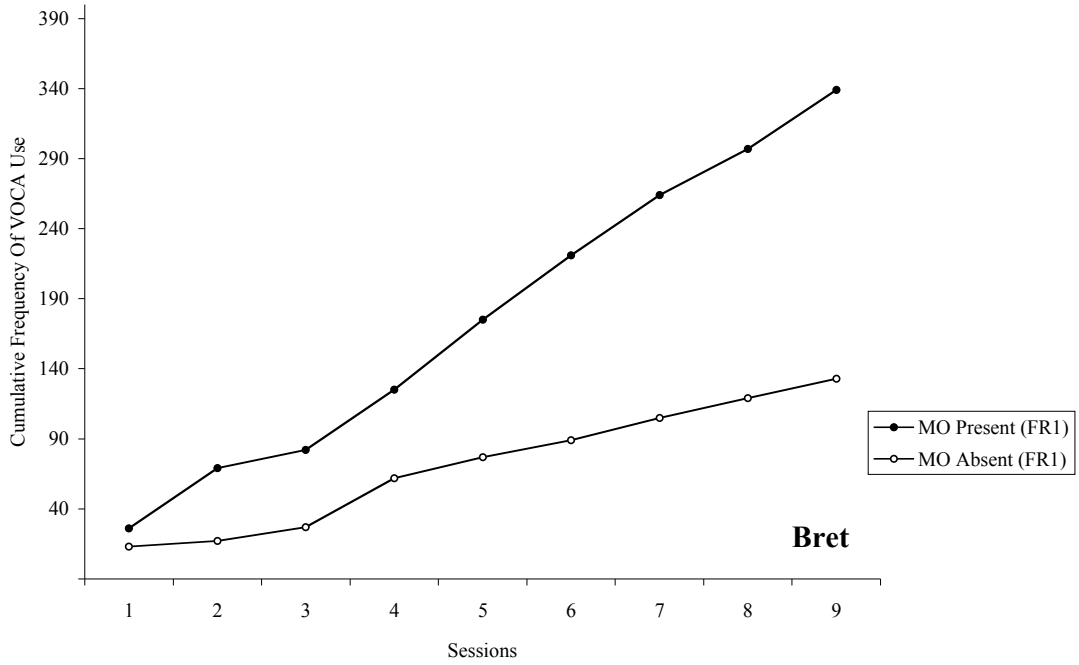


Figure 4.13. Cumulative frequency of intervals with target behavior: Study 2, Bret, Phase III. The values on the abscissa indicate the number of sessions conducted while the values on the ordinate represent the cumulative frequency of intervals with the occurrence of target behavior. Reinforcement was presented on a fixed ratio 1 schedule.

Phase III Results for Morgan

Phase III results for Morgan are presented in Figure 4.14. In Phase III, pre-session access to the highly preferred items identified in the Phase I were manipulated by either providing pre-session access (MO Absent) to the same or by withholding pre-session access (MO present) prior to the commencement of each session (see Methods section for a detailed description). The results for Morgan indicate that when

the MO was absent he had lower rates of responding (VOCA use) during the sessions. When the MO was present he had higher rates of responding during each session even when reinforcement for both MO present and MO absent conditions were presented on a fixed ratio schedule of 1.

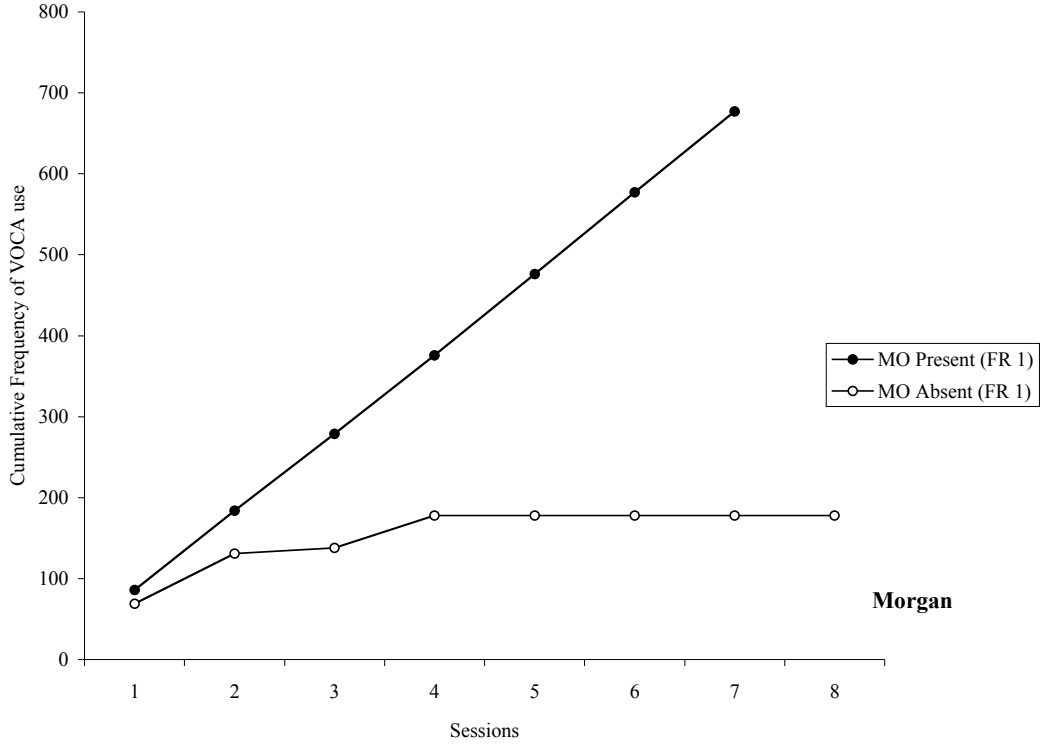


Figure 4.14. Cumulative frequency of intervals with target behavior: Study 2, Morgan, Phase III. The values on the abscissa indicate the number of sessions conducted while the values on the ordinate represent the cumulative frequency of intervals with the occurrence of target behavior. Reinforcement was presented on a fixed ratio 1 schedule.

Phase IV Results for Bret

Phase IV results for Bret are presented in Figure 4.15. Results in Phase IV indicate that when extinction was in effect that responding occurred at high rates when the MO was present both in S^D and S^Δ. In session 1, the frequency of intervals with target behavior under S^D when the MO was present, was 68 while the frequency of responding in S^Δ was, 12. This differentiation in responding in S^D and S^Δ continued till session 8. The cumulative frequency of responding in S^D was 154 and S^Δ was 41. However, for both conditions (S^D and S^Δ) responding was higher when the MO was present when compared to when the MO was absent. When the MO was absent, responding in both S^D and S^Δ were at near zero levels with responding increasing slightly after session 4. The cumulative frequency of responding in S^D was 9 and S^Δ was 1.

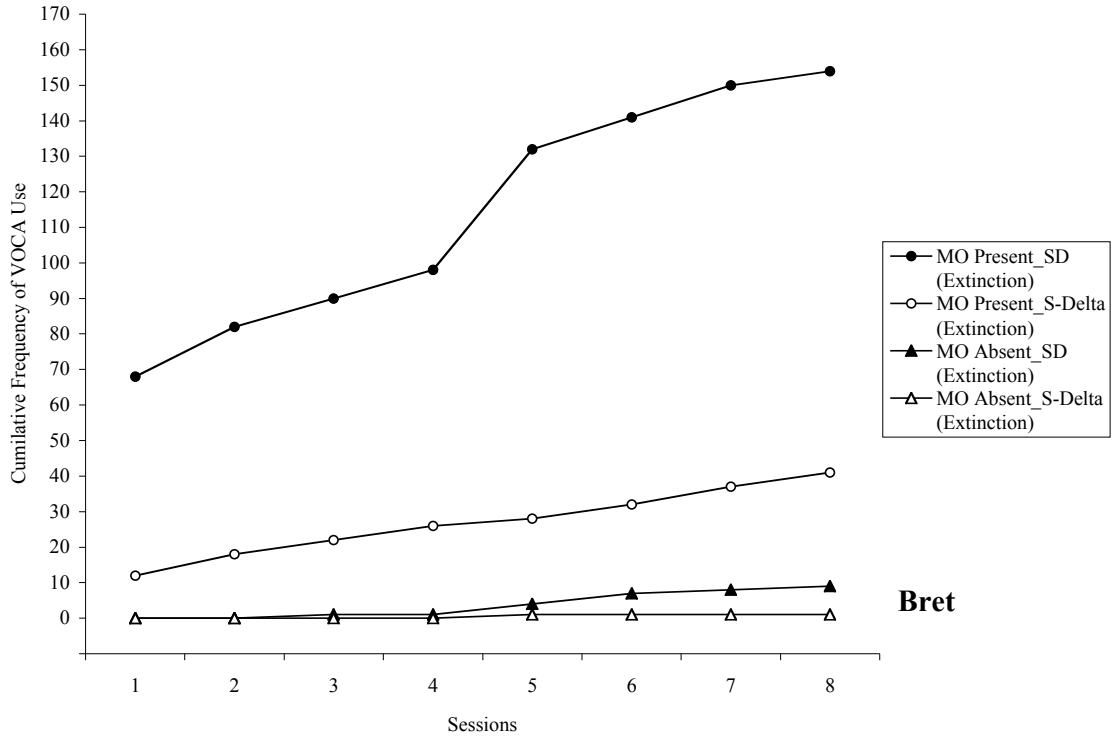


Figure 4.15. Cumulative frequency of intervals with target behavior: Study 2, Bret, Phase IV. The values on the abscissa indicate the number of sessions conducted while the values on the ordinate represent the cumulative frequency of intervals with the occurrence of target behavior. Reinforcement was presented on a fixed ratio 1 (FR-1) schedule.

Phase IV Results for Morgan

Phase IV results for Morgan are presented in Figure 4.16. Results in Phase IV indicate that when extinction was in effect that responding occurred at high rates when the MO was present both in S^D and S^Δ. In session 1, the frequency of intervals with target behavior under S^D when the MO was present, was 2 and MO absent was zero, while the frequency of responding in S^Δ was, zero for both MO absent and MO

present. This differentiation in responding in S^{Δ} when the MO was both present and absent continued till session 8. Responding in S^{D} when the MO was present continued to increase with the cumulative frequency of responding for 12 sessions at 31. Responding in S^{Δ} when the MO was present continued to increase with the cumulative frequency of responding for 12 at 20.

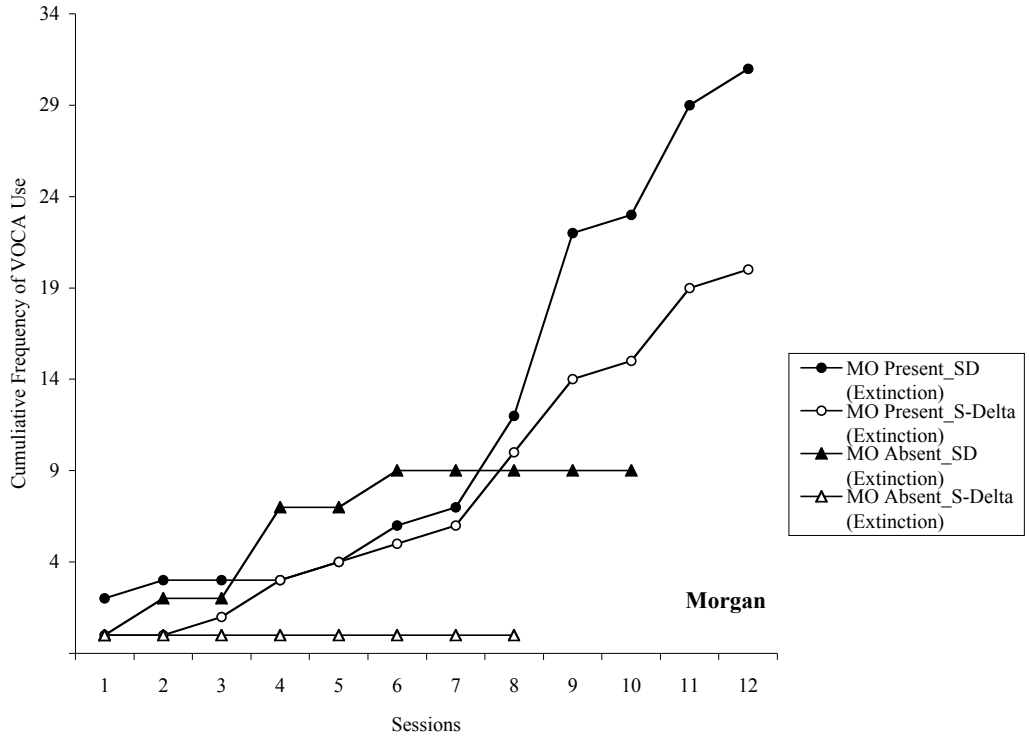


Figure 4.16. Cumulative frequency of intervals with target behavior: Study 2, Morgan, Phase IV. The values on the abscissa indicate the number of sessions conducted while the values on the ordinate represent the cumulative frequency of intervals with the occurrence of target behavior. Reinforcement was presented on a fixed ratio 1 (FR-1) schedule.

However, when the MO was absent and the S^D was present responding increased for 6 sessions and stabilized for 4 sessions (sessions 7-10 had zero responding) thereafter with cumulative responding at session 10 at 9. Overall, for both conditions (S^D and S^Δ) responding was higher when the MO was present when compared to when the MO was absent. When the MO was absent, responding in both S^D

Summary of Results in Study 2

In Study 2, Phase I, results for Bret indicated that his three highly preferred items were marshmallow, M & M and popcorn. Results for Morgan, indicated that his highly preferred items were popcorn, M & M and cookie. Phase II, results indicated that both Bret and Morgan were able to discriminate between S^D and S^Δ conditions when reinforcement was available in the presence of S^D and unavailable in the presence of S^Δ. Phase III, results indicated that when controlled for presession access for MO present and MO absent conditions that responding was lower when the MO was absent and higher when the MO was present for both Bret and Morgan. Phase IV, results indicated that when the MO was present rates of responding were higher in both the S^D and S^Δ for both Bret and Morgan even when all attempts at responding were placed on extinction. Phase IV results indicated that when the MO was absent

responding was lower in both S^{D} and S^{Δ}. Results of Study 1 and Study 2 were similar in all phases across target behavior for all four participants.

Interobserver Reliability

Interobserver reliability is presented in Table 1. Interobserver agreement was calculated according to the Interval-by-Interval method (Hawkins & Dotson, 1979). In addition, Cohen's kappa coefficient was used to calculate reliability between the primary observer and the secondary observer. Kappa was calculated by hand by using the formula k = (Oa - Ea)/(N - Ea) (see Methods section for a detailed description on how Kappa was calculated).

Table 1
Interobserver Reliability for Study 1 & 2 Across Phases

	IOA		3rd party reliability		
Subscale	I-I	Range	I-I	Range	Kappa
Study 1 Phase 1	98.1%	83.3%-100%			.94
Study 1 Phase I1	96.6%	86.6%-100%			.838
Study 1 Phase III	93.0%	86.6%-100%	98.1%	90%-100%	.852
Study 1 Phase IV	100%		100%		1
Study 2 Phase 1	100%		100%		1
Study 2 Phase II	98.1%	83.3%-100%			.81
Study 2 Phase III	93.3%	74%-100%	98.33%	96.0%-100%	.76
Study 2 Phase IV	100%		72%	76.0%-100%	1

CHAPTER 5

DISCUSSION

> The immediate tangible results of science make it easier to appraise than philosophy, poetry, art or theology…all scientists, whether giants or not, enable those who follow them to begin a little further along. (Skinner, 1953, p. 11)

There were two studies conducted in this dissertation. The conceptual logic and methodology for both studies were the same although the topography of behavior studied differed. Phase 1 of each study identified the consequence maintaining the operant. Results of Phase II indicated that all four participants were able to discriminate between S^D and S^Δ conditions. In Phase III the relevant MOs for the target behavior were directly manipulated. Responding was shown to be higher following pre-session conditions in which the MO was present than conditions in which the MO was absent. Finally, Phase IV results indicated that during extinction responding was higher in both the S^D and S^Δ conditions when the MO was present. However when the MO was absent, responding was lower in both S^D and S^Δ.

In both studies results of Phase I demonstrated the consequence maintaining the operant and Phase II demonstrated stimulus discrimination. The results of these two phases by themselves are not noteworthy for an extensive discussion. The implications of identifying the consequence maintaining operant behavior as well as stimulus discrimination have been studied and reported extensively over the years by

numerous researchers (Luiselli & Cameron, 1998). However, the results of Phases I & II were necessary to facilitate Phases III-IV. These latter phases (Phase III-IV) will be discussed in greater detail in the following sections with consideration given to their implications for application to applied settings.

Relevance of Phase III Results

Phase III results indicated that direct manipulation of the MO, had an effect on the responding of participants. That is results indicated that when reinforcement was contingent on target behavior responding was lower in MO absent conditions and higher in conditions when MO was present. Phase III results are not novel and are consistent with previous studies that have examined the reinforcer altering effects of the MO (Gottschalk, et al., 2000; Vollmer & Iwata, 1991). Skinner (1953) proposed that when an organism is under deprivation (MO present) for a given reinforcer, that responses maintained by the same reinforcer will be emitted at increased levels. Conversely, satiation (MO absent) will reduce responding even when the reinforcer is accessible. McGill (1999) asserted that for every class of maintaining consequences that there are parallel MOs that either establish or abolish the effectiveness for that class of reinforcement. While it is impossible to validate that McGill's conceptual logic holds true for *every* class of maintaining consequences, Phase III results, do support his notion that parallel MOs have either establishing or abolishing effects for a class of reinforcement. Although the adaptive significance of these operations is most evident in basic biological processes like *hunger* their application to applied

settings and the treatment of challenging behavior is not lost.

Challenging behavior is not unique to persons with developmental disabilities, but is more common with this population than in people without developmental disabilities (e.g., Einfeld & Tongue, 1996; Kennedy & O'Reilly, in press). The overall prevalence of problem behavior for this total population can be as high as 16.5% (Qureshi, 1994). Research has further indicated that challenging behaviors tend to develop early in life and, once present, persist well in to adult years (Green, O'Reilly, Itchon, & Sigafoos, 2005; Emerson et al., 2001).

An historical examination of the treatment strategies used in applied behavior analysis suggests that most treatment strategies have focused on the reduction of challenging behavior through the manipulation of consequences (McGill, 1999; Luiselli & Cameron, 1998). However, in recent years the trend has been to move away from consequence-based interventions and to develop antecedent-based interventions. Additionally, inclusion of the MO may enhance the effectiveness of other interventions and contribute to a better understanding of both the evocation of challenging behavior as well as the reinforcing effectiveness of the maintaining consequences. McGill states,

> It is likely that clinically significant, long term, generalized change in challenging behavior can only occur if the EOs [MO's] that evoke behavior…are addressed in treatment. (pp. 406-407)

In Study 1, both participants exhibited challenging behavior that differed in topography; self injury and aggressive behaviors (Alex), and bizarre speech (Josh). Both these behaviors when exposed to presession satiation to that MO (MO absent)

occurred at as much as 70% less than when compared to when the MO for the same behavior was present. These results indicate that it may be prudent to consider combining MO manipulations in the design of behavioral support plans in educational settings. This can be accomplished by programming in periods of satiation to the MOs identified for the target behavior.

These results of this dissertation have significant applied implications. For example, in an classroom situation, programming in a rich schedule of attention prior to periods of time when it may not be possible to provide attention would have an abolishing effect and reduce the occurrence of challenging behavior for students whose challenging behavior is maintained by access to attention. Such an antecedent intervention would be useful for educational settings and easily implemented in settings wherein teachers are often juggling multiple tasks and do not always have time to devote to one-one interactions with students who engage in attention-maintained challenging behavior. The failure of many interventions (such as the provision of non-contingent attention) to maintain in certain settings may be due to a poor 'goodness of fit' in the context in which they are implemented (Albin et al., 1996). The results of the current study suggest that a relatively brief intervention that involved manipulation of the relevant MO may provide a better 'fit' in applied settings. For example, group instruction, and circle time are part of regular preschool schedules. However, for a child's whose behavior is attention maintained these activities can be often difficult and disruptive in terms of classroom management due to the relatively low-levels of 1:1 attention. Therefore, by scheduling in periods where

the child has had access to attention prior to the onset of these activities potentially disruptive situations may be avoided.

Such antecedent behavior management is not confined to school settings. The principles of antecedent management of challenging behavior apply across settings. The results of this dissertation have implications for home-based interventions. Consider, for example, that you are a parent with two kids, John and Brea. John has a developmental disability and displays challenging behavior maintained by attention. Brea is a newborn. Now imagine you need to give a bath to the newborn. Results of Phase III, suggests that you may be able to satiate John for a period of time prior to attending to Brea's bath and thus avoid a potentially dangerous situation.

Beyond the above-mentioned application of MO manipulations to applied settings, an interesting participant characteristic in Study 1, lends itself to mention in reference to MO manipulations. In Study 1, Josh's data indicated that challenging behavior is not restricted to self injurious or aggressive behaviors, but can include verbal behaviors such as bizarre speech, that are socially deemed unacceptable. Bizarre speech, while it may appear to be less challenging than aggression or self-injurious behavior is just as problematic, as it excludes the individual from being integrated in the community. Several studies have examined the operant functions of bizarre speech. Most of these studies have identified attention as the maintaining consequence for bizarre speech (Lancaster, LeBlanc, Carr, Brenske, Peet, & Culver, 2004; Dixon, Benedict, & Larson, 2001). In a recent study, Lancaster, et al., (2004) examined the effects of non-contingent reinforcement (NCR) in the form of attention

(attention delivered to participants on a fixed-time schedule) for bizarre speech with two participants. Prior functional analyses had identified their bizarre speech was attention maintained. Their results indicated that exposing the participants to periods of non-contingent attention decreased bizarre speech. Their results reflected results of other studies that have used NCR to reduce challenging behavior (for example, see Wilder et al., 2000). While Lancaster, et al., (2004) did not conceptualize non-contingent reinforcement as a possible abolishing operation (MO absent) their results however indicate that NCR may act as an MO. For example, in Study 1, Phase III, when Josh was exposed to presession attention in the MO absent condition, results indicated that his bizarre speech was lower than in the MO present condition. These results of Phase III, support the idea that bizarre speech, often linked to biological variables (schizophrenia) and often viewed as communication difficulties (Lancaster, et al., 2004) can be reduced by MO manipulations.

The link between communication abilities and the presence of challenging behavior have been oft cited in the literature (e.g. Carr & Durand, 1985). It has been demonstrated that more severe communication difficulties, both expressive (Emerson et al., 2001; Bott et al., 1997; Emerson; 1995; Schroeder et al., 1978), and receptive (Emerson et al., 2001; Sigafoos, 2000) have been correlated with challenging behavior. This assertion can be supported by the numerous studies that have used procedures such as functional communication training to teach individuals with developmental disabilities functionally equivalent communications reponses to replace challenging behavior (Durand, 1999). Sigafoos (2000) reported, that while the

relationship between challenging behavior and communication is correlational, that challenging behavior may be linked to third variable such as neurological and biological variables. Results of Study 1, Phase III support that there may be may be environmental MOs that may be either 'captured' or 'contrived' to enhance the effectiveness of interventions designed to address challenging behavior (Sundberg, 1993). For example, individuals with autism typically have difficulty in not only acquiring novel responses but also maintaining these responses and generalizing them to new untrained environments (National Research Council, 20001). Teaching functional communication training (FCT) in the presence of an MO may enhance the effectiveness of the intervention by increasing the value of a reinforcer (e.g., tangibles) and increasing the probability of a response associated with this consequence in the past (e.g., VOCA use). On the other hand, attempts to teach a functionally equivalent response in the absence of the relevant MO (i.e. following satiation) may result in poor acquisition. For example, in educational settings, teachers who may want to increase communication attempts in a students may want to consider communication training (e.g. VOCA use) in the context of deprivation to an identified reinforcer to capitalize on the effectiveness of the reinforcer when the MO for that reinforcer is present.

Furthermore, addressing these co-varying variables and analyzing them from an MO perspective may shed light on the contextual variables that have both value altering and behavior altering effects. Results of Phase III, offer preliminary evidence to support the concept of combining interventions to address not only the individuals

'challenging needs', such as deficits in communication (Durand, 1990; Sigafoos, 2000) but also the 'challenging environment', such as lack of attention contingent on adaptive behavior (McGill, Clare, & Murphy, 1996).

Additionally, there is current interest in developing positive behavior supports (PBS) for individuals with challenging behavior (Carr, 1999). Antecedent manipulations form a key component of PBS primarily because they act as preemptive intervention strategies and are considered a non-aversive solution to managing challenging behaviors (Carr, 1995; Durand, 1990). Positive behavior supports are based on the philosophy that educational environments should be designed to facilitate opportunities for learning adaptive behaviors rather than managing maladaptive behaviors (Emerson, 2001b). This idea of prevention, is not new, and is consistent with behavior management programs that have strived to reduce challenging behavior (Dunlap, Foster Johnson, & Robbins, 1990). While previous programs have focused on consequence-based interventions, however, an MO perspective may draw attention to: (a) possible limitations, and (b) extensions of approaches based on reinforcement contingencies maintaining challenging behavior (McGill, 1999).

Relevance of Phase IV Results

A third effect, of MOs mentioned by Michael (1993a, 1993b) that has been overlooked in the literature with respect to MOs, is the behavior altering effects of

S^Ds. Laraway, et al., (2003) pointed out that, MOs influence discriminative stimuli (a) by making reinforcement and punishment possible, and (b) by changing the control over behavior exerted by previously established S^Ds. And further stated that once a S^D has been developed, the behavioral effects of that stimulus will be seen only when the relevant MO is in effect (Laraway, et al., 2003). Klatt and Morris (2001), stated that the behavior-altering effect of MOs, can be see most clearly during extinction. Such manipulations of MOs and their relevant S^Ds had not been attempted prior to the current study.

Results of Phase IV, for both Study 1 and Study 2, demonstrated the behavior altering effect of the MO on the S^D in the context of extinction. Specifically, results from Phase IV in both studies indicated that, during extinction responding was higher in both the S^D and S^Δ conditions, when the MO was present than when the MO was absent. These results indicated that in the context of extinction the MO had a behavior-altering effect on the S^D. Previous research had failed to isolate this behavior-altering effect of the MO. These results suggest important implications for (a) using operant extinction in applied settings, (b) examining the behavior altering effect of the MO and, (c) examining the behavior altering effect of the MO on the S^D.

An abundance of studies have demonstrated that operant extinction can produce rapid reductions in challenging behavior (Lerman, Iwata, & Wallace, 1999). Furthermore, studies have demonstrated that the process of extinction may be vital to the success of treatments such as differential reinforcement (Wacker, et al., 1990).

Yet, Lerman, et al., make the cogent argument that extinction may be associated with a number of undesirable side effects; (a) extinction bursts (which is a temporary increase in the frequency, duration, or magnitude of the target behavior), and (b) extinction induced aggression (an increase in aggressive behaviors). One of the major contributions of the development of antecedent based treatments, has been to provide alternatives, to the use of aversive consequences, and a reliance on extinction for the treatment of challenging behavior (Smith & Iwata, 1997). Smith & Iwata (1997) conclude, that if the MOs that establish challenging behavior as reinforcing could be controlled, or if the conditions under which challenging behavior is likely to be reinforced could be limited, then that it may be possible to avoid using aversive consequences that produce negative side effects in extinction based treatments. Results of Phase IV, of both Study 1, and Study 2, indicated that during extinction responding was lower in both the S^D and S^Δ conditions when the MO was absent than when the MO was present. These results have important implications for interventions that may need to use extinction either to rapidly reduce challenging behavior or to implement differential reinforcement.

Additionally, results of Phase IV indicated that when the MO for the contingency maintaining the behavior was absent that operant responding was lower even when the S^D for that behavior was present. The applied implications of these results are two fold. First, they imply that it may be prudent to combine operant extinction with some manipulation of MOs (e.g., prior satiation with the consequences) in order to reduce the negative side effects of extinction during

intervention. Second, they imply that it is not necessary to remove the S^Ds that signal reinforcement from the environment when the relevant MO (abative) is in effect. This second finding may have important relevance for educational and applied settings where it is not always possible to remove the S^Ds from the environment. For example, consider that challenging behavior for a child is maintained by access to tangibles in the form of savory snacks. It may not be always possible to remove savory snacks from the child's environment (e.g., the parent may need to go the grocery store with the child, child may see a television commercial advertising savory snacks etc.,). However, results of Phase IV indicate that when the relevant MOs are manipulated, (that is when the child has being satiated to snacks) then, during the period of time immediately following satiation, that even under extinction there may be reductions of challenging behavior.

A final implication of Phase IV that warrants further attention are the effects of the MO on the S^Δ conditions. Responding in S^Δ conditions, when the MO was present remained at high levels during extinction when compared to when the MO was absent. This has significant implications for applied interventions. For example, treatment failure, in the context of extinction, may be a direct result of MO levels as opposed to stimulus control. Future research would be well served to examine the effects of MO levels on S^Δ conditions when designing interventions.

It is likely that as we develop and refine technologies to better understand operant behavior that we are able to better design interventions to help improve the

quality of life of individuals with developmental disabilities. Results of Phase III and Phase IV suggest that intervention research may benefit from such MO manipulations to address behaviors as complex as challenging behavior and augmentative communication.

Additionally, Phase IV results may indicate ways in which an assessment methodology can identify the behavior-altering effect of the MO on the S^D. By identifying and controlling functional relations between the MO and the S^D, it may be possible to build experimental models of analyzing the three-term-contingency, in the context of not only the value-altering effects, but also the behavior-altering effects of the MO. For example, it may be prudent for future research to examine how the behavior altering effect of MOs, such as health issues (including physical and mental health) may have on their associated S^Ds.

An under researched area with individuals with developmental disabilities is related to the area of emotions and mental health. Skinner (1953) suggested that processes such as deprivation could also apply to *emotions* diverse as rage, love, fear, anger, joy, sorrow, frustration, anxiety, as well as psychiatric and phobic responses. He noted, that these *emotions* share common features in that, they are induced by some environmental condition, and that they alter the probability of a class of behaviors distinguished by a ‘‘common consequence’’ (Skinner, 1953, p. 166). Such *emotions* fall directly into the area of CMO-S (see Chapter 2 for a discussion of CMO-S). Smith & Iwata (1997) noted, that emotional stimuli do not derive their behavior altering effects via differential access to reinforcement, but that they do

however momentarily alter the effectiveness of certain forms of reinforcement. Additionally, they alter the frequency of conditioned and unconditioned responses associated with those reinforcers. An examination of such CMO-S variables may be timely and offer a wider array of treatment strategies to program interventions for persons with disabilities.

To conclude, together, Study 1 and Study 2, supported a beginning trend in examining the behavior-altering effects of MOs. Careful study of MOs that have behavior altering effects on the S^D may not only result in an expansion of treatment alternatives but may also contribute to a fundamental understanding of the mechanisms of the discriminated operant. It is this final perspective that informs not only theoretical efforts but provides challenges for future research.

Future Research

There are a number of limitations with this research that should be addressed in future work. The sample size in this study is quite small therefore this methodology needs to be replicated either directly or systematically with other participants. In addition, an attempt to isolate the effects of the MO on the reinforcing power of the consequences was not undertaken in this study. Such an examination would have broadened the scope of this study. However, this would have required a different methodology where the MO and the S^D are held constant while various parameters of reinforcing consequences are manipulated. Additionally, the relationship between the MO and the S^D was examined only for social-positive

reinforced behavior. However, MOs are also important when considering social-negative reinforced challenging behavior (e.g., Smith, Iwata, Hang-Leong, & Shore, 1995). Clearly, there is a need to examine how such antecedent variables influence negatively reinforced challenging behavior. Further research is needed to develop a methodology to clarify such antecedent functional relationships for negatively reinforced behavior.

However, as it stands, the results of this study may help researchers understand how the MO enters into a functional relationship with the S^D. Such information may help clinicians and practitioners build better interventions to address challenging behavior that is positively reinforced in individuals with developmental disabilities.

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