INCREASING MAND VARIABILITY IN PRESCHOOLERS WITH AUTISM

by

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ABSTRACT

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Language development and the ability to access reinforcement in young children with autism may be impeded by lack of behavioral variability in verbal behavior. The purpose of this study was to investigate the effects of simultaneously teaching multiple responses and extinction of repetition on producing varied verbal behavior in young children with autism. In particular, we examined the effects of these procedures on increasing the behavioral variability of mands used to request edibles in preschool children with autism. For all three participants, neither increasing mand repertoires via teaching multiple responses, nor extinction of repetition, by themselves or in combination were effective at producing stable behavioral variability. However, antecedent strategies (presence of visual cues) were effective at producing varied manding for all three participants.
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CHAPTER 1
INTRODUCTION

After feeding two $1 bills into an often used and historically reliable soda machine, a man presses the button displaying the name of his favorite soda and waits eagerly for the sound of the can dropping. Nothing. He presses the button a second time. Again, nothing. He presses the button harder, then harder, then simultaneously harder and repeatedly. Still, no sound. He presses the button of his second favorite soda, but remains soda-less. He presses the money return button, retrieves his bills and repeats the above process. No success. He tries pressing the button with two hands; maybe more force is required. He tries pressing and wiggling; perhaps there is a bad wire connection. He reaches his hand into the hole from which the soda should come plopping. He slaps the front of the machine with open hands, then bangs on the sides with fists. Finally, he grabs the upper edges of the machine and gives it a violent shake. He hears a sound! To his surprise and delight, the soda can drops down and he retrieves it triumphantly.

What accounts for the range of responses expressed in the above example? One explanation is extinction induced behavioral variability. Organisms who display behavioral variability can engage in a range of topographically different responses to access the same consequence. As related to the above example, when one response in a class contacts extinction, the organism can engage in other responses that have a history of successfully leading to reinforcement. Engaging in diverse responses can also lead to the emission of novel responses that may (or may not) contact reinforcement in the current situation, thereby potentially adding responses to the class. Too much variability
might result in indiscriminant responding and an inability to select responses that reliably produce desired effects. On the other hand, too little variability may result in inflexible responding, impeding the development of rich response classes, as well as the ability to maximize access to reinforcement.

Neuringer (2002) and Lee, Sturmey, and Fields (2007) reviewed the existing body of literature and concluded that basic and applied researchers have reliably demonstrated that behavioral variability is an operant (i.e., can be controlled by its consequences, and come under stimulus control). Establishing that behavioral variability is an operant means that it can be directly influenced via environmental stimuli and contingencies. The results of several studies demonstrate that behavior variability can be directly produced and controlled by access to reinforcement and contact with extinction (Blough, 1966; Duker & van Lent, 1991; Goetz & Baer, 1973; Lalli, Zanolli, & Wohn, 1994; Miller & Neuringer, 2000; Page & Neuringer, 1985; Pryor, Haag, & O’Reilly, 1969). For example, Blough (1966) demonstrated that when reinforcement contingencies required response variation, by reinforcing the least frequent responses, pigeons varied responding accordingly. Researchers have also successfully demonstrated stimulus control of behavioral variability (Denney & Neuringer, 1998; Page & Neuringer, 1985; Ward, Kynaston, Bailey, & Odum, 2008). Page and Neuringer (1985) produced discriminative responding by reinforcing pigeons for patterned responding in the presence of blue key lights and reinforcing varied sequences in the presence of red key lights. Furthermore, when the stimulus reinforcement relations were reversed (blue light paired with varied response sequences and red light paired with patterned response sequence), so did the response patterns.
Given the clear demonstration of behavioral variability as an operant, strategies identified to increase response variability may be particularly applicable to individuals with autism, as one common characteristic is highly stereotypic response patterns. Frith (1972) demonstrated that children with autism engaged in identifiable patterned response sequences, using far fewer of the color options than the children with intellectual disabilities when asked to place colored stickers on paper. Similarly, Boucher (1977) found that, when exposed to simple mazes, children with autism engaged in repeated selection of one specific path, as opposed to the children without autism who did not engage in obvious patterned responding, using both path options.

Failure to produce sufficient behavioral variability can interfere with a child’s ability to maximize reinforcement, and may even result in loss of reinforcement (Mullins & Rincover, 1985). For example, if a child with autism acquired only one way to mand (i.e., make a verbal request), and that response was placed on extinction, the child’s ability to gain access to preferred items would be severely impacted. Therefore, it is critical to explore methods to increase behavioral variability, specifically related to language, for children with autism.

In addition to facilitating greater access to reinforcement, a varied verbal repertoire allows for the shaping of diverse response forms, facilitating selection of effective responses via contact with contingencies (Cammilleri & Hanley, 2005; Lee et al., 2007; Shahan & Chase, 2002). Specifically, when a newly acquired response comes under the control of natural contingencies, it follows that other functionally equivalent responses are also likely to contact those reinforcing contingencies, thereby increasing the variety of responses in an individual’s repertoire (Shahan & Chase, 2002). Without
variability in responding, fewer responses are likely to be selected and strengthened via
contact with contingencies (Shahan & Chase, 2002). As related to the limited or deficient
language skills of children with autism, behavioral variability is desirable, as it may result
in the development of new language responses, as well as increase the ways in which a
child with autism can access reinforcement (both tangible and social).

One potential reason for repetitive or inflexible responding in individuals with
autism could be due to restricted response classes (Lee et al., 2007). This could be
related to deficits inherent in the characteristics of autism (e.g., failure to effectively
establish socially mediated reinforcers, poor imitation and generalization, etc.), and/or an
individual’s specific learning history. Consider a situation in which an individual only
acquired one particular response form for a given situation. For example, typically
developing individuals can gain someone’s attention in a variety of ways: calling the
person’s name, saying: “Excuse me,” clearing one’s throat, touching the person on the
arm, getting directly in front of the person and making eye contact, waving an arm and
making eye contact, any combination of previous listed responses, and a host of other
ways not included here. While all of these responses are topographically dissimilar, they
all can effectively produce the same consequence: gaining a person’s attention.
However, suppose an individual’s attention getting repertoire included only one way to
gain a person’s attention: touching a person’s arm. Now suppose that the target person is
out of reach, across the room, or behind a window. Or imagine a situation where the
person who wants to gain the other’s attention has his/her hands full (e.g., a child holding
a broken toy or a mass of blocks), or has dirty hands (e.g., paint, clay, or peanut butter
covered). The individual can no longer easily access the desired result (attention). After
several ineffective attempts he/she may stop trying altogether. Because children with autism typically have limited language skills, if only one response is acquired and reinforced, then varying responses becomes difficult, if not impossible.

Lee et al. (2007) suggested that lack of response variability could also be the product of an environment in which response variability is not reinforced. In other words, if a single response is continually reinforced, and other, even occasional responses in the same class do not contact reinforcement, varied responding is not likely to be strengthened. This might be illustrated by an example in which a 4-yr-old child with autism and a very limited vocal repertoire has just begun to vocally mand for items saying “Want please.” It is quite probable that her parents will reinforce every instance of this vocal mand. In fact, a clinician working with the family would likely counsel the parents to do just that, in an attempt to strengthen the emerging response. Both of the potential causes described above (restricted response classes and environments in which contingencies do not require variability) could, by themselves, or in combination, restrict behavioral variability, thereby hindering the development of broad response classes and potentially reducing access to reinforcement.

An area of specific concern for children with autism is the use of repetitive, stereotypic and inflexible language. Children with autism often request, comment, or engage in social exchanges using limited or repetitive vocal responses, as opposed to engaging in a wide variety of different responses that serve the same purpose. For example, when asked: “How are you feeling?” a child with autism may always answer “Fine” instead of responding with a variety of responses (e.g., “Great,” “Awesome,” “Awful,” “Sick”). When playing, a child with autism might repeatedly make the
comment: “Awesome!” as opposed to varying responses. In many social situations, repeating the same comment or answer could eventually be placed on extinction, as others may not hear or may choose to ignore the repetitions. In the case of repeating the same comment during play, it is possible that peers might eventually stop engaging with the child altogether, resulting in removal of social reinforcement and potentially setting the stage for social isolation.

Appropriate and effective manding repertoires are often a primary focus in skill acquisition and behavior reduction programs, as manding is the primary way young children access reinforcement. Skinner defined a mand as a verbal operant that is reinforced by access to a “characteristic consequence” (i.e., the thing requested) brought about by a state of deprivation or presence of aversive stimulation (Skinner, 1957). Many children with autism demonstrate stereotypic and repetitive manding. Using the example given earlier, imagine a child with autism who consistently uses the phrase: “Want _____ please.” to gain access to an item or an activity. If that mand became ineffective (e.g., was not understood by the listener, was placed on extinction, etc.), then the child would no longer be able to access desired items or activities.

According to Carmi, Malmberg, Leon, and Stoddard, (2010) typically developing preschoolers demonstrated mand variability in 90% of all mands. In other words, typically developing preschoolers have a broad number of different ways to access the same consequence, in terms of manding. Furthermore, the overwhelming majority of mands were for social positive reinforcement. That is to say, 80% of all mands were for access to activities, items, or attention. If we can assume that these data provide an indication of the effectiveness of varied manding to access reinforcement for young
children, these results may support the need to focus on increasing mand variability for children with autism to ensure that they have a sufficient repertoire to allow them to access reinforcement.
CHAPTER II
LITERATURE REVIEW

Basic Research and Behavioral Variability as an Operant

Basic researchers have produced a rich body of work demonstrating that behavioral variability is an operant (see for review: Lee et al., 2007; Neuringer, 2002). Specifically, researchers have repeatedly shown that behavioral variability can come under the control of discriminative stimuli and can be influenced by consequences such as reinforcement schedules and extinction (Denney & Neuringer, 1998; Page and Neuringer, 1985; Pryor et al., 1969; Ward et al., 2008). These studies are discussed below.

Pryor et al. (1969) conducted a landmark study in an attempt to replicate the “creative” behavior by a porpoise when reinforcement was made contingent on producing previously unreinforced movements (i.e., novel). Researchers conducted training sessions with another porpoise (i.e., not the original porpoise the researchers observed) that reportedly had a rich repertoire of discrete responses (motor movements). Stimulus control was established by having the trainer stand in a specific location only when reinforcement was available. The researchers initially attempted to reinforce only novel responses (previously unseen across all sessions) and place repeated behaviors on extinction. However, they periodically reinforced previously reinforced behaviors to either strengthen a specific response, or to increase overall responding. Throughout the study the porpoise demonstrated a large number of novel responses, as well as combined established responses in previously unseen ways. Thus, Pryor et al. (1969) demonstrated
that behavioral variability, consisting of novel and diverse responses, could be established using differential reinforcement and extinction.

Page and Neuringer (1985) conducted a series of experiments using direct reinforcement contingencies to produce behavioral variability with pigeons. Specifically, the researchers attempted to reconcile the results of previous studies by Schwartz (1980, Experiment 4; 1982 Experiment 1) that failed to produce varied responding using reinforcement. Initially, Page and Neuringer demonstrated that variability in response sequences increased when pigeons were reinforced for engaging in key peck sequences that differed from their last produced sequence (using a lag schedule). Subsequently, the researchers evaluated the look back (i.e., by how many responses a current response must differ to meet the schedule requirement) by requiring a sequence to differ from the last 50 sequences, including those from previous sessions. Results indicated that the pigeons produced diverse and varied sequences meeting the increased requirement. Page and Neuringer went on to compare responding on different schedules of reinforcement, finding that pigeons only varied response sequences when the reinforcement contingencies specifically required them to do so. Finally, the researchers brought varied responding under the stimulus control of a colored light.

Denney and Neuringer (1998) set about demonstrating that behavioral variability could be controlled by discriminative stimuli. To that end, they conducted a series of experiments where response variability, in the form of sequenced responses in rats, came under the control of specific discriminative control. Rats were reinforced for varied responding in the presence of continuous illumination (i.e., vary component). In the yoked component, equal reinforcement was delivered independent of variable responding
in the presence of a different stimulus (a continuous tone). Rats emitted higher response variability in the presence of the stimulus associated with reinforcement contingent on varying. Notable, the greatest diversity occurred immediately following the onset of the discriminative stimulus. When the researchers removed the stimuli, levels of response variability evened out in both components.

In another study demonstrating discriminative control over behavioral variability, Ward et al. (2008) employed a discrimination reversal design. Similar to Denney and Neuringer (1998), Ward et al. (2008) exposed pigeons to vary (response sequences had to differ from the preceding 10 to result in access to food) and yoke conditions (the probability of any response sequence resulting in access to food was yoked to the percent of trials in which food was delivered in the preceding vary component), each associated with a specific stimulus (i.e., different colored key lights). Higher variation of keys pecked was observed in the vary condition, even when the stimuli were reversed for the components. In addition, the researchers reported that the pigeons adapted more quickly in the vary component following a stimulus switch.

**Applied Research and Behavioral Variability as an Operant**

Collectively, the studies reviewed above, as well as many others (see reviews by Lee et al., 2007; Neuringer, 2002; Shahan & Chase, 2002) demonstrate that in basic settings, variability is an operant. Applied researchers have also begun to evaluate strategies for producing and controlling behavioral variability as related to socially significant skills, specifically with individuals with disabilities (Lee et al., 2007; Shahan & Chase, 2002). Goetz and Baer (1973) initially provided social reinforcement to
preschoolers, contingent on producing block structures not previously demonstrated within a given session. In that condition, repetitions within a session were placed on extinction. The number of different block structures increased in the reinforcement contingent condition. When non contingent reinforcement was instated, the participants produced fewer different response forms within each session. Increases of different block structures were observed when reinforcement was again made contingent on varied responding.

Goetz and Baer (1973) demonstrated that response variability of a functional play skill (i.e., producing different block structures) was an operant sensitive to differential reinforcement and extinction. Following that applied study, researchers have evaluated behavioral variability across a variety of populations and skills. Duker and van Lent (1991) placed high frequency gestures on extinction and differentially reinforced other gesture responses, resulting in increases in the number of response variability (i.e., different gestures). Lalli et al. (1994) used extinction and differential reinforcement to increase response variability during toy play with preschoolers with developmental delays. Other skill areas that researchers have recently addressed include: varying responding on a computer game for children with autism (Miller & Neuringer, 2000), individuals with autism answering social questions (Lee, McComas, & Jawor, 2002; Lee & Sturmey, 2006), marital arts moves (Harding, Wacker, Berg, Rick, & Lee, 2004), selecting classroom activities (Cammilleri & Hanley, 2005), manding (Grow, Kelley, Roane, & Shillingsburg, 2008), vocal variability (Esch, Esch, & Love, 2009), and block patterns during play (Napolitano, Smith, Zarcone, Goodkin, & McAdam, 2010).
The utility of response variability, (e.g., potentially facilitating acquisition of new responses and allowing for maximization of reinforcement), combined with the breadth of skills researchers are investigating, suggests that this is an area worthy of continued and refined attention. Several different approaches to increasing response variability have been addressed in the literature and are reviewed below.

**Methods for Producing Behavioral Variability**

The utility of response variability, (e.g., potentially facilitating acquisition of new responses and allowing for maximization of reinforcement) suggests that this is an area worthy of continued and refined attention. Several different approaches to increasing response variability, related to insufficient response repertoires and contingencies of reinforcement and extinction, have been addressed in the literature. What follows is a review of the literature specifically related to producing increases in response variability. Due to the limited body of research, the studies reviewed are not limited to verbal variability or individuals with autism.

**Multiple Exemplar Training**

Borrowing from the strategies identified for producing generalization (i.e., occurrence of responding under non-training conditions, Stokes & Baer, 1977), one approach to increasing variability is to train multiple exemplars. Specifically, it may be important to teach several topographically different responses within one class before response variability can effectively occur. Whereas Lee et al. (2007) did not review any studies specifically examining multiple exemplar training alone, several studies reviewed therein demonstrated that variability increased following acquisition of responses, via
specific training (e.g., functional communication training, script training, etc.), from which the individuals could subsequently vary (Carr & Kologinsky, 1983; Derby et al., 1997; Krantz & McClannahan, 1993, 1998). However, it is important to keep in mind that the multiple exemplar training occurred in conjunction with other contingency based strategies.

Parsonson and Baer (1978), in training preschoolers to demonstrate novel and varied responses to solve several simple problems (e.g., lacing, moving marbles across the room, and hammering), did not observe sufficient increases in response diversity until after several specific responses were trained. Similarly, some additional training (i.e., instructors modeled different block construction) for four of the six participants was required to produce acceptable levels of response variation in the study by Napolitano et al. (2010). Specifically related to producing response variability in verbal behavior, Betz, Higbee, Kelley, Sellers, and Pollard (in press) noted that response diversity in manding was not observed until three different mand frames were sequentially (each mand frame was taught to mastery before teaching the next mand frame). Therefore, researchers have demonstrated that one requirement for behavioral variability may be the presence of sufficient responses within a class. However, it remains unclear if teaching multiple responses alone (i.e., without any additional consequence contingencies) will produce varied responding, or if children with autism will continue to use one default response.

**Script Scheduling**

Researchers have repeatedly demonstrated that a variety of verbal behavior can be taught using scripts (Goldstein, 2002; Krantz & McClannahan, 1993, 1998). Scripts are textual or audio taped language (words, phrases, statements, questions) that support an
individual to engage in vocal behavior (McClannahan & Krantz, 2005). Specifically, Krantz and McClannahan (1993) taught conversation responses (e.g., statements and questions) to children with autism via text scripts. Other researchers have successfully used scripts to teach a wide breadth of vocal responses such as requesting items or attention (Krantz & McClannahan, 1998; MacDuff, Ledo, McClannahan, & Krantz, 2007), commenting (Brown, Krantz, McClannahan, & Poulson, 2008; Reagon & Higbee, 2009; Sarokoff, Taylor, & Poulson, 2001), and conversation skills (Charlop-Christy & Kelso, 2003; Gantz, Kaylor, Bourgeois, & Hadden, 2008; Krantz & McClannahan, 1993; Stevenson, Krantz, & McClannahan, 2000). Once mastered, the physical script materials can be systematically faded, resulting in transfer of stimulus control to the natural environment (McClannahan & Krantz, 2005). In addition, researchers have anecdotally reported that participants demonstrated increased variability, by combining language taught via scripts and using novel language, following script training (Krantz & McClannahan, 1993, 1998). It is important to note that the purpose of using text based scripts with young children is to teach vocal responses using a visual support that can be physically faded, not to teach the children to read.

Script scheduling is one way to potentially produce variability across scripted responses. This involves presenting all of the scripts and implementing procedures, such as rearranging the scripts, or using predetermined varied sequence and providing prompts to ensure that the individual varies use of the scripts. This procedure was successfully used as an alternative intervention for one participant in Betz et al. (in press) when extinction of repetition failed to produce variability. There, the researchers used predetermined prompt sequences to prompt varied script use (with auditory scripts –small
buttons with recorded messages) for one participant for whom contact with extinction (following sequential script training) did not produce increases in response variability. The prompts were eventually faded out, as was the button. All that remained were three colored stickers (on the individual’s snack placemat) that were associated with the auditory scripts throughout the study. Another type of script scheduling requires the systematic removal and replacement of scripts. Specifically, all scripts are presented at the same time. Once an individual uses a script, it is removed. Following use of the last script, all scripts are replaced in a different order. A variation of script scheduling involves creating several different versions of script sequences for an individual to follow. In other words, in each version, the scripts would appear in a different order. The script sequences could be swapped out during an activity, or across activities.

**Differential Reinforcement and Extinction Procedures**

**Extinction.** Researchers have demonstrated that extinction procedures produce behavioral variability (Grow et al., 2008; Lerman & Iwata, 1996). In their review, Shahan and Chase (2002) pointed out that extinction produces increases not just in variability in general, but in a variety of responses that are under similar stimulus control and are likely to produce similar results as the response that is no longer being reinforced. For example, Grow et al. (2008) used extinction procedures to produce variability in manding for the purpose of identifying an appropriate mand response to be used in subsequent functional communication training. The identified mand response was then reinforced and all other inappropriate mands were placed on extinction. Whereas Grow et al. used extinction alone to produce response variability, most other researchers have employed extinction in combination with some form of differential reinforcement.
It is important to note that Neuringer (2002) pointed out that whereas extinction produces variability, it also often concurrently maintains stability. That is to say, extinction can produce stable production of sequenced or patterned responding (Machado & Cevik, 1998; Schwartz, 1981). For example, Neuringer, Kornell, and Olufs (2001) demonstrated that extinction produced small increases in variability and maintained stable production of the response sequences that were most frequent in the preceding reinforcement condition. The findings across these studies indicate that while extinction can increase variability, it may also simultaneously maintain stability (of previously reinforced responses or response sequences).

**Differential reinforcement of least frequent responses.** One method that has been used to increase response variability involves identifying and reinforcing appropriate responses that occur least frequently (Lee et al., 2007). In other words, some frequency criterion is established and any responses that fall below that requirement are differentially reinforced while all responses above the frequency requirement no longer contact reinforcement. Basic researchers have used such an arrangement to assess behavioral variability, selecting least frequent response pairs or sequences for reinforcement (Blough, 1966; Machado, 1993; Shimp, 1967).

Blough (1966) produced complex highly variable inter-response times (IRTs) by differentially reinforcing least frequent responses. The researchers evaluated and categorized IRTs of pigeons’ key pecks and subsequently reinforced responses that occurred least frequently. Duker and van Lent (1991) demonstrated applied utility by using differential reinforcement of least frequent responses to increase varied communicative gestures with adolescents and adults with severe intellectual disabilities.
Lee et al. (2007) concluded that while this schedule might produce response variability, repeated alternations among the low frequency responses (i.e., a sort of patterned responding) could occur.

**Percentile reinforcement schedules.** Similar to reinforcement of least frequent responses, percentile schedules require measuring response frequencies and determining some criterion for reinforcement. Percentile schedules require that responses vary by some specified degree. According to Lee et al. (2007), one method of establishing percentile requirements is to assign a score to a given response as a result of how many trials, or time has elapsed since the last occurrence of that response. Specific reinforcement parameters are continually reset based on responding. For example, 10 responses are recorded and ranked in terms of how frequently each occurred. A criterion is then set at a given level of the ranking, say 50%. The subsequent response would only contact reinforcement if it varied by more than 50% of the preceding responses.

Machado (1993) used a frequency dependent percentile schedule to produce highly varied responding in pigeons. Results indicated a correspondence between the variability requirement and the amount of response variability produced. Researchers have demonstrated applied utility of percentile schedules to increase response variability (e.g., variability in the sequences of responses) of children with autism when playing computer games (Miller & Neuringer, 2000).

**Lag reinforcement schedules.** With lag schedules, a response must differ from a specific number of previous responses to contact reinforcement (Lee et al., 2007). For example, to be eligible for reinforcement using a lag 2 schedule, a response must differ from the immediately preceding two responses. Using the lag 2 example, if a child rolled
a car on a track and then crashed it, he or she would now have to produce a different response (than rolling on a track or crashing) to contact reinforcement. If the child made the car jump over another car, reinforcement would be delivered. Now the child would be required to produce a response different from the preceding two (crashing and jumping) to contact reinforcement (e.g., rolling on track, pushing through a tunnel, driving over a bridge). If the child engaged in rolling the car twice in a row, on the next he would be reinforced for the next occurrence, as long as the response was anything except rolling the car.

Basic researchers have applied lag schedules at very large values. For example, Page and Neuringer (1985) demonstrated that pigeons could produce varied responding on a lag 50 schedule, requiring a response to differ from the previous 50 sequences. Applied researchers have used lag 1 schedules with individuals with autism to produce variable responding to social questions (Lee et al., 2002; Lee & Sturmey, 2006). Cammilleri and Hanley (2005) increased novel selections of classroom activities with typically developing preschoolers using a lag schedule. Esch et al. (2009) successfully increase vocal variability in two young children with autism using a lag 1 schedule. Most recently, Napolitano et al. (2010) demonstrated increases in varied block construction with children with autism following implementation of a lag 1 schedule.

Lee et al. (2007) discussed lag schedules as a successful method to produce and increase behavioral variability. One cautionary note was issued, however. Based on their review of the studies, lag schedules have the potential to produce patterned responding that still meets the reinforcement requirement. This was most apparent in the applied studies using a lag 1 schedule, as participants could vary from among only two different
responses and still access reinforcement. The authors characterized this as “higher order” stereotypy and suggested that a variable lag schedule could potentially remediate this problem. However, this potential limitation would likely be overcome by systematically increasing the lag schedule requirement.

**Differential reinforcement of different or novel responses.** Many researchers have effectively produced and increased response variability by differentially reinforcing novel or different responses while placing repeated responses on extinction. Shahan and Chase (2002) reviewed several ways to define novel or different. For example, all behavior could be considered novel, as each occurrences take place under slightly different stimulus conditions than every other past or future occurrence. The authors concluded that such a broad definition has limited utility in the prediction and control of behavior. Some researchers have employed a stringent definition, requiring that the organism emit previously unseen behavior across all previous sessions (e.g., Pryor et al., 1969). While this may be the purest definition of novelty, this may not be the most practical requirement, as most applied situations likely only require variation between a few different responses rather than continually producing new responses for the first time. Most basic and applied researchers have defined novel, or different, responses as those occurring or contacting reinforcement for the first time within a session (Betz et al., in press; Blough, 1966; Goetz & Baer, 1973; Harding et al., 2004; Machado, 1993; Parsonson & Baer, 1978; Ward et al., 2008).

As described previously, Pryor et al. (1969) and Goetz and Baer (1973) successfully increased response variability by differentially reinforcing novel, or different responses, while placing repeated responses on extinction. Lalli et al. (1994) used
differential reinforcement and extinction to increase response variability, in the form of a variety of untrained play actions, with preschoolers. The children did not engage in any appropriate toy play during baseline, when praise was delivered on a fixed interval 15-s schedule. The researchers then taught the participants to engage in one play action each with several different toys using modeling and physical prompting. Subsequent probe sessions involved the researcher reinforcing the first instance of any trained response or the newest response form (from the prior session) three times, then placing all subsequent repetitions on extinction for the remainder of the session. Probe session were terminated following 60-s without emission of an untrained response. Participants increased the number of untrained play action topographies to as many as nine different actions.

Harding et al. (2004) employed similar methods to increase the response diversity of martial arts moves. The researchers provided verbal praise contingent on the performance of a martial arts move that had not been previously demonstrated within a session. All repetitions of moves within a session were placed on extinction. The participants increased response variability in the training sessions and demonstrated some generalization of variability to sparring sessions.

In a recent study, Betz et al. (in press) evaluated the effects of extinction of repetition (which included the differential reinforcement of different mands within session), and sequentially teaching mand frames to children with autism. Specifically, the authors targeted full mands (i.e., those containing a subject, verb, and noun), and taught mand frames (i.e., verbal structures in which different nouns could be inserted to request a variety of items). The goal was to assess the effects of extinction of repetition (plus differential reinforcement) on variability, given participants who did not already
have a wide repertoire of responses (i.e., no more than one full mand response). Furthermore, the authors explored the effects of sequentially teaching specific responses on producing response variability. Participants were three preschoolers with autism who had only one full mand response in their repertoires.

The participants were initially exposed to a baseline where all full mands were reinforced (FR1) by access to the specific snack items. Following baseline, the researchers conducted an extinction of repetition phase where the first occurrence of all full mands was reinforced and all subsequent repetitions were placed on extinction. Furthermore, the definition of novelty required the full mand to differ from every other full mand observed in a session by more than specific criteria (adding or removing articles and conjunctions, “please,” or the instructor’s name). The purpose of the extinction of repetition phase was to determine if response variability would increase simply by contacting contingent reinforcement for varying mands and extinction for repeating mands.

Following the first extinction of repetition condition, script training was conducted to teach three mand frames. Script training was chosen as a teaching procedure, as researchers have consistently demonstrated its effectiveness in increasing language (Betz et al., in press; Brown et al., 2008; Krantz & McClannahan, 1993, 1998; Reagon & Higbee, 2009).

Betz et al. (in press) used auditory scripts, consisting of a small button activated voice recorder, allowing the inclusion of children who could not read. The mand frames were systematically faded, one word at a time, from end to beginning until the voice recorder was removed. Small colored stickers placed on the buttons were then placed on
the participants’ snack mats when the voice recorders were removed. The colored stickers were intended to assist in transferring stimulus control from the voice recorders to the students’ snack placemats. The scripts were taught sequentially, such that once a script was mastered and faded, a new script was introduced. Researchers used physical prompting to teach the participants to activate the auditory scripts. A brief maintenance condition, followed by an extinction for repetition condition, occurred after each individual script was mastered and before a new script was added. One participant received an alternative intervention consisting of simultaneous script presentation, wherein all three auditory scripts were presented. Responses were prompted similarly to the script training condition. The language contained on the auditory script was faded by removing more than one word at a time. Maintenance and generalization to an untrained setting was assessed 2 weeks following intervention.

All three participants demonstrated zero to one full mands in the baseline sessions. The initial extinction of repetition condition resulted in minimal, to no increases in the number of different mand frames. Therefore, the authors concluded that contingent reinforcement and extinction of repetition alone were insufficient to produce response variability. During each script training phase the participants tended to use only the mand frame being taught. The authors hypothesized that, because the scripts were taught sequentially, tight stimulus control was established. In other words, the presence of an individual script signaled the availability of the snack items for requesting using that specific mand frame. This is problematic because the stimulus control exerted by the individual scripts potentially inhibited response variability.
Varied use of the different mand frames did not appear until the extinction of repetition phase following the third script training condition for two participants, as demonstrated by the participants emitting between four and five different full mands in a given session in the final extinction of repetition condition. Varied manding did not occur until the multiple script training alternative intervention for the third child. These results indicate that teaching single scripts in isolation may not be sufficient to produce varied language. In addition, because response variability did not increase until extinction procedures were implemented, it remains unclear if increasing an individual’s mand repertoire alone can produce increases in diverse responding.

The studies reviewed here suggest several different strategies for directly using reinforcement and extinction to produce behavioral variability. It is clear, from these results that there is applied utility in employing differential reinforcement and extinction procedures to increase diverse responding. However, there is a lack of studies evaluating procedures to increase response variability in children with autism, particularly related to language. As demonstrated by Betz et al. (in press), and suggested by Lee et al. (2007), consequence based contingencies may be insufficient to produce variability in all cases. Given that children with autism are likely to have limited behavioral variability and possess restricted repertoires, it may be necessary to combine contingency procedures, such as differential reinforcement and extinction, with strategies aimed at developing response repertoires to produce desired levels of behavioral variability. Specifically, it is possible that teaching several mand responses simultaneously could reduce the amount of stimulus control and increase the likelihood that individuals will use a variety of responses.
Purpose Statement and Research Questions

The purpose of the current study was to expand the body of literature related to response variability. We focused on addressing questions raised by Betz et al. (in press), regarding the effects of sequentially teaching mand frames and using extinction of repetition to produce mand variability. Specifically, we assessed methods for increasing variable manding in young children with autism by teaching multiple mand frames simultaneously, using script training and fading procedures, and extinction of repetition. When these procedures failed to produce desired results, we then investigated alternative interventions primarily using antecedent strategies. The research questions addressed included:

1. What effect does simultaneously teaching and fading, rather than sequentially teaching (Betz et al., in press), several mand frames (using scripts) have on the number of different mands used by preschoolers with autism during a snack activity?

2. Following acquisition of several mand frames, what effect will subsequent differential reinforcement of different full mands (and placing repetitions on extinction) have on the number of different mands used by preschoolers with autism during a snack activity?

3. If desired results are not obtained, what effect will alternative interventions have on mand variability?

4. If response variation in manding occurs, to what extent are the responses made up of taught, altered, or novel mands?
5. To what extent will varied manding generalize across settings and people?

6. To what extent will varied manding maintain over time?
CHAPTER III

METHODS

Participants

Participants initially included four preschool-aged children diagnosed with autism who reliably emitted no more than one full made frame (i.e., the ability to use one full sentence to request, such as: “I want ______.”). Participants’ ages, at the start of the study, were 4 years 6 months (Nicodemus), 3 years 5 months (Michelle), and 4 years 11 months (Barstow). One participant (Butch, 3 years 6 months old) was discontinued based on failure to acquire the scripted mands (see Results section for full description).

Researchers recruited participants from a university-based intensive behavior analytic preschool for children with autism. To be included, the participants demonstrated the ability to vocalize using 3-5 word phrases or sentences, did not engage in varied manding using full mand frames (i.e., regularly used no more than one full mand frame), and had a history of edible items functioning as reinforcers. Researchers conducted interviews with instructors and brief observations to determine if the eligibility criteria were met. Specifically, instructors were asked to report how the children typically manded for preferred items. During the observations the children were observed during a snack activity and instructional activities and occurrences of mand frames were recorded.

Setting

Experimental sessions took place in a small research cubicle at the preschool. Generalization sessions were conducted with an instructor or case manager who was not
involved in the study and was not the participant’s regular instructor. Generalization sessions took place in the main preschool common area at the table where snack typically occurred. Researchers conducted one to four sessions a day, three to five days a week. Sessions were 5 min in length, with at least 10-15 min separating sessions. Sessions were conducted by research assistants, all of whom were certified by the USU Institutional Review Board (IRB) and trained to implement the procedures by the primary researcher. Specifically, the primary researcher described and demonstrated the procedures to be implemented and role played with the research assistants. A doctoral level researcher was present for the first session of every phase to give instructors direct feedback and correct any inconsistencies between procedures implemented and the protocol.

**Materials**

Sessions were conducted at a small table with at least two chairs. During sessions, three snack items in clear plastic containers were placed in a straight line, equidistance from each other and the participant (except during simultaneous script presentation and training—described below). Also present on the table were data collection materials (e.g., paper, pencil), a timer and a small video camera. During script training sessions, we presented the scripts, which were printed in black 16 point Times New Roman font on white card stock, on the table in front of the participant.

**Response Definition and Measures**

Responses were scored for occurrences of the three scripted mand frames, the default mand frame, total different mand frames, and total number of mands. Only mand
frames in the form of full sentences (i.e., included a subject, verb and noun – an available edible item) were scored. Please see Table 1 for specific examples.

The primary dependent variable was the number of different mand frames used within each session. Different mand frames were those frames that were complete sentences (i.e., contain a subject, a verb, and the name of one of the available edible stimuli) and differed from other mand frames already emitted in that session by more than the addition of an adult’s name, substituting nouns (i.e., the snack item name, for example, swapping chip for marshmallow), adding/deleting “please,” or rearranging the word order. To measure the total number of different mand frames used, we recorded the number of times the participant emitted his or her default mand frame (the frame s/he consistently demonstrated in baseline) and each of the scripted mand frames, as well as any other untaught frames. Scripted mand frames were defined as those mand frames matching the language taught via the script word for word, with the exception of adding an adult’s name, substituting nouns (i.e., swapping cookie for chip), adding/deleting “please.” Such mand frames were scored as scripted regardless of whether the physical script materials were present. We also recorded the total number of mand frames used per session by simply counting all of the mand frames used. Please see Appendices B-F for examples of data collection sheets.

During sessions, the instructor used a pencil and paper to record all mand frames by placing a tally mark next to the indicated mand frame (i.e., default mand frame, or one of the three scripted mand frames) or by transcribing exactly what was said. Depending on the experimental condition, the instructor also recorded if prompting was required.
(script training) and recorded if repetitions (extinction of repetition and alternative interventions) of a given mand frame occurred.

Table 1

*Examples of Different and Not Different Mand Frames According to Definition*

<table>
<thead>
<tr>
<th>Different Mand Frames</th>
<th>NOT Different Mand Frames</th>
</tr>
</thead>
<tbody>
<tr>
<td>“I want chip.”</td>
<td>“I want chip.”</td>
</tr>
<tr>
<td>“May I have chip?”</td>
<td>“I want cookie.”</td>
</tr>
<tr>
<td>“Please give me cracker.”</td>
<td>“Alice, I want chip.”</td>
</tr>
<tr>
<td>“I would like gummy bear.”</td>
<td>“I want chip please.”</td>
</tr>
<tr>
<td>“May you please give me a chip?”</td>
<td>“Please I want chip.”</td>
</tr>
<tr>
<td>“I want to have some chips.”</td>
<td>“Chip I want.”</td>
</tr>
</tbody>
</table>

**Reliability and Treatment Integrity Measures**

A trained independent observer collected reliability data in an average of 36%, 39%, and 38% of sessions for Nicodemus, Michelle, and Barstow, respectively, across all phases of all conditions. Agreements were defined as both scorers recording the same totals, per mand frame, and/or transcribing the same words (for those frames other than the default and scripted) and indicating prompt(s) used. We calculated reliability by dividing the number of agreements by the total number of responses in a given session (whole session), and then multiplying by 100%. Average reliability percentages for Nicodemus, Michelle, and Barstow were 99% (range 86-100), 99.3% (range 80-100), and 99.5% (range 75-100), respectively.
An independent observer also measured treatment integrity for the following percentages of sessions across all phases of all conditions: 35% for Nicodemus, 33% for Michelle and 36% for Barstow. Data were collected on correct implementation of procedures in each phase. The number of correctly implemented components was divided by the total number of components and multiplied by 100% to obtain treatment integrity scores. Depending on the condition, treatment integrity components included: providing the correct instruction, waiting the prescribed time, using the correct prompt procedures, using the edibles identified from the pre session assessment, reinforcing correct responses, withholding reinforcement phases where extinction of repetition is employed, and writing down each mand word for word. Average treatment integrity percentages for Nicodemus, Michelle, and Barstow were 99.7% (range 92.3-100), 99.8% (range 92.8-100), and 96.4% (range 80-100), respectively.

**Script Pre-Training**

Researchers conducted probes to determine if the participants could read the individual words to be used in the scripts. Single words were presented on cards printed in large font. Any words that were not independently read during the probe session were then taught to participants. Teaching sessions consisted of 10 trials for each word. An instructor held up an index card and allowed the participant 3 s to read the card. Brief verbal praise was delivered following correct responses. If no response occurred within 3 s, the instructor removed the card, ending the trial. No other programmed consequences followed an incorrect response. The instructor then re-presented the same card and provided an immediate vocal model of the word. Vocal prompts ceased as independent
responding occurred, or were faded using a time delay procedure (2 s, 4 s, etc.). Pre-
training ended when a participant correctly read all words independently with 90% 
accuracy (9/10 trials) in two consecutive sessions.

We also assessed the participant’s ability to follow a full sentence text script, as well as a faded script (the last word removed). The purpose of pre teaching script following for a full and a faded scripted ensured that using text scripts was an effective method for teaching the mand frames. Correct script following was defined as intelligibly stating the scripted mand frame. Given the age of the participants, mispronunciations were allowable, as long as the utterance was intelligible to the instructor. However, repeating or omitting words was not considered correct. The script used in pre-training was the same length as those targeted for use in the study, but it did not contain any of the same words from those target scripts. The pre-training script was a short tact (“That dog is”) and was accompanied by a printed picture of a red cartoon dog. Participants were required to read the script and fill in the blank. For example, a participant might have read: “That dog is” and filled in with any one of the following: big, red, Clifford, silly, or any other appropriate word.

Script pre-training sessions were comprised of 10 consecutive trials. The instructor placed the picture of the dog on the table, placed the text script on the table in front of the participant and then waited 5 s for a response. Correct script following resulted in brief social praise. If no response occurred within 5 s the instructor physically prompted the participant from behind to place a finger under each word. If the participant failed to read each word within 5 s the instructor physically prompted the
participant to place a finger under each word while simultaneously providing a verbal model of each word.

We faded scripts by cutting off the last word of the script (e.g., “That dog is.”) became “That dog”) once the participant independently and correctly followed the script with 90% accuracy in one session. If a participant did not demonstrate sufficient progress towards acquisition of the pre-training script (i.e., accuracy at or below 20% for a minimum of eight sessions) then pre-training was implemented for the individual words as described above. Script pre teaching ended when the participant independently followed the faded script (i.e., last word missing) with 90% accuracy in one session.

**Experimental Design**

We employed a concurrent multiple baseline across participants design with embedded reversals. Researchers conducted the following conditions in this order with all participants: baseline, extinction of repetition, multiple-script training and fading, baseline (with generalization probe), extinction of repetition, multiple-script training, extinction of repetition, and multiple-script training (see Appendix A: Flow Chart of Phase Progression). One participant (Barstow) required booster sessions during his third multiple-script training phase, which will be described in the results section. Specific procedures are described in the results section. Following the last multiple-script training phase, individualized alternative interventions were implemented. Finally, we conducted generalization and maintenance sessions with all three participants.

**Item Identification**
Researchers conducted informal interviews with parents and teachers to identify 10 highly preferred snack items. Prior to intervention, the researchers provided participants access to each item to ensure that the participants consumed the items. Participant’s instructors were asked to limit at access to the 10 items identified for use in experimental sessions. In addition, the participants did not participate in the preschool’s regularly scheduled snack activities for the duration of the study. Before each research session, an informal multiple-stimulus preference assessment without replacement, similar to Betz et al. (in press), was conducted. The purpose was to capitalize on motivating operations by identifying the three most preferred items for use in that session. An instructor presented the 10 items on a table equidistant from each other and the participant and asked the participant to choose one. The participant was then allowed to consume the item selected. The remaining nine items were rearranged, re-presented, and the participant was asked to choose again. This was repeated a total of three times to identify the top three items to be used in the ensuing session.

**Experimental Procedures and Conditions**

**General Procedures**

Across all sessions and conditions, the participants were seated at the end of a child sized table. An instructor was seated next to the participant on the side of the table. Three equally spaced snack items in clear containers were placed in front of the participant. The instructor rotated the position of the snack items across sessions. The adult provided the general statement: “Time for snack.” to signal the start of the session. Throughout the session, if approximately 30-45 s passed with no manding, the instructor
gestured to the items and labeled them. No programmed consequences were provided for gestures or mands not in the form of a full sentence (e.g., single words or pointing). The instructor did not ask any questions (e.g., “What do you want?” or “Do you want anything?”). Any mands for items not immediately present were ignored. Instructors briefly responded to any socially appropriate statements or questions. For example, if a participant said: “I got a green one” the instructor might have responded: “Yep, it’s green.”

Occurrence of problem behavior (e.g., crying, aggression, etc.) resulted in no programmed consequences, with the exception of blocking to ensure safety. Specifically, when a participant reached towards the snack containers the instructor placed her hand between the participant’s and the container and gently redirected the participant’s hand away. When a participant reached out to grab the instructor’s arm, the instructor looked away while blocking the participant’s hand with her own and gently redirecting the participant’s hand back to his/her lap or to the table top. Occurrences of problem behavior were limited to infrequent occurrence of the behavior described above (i.e., touching or grabbing toward the containers, or reaching toward the instructor’s arm). The session ended when the full 5 min elapsed, indicated by the timer sounding and the instructor stating: “All done.”

Baseline

The purpose of this condition was to assess the level of variability present before intervention. We implemented the general procedures described above. All mand frames (as previously defined) resulted in immediate access to the item. Single words, gestures, or language not in the form of a clear, direct mand (e.g., stating: “I like Cheetos.”) were
not reinforced. This phase continued until participants demonstrated stable responding (i.e., stable levels of different mand frames).

**Baseline Generalization Probe.** A generalization probe was conducted at the end of baseline to determine if varied responding occurred in a setting other than that used for the research sessions. The session procedures were identical to the baseline sessions, except for the location and the person running the session. The setting for generalization probe was in the common preschool area at the table typically used for snack activities and the person was an unfamiliar instructor or case manager at the preschool.

**Extinction for Repetition**

In this condition we evaluated if exposure to contingencies requiring production of different (varied) mand frames, specifically extinction for repeating mand frames within a given session, resulted in varied responding. During this phase, only the first occurrence of a mand frame resulted in reinforcement (i.e., access to the requested item). Any subsequent use of a previously emitted mand frame within a given session resulted in extinction (i.e., no item delivered and no other programmed consequence occurred). In order to access an edible item within each session, the participant was required to produce a mand frame different from any used previously within that same session. The general procedures were followed with regard to set up, as well as starting and terminating the session. Because it was possible that placing previously reinforced responses on extinction might produce problem behavior (e.g., aggression, self-injury, or attempts to leave the area), all attempts at engaging in problem behavior were blocked to protect the participant, as previously described in the “general procedures’ section. This
condition continued until participants demonstrated stable responding (i.e., stable levels of different mand frames).

**Multiple-Script Training**

The purpose of this phase was to concurrently teach several mand frames in an effort to reduce the chances of establishing tight stimulus control by the individual scripts. Specifically, teaching one script at a time could potentially establish that script as the discriminative stimulus for manding and suppress potential response variability. The physical set up was identical to baseline (i.e., snacks present on the table, etc.). Three mand frames were taught to each participant (“I would like .”, “May I have ______ ______.” and “Please give me ______.”). All three scripts were sequentially presented throughout each session, with the sequence remaining the same throughout a given session; however, the sequence varied across sessions. Each script was assigned a number from one through three for each participant and a random number generator was used to create a list indicating which script the instructor would start with for each session. Each of the three scripts was presented approximately the same number of times across sessions. Teaching and fading procedures were similar to those described in the pre-training section (physical and vocal prompts, and time delay, wherein the 3 s delay was increased to 6 s). All mand frames, meeting the previously described requirements, were reinforced during these sessions.

Following the vocal cue: “It’s time for snack.” the participant was given 3 s to request a snack item. If no mand frame was emitted, a script was placed on the table directly in front of the participant. Any time the participant followed the script, with or without prompting, the instructor delivered the requested item. If the participant did not
emit the scripted mand frame within 3 s, the instructor physically prompted the participant to attend to the script by placing the participant’s finger under the first word on a text script. If the participant still did not emit the scripted mand within 3 s of the initial physical prompt, the instructor provided another physical prompt and a verbal model (stating the scripted mand frame). The instructor repeated this procedure until the participant engaged in the scripted response or until the session ended (i.e., the full 5 min elapsed). Following consumption of an item, if no mand frame was emitted the instructor presented another, different script, and followed the procedures described above. If a participant independently began following the script once it was presented, but made an error or stopped, the instructor immediately provided a physical prompt and verbal model. This process continued for the duration of the session.

Script fading began within this phase once a participant followed all three scripts independently on 100% of opportunities in one session. Scripts were faded as follows. Two word scripts consisted of all but the last word in the script. This was achieved by cutting off the last word in the mand frame. The next fade was to first word only scripts, in which we cut off the middle word of the mand frame. The three scripts were faded at the same time (i.e., words will be removed at the same time across all three scripts), when each script was used independently for 100% of presentations. The script-training phase ended once a participant independently used all three first word only scripts (last two words removed) on 100% of presentations for one session.

Each participant contacted this condition three times in three separate experimental phases. For the first phase, the full scripts were initially presented. However, in the second and third exposure to the multiple-script training condition, the
first only word scripts were reintroduced. Finally, in the third repetition of this condition scripts were faded from first \textit{word} only to first \textit{letter} only. With first letter only scripts, the end of the first word was cut off and the first letter remained (i.e., the script “I would like” became “I,” “May I have” became “M,” and “Please give me” became “P”).

The procedures were identical for all participants across all three repetitions of the multiple-script training condition, with one exception. Based on Barstow’s responding in his third multiple-script training phase we implemented some modified procedures and booster sessions. The specific procedures are fully described in the results section.

\textbf{Return to Baseline}

The purpose of the return to baseline condition was to evaluate if adding to the participants’ mand frames repertoires, via the multiple-script training procedures, was sufficient to increase response variability. The sessions followed procedures identical to the initial baseline phase. Specifically, no script materials were present and all appropriate mand frames resulted in delivery of the requested item. This condition ended when the participants demonstrated stable responding.

\textbf{Return to Extinction of Repetition}

The purpose of this condition was to evaluate if, following acquisition of additional mand frames via the multiple script training procedure, response variability would increase when participants contacted direct reinforcement for varying responding. The procedures were identical to those previously described for this condition. This condition continued until stable responding was achieved.

\textbf{Simultaneous Script Presentation}
The purpose of this phase, as an alternative intervention, was to teach the
participants to use all three first letter only scripts when all three scripts were present.
Specifically, this condition was aimed at establishing the first letter of each faded script
as the controlling stimulus for varied manding. The physical set up was similar to
baseline, with the exception that all three scripts (i.e., “I,” “M,” and “P”) were placed on
the table in front of the participant. For Nicodemus the individual first letter only scripts
were placed directly on the table. However, based on Barstow’s responding (he
periodically touched and moved the scripts), the scripts were attached to each
participant’s placemat that was previously used in general snack activities. This
prevented the participants from moving the scripts during sessions. A random number
generator was used to create a list indicating the order in which to place the scripts for
each session. The three containers were purposefully not placed directly behind any one
script in an attempt to avoid a script being associated with a specific edible stimulus. All
mand frames meeting the previously described requirements were reinforced during these
sessions.

Once stable variability was observed (e.g., using all three mad frames for three
consecutive sessions), a no script probe was conducted. The purpose of the no script
probe was to determine if mand variability would decrease when the scripts were
removed. In this probe no scripts were presented, but all other procedures were the same.
Probes were discontinued if a participant engaged in zero to one different mand frame in
a session. Following the no script probe, the alternative intervention was reinstated to
ensure that mand variability levels returned to those observed previously in this
condition. Generalization sessions immediately followed this condition for the two participants for whom this intervention was successful (Nicodemus and Barstow).

**Alternative intervention for Michelle.** Because Michelle failed to mand at all in the simultaneous-script presentation intervention we systematically implemented and evaluated several different interventions. The intervention sequence was as follows.

**Simultaneous-script training.** This condition was implemented for the purpose of teaching Michelle to use all three scripts to mand when the scripts were simultaneously presented. The set up and general procedures used in the simultaneous-script presentation condition were used. However, in this training condition, script use was prompted. A random number generator was also used to determine the order in which the scripts should be prompted during each session. Following the vocal cue “It’s time for snack.” Michelle was given 3 s to request a snack item. If she emitted a mand frame, the requested item was delivered. If no mand frame was emitted, the instructor physically prompted her to attend to one of the scripts by placing the participant’s finger under the first word on a text script. The instructor rearranged the snack containers following each reinforced mand.

The instructor repeated this procedure until she engaged in the scripted response or until the session ended (i.e., the full 5 min elapsed). Following consumption of an item, if no mand frame was emitted, the instructor prompted another, different script, and followed the procedures described above. This process continued for the duration of the session. Once Michelle used all three scripts independently on a minimum of 75% of uses within one session, the training condition was terminated and we returned to the simultaneous-script presentation condition. The criterion was reduced, as she was
consistently making one error in each session, which was holding her back from moving on to the next phase. Therefore, based on this response pattern and her previous performance in the script training phases (i.e., that she demonstrated mastery of the scripts previously) we decided to reduce the mastery requirement so that she could progress to the next phase.

*Return to simultaneous-script presentation.* Michelle returned to this condition to evaluate if having all three faded scripts present at the same time would produce varied manding. The procedures were identical to those previously described. Based on her unstable responding under these conditions, we implemented another alternative intervention.

*Simultaneous-script presentation and lag 2 schedule.* In this condition we evaluated if the presence of the three first letter only faded scripts combined with progressively increasing consequence contingencies would elevate her mand variability to a stable level. The set up was identical to the simultaneous-script presentation condition. We implemented a lag schedule that progressed from a lag 1 to a lag 2 within each session. The first mand frame in a session was reinforced, as which point the lag 1 schedule began. On the lag 1 schedule Michelle was required to emit a different mand frame the first one in order to access reinforcement. Once the lag 1 schedule requirement was met she progressed to a lag 2. On the lag 2 schedule she could contact reinforcement only if the current mand frame differed from the two immediately preceding frames. Based on the fact that, during this intervention, she did not vary her responding at all, and overall levels of manding decreased (as compared to other intervention phases), we implemented another alternative intervention.
Simultaneous-script presentation + script removal + extinction of repetition.

Given that even the briefest contact with extinction suppressed variability, or responding altogether, we implemented the simultaneous-script presentation procedures with increased antecedent strategies aimed at producing variability. We hypothesized that the scripts served as discriminative stimuli to signal the availability of reinforcement for using the scripted mand frames. However, based on Michelle’s lack of varied responding in the presence of static presentation of all three scripts, we decided to implement antecedent management strategies to essentially schedule response variability by removing each script once it was used. Extinction for repetitions remained in place, in attempt to provide specific consequence based contingencies. Set up and general procedures were similar to the simultaneous-script presentation condition. However, once she used each script the instructor removed it. Once all scripts were used the instructor replaced all three in a different order. No prompts were issued. Following three sessions with at least 3 different mands frames, we implemented a no script probe to evaluate if mand variability remained in the absence of the intervention package. After the no script probe the intervention package was re-implemented.

Generalization

One generalization probe was conducted at the end of the first baseline phase. The probe took place in the general preschool room and the typical snack table for participants at the university based preschool with an unfamiliar instructor. Following the last intervention session several generalization sessions were conducted. All sessions were conducted during the regularly scheduled snack activity in the preschool with up to four peers present. Sessions were approximately 10 min in length, although this varied
some, due to the naturally occurring contingencies in the preschool. Each participant’s terminal intervention package (materials and procedures) was in place for all snack activities, not just those during which generalization data were collected. Specifically, for Nicodemus and Braden, the first letter only scripts were attached (with loop and hook) to the placements typically used in snack activities at the preschool. Their placemats were present on the table in front of them (the script order was rearranged prior to the start of snack) and no prompts were given. For Michelle, initially the same procedures from the final simultaneous-script presentation with script rotation and extinction condition were in place. However, based on lack of responding following contacting extinction for repetitions, the procedures were revised. The extinction procedures were dropped, and repetitions were allowed. We provided pre exposure to each script and reinforcement via prompting (physical, or physical and vocal model) for two sessions, and then reduced to a vocal instruction to use the scripts. The instructor told Michelle: “Remember, you can ask for snacks by asking ‘May I have,’ ‘I would like,’ or ‘Please give me’.” The instructor pointed to each corresponding script while giving the instruction.

**Maintenance**

Maintenance probes were conducted at 2 and 4 weeks following the end of the generalization condition to assess if varied manding maintained. Session procedures were identical to those in place during generalization.
CHAPTER IV

RESULTS

Three (Nicodemus, Michelle, and Barstow) of the four participants completed the study. Butch completed the pre-training and the first two conditions (baseline and one extinction phase), but did not demonstrate the ability to master the three target scripts in the multiple-script training condition. Specifically, after a total of 12 sessions in the multiple-script training phase, at the full script level (i.e., the text scripts were never faded), he independently used the full script “I would like” 8% (3/25 presentations), and the full script “May I have” 7% (2/28 presentations) of opportunities. He never independently used the third script (“Please give me”). Given that Butch was not making sufficient progress in independently following the text scripts, he was excluded from the study.

Pre-Teaching

Nicodemus correctly read three (“I,” “me,” and “Please”) of the eight script words during the initial probe session. The remaining words were mastered (reading word correctly on 9/10 trials across two consecutive sessions) after the following number of pre-teaching sessions: “like” three sessions, “May” three sessions, “would” four sessions, “have” four sessions, and “give” in two sessions. Nicodemus did not demonstrate the ability to follow the printed pre-training script (“That dog is ________ “ accompanied
by a picture of Clifford, a big red dog) prior to training, but did so after six pre-teaching sessions (correctly following the script in 9/10 trials in one session). We then faded the last printed word (“is”) by cutting it off and Nic demonstrated mastery at this fading level after 10 sessions.

Michelle correctly read one (“Please”) of the eight script words during the initial probe session. She mastered the remaining seven words after the following number of sessions: “May” four sessions, “give” seven sessions, “would” 15 sessions, “I” two sessions, “me” four sessions, “like” nine sessions, and “have” in four sessions. Michelle did not read the pre-training script during the probe session. She mastered following the full script in five sessions and required five additional sessions to master the faded script.

Barstow did not correctly read any of the eight script words during the initial probe session. He mastered the words after the following number of sessions: “I” 12 sessions, “May” 13 sessions, “me” 10 sessions, “have” five sessions, “would” 18 sessions, “Please” nine sessions, “like” six sessions, and “give” in three sessions. Barstow did not read the pre-training script during the probe session. Initially, Barstow did not demonstrate acquisition of the full script. He completed 12 pre-training sessions with the full script with a range of 0-20% accuracy. In other words, in 10 trials he only followed the script independently two times during some sessions. We added in training trials with the individual words used in the scripts to potentially support his acquisition of the full script. He mastered all three words in four sessions over two days. Once the individual word training began he mastered the full script in nine sessions, with accuracy ranging from 20-100%. In total, Barstow mastered the full script in 21 sessions. He mastered the faded script in one session.
Mand Variability

Nicodemus

Nicodemus’ data are presented in the upper panel of Figure 1. The initial baseline condition was conducted to assess to what degree the participants might vary, if at all, prior to experimental manipulations. Nicodemus did not demonstrate mand variability, as he only used his default mand frame (“I want”) in the first baseline condition, demonstrating no response variability. He manded, using a full mand frame, a total of six times in each of the first two sessions, and seven times in the third (Figure 2, top panel). Following the baseline phase, we conducted one generalization probe with an unfamiliar teacher in the main ASSERT preschool area. Nicodemus only used his default mand frame during this session and requested a total of seven times.

Next, we implemented the extinction of repetition condition. Complete mand frames were only reinforced the first time they were emitted. During extinction of repetition, Nicodemus demonstrated the same stable patterning, seen in baseline, of manding exclusively using his default mand frame (“I want”). The purpose of this condition was to evaluate if exposure to consequence based contingencies, specifically a contingency that required variability to access reinforcement, would be sufficient to produce varied manding. Whereas Nicodemus manded at increased levels during this phase, it decreased across the three sessions. He manded 29 times in the first session, 36 times in the second, and 11 in the third session during extinction of repetition.
In the multiple-script training phase Nicodemus met the first fade criterion to two word scripts (removal of the last word) in session five, and the second fade criterion to first word only scripts (removal of the last 2 words, resulting in only the first word remaining) at session 12. Nicodemus used his default mand frame once in the first and second sessions, then never again in this condition. Overall, Nic completed nineteen sessions in this condition. His overall frequency of manding during multiple-script training ranged from 5 to 11 per session.

We returned Nicodemus to baseline conditions to evaluate if, following acquisition of several mand frames, mand variability would increase without the addition of specific consequence based contingencies. No variability was observed in this phase of the baseline conditions; he returned to exclusively using his default mand in all three of the baseline sessions. Nicodemus engaged in more manding (between eight and 18 mands) in this second baseline phase than in the first baseline phase.

Following the second baseline phase, we implemented another extinction of repetition phase. The purpose was to see if the combination of an increased mand frame repertoire plus consequence based contingencies could be effective at increasing mand variability. This treatment was not effective at producing variability for Nicodemus, as he resumed exclusive use of his default mand frame in all three extinction sessions. However, as with the second baseline condition, he demonstrated an increased level in overall manding, as compared to the first extinction of repetition condition. Specifically, he engaged in 34, 50, and 18 mands across the three sessions.

We returned to the multiple-script training condition a second time to ensure that Nicodemus could follow the scripts. As opposed to the first multiple-script training
phase, wherein Nicodemus used the full script first and faded from there, in the second
phase he started with the first word only faded script. In other words, as he met the
mastery criterion to proceed to the first word only faded scripts at the end of the first
multiple-script training phase, he was not required to start over again with a full script.
Nicodemus used all three scripts with 100% accuracy by the second session. He emitted
10 mands in the first session and 11 and the second.

Once we confirmed the acquisition of the three scripts, we conducted a third
exposure to the extinction of repetition condition. Nicodemus’s response variability
increased over previous extinction of repetition and baseline phases. Specifically,
Nicodemus emitted only one mand frame in 5 of 11 sessions, two different mand frames
in four sessions, and three different mand frames in two sessions. Overall, Nicodemus
used two or three different mand frames in just over half of the sessions in this phase.
When Nicodemus used only one mand frame within a given session it was always his
default frame. He used the scripted mand frame “Please give me” in five sessions, and
the scripted frame “I would like” in two. He never used the scripted mand frame “May I
have.” Therefore, in the sessions with three different mand frames, two are scripted and
one is his default frame. Over the course of this phase, Nicodemus emitted between 4
and 32 mands in a given session, with the earlier sessions in the phase containing the
highest occurrence of mands.

Next we returned to the multiple-script training condition to further expose
Nicodemus to the three target scripts and to attempt to fade the scripts one more level, to
first letter only scripts, in preparation for an alternative intervention aimed at further
increasing variability (consistent use of three to four mand frames). Nicodemus began
with first word only scripts and met the fade criterion, correctly using all three scripts for 100% of presentations, by the eighth session of this phase. We then moved to the next fading step for first letter only scripts and he met criterion in three sessions. Overall, Nicodemus completed 11 sessions in the third exposure to the multiple script training procedures and manded between eight and 11 times during these sessions.

Nicodemus’s alternative intervention (here after referred to as simultaneous-script presentation), consisting of simultaneously presenting the three first letter only scripts (“I,” “M,” “P”), resulted in more stable response variability. With the simultaneous-script presentation in place, he used using two different mand frames for two of nine sessions (the third and fifth), three different mand frames for seven of nine sessions, and four different mand frames for one of nine sessions (the sixth). In contrast to the most recent multiple-script training phase, where he used his default mand frame most frequently, in the simultaneous script presentation phase Nicodemus primarily used the three scripted mand frames, using his default frame very infrequently (in two of nine sessions). It should be noted that during session nine, Nicodemus began to mand for one item exclusively. As this occurred, he began to use the script that was closest to that stimulus. To prevent this pattern of responding in the subsequent session the containers were rearranged following each reinforced mand. Specifically, after delivery of a requested edible, the instructor picked up the containers and put them in a different order. He engaged in a range of four to 18 mands across these sessions.

Following the simultaneous script presentation phase, we conducted a probe session without any visual script materials present. The purpose of this probe was to remove the visual supports that were present in the alternative intervention to determine
if the scripts (the first letter of the target mand frames) were necessary to elicit response variability. Nicodemus reverted to using only his default mand frame. Whereas Nicodemus engaged in an average of 12.6 mands per session, across all sessions excluding generalization and maintenance, with a range of 4-50 within a given session, he manded only once in the no script probe. He did exhibit several other responses (“chips, ok,” “help,” grabbing the instructor’s arm, and grabbing the containers) that suggest that he was motivated to access the edible items present. Following the no script probe we returned Nicodemus to the simultaneous script presentation condition for one session to ensure that the intervention remained successful in producing varied responding. Nicodemus used three different mand frames in that session. He did not use his default mand, but rotated across the three scripts, manding a total of 11 times in that session.

In the generalization sessions, we continued the alternative intervention during Nicodemus’s regularly scheduled snack activity at the ASSERT preschool. It is important to remember that these sessions, as well as the maintenance sessions, were approximately 10 min long (twice as long as the experimental sessions). The placemat with the three first letter only scripts was present for generalization sessions. He used three different mand frames in the first and third session and four in the second. In the first session of this phase, Nicodemus used one scripted mand frame (“May I have”), his default, and an altered frame “I want some water please”). He requested, using a full mand frame, a total of 10 times. In the next generalization session, he used all three scripted mand frames and his default frame, manding 19 times. In the final
generalization session, Nicodemus used all three scripts, but not his default frame, requesting a total of 11 times.

Two weeks after the last generalization session, we conducted a 2-week maintenance probe during snack (simultaneous script presentation procedures still in place). Nicodemus used two scripted mand frames (“Please give me,” and “May I have”) and made a total of 28 mands. Finally, we conducted a maintenance session four weeks following the last generalization session. Nicodemus used the same two scripted mand frames as in the previous maintenance session, plus his default, for a total of three different mand frames. He emitted a total of 40 mands.

Michelle

Michelle did not produce any full mand frames, using full sentences, in the first two baseline sessions (Figure 1, middle panel). In the third through sixth baseline sessions she exclusively used her default mand frame of “I want.” Excluding the first two sessions, where no requests were made, Michelle emitted relatively high levels of manding across the remaining sessions (19, 28, 22, and 29, respectively [Figure 2, middle panel]). A generalization probe was conducted with an unfamiliar adult instructor in the general preschool area and Michelle requested 17 times using only her default mand frame.

We then implemented the first extinction of repetition phase, where within session repetitions of mand frames were placed on extinction. In the first two sessions, Michelle manded using only her default frame. She engaged in a total of 25 mands in the first session, and 16 in the second. In the third session in this condition she did not emit any mands that met the reinforcement requirement (i.e., a full sentence).
Michelle then moved on to the multiple-script training condition. Following implementation of the multiple-script training procedures, Michelle met the first fade criterion to two word scripts in the fifth session. She met the next fade level requirement to one letter only scripts in the ninth session. Not once, across the 19 multiple-script training procedures, did Michelle use her default mand frame. In the first three sessions, Michelle engaged in four, five, and seven total mands, respectively. However, in subsequent sessions in this phase, her total mands ranged from nine to 13.

Michelle displayed variable responding during her second baseline condition but generally manded at overall higher rates than the previous baseline and differential reinforcement conditions. In the first and third sessions, she did not demonstrate any varied manding, using only her default mand frame. In the first session she requested 25 times, but only once in the third session. She used two mand frames in four of the eight sessions and three mand frames in one session. In the second, sixth, and eighth sessions she used her default mand frame and an untaught mand frame (“I need ____.”). In the fourth session she primarily used her default mand frame, but also used the rearranged scripted frame “Give me ____ please” (taught as “Please give me.”). She varied across her default and untaught “I need” mand frames, and used the scripted frame “I would like” once, in session five. She did not mand at all in the seventh session.

In the subsequent extinction of repetition phase (second occurrence of this condition) Michelle’s mand variability displayed a decreasing trend, ending in complete cessation of manding. She used two different mand frames in the second session (primarily her default and one occurrence of the scripted frame “I would like”); however, in three of six sessions she only used her default mand frame. In the last two sessions,
she did not engage in any manding. To ensure that she had acquired the three scripts, we returned her to the multiple-script training (third exposure to this condition) with the script at fade level 2 (last two words removed), and she used all three scripts with 100% accuracy in the first session. A return to the extinction of repetition condition (third exposure) produced no manding during the three sessions. The multiple-script training condition was then re-implemented in order to fade the scripts to the first letter only, in preparation for an alternative intervention. Michelle required only two sessions to meet the fade criterion (correct independent script use on 100% of presentation). We then faded the scripts to the first letter only (“I,” “M,” “P”) in the third session and she independently used the three scripts on 100% of presentations.

As with Nicodemus, Michelle was then exposed to the simultaneous script presentation condition. However, in the presence of all three faded scripts, Michelle engaged in 0 manding for two consecutive sessions. Because in all previous conditions the instructor presented one script at a time, we began a condition to train the use of the simultaneously presented scripts. In the simultaneous script training condition Michelle required nine sessions to meet the mastery criterion (using each script independently a minimum of 75% of usages). Once Michelle used all three scripts when simultaneously presented, she returned to the simultaneous script presentation condition. In this second phase of the simultaneous script presentation condition, wherein the faded scripts were all presented at the same time and no prompts were given, Michelle’s mand variability was not stable.

In two of the nine sessions she used all three of the scripted mands, in five sessions she used two scripted mands, and in two sessions she used only one scripted
mand (“May I have” in the fifth, and “Please give me” in the sixth). She never used her default mand frame. While she often did not vary across the three scripts within a given session, she did vary script use across sessions. In other words, there was not one particular script that she consistently failed to use, or used notably less than others across the sessions in this phase. Michelle also tended to engage in patterned responding, using the scripts in a left to right pattern. Michelle engaged in high levels of manding in this phase, similar to levels seen in two baseline phases. Her total mands ranged from 21 to 37 across the sessions.

Because Michelle was not consistently varying her manding across the three scripts during sessions, we implemented a condition that combined the simultaneous presentation of the three scripts and consequence contingencies aimed at increasing response variability using a lag schedule. In this condition Michelle never contacted even the initial lag 1 schedule. In all three sessions Michelle engaged in one mand, using a script, and then continued to mand exclusively using that script, even though all repetitions were placed on extinction. Thus, she contacted reinforcement for the first mand in each session, but never contacted reinforcement again in a session because she never varied. Across the three sessions she requested a total of 12, four, then seven times.

Michelle was then exposed to a modified version of the simultaneous script presentation condition in which we implemented a package of antecedent (removing each first letter only script following its use and replacing all three in a different order once all three had been used) and consequence strategies (extinction of script repetitions). In this intervention phase Michelle’s mand variability was stable at levels similar to previous
training phases. Specifically, she used four different mand frames in the first session (all three scripts and her default), and all three scripts in the second through fourth sessions.

It is important to note that, across all four session, Michelle repeated a scripted mand frame, once the script had been removed, only once. Therefore, she did not effectively contact the extinction contingencies (for repetitions) in this phase. She also engaged in patterned responding, generally using the scripts from left to right, but occasionally using them from right to left. Her overall manding levels were lower than baseline and simultaneous script training conditions, but much higher than in previous phases containing differential reinforcement and extinction. In the first session she engaged in 18 mands, 23 in the second session, 21 in the third, and nine in the fourth session.

We conducted a probe session in which we removed the intervention package (no scripts or antecedent and consequence strategies). In this probe Michelle did not emit any mands. We reintroduced the intervention package and she immediately returned to using all three scripts.

Following the last probe with the intervention package in place Michelle entered the generalization phase. The intervention components were in place in the generalization phase. In the first session she almost exclusively used her default mand frame (“I want”) and used the “May I have” script once. In the second and third sessions she did not request at all. In the fourth session we forced exposure to each script by providing an immediate prompt to use each script to receive a requested edible. Specifically, once the cue “It’s time for snack” was given, the instructor immediately used a physical prompt, placing Michelle’s finger on the script. If she did not use the
mand frame right away the instructor re-issued the physical prompt with a vocal model of the scripted frame.

Following the forced exposure, Michelle independently used two scripts and her default to mand for items. She then repeated a previously used mand frame and contacted extinction. She repeated the same frame again, contacting extinction a second time, after which she ceased to mand for the duration of the snack activity. A similar pattern was seen in the fifth session. So, in the next session we prompted use of two scripts, and before we could prompt use of the third she independently used it and contacted reinforcement. She used two scripts twice each, and one script once. She then repeated a scripted mand frame (once it had been removed), contacted extinction and stopped manding for the remainder of the snack time.

In the sixth session of the generalization phase, we decided to modify the pre-exposure and consequence components of the intervention. At the beginning of the session the instructor reviewed each script, saying: “remember, you can ask for snacks by saying ‘I would like,’ ‘May I have,’ or ‘Please give me’.” No prompts were delivered. In addition, the extinction for repetitions was dropped, as her response patterns across the study indicated that contacting extinction suppressed all responding. During the sixth session Michelle used all three scripted mand frames and requested a total of 11 times. It should be noted that, whereas the snack activity typically lasted 10 min, this session was ended after 6 min. Because the generalization sessions took place within the standard preschool snack activity, the decision to end the session was not made by the researcher, but by the instructor in charge of the activity. Procedures were put in place to ensure that the snack activity, from then on, would last for approximately 10 min. Michelle
continued to use all three scripts for the remaining two generalization sessions, manding a total of 18 and 17 times respectively.

We conducted 2 and 4-week maintenance probes during snack in which Michelle used three different mand frames (the three scripted mand frames). Michelle did not use her default mand frame. She requested a total of 19 and 18 times respectively.

**Barstow**

During the initial baseline, Barstow used his default mand frame (“I want”) almost exclusively (Figure 1, bottom panel), demonstrating almost no variability. In the first session, Barstow did not emit any mands that met the requirement for reinforcement (i.e., he did not mand in the form of a full sentence [Figure 2, bottom panel]). In the fourth session he used the mand frame “May I have” once, however, he manded 26 times using his default mand frame. His overall frequency of manding, across baseline sessions, ranged from a total of four mands, to 27 within a given session. In the generalization probe (with an unfamiliar teacher in the main ASSERT preschool area), Barstow manded exclusively with his default mand frame a total of 37 times.

During the first phase of the extinction of repetition condition, Barstow demonstrated a very similar patterning of manding as seen in baseline, generally manding using his default frame (“I want”). Barstow demonstrated an overall decreasing trend in the number of mands per session during this phase. Specifically, he manded 33 times in the first session, 37 times in the second, 42 in the third, 20 in the fourth, and seven times in the fifth and final session.

Barstow began the multiple-script training condition next and did not meet the first fade criterion to two word scripts until the 16th session. He met the second fade
criterion to first word only scripts at session 22. He used his default mand frame in five of 22 sessions (twice in session 1, and once in sessions 3, 4, 7, and 20). Total mands for a given session ranged from 6 to 14.

Barstow returned to the baseline condition and demonstrated no response variability. In the first session, Barstow did not emit any mand frames. In the subsequent three sessions, he reverted to his default frame and did not use any of the scripted mand frames. His overall frequency of manding was much lower than in previous conditions (six in the second session, three in the third, and only one in the fourth). A second extinction of repetition phase followed and he continued to exclusively use his default mand frame at very low levels (one mand in the first session, four in the second, and two in the third). Another exposure to the multiple-script training condition was implemented. As with Nicodemus and Michelle, Barstow began with first word only scripts. Barstow used all three scripts with 100% accuracy by the third session. He mandated a total of 9, 12, and 10 times in the three sessions.

In the third exposure to the extinction of repetition condition, Barstow’s variability was similar to previous baseline and extinction of repetition phases. He generally used only one mand frame (five of seven sessions). Interestingly, he used the scripted frame “May I have” more frequently than his default frame. Specifically, he used his default only in one session, the scripted mand frame only in three sessions, both in two sessions, and no full mands in one (the first session). His overall number of mands per session reduced to levels similar to those demonstrated in the second baseline condition (across sessions, total number of mands: 0, 1, 5, 11, 3, 1, 2).
Barstow then returned to the multiple-script training condition to prepare for an alternative intervention. Barstow demonstrated variable accuracy in following the scripts and began to exhibit some incorrect, stereotypic responding in the presence of the scripts, most notably for the “I would like” script. When that script was presented, he would often repeat the words “would” or “like” two to three times in the middle of the script. On some occasions, his vocalizations related to this script were not fully intelligible. However, on other occasions, he produced “I would like” correctly and clearly.

Following session 9, we decided to implement a booster training session is an attempt to strengthen his vocal response for the script with which he was having difficulty. We conducted one 15 min session, in which the instructor initially presented one full script repeatedly until he followed it independently. The next step was to fade to a two-word script until he followed the faded script independently. This was repeated for a first word only script. The entire process was repeated for each script. However, because during presentation of the “I would like” script he continued to produce incorrect vocal responses, the instructor implemented trials, identical to the multiple-script training sessions. When this did not prove effective at shaping his vocal responding, five errorless trials (immediate full vocal model prompts) were implemented. Immediately following the block of five trials the script was presented and left out until Barstow provided a correct vocal response at both fade levels (two word and first word only script). A correct response was defined as stating the script “I would like _.” with no word repetitions. Mispronouncing “would” (e.g., “worr’d”) was accepted. The session was terminated when Barstow correctly followed the “I would like” script once at both fade level.
Following that 15 min booster session, multiple-script training session resumed, but with modified teaching procedures (sessions 10-14). Because Barstow could produce the correct vocal response, all prompts were removed. The scripts were presented one at a time and any incorrect vocalizations were ignored. Correct script following resulted in delivery of the requested stimuli. Across these modified sessions, Barstow correctly followed the “May I have” script on 100% of presentations. He correctly followed the “Please give me” script in four of six presentations. In the remaining two presentations he emitted one and three incorrect responses, respectively, before correctly following the script. In contrast, he never correctly followed the “I would like” script (0/9 presentations) and engaged in an average of 3.7 incorrect responses (range one to 12) before emitting the correct response.

At this point (following session 13) we decided to implement booster session just to shape up the vocal response for the “I would like” script. The booster sessions were 5 min in duration. The same definition of a correct response was used (i.e., no repetitions, but approximations/mispronunciations were acceptable). A total of seven booster sessions were conducted. In those sessions, we began back at the full script, presented it and provided an almost immediate (within 1 sec) vocal model of the correct response. On the fifth session Barstow emitted one independent (before the instructor provided the vocal model prompt) correct response. Mastery criterion was set at correctly following the script in 75% of presentations either independently, or following one full vocal prompt. Barstow met the mastery criterion in the seventh session.

Multiple-script training sessions were resumed following the seventh booster session. The original procedures were used (i.e., physical prompt, followed by physical
plus vocal model prompts) and the scripts were faded to first word only. A new fading
criterion required Barstow to use each of the three scripts correctly a minimum of one
time in one session for the next fade level to be implemented. This was notably looser
than the original criterion (correct independent use in 100% of presentations). However,
the reduced criterion reflected our concerns with keeping Barstow in the training
condition for such an extended period. He met the fade criterion after only two sessions
and required only one session at first letter only. Throughout the third multiple-script
training phase Barstow used his default mand only one time (this occurred in the fifth
session). Once Barstow demonstrated the ability to follow the first letter only scripts we
began the alternative intervention.

Barstow’s alternative intervention was identical to Nicodemus’s, involving the
simultaneous presentation of all three first letter only scripts on his placemat and no
prompting. In the simultaneous-script presentation condition his response variability
increased to stable levels, similar to those seen in previous training sessions. In
Barstow’s first and second sessions in the simultaneous script presentation he only
engaged in one mand frame (using the “I” script for “I would like”). In addition, his
overall manding in these sessions was very low (one and three total mands, respectively).
These sessions occurred after Barstow missed several days of preschool due to an illness.
In an attempt to ensure that Barstow contacted reinforcement for using each of the three
scripts one session was conducted wherein we forced exposure by providing in
immediate prompt for each script at the very beginning of the session. In that modified
pre-exposure session an immediate vocal model prompt was provided for each script (two
vocal models were required for the “Please give me” script, as he did not immediately
imitate the model). Following the initial prompts, no additional prompts were issued. Barstow correctly used all three scripts independently and engaged in a total of 26 mands in this session. Three more typical simultaneous script presentation sessions were conducted and Barstow continued to use all three scripts in all sessions. At no point during this phase did Barstow use his default mand frame. Across those sessions Barstow’s total mands ranged from 12 to 23.

A no script probe was implemented to assess how Barstow would respond without the presence of the three scripts. He manded a total of six times, using the taught frames “I would like” and “Please give me.” In a second probe he manded only three times, exclusively using the taught frame “I would like.” We returned Barstow to the simultaneous script presentation condition (which was his alternative intervention) and he varied manding across all three scripts, engaging in a total of 11 mands.

During the first generalization sessions (placemat and scripts present) at the regularly schedule ASSERT snack time, Barstow used all three scripted mand frames and used his default mand frame once. He requested a total of 25 times. In the subsequent three generalization sessions he used all three scripts, but did not use his default. Across those sessions he requested a total of 5, 34, and 35 times. Follow the generalization session the placemat and scripts were present at all snack activities.

A 2- and 4-week maintenance probe during snack was conducted in which Barstow used three different mand frames. Specifically, he used the three scripts, but not his default mand frame. He requested a total of 35 and 50 times, respectively.
Figure 1. Results of the total number of different mand frames in all phases, and percent independent script use in multiple script training phases, per session for all participants. The top panel depicts the number of different mands used (closed triangles, left y-axis) and the percent of independent script use (open squares, right y-axis) for Nicodemus. The middle panel depicts the same measures for Michelle. The bottom panel shows the
same measures for Barstow. In the bottom panel for Barstow the “Bs” indicate that a booster session took place prior to that session, or during the break in sessions.

Figure 2. Results of the total number of mand frames used per sessions for all participants across all phases. The top panel depicts the total number of complete mands for Nicodemus. The middle panel depicts the total number of complete mands for Michelle. The bottom panel depicts the total number of complete mands for Barstow.
Michelle. The bottom panel depicts the total number of complete mands for Barstow. In the bottom panel for Barstow the “Bs” indicate that a booster session took place prior to that session, or during the break in sessions.
CHAPTER V
DISCUSSION

The main purpose of this study was to investigate strategies to produce mand variability in preschool age children with autism. This study sought to extend the Betz et al. (in press) study in part, and investigate some questions revealed therein. The results of this study will be discussed as related to the purposes previously outlined. Primarily, we were interested in (1) if extinction of repetition alone would produce mand variability, (2) what effect simultaneously teaching and fading several mand frames, via scripts, might have on mand variability, (3) what degree results differ from those obtained in Betz et al. (in press), and (4) once several mand frames were acquired, what effect extinction of repetition would have on mand variability. Where relevant, direct comparisons to the results obtained in Betz et al. (in press) will be made.

It is well established, in both the basic (Antonitis, 1951; Eckerman & Lanson, 1969; Margulies, 1961) and applied (Grow et al., 2008; Harding et al., 2004; Lali et al., 1994) research literature, that extinction can be an effective strategy to produce response variability. Therefore, we began this study by exploring if extinction alone would produce varied manding. However, low levels of variability in the first extinction phase for all three participants indicated that for these participants, extinction alone was insufficient to produce response variability.

These results support the findings in Betz et al. (in press). In that study, three preschoolers with autism, and a history of limited mand variability, demonstrated low to no mand variability in an initial extinction of repetition condition. Taken together, these results indicate that, at least for some young children with autism, extinction alone may
not be an effective strategy for inducing response variability. This may be due to the fact that young children with autism often have very restricted repertoires, thereby limiting the responses across which they can effectively vary should one response become ineffective at garnering the desired effect (in the case of these two studies –access to edible stimuli).

Whereas we measured the different complete mand frames, it is important to clarify that we did not directly measure other possible dimensions along which variability might have occurred. For example, we did not directly measure variability along the dimensions of non-vocal verbal behavior (e.g., frequency or duration of eye contact, touching the instructor’s hand, arm, or leg, pointing or reaching towards the snack items), nor did we measure variability along the dimension of the vocal productions, other than the content of the words (tone of voice, inflection, etc.). Therefore, it is possible (in fact it is quite likely) that variability across other dimensions of behavior occurred to which or measurement system was insensitive.

We then set out to evaluate what effect increasing participants’ response repertoires might have, if any, on response variability by returning the participants to baseline conditions. Baseline conditions included reinforcement for any and all mand frames (as previously defined). Whereas Betz et al. (in press) employed the same procedures in their baseline conditions, this is different than traditional baseline conditions wherein researchers might implement extinction or status quo (i.e., whatever procedures are typically used in a similar context). For two participants (Nicodemus and Barstow) acquisition of three mand frames did not produce increased variability in a return to baseline. The third participant (Michelle) engaged in some increased response
variability, as compared to the first baseline. However, the increase was minimal (from one mand frame in previous conditions to two different mand frames).

Therefore, it appears that simply teaching several different mand frames may not always be sufficient to increase variability. These results are in accordance with the Betz et al. (in press) findings. There, participants demonstrated low, to no, increases in variability following the sequential acquisition of three mand frames when no specific contingency was in place to induce variable responding. The researchers conducted a maintenance condition (where any and all mand frames in the form of a complete sentence were reinforced) immediately following the mastery of each script and found no notable increases, suggesting that simply increasing participant’s mand repertoire alone was insufficient to elicit response variability.

It is possible that the reinforcement schedules in place in our return to baseline and Betz and colleagues’ maintenance condition were not conducive to producing response variability. Researchers have consistently demonstrated that FR1 schedules do not engender high levels of variability (Boren, Moerschbaecher, & Whyte, 1978; Eckerman & Lanson, 1969; Tatham, Wanchisen, & Hineline, 1993). One characterization of this effect is that access to reinforcement on ratio schedules is relative to rate of responding. Therefore, the more responding that occurs the more reinforcement an individual can access. In the case of young children with autism, it seems intuitive that on an FR1 schedule they would resort to using their most established mand response to maximize reinforcement, which is in direct conflict with producing variability. Thus, it is possible that simply increasing an individual’s response repertoire may result in
increased response variability on a different schedule (e.g., a higher FR schedule, and FI schedule, or some variable schedule).

In the current investigation we sought to evaluate if there was any benefit to teaching several responses at once, as opposed to the teaching strategies used in Betz et al (in press). The procedures in Betz et al. (in press) included teaching one mand frame to mastery, returning to essentially an FR1 condition, and then exposing the participants to extinction. Two participants clearly did not increase mand variability until the extinction phase following acquisition of the third and final mand frame. In addition, during each script-training phase, participants tended to only use the mand frame that was being taught at that time, even during training for the third mand frame (at which point each participant had at least three mand frames in his or her repertoire –the two scripts and the frame present when entering the study).

It is possible that teaching in this sequential manner established the presence of each script as a discriminative stimulus, hindering variability. Therefore, in the current study we taught the three target mand frames together. For two participants (Nicodemus and Barstow), no increases in variability were observed in a return to baseline following multiple-script training. For one participant (Michelle), mand variability increased somewhat in the return to baseline following multiple-script training, as compared to the initial baseline phase. This suggests that multiple-script training may produce some moderate increases in varied responding in some cases, however, in other cases (Nicodemus and Barstow) it does not appear to be superior to sequential-script training.

As previously discussed, one explanation of the limited variability demonstrated during each script training phase in the Betz et al. (in press) study was that the auditory
script exerted very tight stimulus control over responding. This was demonstrated when the participants almost exclusively used the mand frame that was currently being taught. In addition, for one participant in that study, such strict stimulus control was established that the visual stimuli that were intentionally associated with the scripts were required in the alternative intervention to produce variability. In the present investigation we hypothesized that teaching the scripted mand frames at the same time might reduce this effect. However, all three participants demonstrated patterns of responding that indicate that tight stimulus control did occur. Whereas variability was nonexistent to minimal in the extinction phases (no scripts present), once the scripts were re-introduced the participants varied responding across the three scripted mand frames. However, one participant required specific training and modified procedures to vary responding across the three scripts.

Given that neither extinction of repetition alone, nor expansion of participants’ mand repertoires, was sufficient to produce response variability in the three participants in the current investigation, we move on to the next question. We examined if, as was the case for two participants in Betz et al. (in press), extinction of repetition following acquisition of multiple responses would produce variability. Two of the participants (Nicodemus and Barstow) in the current study did not engage in any response variability in the extinction phase following multiple-script training. The third participant (Michelle) increased variability in one session, but then stopped responding all together. Given that these results differed from the expected extinction of repetition induced increases demonstrated in previous studies (Betz et al., in press; Grow et al., 2008; Lerman & Iwata, 1996) we ensured mastery of the scripted mand frames and conducted
second exposure to extinction. This resulted in some increases for one participant (Nicodemus), brief but not lasting increases for another (Barstow), and suppressed manding all together for the third (Michelle). For these participants, even with increased repertoires, extinction was insufficient to elicit desirable and stable increases in variability. For at least one participant, exposure to extinction of repetition had detrimental effects, as related to her ability to access reinforcement.

These findings are in direct contrast to the findings in Betz et al. (in press). The authors suggested that, for two participants, a minimal number of responses were required in their repertoire before extinction of repetition effectively produced varied responding. It is not clear what the divergence between the results of this study and the Betz et al. (in press) investigation imply. It is difficult to generalize conclusions across so few individuals. It is possible that specific participant characteristics (e.g., language abilities) and learning histories could account for the fact that, in the presence of a sufficient response repertoire, extinction of repetition might be effective at producing variability or not. Because this was an extension, not a strict replication of the Betz et al. (in press) study, it is also possible that procedural differences (use of text versus auditory scripts, multiple-script teaching versus sequential, stimuli presentation and prompting nuances, etc.) could have influenced the effects of extinction, as compared to those obtained in the Betz et al. (in press) investigation.

One explanation for why extinction of repetition failed to produce variability here may be related to language differences between the participants here and those in Betz et al. (in press). It is quite possible that some very young children with autism and limited mand repertoires are unlikely, in the best of circumstances, to produce enough mand
variety to access reinforcement during a 5-min session simply due to language deficits. However, while that might shed some light on the findings here, it does not explain why extinction of repetition was effective for two of three participants in Betz et al. (in press).

Another consideration is the effects of repeated exposure to extinction. In the current study the participants repeatedly contacted extinction, which reduced overall responding, and suppressed it altogether for one participant. Even though a differential reinforcement component (access to reinforcement for producing a different mand frame) was in place, the participants did not contact this schedule. It is possible that the extinction for repetition procedures simply acted as extinction for manding overall. It is unknown if we could have obtained different results if we would have implemented a more gradual extinction procedure, or if we would have intermittently reinforced mand frames, even if the frame had been previously emitted within a given session. For example, Pryor et al. (1969) made the decision to periodically reinforce previously emitted responses to reduce the likelihood that extinction would suppress overall responding.

It is also likely that the scripts may have acted as discriminative stimuli, indicating availability of reinforcement and producing more manding when they were present. Sessions wherein scripts were absent may have signaled reduced access to reinforcement, reduced interaction with the instructor, and significantly increased response effort. This is illustrated particularly well by one participant’s (Michelle) responding across the second extinction, second multiple-script training, third extinction, and third multiple-script training phases. Her responses ceased in the last two sessions of the second extinction phase only to increase right back up in the second multiple-script
training. In the third extinction phase she never responded at all, but then increased immediately when the multiple-script training was reinstated. A similar response pattern was demonstrated by the other two participants, supporting the conclusion that stimulus control was a major determining factor in responding across and within sessions.

What remains unclear is exactly how the discriminative control was established. One possibility is that the teaching procedures themselves established strong stimulus control. In the experimental context, participants were continually exposed to availability of reinforcement in the presence of the script materials. Specifically, when the scripts were present, independent or prompted script use resulted in access to reinforcement. In the baseline and extinction conditions, the scripts were never present and the participants contacted proportionally less reinforcement. Manding, via following the scripts, may have increased because of the established history of being reinforced in the presence of the script materials. These findings are similar to those in Page and Neuringer (1985), where varied responding was brought under the control of the key light colors. Future researchers may wish to explore the utility of stimulus control, as related to behavioral variability in applied settings.

In addition to the above questions, we were interested in evaluating the content of varied responses to determine the extent to which the varied responses were made up taught responses (via script training), altered, or novel mands. However, given the current results that participants primarily used their default or scripted mand frames, these analyses were not possible. All three participants frequently added “please” to the default “I want” mand frame. While this did not meet the requirement for different or altered, it does demonstrate some low level of variability that may not have been
captured. One participant (Barstow) used the targeted mand frame “May I have” once time in the initial baseline condition. Another participant (Michelle) used an untaught mand frame (“I need”) in four sessions in the second baseline phase. It is interesting that this never before used mand frame emerged in a baseline phase, as opposed to extinction. Finally, one participant (Nicodemus) altered his default fame by adding “some” in the generalization condition. Overall, the three participants here primarily varied their responses across four different mand frames (the default and the three scripted frames), as opposed to creating novel or altered mand frames. Given the data presented in Betz et al. (in press), it is not possible to determine to what degree the variability obtained included altered and/or untaught mand frames. However, because the participants did, on occasion, use five and six different mands within a session, it seems that some amount of altered or untaught mands were produced.

Regarding generalization of response variability to non-training setting and people, response patterns of all three participants indicate that response variability was fairly stable and remained at levels similar to the experimental setting. This suggests that the physical scripts exerted stimulus control to produce varied manding for two participants (Nicodemus and Barstow). Interpretations for the third participant (Michelle) are more complicated, as her intervention not only involved the presence of the three scripts, but also their systematic removal and replacement by an adult. Presenting a placemat with scripts attached seems to be a reasonable and manageable long term intervention in a preschool setting, allowing participants who have a history of primarily using one repetitive mand frame and the item name plus “please” (e.g., “Chip, please.”) to vary across at least three different mand frames.
With the alternative interventions in place (simultaneous script presentation for Nicodemus and Barstow, and simultaneous script presentation + vocal instruction + removal for Michelle), all three participants maintained levels of mand variability comparable to those observed during intervention. This suggests that the scripts maintained discriminative control, not only outside of the research setting, but also over time. The results obtained using these procedures are promising for clinicians and educators, as they indicate the potential to produce lasting increases in response variability, at least as related to mands.

An interesting possible conclusion that can be drawn for these participants is that antecedent strategies were generally superior to consequence based interventions, for all participants. That is to say, that minimal variability was demonstrated (participants varied in only one of three exposures to extinction) when the participants were exposed to direct consequence contingencies requiring variability to access reinforcement (extinction of repetition). In fact, any attempt to implement extinction of repetition (even within a lag schedule) with one participant suppressed all responding. In contrast, a simple antecedent strategy (with modifications for one participant –Michelle) increased and maintained levels of response variability to, or near, those demonstrated in training conditions. This potential conclusion is tempered by the fact that the participants did not contact the differential reinforcement component of the extinction for repetition condition.

These findings beg the question –If we had simply applied the antecedent technologies (presentation of the faded scripts), following multiple-script training, could we have achieved similar results? It is possible that including a verbal instruction to vary
manding could produce variability. For example, simply stating something like: “Ask for snacks in different ways.” or providing an initial verbal model of different mand frames might be sufficient to produce varied manding for some individuals. The fact that extinction of repetition, and other schedules of reinforcement were insufficient at producing behavioral variability for these participants, whereas antecedent strategies were effective, has important implications for how we investigate and teach strategies geared toward increasing response variability for individuals with autism.

**Limitations and Future Directions**

In this study we sought to extend an emerging area of investigation into strategies for increasing response variability in individual with autism. Specifically, we set out to build on a recent study by Betz et al. (in press). Several findings here support those obtained in Betz et al. (in press). However, it is with caution that researchers and clinicians should interpret these data. Only three participants completed the study; therefore, generalization of the overall and individual results to other children with autism is limited. This is especially true, given that the current results diverge from those in Betz et al. (in press) with regard to effectiveness of extinction, following acquisition of mand frames, to produce response variability.

One limitation to the investigation may have been the choice to implement the very strict contingency of extinction for repetitions. Given the response patterns relative to extinction of repetition (cessation of all manding), it is possible that under less strict consequence contingencies, response variability may have been demonstrated more quickly. It is also possible that, if the scripts exerted stimulus control (for manding and
varied script use) response variability might have occurred following acquisition of the scripted mand frames. For example, it may be less effortful for young children with autism to vary on lag 1 or lag 2 schedules of reinforcement. On these types of schedules, participants would contact reinforcement more frequently than schedules requiring no repetitions within a given session. Furthermore, the intermittent contact with reinforcement and extinction on a lag schedule may strengthen the newly acquired responses, producing more persistent responses in an individual’s repertoire. Given that previous researchers have demonstrated that lag schedules can increase variability (Cammilleri & Hanley, 2005; Lee et al., 2002; Lee & Sturmey, 2006; Napolitano et al., 2010), future researchers may wish to explore this application to mands, and other verbal operants, with young children with autism.

Another option to potentially mitigate the response suppressing effects of extinction could be to implement response-independent reinforcement procedures. Franks and Lattal (1976) demonstrated responding could be reinstated, following extinction, by delivering response-independent reinforcement. Specifically, rats’ responding was placed on extinction (i.e., food was no longer delivered following bar presses) until near zero levels were obtained. Researchers then implemented response-independent reinforcement by delivering food on a fixed-time schedule, resulting in reinstatement of bar pressing. This procedure could be extended to the current application, wherein edible reinforcers could be delivered non-contingently (e.g., absent of a specific mand) to potentially reinstate manding responses.

In the present study, we were not able to effectively transfer stimulus control from the scripts (and instructor removing the scripts in once case) to the naturally occurring
stimuli (e.g., presence of snack items, an adult ready to deliver requested snack items) via the fading procedures. Fully fading text scripts used to increase vocal language with children with autism has been a problem for some previous researchers (Gantz et al., 2008; Krantz & McClannahan, 1993). Even when using auditory scripts, sometimes a visual stimulus was required to elicit the target vocal responses (Betz et al., in press; Reagon & Higbee, 2009). However, given that children with autism often have communication deficits requiring specific intervention, the presence of significantly faded scripts is a potentially viable strategy to promote language. Future researches might continue to investigate ways to successfully transfer stimulus control to naturally occurring elements. For example, it may prove efficacious to teach the multiple mand frames in the naturally occurring snack activity.

In addition, future researchers may want to investigate the effects of pairing an arbitrary stimulus with contexts in which varied responding is reinforced. As in Page and Neuringer (1985), researchers could identify a signal (e.g., a green triangle) to be presented in conditions where variability is reinforced and then thin the schedule of reinforcement. The signal would not be present in conditions where patterned responding is reinforced. If stimulus control was established, researchers could then investigate the applied utility and generalization of the effects by measuring variability in some natural setting appropriate for the skills targets and then inserting the “vary” signal. For example, a child could be reinforced for varied play statements in the presence of a big yellow smiley face and reinforced for repetitive play statements in the absence of the smiley face. Once discriminative responding is established the smiley face could be placed in the general play area.
One unfortunate result in the current study is that participants greatly reduced the use of their default frame in research sessions and in the snack activity. Instructors anecdotaly reported that all three individuals continue to mand using “I want” within work and play contexts, however, no data were collected to confirm this. It is somewhat concerning that the participants’ functional mand repertoires were somewhat limited, at least of the snack setting. In addition, one participant (Michelle) emitted an untaught mand frame during one baseline phase, however that frame was never heard again. This could be an effect of the scripts exerting strict stimulus control over manding. In other words, the presence of the scripts may have signaled that, in order to access reinforcement, those specific mands were required. Future researchers interested in expanding response repertoires of young children with autism for the purpose of increasing variability should explore methods that would allow maintenance of existing responses.

Finally, levels of variability may have been influenced by the fact that mands were chosen for this evaluation. We made the decision to using mands, as we anticipated that no arbitrary reinforcement would be required, as the mand responses resulted in immediate access to the requested item. However, given the age and limited language abilities of the participants, there may effectively be a ceiling on the number of mand frames appropriate for this group. For example, it is unlikely that the participants would be able to acquire and use the longer frame: “Could you please hand me one of those skittles?” Thus, it may be the case that a higher degree of variability would be obtained in contexts with a greater number of potential responses of relatively equally complexity. Future researchers may wish to continue to explore variability with tacting during play,
intraverbals during play or other social interactions (e.g., answering common social questions such as: “What’s your favorite food?”) or with play or basic pre-academic actions (e.g., making patterns, completing art activities).

**Implications and Conclusions**

This study is an extension of Betz et al. (in press), and of the emerging body of research exploring behavioral variability as an operant. Several implications may be drawn from this study that might prove useful for future researchers and clinicians. The results of the current investigation are yet another demonstration supporting previous findings regarding the utility of scripts to teach vocal responses (Betz et al., in press; Krantz & McClannahan, 1993, 1998). However, the current findings also highlight an often experienced limitation with script technology; the difficulty of completely removing the physical script materials. Whereas it seems acceptable that minimal script cues remain in place if an individual’s communication skills are significantly increased, researchers should continue to investigate methods allowing the materials to be completely removed.

A significant implication is that the results here support the findings in Betz et al. (in press) that extinction of repetition, by itself, may not sufficiently increase response variability, as related to verbal behavior. Taken together, these results stand in direct contrast to previous findings (Grow et al., 2008; Goetz & Baer, 1973; Harding et al., 2004). Researchers should continue to investigate if extinction (of repetition) alone is effective at producing behavioral variability in individuals with restricted response repertoires. In addition, researchers should continue to explore and compare the full
range of methodologies that have been shown to produce behavioral variability. In the meantime, researchers, clinicians, and educators should consider training up several different responses, in a given class, before applying extinction of repetition for the purpose of increasing response variability in young children with autism.

In the current investigation, the most robust effects were obtained for all three participants when antecedent strategies were implemented in the absence of consequence-based contingencies that required response variability. It is important not to overlook that reinforcement (a consequence) for manding was implemented throughout the study. Specifically, two participants (Nicodemus and Barstow) engaged in the most variability when the faded scripts were presented. No other systematic intervention components were necessary. In this context, both participants varied their manding, using all three scripts, in the absence of any adult prompting or consequence management. The third participant (Michelle) required a verbal reminder to use all of the scripts and systematic removal and re-presentation of the scripts to vary across all three. However, it is possible that these antecedent strategies are more likely to be implemented in applied settings, as compared to extinction, or other consequence-based strategies. Clearly, continued investigation is required to identify the specific components of antecedent and consequence-based strategies that make up the most effective treatment package when attempting to increase behavioral variability. In the meantime, clinicians and educators might consider employing similar antecedent strategies to those used here to increase response variability. For example, if scripts were used to teach multiple play statements, those scripts could be used to increase the degree to which participants use and vary
across the responses by presenting the faded scripts (in a different order for each presentation) and potentially giving a vocal instruction to use them all.

The procedures used in the current study, as well as the results obtained, contribute to the body of research on behavioral variability, as well as to clinicians and educators. It is crucial that researchers continue to replicate and refine the procedures used in this study, as well as their feasibility in applied and natural settings (e.g., clinics, classrooms, and homes). Specifically, it should be assessed if similar results could be obtained just with increasing response repertoires and implementation of antecedent strategies alone? It will be important for investigators to attempt to determine the degree to which stimulus control contributes to stimulus variability, especially as related to vocal responses acquired via script training. Another focus should be the degree to which increases in variability maintain over longer periods of time and generalize to other settings, people, and even response classes. In other words, if response variability is obtained for manding for snack items, will increases occur relative to varied responding for manding in other contexts, to with tact or intraverbal classes? This study contributes to the existing response variability literature by strengthening some pervious findings and indicating several areas for future investigation, as well as by providing information that may be informative to clinicians and educators who are concerned with increasing variability of vocal behavior.
REFERENCES


of Applied Behavior Analysis, 10, 349-367.


APPENDICES
Appendix A

Flow Chart of Phase Progression
Appendix B

Baseline Condition Data Sheet
Baseline Condition Participant:

<table>
<thead>
<tr>
<th>Date:</th>
<th>Instructor:</th>
<th>Session Number:</th>
<th>Reli Taken?</th>
<th>Y</th>
<th>N</th>
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</table>

**Session Instructions:** Provide the requested edible following each *full mand* (i.e., a full sentence containing a subject, verb, and noun). Do not reinforce any other mands (e.g., gestures, single words, or things like “Want M&M”).

**Data Collections Instructions:** Write each mand used (even those that are not full mands, for example, “Chip please.”). Tally word-for-word repetitions of a mand in the column next to the mand.

<table>
<thead>
<tr>
<th>Mand (word for word)</th>
<th>Tally</th>
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**Different Mand Frame Definition:** complete sentences (i.e., contain a subject and a verb) differing from other mands already emitted the session by more than the addition of an adult’s name, substituting nouns (i.e., the snack item name), or rearranging the word order, or adding or deleting “please.”
Appendix C

Data Sheet for Extinction of Repetition Prior to Script Training Conditions
FIRST Extinction Condition Participant: ________________

Date: _____   Instructor: ________________   Session Number: _____   Reli Taken? Y N

Session Instructions: Session Instructions: Provide the requested edible following the first occurrence only of each mand frame (i.e., a full sentence containing a subject, verb, and noun). Do not reinforce any other mands (e.g., gestures, single words, or things like “Want M&M), or repetitions of mand frames.

Data Collections Instructions: Write each mand frame used. If you reinforced the 1st occurrence, circle “Y.” If you accidentally did not reinforce a 1st occurrence, mark an “x” over the “Y.” Tally word-for-word repetitions of a mand frame in the column next to the mand.

<table>
<thead>
<tr>
<th>Mand (word for word)</th>
<th>Sr+ 1st</th>
<th>Tally Repeats</th>
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<tbody>
<tr>
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<td>Y</td>
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</table>

Total FULL Mands

Total DIFFERENT Mands

Different Mand Frame Definition: complete sentences (i.e., contain a subject and a verb) differing from other mands already emitted the session by more than the addition of an adult’s name, substituting nouns (i.e., the snack item name), adding or deleting “please,” or rearranging the word order.
Appendix D

Data Sheet for Multiple-Script Training Conditions
Multiple Script Training Condition Participant: ________________

Date: ____________ Instructor: ______________ Session Number: __________ Reli Taken? Y N

Mand Frame Started With (circle): 1 2 3 Default Mand Frame: ______________

If participant uses a taught mand frame *WITHOUT SCRIPT PRESENT* write in “NO SCRIPT”

<table>
<thead>
<tr>
<th>Mand</th>
<th>Level</th>
<th>Sr+?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3</td>
<td>Default</td>
<td>Untaught</td>
</tr>
<tr>
<td>1 2 3</td>
<td>Default</td>
<td>Untaught</td>
</tr>
<tr>
<td>1 2 3</td>
<td>Default</td>
<td>Untaught</td>
</tr>
<tr>
<td>1 2 3</td>
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<td>1 2 3</td>
<td>Default</td>
<td>Untaught</td>
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<tr>
<td>1 2 3</td>
<td>Default</td>
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<tr>
<td>1 2 3</td>
<td>Default</td>
<td>Untaught</td>
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<tr>
<td>1 2 3</td>
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<td>1 2 3</td>
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<td>1 2 3</td>
<td>Default</td>
<td>Untaught</td>
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<tr>
<td>1 2 3</td>
<td>Default</td>
<td>Untaught</td>
</tr>
</tbody>
</table>

**Totals**

<table>
<thead>
<tr>
<th>Default</th>
<th>Script 1</th>
<th>Script 2</th>
<th>Script 3</th>
<th>Untaught</th>
<th>Total Different</th>
</tr>
</thead>
</table>

*Different Mand Frame Definition:* complete sentences (i.e., contain a subject and a verb) differing from other mands already emitted the session by more than the addition of an adult’s name, adding or deleting “please,” substituting nouns (i.e., the snack item name), or rearranging the word order.
Appendix E

Data Sheet for Extinction Following Script Training Conditions
Extinction FOLLOWING MST Condition Participant:

**Session Instructions:** Provide the requested edible following the first occurrence only of each mand frame (i.e., a full sentence containing a subject, verb, and noun). Do not reinforce any other mands (e.g., gestures, single words, or things like “Want M&M), or repetitions of mand frames.

**Data Collections Instructions:** Circle Y or N to indicate if the 1st occurrence was reinforced. Tally word-for-word repetitions of a mand frame in the “repetitions” row, “Tally” cell (these are NOT reinforced). Write in any alterations or novel frames in the “Other Mand Frame” section, circling “yes” or “no” to indicate if the 1st occurrence was reinforced and tally repetitions.

<table>
<thead>
<tr>
<th>Date:</th>
<th>Instructor:</th>
<th>Session Number:</th>
<th>Reli Taken?</th>
<th>Y</th>
<th>N</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th><strong>Mand Frame #1</strong></th>
<th><strong>Mand Frame #2</strong></th>
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<tbody>
<tr>
<td><strong>1st Occurrence</strong></td>
<td><strong>1st Occurrence</strong></td>
</tr>
<tr>
<td>Sr+?</td>
<td>Sr+?</td>
</tr>
<tr>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>Repetitions</td>
<td>Repetitions</td>
</tr>
<tr>
<td>Tally</td>
<td>Tally</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Mand Frame #3</strong></th>
<th><strong>Default Mand Frame</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1st Occurrence</strong></td>
<td><strong>1st Occurrence</strong></td>
</tr>
<tr>
<td>Sr+?</td>
<td>Sr+?</td>
</tr>
<tr>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>Repetitions</td>
<td>Repetitions</td>
</tr>
<tr>
<td>Tally</td>
<td>Tally</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Other Mand Frames</strong></th>
<th><strong>Sr+ 1st?</strong></th>
<th><strong>Tally Reps</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N</td>
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<tr>
<td></td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N</td>
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<table>
<thead>
<tr>
<th><strong>Session Totals</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Number of Mands</td>
</tr>
<tr>
<td>Total Number of DIFFERENT Mands</td>
</tr>
</tbody>
</table>

**Different Mand Frame Definition:** complete sentences (i.e., contain a subject and a verb) differing from other mands already emitted the session by more than the addition of an adult’s name, adding or deleting “please,” substituting nouns (i.e., the snack item name), or rearranging the word order.
Appendix F

Data Sheet for Lag Schedule and Extinction Condition
Lag Schedule + Simultaneous Script Presentation  Participant: __________

Date: _____  Instructor: ___________________  Session Number: _____  Reli Taken?  Y  N

Instructions
- Reinforcement the 1st mand frame
- Only reinforce the subsequent frame if it is different from the first (Lag 1)
- Once a second (different) frame is emitted and reinforced, only reinforce the subsequent mand frame if it is different from the immediately preceding 2 frames (Lag 2)
- Continue on Lag 2 for remainder of the session
- Circling “Y” in Sr+ column indicates that the current schedule has been met.

<table>
<thead>
<tr>
<th>Sr+?</th>
<th>MAND FRAME: circle one</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Y I M P D Other:</td>
</tr>
<tr>
<td>2.</td>
<td>Y I M P D Other:</td>
</tr>
<tr>
<td>3.</td>
<td>Y I M P D Other:</td>
</tr>
<tr>
<td>4.</td>
<td>Y I M P D Other:</td>
</tr>
<tr>
<td>5.</td>
<td>Y I M P D Other:</td>
</tr>
<tr>
<td>6.</td>
<td>Y I M P D Other:</td>
</tr>
<tr>
<td>7.</td>
<td>Y I M P D Other:</td>
</tr>
<tr>
<td>8.</td>
<td>Y I M P D Other:</td>
</tr>
<tr>
<td>9.</td>
<td>Y I M P D Other:</td>
</tr>
<tr>
<td>10.</td>
<td>Y I M P D Other:</td>
</tr>
<tr>
<td>11.</td>
<td>Y I M P D Other:</td>
</tr>
<tr>
<td>12.</td>
<td>Y I M P D Other:</td>
</tr>
<tr>
<td>13.</td>
<td>Y I M P D Other:</td>
</tr>
<tr>
<td>14.</td>
<td>Y I M P D Other:</td>
</tr>
<tr>
<td>15.</td>
<td>Y I M P D Other:</td>
</tr>
</tbody>
</table>

Appendix G
Informed Consent
INFORMED CONSENT
Increasing Mand Variability in Preschoolers with Autism

Introduction/Purpose  Professor Thomas S. Higbee in the Department of Special Education and Rehabilitation at Utah State University is conducting a research study to find out more about how to teach children with autism to vary the ways they request. You have been asked to take part because your child is currently enrolled as a student in the ASSERT Preschool Program. There will be approximately 4 participants at this site. There will be approximately 4 total participants in this research.

Procedures If you agree to be in this research study, the following will happen to you and your child:

- We will briefly interview you to identify several of your child’s favorite snack items.
- Your child will be seated at a table with 3-5 of his/her preferred snack items and told: “It is snack time.” This will last for 5 minutes and will happen 1-3 times per day for 3-5 days per week.
- He/she will be taught 3 different ways to ask for those snack items (e.g., “I want ____”, “Can I have ____ please”, etc.). Your child will be taught using printed or auditory (played on a small recording device) scripts.
- As your child learns the different ways to request the scripts will be taken away.
- After your child has learned the 3 different ways to request an item, he/she will only get access to requested snack items by asking in a different way each time.
- All sessions will be videotaped. Only the researchers will view the videotapes. Any videotapes created will be kept in a locked file cabinet in a locked room of the researcher. They will be destroyed after a period not to exceed 3 years.
- It is anticipated that your child will be finished participating in the study within 3-4 months.

New Findings During the course of this research study, you will be informed of any significant new findings (either good or bad), such as changes in the risks or benefits resulting from participation in the research, or new alternatives to participation that might cause you to change your mind about continuing in the study. If new information is obtained that is relevant or useful to you, or if the procedures and/or methods change at any time throughout this study, your consent to continue participating in this study will be obtained again.

Risks Participation in this research study may involve some added risks or discomforts. However, the risks involved in participation are minimal. There are no physical risks associated with participation in this study. Your child will be under the direct supervision of at least one trained adult at all times to ensure that any potential unforeseeable risks will be minimized. Possible risks include your child engaging in problem behavior (e.g., crying, pushing away materials, siding out of his/her chair, etc.).

Benefits There may or may not be any direct benefit to you from these procedures. The investigator, however, may learn more about effective ways to teach children with autism to vary their requesting.
INFORMED CONSENT
Increasing Mand Variability in Preschoolers with Autism

The information gained from this study may benefit other students, teachers, and researchers in the future.

Explanation & offer to answer questions Dr. Higbee and/or Tyra Sellers have explained this research study to you and answered your questions. If you have other questions or research-related problems, you may reach Professor Higbee at 797-1933, or Tyra Sellers at (435) 797-2381.

Payment/Compensation There is no payment or compensation associated with participation in this project.

Voluntary nature of participation and right to withdraw without consequence Participation in research is entirely voluntary. You may refuse to participate or withdraw at any time without consequence or loss of benefits. You may be withdrawn from this study without your consent by the investigator if your child moves from the area, is frequently absent, or chooses not to participate during the research sessions. Your decision to have your child participate, or not, will in no way affect your child’s placement (or status on the wait list) or services at ASSERT. Furthermore, ASSERT services will not be affected should you choose to withdraw your child at any time.

Confidentiality Research records will be kept confidential, consistent with federal and state regulations. Only the investigators will have access to the data that will be kept in a locked file cabinet in a locked room. Personal, identifiable information, data and any videotapes will be kept for a period not to exceed 3 years, and will then be destroyed (shredded). If the results of this study are published, no names will be used that will reveal the identity of the participants.

IRB Approval Statement The Institutional Review Board for the protection of human participants at USU has approved this research study. If you have any pertinent questions or concerns about your rights or a research-related injury, you may contact the IRB Administrator at (435) 797-0567 or email irb@usu.edu. If you have a concern or complaint about the research and you would like to contact someone other than the research team, you may contact the IRB Administrator to obtain information or to offer input.

Copy of consent You have been given two copies of this Informed Consent. Please sign both copies and retain one copy for your files.

Investigator Statement “I certify that the research study has been explained to the individual, by me or my research staff, and that the individual understands the nature and purpose, the possible risks and benefits associated with taking part in this research study. Any questions that have been raised have been answered.”
INFORMED CONSENT
Increasing Mand Variability in Preschoolers with Autism

Signature of PI & student or Co-PI

__________________________  ____________________________
Thomas S. Highbee          Tym Sellers
Principal Investigator     Student Researcher (or Co-PI)
(435) 797-1933             (435) 797-2381
thom.highbee@usu.edu        tsellers@mac.com

Signature of Parent/Guardian By signing below, I agree to participate.

__________________________  ____________________________
Signature                  Date

__________________________
Relationship to Participant
TYRA P. SELLERS, M.A., J.D., BCBA

701 S 1540 W
Logan, UT 84321
720.250.7661
tyrasellers@mac.com

EDUCATIONAL HISTORY

UTAH STATE UNIVERSITY - LOGAN, UT
Major: Special Education
Emphasis: Applied Behavior Analysis Specialization
Advisor: Thomas S. Higbee, PhD, BCBA-D
Degree: Doctorate of Philosophy, 2011

SAN FRANCISCO STATE UNIVERSITY - SAN FRANCISCO, CA
Major: Special Education
Emphasis: Vocational Education
Advisor: Nicholas Certo, PhD
Degree: Masters of Arts, 2002

UNIVERSITY OF SAN FRANCISCO - SAN FRANCISCO, CA
Major: Law
Degree: Juris Doctorate, 1998

SAN FRANCISCO STATE UNIVERSITY - SAN FRANCISCO, CA
Major: Philosophy - Cum Laude
Degree: Bachelors of Arts, 1995

PROFESSIONAL CERTIFICATIONS

June 2003 Board Certified Behavior Analyst (BCBA™)
Certification Number: 1.03.1167

PROFESSIONAL POSITIONS - CLINICAL

August 2009 to July
Park City School District (via Utah State University)
Behavior Consultant
Duties: Trained professional and direct line staff to design
Park City, UT
and implement behavior analytic-based preschool and elementary programs for children with autism; monitored staff performance via formal observation and evaluation; conducted educational and behavior assessments; and designed curriculum and positive behavior intervention plans.

April 2008 to Oct 2010  
Behavior Intervention Specialists of Los Angeles  
Co Director of Program Quality  
Duties: review progress reports and initial assessment to ensure quality

March 2007 to present  
ASSERT Preschool, Utah State University  
Assistant Director  
Duties: case management, assessment, curriculum development, staff supervision and training, and parent consultation and training, as well as consulting schools, as needed

July 2005 to present  
SBEC  
Director -Behavior & Education Consultant  
Held contracts with several large school districts providing behavior and inclusion services for all grade levels (e.g., Functional Behavior Assessments, Positive Behavior Intervention Plans, staff and parent training), as well as developing preschool services and curriculum for students with Autism Spectrum Disorder and district-wide staff training

Oct 2004 to May 2005  
North West Regional Education Service District  
Autism Spectrum Disorder Specialist  
Conducted initial Autism eligibility evaluations using a variety of standardized and observational tools, as well as provided ongoing consultative support for educational team members and students, primarily for Early Intervention students. Developed and gave small & large group trainings.

July 2002 to August 2004  
Behavior & Education Consultant (private)  
Held contracts with several large public school districts, non-public schools, group homes, and private individuals. Worked with IEP team members and families to best meet the needs of each individual through direct observation, consultation, collaborative meetings, and training. Conducted Functional Behavior Assessments, Positive Behavior Intervention Plans, Emergency Plans, educational goals, and curriculum; trained parents, teachers, school psychologists, paraprofessionals and other staff; ran Social Language/Skills Groups. Provided direct ABA services where required
<table>
<thead>
<tr>
<th>Date</th>
<th>Role</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>July 2002 to August 2004</td>
<td><strong>Behavior &amp; Education Consultant (private)</strong>&lt;br&gt;Held contracts with several large public school districts, non-public schools, group homes, and private individuals. Worked with IEP team members and families to best meet the needs of each individual through direct observation, consultation, collaborative meetings, and training. Conducted Functional Behavior Assessments, Positive Behavior Intervention Plans, Emergency Plans, educational goals, and curriculum; trained parents, teachers, school psychologists, paraprofessionals and other staff; ran Social Language/Skills Groups. Provided direct ABA services where required.</td>
<td>East Bay Area, CA</td>
</tr>
<tr>
<td>July 2002 to August 2004</td>
<td><strong>Communication &amp; Behavior Consultants</strong>&lt;br&gt;<strong>Behavior Analyst &amp; Partner</strong>&lt;br&gt;Developed curriculum/materials and ran social skills groups for individuals with Asperger’s Syndrome, High Functioning Autism, Non-Verbal Learning Disorder, and other cognitive impairments. Conducted parent training and held crossover meetings with school personnel.</td>
<td>East Bay Area, CA</td>
</tr>
<tr>
<td>Oct 2000 to July 2002</td>
<td><strong>District Behavior Analyst</strong>&lt;br&gt;Provided all needed behavior services for students attending Early Intervention, Special Education and Alternative Programs, as well as those on a 504 plan within a school district comprised of approximately 60 schools. Duties included: Functional Behavior Analysis, Positive Behavior Intervention Plan, full inclusion, staff/parent training, and transition services.</td>
<td>Pinole, CA</td>
</tr>
<tr>
<td>August 1992</td>
<td><strong>Spectrum Center</strong>&lt;br&gt;<em>Education Specialist</em> (initially aide, then teacher)</td>
<td>Rodeo &amp; Pinole, CA</td>
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**Teaching Experience**

<table>
<thead>
<tr>
<th>Year</th>
<th>Institution</th>
<th>Role</th>
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<tbody>
<tr>
<td>Fall 2009</td>
<td>Utah State University -Logan, UT</td>
<td><strong>Instructor</strong>&lt;br&gt;SPED 5010, Distance Education Section&lt;br&gt;Undergraduate level course in applied behavior analysis (Part I)&lt;br&gt;Advisor: Thomas S. Higbee, Ph. D., BCBA-D</td>
</tr>
<tr>
<td>Spring 2009</td>
<td>Utah State University -Logan, UT</td>
<td><strong>Teaching Assistant</strong>&lt;br&gt;SPED 5050&lt;br&gt;Undergraduate course in applied behavior analysis (Part II)&lt;br&gt;Advisor: Robert Morgan, Ph. D.</td>
</tr>
</tbody>
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Fall 2008  Utah State University -Logan, UT  
**Teaching Assistant**  
SPED 5010  
Undergraduate level course in applied behavior analysis (Part I)  
Advisor: Thomas S. Higbee, Ph. D., BCBA-D

Fall 2002  Chapman University -Concord CA Campus  
**Instructor**  
Master’s Level Course in Behavior Analysis & Classroom Management

**Presentations**


Logan, UT.


**Publications - Peer Reviewed Journals**


**Publications - Other (Non-Refereed)**


**Editorial Experience**
2010  Guest Reviewer  
Behavior Analysis in Practice  
Journal of Applied Behavior Analysis

2009  Guest Reviewer  
Behavior Analysis in Practice

EDITORIAL EXPERIENCE CONTINUED

2007  Guest Reviewer  
Education and Treatment of Children

MEMBERSHIP IN PROFESSIONAL ASSOCIATIONS

Association for Behavior Analysis  
California Association for Behavior Analysis