

Utah State University

DigitalCommons@USU

---

All Graduate Theses and Dissertations

Graduate Studies

---

5-2009

## The Effects of Script-Fading Procedures and Extinction Procedures on the Variability of Mand Frames Used by Young Children with Autism

Alison M. Betz  
*Utah State University*

Follow this and additional works at: <https://digitalcommons.usu.edu/etd>



Part of the [Special Education and Teaching Commons](#)

---

### Recommended Citation

Betz, Alison M., "The Effects of Script-Fading Procedures and Extinction Procedures on the Variability of Mand Frames Used by Young Children with Autism" (2009). *All Graduate Theses and Dissertations*. 420.  
<https://digitalcommons.usu.edu/etd/420>

This Dissertation is brought to you for free and open access by the Graduate Studies at DigitalCommons@USU. It has been accepted for inclusion in All Graduate Theses and Dissertations by an authorized administrator of DigitalCommons@USU. For more information, please contact [digitalcommons@usu.edu](mailto:digitalcommons@usu.edu).



THE EFFECTS OF SCRIPT-FADING AND EXTINCTION PROCEDURES ON THE  
VARIABILITY OF MAND FRAMES USED BY YOUNG  
CHILDREN WITH AUTISM

by

Alison M. Betz

A dissertation submitted in partial fulfillment  
of the requirements for the degree

of

DOCTOR OF PHILOSOPHY

in

Disability Disciplines  
(Applied Behavior Analysis)

Approved:

---

Thomas S. Higbee  
Major Professor

---

Sarah Bloom  
Committee Member

---

Timothy Slocum  
Committee Member

---

Sarah Rule  
Committee Member

---

Beth Foley  
Committee Member

---

Byron Burnham  
Dean of Graduate Studies

UTAH STATE UNIVERSITY  
Logan, Utah

2009

Copyright © Alison Betz 2009

All Rights Reserved

## ABSTRACT

The Effects of Script-Fading Procedures and Extinction Procedures  
on the Variability of Mand Frames Used by  
Young Children with Autism

by

Alison M. Betz, Doctor of Philosophy

Utah State University, 2009

Major Professor: Dr. Thomas S. Higbee  
Department: Special Education and Rehabilitation

A primary deficit seen in many children with autism, particularly those with limited verbal repertoires, is repetitive and rote verbal behavior. This type of repetitive or rote verbal behavior can be stigmatizing and may severely limit access to primary reinforcers. Therefore, it may be beneficial to attempt to increase response variability in verbal behavior demonstrated by children with autism. Previous researchers have focused their efforts on examining response variability in motor behavior or existing verbal behavior, rather than new or recently taught verbal behavior. A potentially complementary intervention for teaching new verbal interactions is the use of scripts and script fading procedures. However, the effect of scripts and script fading procedures on the response variability of verbal behavior remains unknown. Thus, the present study attempted to answer several research questions. First, we examined the effects on extinction on response variability of mand frames used by young children with autism that exhibit limited manding repertoires. Second, we examined the effects of script training on the variability of mand frames, and finally, the effects of extinction after teaching a variety of mand frames with children with autism. Results demonstrated that (a) extinction prior to any teaching was not successful in increasing response variability, (b) teaching multiple mand frames in a successive pattern did not

increase response variability of mand frames for any of the participants, (c) extinction after teaching additional mand frames increased response variability for two of the three participants, and (d) a multiple script presentation intervention increased response variability of mand frames for one participant.

(123 pages)

## ACKNOWLEDGMENTS

I extend my sincerest appreciation and gratitude to Thomas Higbee, my major professor, for all of his time and dedication in assisting me through my dissertation as well as throughout the past four years I spent at Utah State University in the graduate program. I would also like to specifically thank my committee members, Charles Salzberg, Timothy Slocum, Sarah Rule, Sarah Bloom, and Beth Foley, for all of their help and encouragement.

I am particularly appreciative of and would like to thank three of my fellow doctoral students, Kristen Kelley, Joy Pollard, and Tyra Sellers, for all of their time and effort they put forth ensuring the success of this study. I cannot begin to express my appreciation for all they have done. And to the families that allowed their children to participate in this study, a mere thank you does not begin to express how grateful I am for their cooperation and commitment to this study.

Finally, I would like to thank my family and friends, specifically Andrew Morgan, for their continual support and encouragement through my entire educational career. Thank you for the unconditional love and support while I was on this journey. I am truly blessed to be surrounded by so many wonderful people. All those that are mentioned above are in some part responsible for the accomplishment of completing this dissertation and my doctoral program. And for this reason, I share this accomplishment with all of you.

Alison Betz

CONTENTS

	Page
ABSTRACT .....	iii
ACKNOWLEDGMENTS .....	v
LIST OF TABLES .....	viii
LIST OF FIGURES .....	ix
CHAPTER	
I. INTRODUCTION .....	1
II. LITERATURE REVIEW .....	4
Response Variability .....	4
Scripts and Script-Fading Procedures .....	12
Conclusion .....	17
III. METHODS .....	20
Participants and Settings .....	20
Materials and Pretraining .....	24
Independent Variables .....	25
Experimental Design .....	28
Dependent Variables and Measurement Procedures .....	28
Experimental Conditions .....	31
IV. RESULTS .....	37
Pre-teaching .....	37
Scripted versus Unscripted Responses .....	38
Number of Different Mand Frames .....	49
Novel Mand Frames .....	63
V. DISCUSSION .....	65
Limitations .....	76
Implications and Conclusions .....	79
REFERENCES .....	84
APPENDICES .....	87
Appendix A: Data Sheet for Baseline Conditions .....	88
Appendix B: Data Sheet for Extinction Prior to Script-Training Conditions .....	90

	vii
Appendix C: Data Sheet for Script Training Conditions .....	92
Appendix D: Data Sheet for Extinction after Script Training Conditions .....	94
Appendix E: A List of Mand Frames Used by Jillian .....	97
Appendix F: A List of Mand Frames Used by Drew .....	100
Appendix G: A List of Mand Frames Used by Travis .....	103
Appendix H: Informed Consent .....	106
CURRICULUM VITAE .....	110



LIST OF TABLES

Table		Page
1	Jillian's Script-fading Data.....	50
2	Drew's Script-fading Data .....	51
3	Travis' Script-fading Data.....	52

## LIST OF FIGURES

Figure		Page
1	Results of the total number of scripted and unscripted mand frames used for all participants .....	39
2	Results of the total number of different mand frames used along with the number of different scripted and unscripted mand frames used for all participants.....	54
3	Results for the total number of different mand frames used along with number of different scripted and unscripted mand frames used for all participants under the strict operational definition .....	61
4	Results for the total number of novel mand frames used across all conditions for all participants .....	64

## CHAPTER I

### INTRODUCTION

Autism is a developmental disability that is characterized by deficits in social functioning, communication, and language, and marked by repetitive or stereotyped behavior (American Psychiatric Association, 1994). It is often the case that children with autism exhibit little to no functional language or social interactions. When these children do engage in verbal behavior, it is common for these behaviors to be rote or repetitive. Repetitive and stereotyped behaviors in language may include behaviors such as perseveration on a particular topic, echolalia or delayed echolalia, or replying to social initiations with the same response with no variation.

Repetitive behaviors in children with autism and other developmental disabilities may be a product of a restricted repertoire. As applied behavior analysts, one of our goals is to teach new skills and to promote generalization through transferring the control of newly learned responses to natural occurring contingencies. As more behaviors are acquired, more will contact reinforcement through natural contingencies, thus, increasing the variants of responses used. Therefore, some researchers (i.e., Lee, Sturme, & Fields, 2007) suggest that teaching multiple exemplars within the same response class may increase the variability in responses, thus reducing repetitive responding.

Researchers have shown that children with autism have difficulty varying responses and engage in more patterned responses than those of their typically developing peers and even peers with other disabilities (Carcani-Rathwell, Rabe-Hasketh, & Satosh, 2006; Frith, 1972; Richler, Bishop, Kleinke, & Lord, 2007). For example, Frith reported that when asked to place colored stamps on a piece of paper, children with autism created more patterned sequences than their typically developing peers and peers with mental retardation and they also tended to use less of the available colors than peers.

Language is a specific area in which repetitive and stereotyped behaviors are often seen in children with autism. For example, a child with autism may only know how to mand (i.e., request) for an item using one specific statement or frame (i.e., "I want \_\_\_\_"). Thus, every instance in which the child mands for items, he states his request using the same mand frame. A mand is defined as a verbal operant in which the response is reinforced by a characteristic consequence and is therefore under the functional control of relevant conditions of deprivation or aversive stimulation (Skinner, 1957). Therefore, a mand frame is a set of words comprised of at least a subject and verb that can be combined with the mand itself. These frames can be used to mand for multiple objects, thus setting the *frame* for the mand (i.e., "I want \_\_,"; "Can I have \_\_,"). Such a limited mand repertoire may ultimately interfere or limit the functional use of this type of verbal behavior for children with autism. Thus, it was more difficult to obtain reinforcement from others via mands.

These repetitive behaviors, verbal or otherwise, seen with children with autism may be due, partially, to an inability to vary responding or behaviors (Lee et al., 2007). The lack of variability in responding may severely limit a person's ability to access reinforcing consequences. For example, if a response does not result in a specific consequence, a person may then engage in a different response within the same class that has, in the past, resulted in the same consequence. If a child does not have multiple responses within a class, he or she may not be able to respond effectively, thus increasing the probability of extinguishing the already established responses. This may be a problem if the child does not have any other functional means of contacting the maintaining consequence which, in turn, may produce aberrant behavior. If a young child with autism only has one response within a class and that response is not reinforced, the child does not have another functionally appropriate way of gaining access to the reinforcer maintaining that response. For example, when a child with autism is asked the question, "How are you?" that child may only know one response, "Fine." This restricted repertoire of responding to the question

“How are you?” always with the answer “Fine” may limit the reinforcing properties of the conversation for both the child with autism and the conversation partner; therefore, creating a possibility for extinction of the single response, “Fine.” On the other hand, if a child learns a variety of responses to the question, “How are you?”, such as “Fine,” “Great,” “Awesome,” “not well,” “okay,” etc., the chances that the entire response class will be extinguished is minimal. If one response (i.e., “fine”) does not produce adequate reinforcement, the child then has other responses in the same class that may do so. Thus, it seems important for educators to teach variable responding to children with autism, to ensure that their repertoires are more extensive, thus creating more opportunities for reinforcement and positive social interaction.

## CHAPTER II

### LITERATURE REVIEW

#### Response Variability

Many researchers in both experimental and applied settings over the past 50 years have demonstrated that variability in responding can be considered an operant, in that it is a dimension of behavior that can be experimentally controlled through technologies such as reinforcement schedules and extinction, and can come under the control of a discriminative stimulus (Duker & Van Lent, 1991; Goetz & Baer, 1973; Machado, 1989; Pryor, Haag, & O'Reilly, 1969; Ward, Kynaston, Bailey, & Odum, 2007). Several of these studies are described below.

#### *Variability as an Operant Dimension of Behavior*

In their review of the research, Lee et al. (2007) suggested underlying mechanisms that may influence response variability. They suggested that the schedule of reinforcement may strongly influence the variability observed in responses of both animals and humans. For example, the authors concluded that continuous reinforcement produces less variability than intermittent schedules of reinforcement. After further investigation of past research, the authors also reported that extinction procedures increase variability in responding more than continuous reinforcement and, in fact, once extinction sessions were implemented, the variability of responding in subsequent continuous reinforcement sessions decreased.

Lee et al. (2007) also suggested that not only can the schedule of reinforcement for target responses increase the variability observed in those responses, but one can also directly reinforce variability. The effects of directly reinforcing response variability has had a strong presence in the behavior analytic research for decades and remains a popular topic among both basic and applied researchers. Past researchers have provided significant evidence that demonstrates variability

should be considered an operant dimension of behavior due to the ability to alter the variability seen in responding through consequences.

For example, Pryor et al. (1969) taught porpoises to emit novel responses that were never developed through shaping and that were never known to occur in this particular species by reinforcing different responses and extinguishing responses that have already occurred each training session. During the final sessions, the porpoise produced new behaviors in six out of seven consecutive sessions and, in two sessions, began with new responses and did not emit any response that went without reinforcement (a previously observed response). Pryor and colleagues demonstrated that through reinforcement and extinction, one can produce novel and variable responding.

In their 1985 study, Page and Neuringer specifically examined variability in behavior. They replicated a series of studies conducted by Schwartz (1980, 1982) which found that reinforcement was not able to control variability in responding. However, during their first two experiments, Page and Neuringer found that they were able to increase variability in responding by reinforcing pigeons' key peck sequences only if they differed from the *previous*  $n$  trials. For example, the pigeons' responses were reinforced if the sequence of keys pecks was different than the last 2, 4, 8, 16, etc. sequences the pigeons emitted immediately prior to the sequence being reinforced. Across an additional four experiments, Page and Neuringer (1985) reported that pigeons' responses: (a) displayed variable patterns even when the current pattern had to differ from each of the last 50 trials; (b) increased in response variability as the requirement of the number of responses per trial increase; (c) showed high levels of variability when reinforcement was contingent on response variability; and (d) were under the control of environmental stimuli in which with a red light present, the pigeons emitted variable patterns and under the blue lights they repeated a fixed pattern. After reporting the results of these six experiments, Page and

Neuringer concluded that behavioral variability is an operant dimension of behavior and is controlled by contingent reinforcement.

More recently, Ward et al. (2007) provided more evidence to support the notion that variability is an operant dimension of behavior by examining the discriminative control of variability. Ward et al. compared variability under a condition in which 4-response sequences that differed from the previous 10 produced food to a yoked condition in which any 4-response sequence had a fixed probability of producing food. The authors reported that variability of key peck sequences was higher in the varied conditions than in the yoked condition and across successive reversals, the level of variability in the varied conditions adapted more rapidly to the reversed contingencies.

These results, along with several other studies previously mentioned, support the conclusion that variability is a likely operant dimension of behavior. However, these researchers examined response variability in basic, laboratory settings rather than less-controlled natural settings such as schools. In the previously mentioned studies, the authors' primary research questions concentrated on determining whether response variability was, in fact, an operant dimension of behavior. They were not, however, focused on finding efficacious interventions that could be used to produce variability in the natural or educational setting. Therefore, given that response variability appears to be an operant dimension of behavior that is susceptible to reinforcement and given that it appears to be an important feature of the behavior of typically developing children, it seems necessary to examine procedures for increasing response variability in more applied settings, especially with children with autism for whom a lack of response variability is a particular problem.



*Increasing Response Variability in Applied Settings*

To date, multiple researchers have examined response variability with human participants in more applied areas and have demonstrated the effectiveness of various procedures (Duker & Van Lent, 1991; Lee, McComas, & Jawor, 2002; Miller & Neuringer, 2000). Several of the researchers conducting these studies examined procedures that were used successfully in the laboratory setting with animals to determine if they would produce the same outcome of increasing response variability in human participants. Procedures such as the percentile reinforcement schedule (Miller & Neuringer), lag schedules of reinforcement (Lee et al.), differential reinforcement of the least frequent responses (Duker & Van Lent), as well as others, were studied using human subjects. However, once again, finding efficient ways to increase response variability in the natural setting was not the primary reason for conducting the majority of these studies.

Although many of these procedures did, in fact, increase the response variability of human participants, their utility as applied interventions in natural settings is less certain. One conclusion that Lee et al. (2007) drew from their review of literature on response variability is that some of the procedures that have been demonstrated to increase variability in responding, such as those mentioned above, may be difficult if not impossible to implement in an applied setting. For example, Lee et al. stated that the clinical ease of procedures such as percentile reinforcement schedules has yet to be determined. Furthermore, it may be impractical for clinicians and teachers to continually update the schedule of reinforcement for a particular response based on the student's current performance. However, due to the clinical importance of producing less restrictive and more variable behaviors in children with autism, it is imperative that researchers focus on evaluating techniques that will increase variability while remaining manageable for teachers and clinicians.

### *Extinction Induced Variability*

One procedure that is commonly used to increase response variability that is comparatively easy to conduct in the natural setting is extinction. Using extinction to increase response variability requires a participant to emit a response that has not been previously reinforced to receive reinforcement. In other words, once a response is emitted and reinforced, it will not be reinforced again. Some researchers use extinction procedures across all sessions (i.e., Pryor et al., 1969), which consists of only reinforcing novel responses that the participant has never demonstrated or emitted. Thus, if a response is emitted for the first time in session 2, it will be reinforced. If that same response was emitted again in a following session (i.e., session 3, 4, 5, etc.), that response did not result in reinforcement. One limitation with only reinforcing a response the first time it is emitted is that one may run the risk of reaching a ceiling of responding. This may especially occur if there are only a limited number of response topographies within the target class.

To account for the possible limitations of using extinction procedures across all sessions (i.e., only reinforcing novel responses), some researchers have used within session extinction procedures. This procedure consists of reinforcing only the first time a response is emitted within each session. For example, the response, "fine," is emitted when asked "How are you?" This response will be reinforced the first time it is used during the session. If the participant responds to the same question with the same response, "fine," in the same session, it will not result in reinforcement. However, if this response is emitted in the next session to the question, "How are you?" the response will be reinforced.

Lalli, Zanolli, and Wohn (1994) used extinction and positive reinforcement to increase the number of untrained topographies emitted by children during toy play. Two preschool aged students with mild developmental delays participated in this study. A 10-s partial interval recording system was used to record the first occurrence of each topography of toy play emitted

by the participants. The researchers chose multiple toy play topographies the participants could engage in with a toy airplane, a doll, and toy animals. A multiple baseline design across toys was used to evaluate the effects of extinction plus reinforcement on toy play behaviors. During baseline, the researcher provided the participant with a toy and provided praise on a 15-s fixed interval (FI) schedule. Following baseline, one 15-min training session was conducted with each participant for one topography related to the target toy. For example, the instructor while playing with a doll, the instructor would teach the participants to make the doll walk. During the training session, the researchers used model and physical prompts to train the target topography. Probe sessions began the day immediately following the training session. During probe sessions, the researcher (a) provided descriptive praise following either the first occurrence of a trained topography or the newest topography demonstrated, (b) put the reinforced topography on extinction after the topography was reinforced three times on a FI 30-s schedule, (c) terminated the session after 60-s elapsed without a new untrained topography, and (d) started the next session by reinforcing the newest untrained topography from the previous session.

Lalli et al. (1994) reported that neither of the participants demonstrated any appropriate toy play during baseline for either toy. Once the participants were trained on one topography of each toy and after extinction procedures were implemented, both participants showed varied responding in toy play topographies. The results of this study support the hypothesis that variability is an operant dimension of behavior. Furthermore, the authors demonstrated that response variability increased when previously emitted responses were put on extinction. The authors concluded that behavioral repertoires could be expanded by the systematic use of extinction and reinforcement procedures.

Harding, Wacker, Berg, Rick, and Lee (2004) also used extinction and reinforcement to increase response variability during martial arts training. During drill and sparring conditions, students were asked to demonstrate different techniques in response to the instructor's punch.

During the drill sessions, students received reinforcement (i.e., instructor feedback) for each move that was not previously seen in the session. Thus, each time a participant repeated a response to the teacher's punch within one session, the teacher did not provide any verbal feedback (extinction). Only the first time each response to the teacher's punch was emitted was reinforced. During subsequent sparring sessions, no reinforcement was provided to test the generalization effects the extinction procedures. The authors reported that response variability increased when extinction plus reinforcement was implemented. They also noted that the increases in response variability generalized to the sparring condition. This study adds to the previous literature that supports the hypothesis that variability is an operant dimension of behavior and extends the previous literature by demonstrating generalization of variability. However, the authors did not evaluate if increasing the martial arts students' repertoire alone (i.e., teaching them a variety of responses) would increase the variability in responses without extinguishing previously seen responses.

Researchers such as Lalli et al. (1994) have successfully used extinction to increase response variability with children with autism. However, there is still much that is not known about using extinction for this purpose. For example, there are few studies in which researchers have attempted to demonstrate that extinction without teaching any specific behaviors can increase the variability of verbal responses. Grow, Kelley, Roane, and Shillingsburg (2008) conducted a study examining the effects of extinction on the selection of mand responses. The purpose of this study was to determine if appropriate mand responses would replace inappropriate mands during an extinction condition and if the appropriate mands would be maintained by the same consequences as the inappropriate mand. Participants all demonstrated inappropriate mand responses (i.e., grabbing) and very few to zero appropriate mand responses at the beginning of the study. The researchers measured the inappropriate behaviors and appropriate behaviors during baseline conditions in which all mands, inappropriate or appropriate, were reinforced. During

treatment, all inappropriate mands were extinguished and one appropriate mand that was seen during baseline was reinforced with the same consequence that was maintaining the inappropriate mand. The researchers reported that extinguishing inappropriate mands may be an effective method to increase more appropriate responses.

One purpose of this study was to determine if one could teach a function communication response without having to teach that response specifically. However, all participants did show at least one appropriate mand in their repertoire prior to treatment (or just after beginning treatment for one participant). Thus, it may be that the extinction procedures increased appropriate verbal mands because the participants previously demonstrated they had an alternate response within the same response class as the inappropriate mands. This limits the generalization of the results because it is not known if extinction procedures will increase the rates of appropriate responses if participants do not have those skills in their repertoire already.

It should also be noted that Grow et al. (2008) chose only one previously demonstrated, appropriate mand to reinforce as the alternate response. Therefore, only that response was reinforced while all inappropriate mands were placed on extinction. Because the authors only identified one appropriate response to reinforce, it is not known whether the participants demonstrated any variability in their verbal behavior (mands) during sessions. And, it is not clear from examining the data if the participants simply used only one appropriate request to mand for the preferred item or if they demonstrated any variability in their responding.

While Grow et al. (2008) demonstrated that extinction procedures did increase the use of appropriate mands; there are still questions that remain unanswered about the use of these procedures on verbal behavior. For example, it is still not clear whether extinction procedures similar to past research will increase the overall variability in verbal responses, especially if the participants demonstrate a restricted repertoire. Grow et al. demonstrated that they could use extinction procedures to decrease inappropriate mands while increasing rarely used appropriate

mand in participants with autism; however, it is not known if the same procedures would be successful if the participants had a restricted or limited repertoire of appropriate mands. In other words, it is not known if the extinction procedures alone would increase variability without previously teaching multiple, functional verbal responses.

Despite the potential limitations of using extinction procedures to increase response variability, past researchers suggest that this procedure can still be an effective way of producing variable responding in different response topographies across populations. Studies also demonstrate that when compared to other interventions, an extinction procedure may be one that produces increased procedural fidelity and one that uses a less effortful data collection and monitoring system. These findings suggest that extinction might be well suited for educational settings.

Due to growing amount of literature that supports the use of extinction procedures to increase response variability, the next logical step in examining these procedures may be to determine if extinction can be as effective in increasing variability in verbal responses as seen in other types of behavior. In past research, the majority of motor and verbal behaviors studied were already present in the participants' repertoires. Therefore, it may be beneficial to examine the effects of extinction on response variability when a child has a limited verbal repertoire. Finally, there are no research studies that examine the effects of extinction on response variability prior to any teaching with participants with a limited repertoire to those effects of extinction on response variability once the target response class includes multiple responses.

#### Scripts and Script-Fading Procedures

Teaching more functional and appropriate verbal behavior and social interactions has been a focus in the behavioral literature for many years. Scripts and script fading procedures, specifically, have been one set of techniques that have been widely used to increase verbal behavior and social interactions in several settings and across multiple populations. Scripts are

visual, textual, or audio cues that prompt vocalizations during social interactions (McClannahan & Krantz, 2005). They are designed to assist children in initiating, sustaining, and participating in conversational exchanges that may include statements and questions about activities or items.

Scripts have been used to increase conversational exchanges (Sarokoff, Taylor, & Poulson, 2001), answering and asking questions (Charlop-Christy & Kelso, 2003), bids for joint attention, such as “Watch me,” (Krantz & McClannahan, 1998), and other common social interactions. Researchers studying these procedures have reported similar results such as (a) using scripts and script fading procedures can increase the frequency of scripted as well as unscripted responses made by participants; (b) scripted and unscripted statements are maintained after scripts are faded; and (c) scripts can be faded to minimal cues, if not faded out completely,

#### *Review of Recent Script Research*

Krantz and McClannahan (1993) used a multiple baseline design across participants to examine the effects of using script-fading procedures to teach children with autism to initiate to peers. Four children with autism ranging from ages 9 – 12 years were taught 10 written scripted statements through manual guidance. All 10 scripts were targeted at appropriate social initiations and were faded from end to beginning in five steps. For example, one target script for this study was (step 1) “(Name), what do you like to do best?” This script was then faded to (step 2) “(Name), what do you, (step 3) “(Name), what, (step 4) “(First initial), and (step 5) “. Sessions took place during three different table top art activities where other students were present. Across all phases, the researchers measured initiations to peers as well as scripted and unscripted social interactions. For the purpose of their study, Krantz and McClannahan defined scripted statements as “those that matched the written script, with the exception that conjunctions, articles, prepositions, or pronouns could be altered or deleted, and verb tense could be changed,” (Krantz & McClannahan, p. 124). Unscripted responses were defined as verbal productions were different from the script by more than conjunctions, articles, prepositions, or changes in verb tenses.

Krantz and McClannahan (1993) reported that during baseline sessions, all participants rarely initiated interactions to peers. During the first four fading steps of the scripts, participants showed an increase in scripted and unscripted initiations. However, when fading step five (single quotation marks) was introduced, scripted and unscripted initiations increased even more for three of the four participants and unscripted initiations alone increased while scripted initiations decreased for the fourth participant. Although the researchers reported favorable outcomes for using written scripts to teach peer initiations, there were some limitations that should be noted. First, the authors were not able to completely fade the written scripts and reported a single quotation mark or the single quotation mark in addition to the first letter was needed to maintain peer initiations. This is a common limitation in the script-fading literature and similar results have been reported in other studies (i.e., Krantz & McClannahan, 1998; MacDuff, Ledo, McClannahan, & Krantz, 2007).

Secondly, although the authors reported that as the scripts were faded, participants engaged in more unscripted responses, including elaborations and recombining scripts with responses already in their repertoire, they did not report how many different variations of initiations were used each session or across sessions in total. In the script-fading literature, data are typically reported in global fashion as scripted versus unscripted responses. However, it is rare that the specific number of different responses is reported. Therefore, the data may show that a participant emitted five unscripted responses in a session, for example, but all five of those statements may have been identical to each other. An example of reporting results of script-fading studies (i.e. in a more global fashion) can also be seen in the study conducted by Krantz and McClannahan (1998). In this study, the authors examined the effects of using textual scripts to teach students with autism to engage in bids for joint attention. The target scripts that were taught to each participant were, "Look" and "Watch me," which were embedded in their daily activity schedule. The authors reported that two of the three participants quickly began to emit the



scripted responses as well as elaborate and make unscripted statements. However, similar to the study conducted in 1993 by the same authors, they did not report the number of different statements produced in each session, so the degree of variability in responding produced by the script intervention is unknown.

More recently, Brown, Krantz, McClannahan, and Poulson (2008) conducted a study to specifically examine the generalization effects of script fading procedures on social interactions. The purpose of this study was determine if a transfer of stimulus control from the script could occur to natural environmental stimuli (e.g., transfer of control for the script about the candy bar to the candy bar itself). The authors used a multiple baseline design across settings with three different participants with autism. During this study, each participant was observed both prior to and after teaching social interactions with scripts in three different simulated retail store settings. For all participants, the authors reported that scripts were successfully faded, scripted and unscripted responses increased and maintained, and the social interactions generalized to the community store settings during posttests. This suggests that using script training brought the social interactions under stimulus control of the environmental stimuli, rather than scripts, or teacher controlled stimuli, maintaining stimulus control. The researchers may have accomplished this transfer by not only successively fading the scripts, but by strategically placing the scripts on the corresponding stimulus. Many of the stimuli also contained textual cues that were similar to the scripts (e.g., words on the wrapper of the candy bar). In addition, they conducted generalization probes in which the scripts were not present. This may have promoted the transfer of stimulus control by allowing responding in the absence of scripts.

One of the limitations of script literature discussed thus far and a common limitation seen throughout the majority of script research is that the primarily script technology tends to be textual. This can pose a problem with students who are unable to read. Stevenson, Krantz, and McClannahan (2000) published a study that examined the effects of auditory scripts in the form

of a Language Master Card on social interaction skill for nonreaders. In this study, participants with autism were taught to slide a card with a script recorded on it through a machine that then played the recording. Through the use of manual prompts the participants were taught to use and imitate the audio scripts during their standard activity schedule. Five scripts were taught to each participant. The scripts were interactions in the form of questions and statements that the participant made toward an adult. Each script was faded using a backward-fading procedure in which the last 1/5 of the script was removed each fading step. The authors reported that all participants learned the scripted statements, maintained the use of those scripted statements while the scripts were faded, and demonstrated unscripted statements during the fading process as well. Therefore, they concluded that the use of auditory scripts were just as effective as textual scripts for students who were nonreaders.

Similar to the authors of the previously discussed studies, several other researchers have reported that using scripts has increased unscripted responses (i.e., Krantz & McClannahan, 1993; Sarakoff et al., 2001). Unscripted responses usually consist of recombined elements of the scripted statements or the additions of new or different nouns, verbs or both (Lee et al., 2007). The increase in unscripted responses may suggest increases in response variability; however, as stated previously, authors typically report only the total number of unscripted responses used and do not report the number of *different* unscripted responses used, thus often making it impossible to conclude how much variability is demonstrated when using scripts to increase verbal behavior. Therefore, it is not known if scripts and script-fading procedures have any effect on the response variability of verbal responses or if students taught social interactions using this technology will continue to only use a limited number of verbal responses in their repertoire.

## Conclusion

One of the primary deficits seen in children with autism is in social interactions and communication. Finding effective interventions increase and strengthen these skills has been a focus in behavioral research for several years. One intervention that has been studied specifically is scripts and script-fading procedures. Researchers have clearly demonstrated that the use of scripts and script-fading can increase social interactions in a variety of forms. Most of the researchers that study these procedures report that participants demonstrate an increase in not only scripted responses, but in unscripted responses as well. Thus, the total number of interactions increases. However, the authors do not report how much variability is demonstrated within these interactions. Therefore, it cannot be determined from the current literature on scripts and script-fading procedures if these interventions are producing rote and repetitive responding or variable responding.

Past researchers have demonstrated that response variability is an operant dimension of behavior. Thus, researching different interventions that may affect response variability has had a strong presence in the behavior analytic research within the past few decades. One procedure that has been shown effective in increasing response variability is extinction. Several researchers have demonstrated the success of this intervention in increasing response variability in many population and behaviors (Goetz & Baer, 1973; Harding et al., 2004; Lalli et al., 1994). Although extinction procedures have been successful in the past, there is still a limited amount of research that supports the use of such procedures in an applied setting. And, to date, there are no studies that examine the effects of extinction both before and after teaching additional responses. In addition, there are no studies that examine the effects of scripts and script-fading on response variability.

The quality or degree of variability that extinction procedures produce is also unknown. There are no studies in the past literature that report the extent to which each response varies

when using extinction as a method to increase response variability. The current investigation attempted not only to investigate whether extinction produces increases in the variability of mand frames the participants used, but we also analyzed the extent to which each mand frame differed from others. There were two categories of variability identified for the present study. First, participants could demonstrate minor changes to a core mand frame used. For example, a participant may have used the mand frames, "I want \_\_\_" and "I want \_\_\_ please." The addition of the word *please* is a minor change to the core mand frame, "I want." The second category of variability was changes to the core frame. Changes to the core frame meant there was a larger degree of variability between the mand frames. For example, a participant may have used the mand frames, "May I please have" and "Can I have \_\_\_ please." In this example, there are differences between the core mand frames used creating larger differences between the two frames. The current investigation measured the degree of variability to determine the whether script-fading and extinction procedures produce greater differences when combined than when implemented individually.

Due to the effectiveness of scripts and script-fading procedures in increasing social interaction and the positive effects of extinction on increasing response variability that has been demonstrated by past researchers, the next logical step may be to examine these procedures together to determine the combined effects on response variability of social interactions. Because of the lack of studies that have been published that demonstrate the direct effects of scripts or the effects of pairing extinction with scripts and script fading procedures, the purpose of this study is to begin to examine how we can use the knowledge we have on response variability in the basic literature in applied settings with those students that engage in rote and repetitive responding. We did this by attempting to answer the following questions:

1. To what extent do extinction and script-fading procedures increase the total number of scripted and unscripted mand frames used by young children with autism during snack time?
2. To what extent does extinction alone increase variability of scripted and unscripted responses, specifically the use of mand frames, with young children with autism during snack time?
3. To what extent do script fading procedures increase the variability of scripted and unscripted mand frames during snack time with young kids with autism?
4. To what extent do script fading procedures combined with extinction increase the variability in scripted and unscripted mand frames during snack with young children with autism?
5. Given an increase in the variability of mand frames, to what extent does the response variability maintain after script fading and extinction procedures are implemented during snack time with young children with autism?
6. To what extent do extinction and script-fading procedures increase novel mand frames emitted by young children with autism during snack time?

## CHAPTER III

## METHODS

## Participants and Settings

Three preschool aged children with autism; Jillian, Drew, and Travis, participated in this study. All participants met the DSM-IV-R (APA, 1994) criteria for autism spectrum disorder. Participants also met the eligibility criteria for and received special education services under the Utah State Board of Education special education autism category (IDEA, 2004). All participants were recruited from the contact list of a local university-based preschool for children with autism. One participant, Jillian, was identified through the wait list for the preschool, she attended a public preschool 4 days per week for approximately 2.5 hrs per day Two of the participants, Drew and Travis, attended the university-based preschool 5 days per week for 4 hrs per day. Participants were identified by case managers from the university-based preschool as meeting the inclusion criteria for the study. To be included in this study, a participant had to meet the following criteria: (a) had a medical diagnosis of autism according the DSM-IV-R guidelines (APA); (b) could communicate with vocal language using a minimum of three word phrases; (c) was motivated by edible reinforcers; and (d) prior to the beginning of the study used at least one, but no more than two, mand frames. Participants were identified as meeting the inclusion criteria through observations during a typical snack interview and parent and teacher interviews. Once the participants were identified as meeting the inclusion criteria, the researcher assistants obtained parental consent for all students to participate in the study.

Jillian, aged 3 years 9 months at the beginning of the study, was a Caucasian female and had been attending a special education public preschool for approximately 9 months. At the beginning of the study, Jillian had a limited expressive and receptive language repertoire. Parents reported that she had about 300 words in her repertoire; however, most of these words were labeling concrete objects. It was also reported she engaged in little spontaneous language and

often engaged in echolalia and delayed echolalia. At the beginning of this study, Jillian was able to mand for preferred items using approximately two three-word phrases; "I want \_\_\_\_\_," and "I need \_\_\_\_\_." However, she solely used the frame: "I want \_\_\_\_\_" during observations. The Preschool Language Scale-4 (PLS-4) was administered to Jillian approximately 7 months prior to the study. Jillian's scores on the PLS-4 indicated that her auditory comprehension was moderately delayed with a standard score of 73 and a percentile rank of 4 and her expressive language abilities were in the low average range with a standard score of 85 and a percentile rank of 16. Jillian's total language score was 77 with a percentile rank of 6. It was noted that Jillian demonstrated difficulties specifically with understanding descriptive concepts, following two step-related commands, using plurals, answering questions, and using appropriate verb conjugations. The Battelle Developmental inventory (BDI) was also conducted with Jillian at approximately the same time as the PLS-4. This is a standardized test that is used to obtain information on the level of the student's development in the following areas: cognitive, personal-social, and adaptive and Jillian obtained standard scores of 77, 76, and 89 respectively.

Drew was a 3-year 9-month-old Caucasian male. Drew attended a university-based ABA preschool for children with autism for approximately 6 months before the beginning of this study. Through parental and educational reports, it was noted that Drew had an extensive tacting (labeling) repertoire and could independently mand for items using the mand frame, "I want \_\_\_\_\_," when preferred items were present or absent; however, he frequently would mand for preferred items using one or two word phrases (i.e., "cookie please"). The BDI and PLS-4 were also conducted with Drew approximately 11 months prior to the beginning of this study. The BDI indicated that Drew was below average in the adaptive, personal-social, and cognitive domains receiving a standard score of 76, 70, and 71, respectively. Drew also received below average scores on the PLS-4. He obtained a standard score of 66 with a percentile rank of 1 in the expressive language domain and a standard score of 70 with a percentile rank of 2 in the receptive

language domain. Drew's total language score was 65 and obtained a percentile ranking of 1.

During the PLS-4 it was noted that Drew could identify familiar objects, body parts, and verbs in context. He could also vocalize and gesture to request preferred items, produce sound combinations. However, it was also reported that Drew had difficulty understanding prepositions, recognizing pronouns and actions, imitating words, naming some objects, and rarely asked questions.

Travis was a 4-year-old male with a diagnosis of autism. Prior to the beginning of this study, Travis frequently used "I want \_\_\_\_" to mand for preferred items. He was also able to communicate using full sentences and multiple word phrases. School psychologists attempted to conduct the PLS approximately 1 year 5 mo prior to the beginning of this study with Travis, however, it was reported that Travis was untestable due to problem behavior and limited verbal ability. Another standardized test was conducted with Travis at approximately the same time this research study began. This test was the Clinical Evaluation of Language Fundamentals – Preschool 2 (CELF-Preschool 2) which tested Travis's understanding and use of language (i.e. receptive and expressive skills). For each of these subtests 100 is the mean with a standard deviation of 15. Therefore, a score of 100 represents the performance of a typical child of a given age. Travis obtained a score of 53 on Core Language which is a measure of general language ability that quantifies a child's overall language performance. This encompasses sentence structure, word structure, and expressive vocabulary. He obtained a standard score of 45 in receptive language and 57 on expressive language. The test summarized that Travis had severe delays in his core language score as well as in his receptive and expressive language. Both Drew and Travis attended a university-based preschool for children with autism utilizing behavioral teaching methods. Travis and Drew attended this preschool for 1.5 years and .5 years respectively prior to the beginning of this study.



### *Pre-training Settings*

Script pre-training prior to any experimental research sessions for each participant. Pre-training script sessions for Jillian were conducted at the kitchen table located in her home. The setting included a kitchen table, and two chairs, along with toys and edibles used to reinforce correct responses.

Pre-training for Drew and Travis occurred in their typical work area consisting of a cubicle, table, and two chairs. Pre-training sessions occurred for both participants during their typical school day by research assistants for this study and the participants' typical instructors.

### *Research Setting*

Jillian's sessions were conducted at the kitchen table of her home. Similar to sessions with the other participants, Jillian sat at the table directly across from the researcher with the snack items placed between them and her placemat was set directly in front of her. A digital video recorder was set up at the end of the table, out of Jillian's reach. During each session, all other family members we asked to remain out of the kitchen and connecting rooms. Thus, the only people present were Jillian and the researchers. Breaks between sessions for Jillian consisted of Jillian leaving the research area (kitchen) and playing with her sister and mother in another room. During breaks for Jillian, toys were available, but food was not.

Sessions for Drew and Travis were conducted at the university-based preschool during their typical school day. Sessions were conducted at a small table away from the general teaching area, or in the participant's private work area. During the sessions, the researcher sat across from the participant with three snack bins placed on the table between the researcher and the participant and a placemat with the participant's name in the center placed directly in front of the participant. A digital video recorder was placed on separate table next to the researcher. Breaks between sessions for both Drew and Travis were conducted in the preschool and consisted of them returning to their typical daily routines of instruction in between sessions.

## Materials and Pre-training

All sessions included a placemat that was set on the table directly in front of the participant. The placemat was an 8.5 x 11-in piece of laminated paper that contained the participants' name typed in the center. This placemat was present during every session. Snack items were also used for each participant. Ten preferred food items were identified and used for the brief preference assessment prior to each session. These items were typical foods that a student may be given during their typical snack time (i.e., goldfish crackers, potato chips, fruit snacks, raisins, etc.). Each food item was stored and presented in a 16-oz plastic container.

Finally, the voice recorder button was used for the auditory scripts. The voice recorder button was circular device approximately 2-in in diameter with a small button located in the center of the device. When the participant pressed the button, a recorded script was activated. For the purpose of this study, a different voice recorder button was used for each script and script fading step. In addition, a small colored, round sticker was placed on the button in the center of the device. Each script that was taught was paired with a different color sticker (i.e., the script, "Can I please have \_\_\_\_" contained a red sticker on the button, while the script, "I would like \_\_\_\_" contained a blue sticker). The color of the stickers remained consistent throughout the script training phases and remained on the button throughout the fading steps. Once the button was removed, the final fading step included placing the colored sticker associated with the target script on the placemat above the participants' names.

### *Pretraining Scripts and Use of the Voice Recorder Button*

Auditory scripts were used for all three participants. Auditory scripts were chosen because none of the participants had acquired sufficient reading ability to use textual scripts. Prior to the beginning of the study, pretraining occurred with each participant until he or she could demonstrate the ability to independently push the voice recorder button and repeat the script when the last word was faded from the voice recorder button. Scripts used during pre-training were not

related to the scripts used in the teaching sessions of the study. The script used for pre-training was the mand frame that the participant was currently using to request items. For all participants this mand frame was "I want \_\_\_."

Pre-training consisted of an instructor or research assistant presenting the voice recorder button and providing the participant approximately 5 seconds to respond. If he or she did not press the voice recorder button within the 5 seconds, the instructor manually prompted the participant to press the button. If the participant pressed the button and he or she did not repeat the prerecorded script, the instructor presented the voice recorder again using a manual prompt to press the button (if needed) and a verbal prompt to repeat the script. The instructor then presented the button to the participant to begin another trial. Once the participant could independently push the voice recorder button and repeat the script 90% of trials (9/10) for one session, the last word was faded from the script. The participant was prompted to complete the script using the same procedures as above (if necessary). Training for each script fading step continued until the participant could complete the full script after the last word was faded for 90% (9/10) trials for one session.

### Independent Variables

The independent variables included in this study included (a) first response reinforcement plus extinction (extinction), and (b) script training with manual and verbal prompts. For the remainder of this paper and consistent with the literature, we will refer to "first response reinforcement plus extinction" as "extinction."

#### *First Response Reinforcement plus Extinction (Extinction)*

The extinction procedures for this study included reinforcing a mand frame only the first time it was emitted by the participant during a session and then placing that mand frame on extinction for the remainder of the session. In other words, during the sessions, any time a mand

frame was used after the initial reinforcement; the researchers did not reinforce that frame for the remainder of the session. Sessions during extinction phases continued until stability in the level and trend of the data was demonstrated. Previous research suggests that extinction may produce increases in aberrant behavior such as bursts of inappropriate responding or problem behavior (see Lerman, Iwata, & Wallace, 1999 for a review). In addition, there is a risk of completely extinguishing the responses the participants already demonstrate. To avoid increased or excessive rates of problem behavior and to ensure already established responses were not extinguished without teaching any alternative or replacement responses, we attempted to minimize the number of sessions in which a participant was exposed to the extinction procedures.

### *Script Training*

Auditory scripts were used for all participants in this study. For this study, script training procedures followed typical script and script fading procedures in the literature (i.e., Krantz & McClannahan, 1993; Stevenson et al., 2000). To teach each scripted mand frame, a single script consisting of one mand frame recorded on the voice-recorder button was placed in front of the participant for the entire session. Manual prompts were used to teach the participant to attend to the script during the session. This occurred by the researcher hand over hand prompting the participant to place their finger on the script and press the button. Once the participant pressed the button, he or she was given 5 seconds to correctly repeat the auditory script. If the participant did not independently and correctly repeat the recorded script after 5 seconds, the instructor manually prompted the participant to press the auditory script button once again, but this time used an immediate verbal prompt to guide the participant through following the script appropriately. This included the instructor restating the script immediately after the recording. These procedures were implemented until the participant independently repeated the script recording.

### *Script-Fading*

Once the participant correctly followed the auditory scripts with zero verbal prompts during 90% of opportunities during one session, the script was faded using a backward fading procedure. Each script was faded word by word until there were no words recorded on the script. Once the participant successfully used the mand frame in the presence of just the button, a colored sticker that was present on the auditory recorder, was then placed on the participant's placemat. For example, the script "I want \_\_\_" would be faded in the following steps: (1) "I want," (2) "I," (3) the voice recorder button with no words present, and (4) the colored sticker placed on the placemat. The additional sticker was included in the fading steps to help promote the transfer of stimulus control from the script to a more natural environmental stimulus (i.e., the placemat).

### *Treatment Fidelity*

Treatment fidelity data were collected across all conditions for at least 30% of sessions. An independent observer collected data on the implementation of the experimental procedures either from digital recordings of sessions or live. Treatment fidelity data was taken on the following responses: (a) an indirect prompt was used every 30 seconds (baseline and extinction conditions), (b) the proper responses were reinforced, (c) incomplete mand frames (all conditions) and already used mand frames (extinction) were not reinforced, and (3) proper prompting procedures were followed for teaching conditions.

Treatment fidelity data were taken for 33%, 34%, and 35% of sessions for Jillian, Drew, and Travis respectively. The overall mean percentage for Jillian was 97.1% (range 81% to 100%), 97.2% (range 82% to 100%) for Drew, and 97.8% (range 83.3% to 100%) for Travis. The mean percentages of accurate implementation of baseline and reversal procedures were 100%, 97.1% (range 82% to 100%), and 98.8% (range 88.9% to 100%) for Jillian, Drew, and Travis, respectively. The mean percentage of procedural fidelity for extinction conditions was 97.7%

(range 90% to 100%) for Jillian, 95% (range 82.4% to 100%) for Drew, and 96% (range 88% to 100%) for Travis. Finally, the mean percentages for accurate implantation of script training procedures were 95.7% (range 81% to 100%) for Jillian, 97.9% (range 82% to 100%) for Drew, and 98.1% (range 83.3% to 100%) for Travis.

### Experimental Design

A multiple baseline across participants design was used to determine the effects of scripts and a script fading procedure as well as an extinction procedure on the response variability of mand frames used by young children with autism. The following phases are included for each participant: (a) baseline, (b) extinction, (c) three sequential script teaching phases, (f) alternative teaching procedures (when applicable), and (g) 1- and 2-week follow-up generalization probes. The general sequence for each participant including the following: an initial baseline (A) phase, an initial extinction (B) phase, the first script training phase (C1), followed by baseline (A) and extinction (B) phases, the second script fading phase (C2), followed by baseline (A) and extinction (B) phases, the third script fading phase (C3), followed by baseline (A) and extinction (B) phases, then an alternative teaching procedures phase (Drew) and/or generalization and follow up probes. During each script training session a new scripted mand frame was taught; thus C1, C2, and C3 used the same procedures, however different scripts were taught in each phase. For Drew, an additional reversal was conducted across an alternative intervention (D) and baseline (A), thus creating an ABC1ABC2ABC3DAD design. These conditions are outlined in detail below in the procedures section.

### Dependent Variables and Measurement Procedures

During all sessions, the total number of mand frames, scripted and unscripted mand frames, and the number of different mand frames were measured. In addition, the cumulative number of novel mand frames across the study was recorded. Researchers scored each variable en

vivo for each session. Treatment fidelity and interobserver agreement measures were scored in vivo or from video recordings after the session was completed. The researcher recorded, verbatim, each complete mand frame used by the participant with a pencil and paper (see Appendices A-D). To be recorded as a complete mand frame, the frame had to include at least a subject, a verb, and the preferred item. The researchers then scored whether each response was either scripted or unscripted and, when applicable, whether the response was reinforced. Each dependent variable is defined below.

#### *Scripted Mand Frames*

Scripted mand frames were defined as verbalizations that were identical to any script frame being taught or previously taught + the snack item label. For example, if the script stated, "I want \_\_\_\_\_," the verbalization would be recorded as a scripted mand frame only if the participant said, "I want + (snack item)." If the snack item varied across the use of the same mand frame, it was still recorded as a scripted mand frame (i.e., "I want *cookie*," and "I want *chips*," were scored as the same mand frame). In addition, for the purpose of this study, a response was scored as scripted regardless of whether the script was present. Therefore, once the script was completely removed during baseline and extinction conditions, if a participant used a previously taught script, it was still recorded as a scripted statement.

#### *Unscripted Mand Frames*

Unscripted mand frames were defined as a deviation of one or more words from a previously taught or current script. This includes the addition, subtraction, or modification of words, verbs, or adjectives in the current script or previously taught script. In addition, the response had to be a complete mand frame (i.e., two or more words chained together to request a snack item) to be recorded as an unscripted response. Therefore, any unscripted responses that were not direct mands for snacks (i.e., "I like cookies,") were not recorded as an unscripted mand

frame. Unscripted mand frames were recorded as such regardless of the presence of a script or partial script.

#### *Number of Different Mand Frames*

A mand frame was scored as “different” if it varied from any of those previously used in the current session by more than articles, conjunctions, or adjectives that specifically describe the item being requested (i.e., big cookie, blue candy, etc.). The number of different mand frames was calculated by counting each mand frame that was different from any of those previously used during that session. This included scripted and unscripted mands.

#### *Novel Mand Frames*

The cumulative number of novel mand frames across all conditions was recorded for each participant. Novel mand frames were defined as a mand frames that had not been emitted during any previous session. In other words, to be scored as a novel mand frame, it had to be the first time it was used across any of the previous sessions.

#### *Interobserver Agreement*

An independent observer collected interobserver agreement data (IOA) for 33%, 33.6%, and 37.5% of sessions with Jillian, Drew, and Travis respectively. First, exact agreement was calculated for mand frames used across all conditions and phases. A percentage was calculated by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100%. To be scored as an agreement both observers had to record the exact same mand frames and the exact number of frames in the correct order. IOA was also calculated on whether the mand frame was independent or prompted and which prompt type was used as well as whether the mand frame was recorded as scripted or unscripted.

Overall IOA percentages for Jillian, Drew, and Travis were 99% (range 89% to 100%), 96.2% (range 63% to 100%), and 98.3% (range 85% to 100%), respectively. The mean IOA



percentages for baseline sessions were 98.2% (range 89% to 100%) for Jillian, 96.5% (range 88.2% to 100%) for Drew, and 98.5% (86.7% to 100%) for Travis. The mean IOA percentages for extinction were 97.4% (range 92% to 100%), 90.5% range 63% to 100%), 98.9% (range 85% 100%) for Jillian, Drew, and Travis, respectively. Finally, the mean IOA percentages for script training sessions for Jillian were 99.4% (93% to 100%), and 98% (range 91% to 100%) for Drew and 98% (range 94.4% to 100%) for Travis.

## Experimental Conditions

### *General Procedures*

Research assistants conducted all sessions. One to four sessions were conducted each day with at least 10 minutes between each session. Sessions were conducted three to five days per week. All sessions were 5 minutes in length, which was tracked using a portable kitchen timer. Each session was videotaped in case any session data had to be reviewed and for the purposes of scoring IOA and treatment fidelity data.

Each session began with a modified brief preference assessment using procedures similar to those of a Brief Multiple Stimulus Preference Assessment without Replacement (Carr, Nicolson, & Higbee, 2000). Ten items that were identified as being highly preferred by teachers and parents were presented on the table in front of the participant. The participant was instructed to pick what he or she wanted and was allowed to consume the item chosen. The remaining nine items were then rearranged and presented to the participant. He or she was told, once again, to choose what he wanted as was able to consume the item. This was done once more to identify the top three most preferred items. The three items the participant chose were then used for the following experimental session.

Three containers with the chosen items were placed on the table in between the participant and researcher. The participant sat across from the researcher and had a place mat in front of him/her on the table. Once the participant was sitting across from the researcher, he or

she was given the instruction, "It's time for snack." During all sessions except script fading sessions, if the participant did not request any item after 30 seconds, the researcher prompted him/her by stating, "Pick one." During script fading sessions, if no mands were made for 30 seconds, the researcher prompted the participant to use the script. This prompting procedure continued throughout the session to insure the number of prompts were consistent across all sessions and to direct participants' attention to snack time to optimize requesting opportunities.

All requests for any food items or other tangible items that were not currently available were ignored and the researcher would only briefly respond (one to two words) to the participant if any social interaction was initiated. For example, if the participant says, "look, it's a red Skittle," the researcher could say, "Yes, you are right." The researcher did not initiate any conversations or ask questions to the participant. This was specified to attempt to keep the time available for the participant to mand for items consistent across all sessions.

If the participant engaged in any inappropriate behavior such as crying, screaming, attempting to leave the area, throwing items, etc., the behaviors were ignored or blocked/redirected. The researcher continued to block/redirect the participant while continuing to give the prompt, "Pick one," or prompt to the script every 30 seconds. All sessions continued for the full 5 minutes with the exception of a modification made for Travis. Sessions for Travis were terminated if he did not choose snacks during the preference assessment or if he did not mand for a snack item at least once during the first minute of the research session. Details of modifications for Travis are discussed in the results section below.

### *Baseline*

During the baseline condition, all procedures specified above were followed. If the participant did not mand for an available item within the first 30s of the session, the verbal prompt, "Pick one," was given. During this phase, all complete mand frames were reinforced with access to the item requested. Participants were not reinforced for gestures toward a snack

(i.e. pointing or touching the snack bin), one word utterances (i.e., “cookie”), or incomplete mand frames (i.e., “want cookie”).

### *Extinction*

The purpose of this phase was to determine if implementing an extinction procedure prior to teaching new mand frames would increase the variability in mand frames used for participants with a limited manding repertoire (i.e., only used one frame to mand for preferred items). During this phase, each mand frame was reinforced only the first time it is used by the participant during a session. After a mand frame was used once and reinforced with access to the relevant snack item, that mand frame was put on extinction for the rest of that session.

### *Script Teaching and Script Fading*

The purpose of the series of script training conditions was to determine if building the participant’s mand repertoire by teaching different mand frames was sufficient to produce variable responding. In addition, we taught the scripts in a successive fashion to determine if the number of different responses a participant was taught increased the amount of response variability in the mand frames used. During this series of phases, students were taught three mand frames, one during each training phase, using scripts and script fading procedures. The scripts “I would like \_\_\_\_\_,” and “May I please have \_\_\_\_\_” were taught to all participants. The third script taught to Drew and Jillian was, “Can I get some \_\_\_\_\_” and the third script for Travis was “Can I have some \_\_\_\_\_.” These scripts were chosen because they were comprised of multiple words that could be easily rearranged and interchanged across frames to produce new frames. For example, if a participant was taught, “I would like \_\_\_\_\_” and “Can I get some \_\_\_\_\_,” the participant could potentially develop a new frame, “I would like some \_\_\_\_\_.”

Participants were taught one script at a time and the next script was not introduced until the current script was completely faded. Each script had its own colored circular sticker placed on the voice recorder button. The purpose of the sticker was to help transfer stimulus control from

the script to the participant's place mat (a stimulus found in the natural environment). The Target script was placed in front of the student on the place mat containing the participants' name.

During this phase, all scripted and unscripted mand frames were reinforced with access to the relevant snack item. This allowed the participant to gain access to snack items by using any of the scripts he or she had already learned or had in his or her repertoire prior to the study, the script he/she was currently learning (scripted frames), or any untaught or modified mand frame (unscripted frame). However, to be reinforced, the response had to be presented in a frame. Therefore, gestures, one word responses, or incomplete mand frames were not reinforced.

To ensure the participant learned the target script while still promoting the use of different mand frames, the following procedures were followed: (a) if the participant did not mand for a snack item for 30 seconds, the researcher manually prompted him or her to use the script. If the participant did not verbally follow the script within 5 seconds of attending to it (pushing the button), the researcher then manually prompted the participant to push the button and used an immediate verbal prompt following the script; and (b) If the participant used any mand frame other than the target script for two consecutive mands, the research immediately prompted the participant to attend to the target script using manual prompts. The prompting procedures continued until the participant repeated the script or the session ended.

Scripts were faded when the participant followed the script 90% of independently initiated or manually prompted button pushes in the absence of verbal prompts for one session. Scripts were faded using a backward-fading procedure in which the last word of the script was removed until the all words are faded. Once all words were faded, the icon (colored sticker) was presented on the participants' place mat. Once the icon was completely faded from the place mat, the script was completely removed and the next condition began.

*Return to Baseline*

A return to baseline was conducted after each script was completely faded. Return to baseline phases were conducted exactly as the original baseline phase. The purpose of this phase was to assess the variability of mand frames used once scripts were taught and faded.

*Extinction after Teaching*

This phase was implemented after each script was taught and faded to determine if the implementation of extinction along with teaching mand frames using scripts would increase response variability more than scripts alone or extinction alone. If the results demonstrated that extinction prior to any teaching increased response variability to levels similar to those seen after teaching, it could be concluded that teaching may not necessary to produce variable responding in verbal behavior with participants with a limited manding repertoire. However, if extinction prior to teaching did not produce an increase in response variability, we could then suggest that extinction procedures are more effective in combination with language training. This phase was identical to the previous extinction phase and continued until there was stability in the data.

*Alternate Intervention: Multiple Script Presentation*

Due to the minor increases in the variability of mand frames used by Drew after the completion of all programmed conditions, an alternate intervention was implemented. This intervention included presenting all scripts at once during each session. This condition began by presenting all three voice recorder buttons out, each containing a script taught in previous conditions. All voice recorders had a full script. The research assistants prompted Drew to push and follow one of the voice recorder buttons in a quasi random order to ensure Drew did not begin to produce mand frames in a specified order. This was done by creating three prompting sequences that consisted of a list of the three scripts in which the research assistant followed to prompt Drew to attend to a specific script. If Drew did not initiate a mand frame within 30

seconds of the start of the session or from the previous request, the research assistant would prompt him to use the script first script on the list. The researcher would also prompt the Drew to use another script if he used the same script twice in a row.

Once Drew independently varied across all scripts in the absence of verbal prompts 90% of the session for one session, script fading began again. All scripts were faded at the same time, but unlike previous script training conditions, scripts were faded with fewer steps. After mastery of full scripts, scripts were faded to the first word only, then to just the three sticker placed on the place mat. Scripts were rearranged throughout the sessions for all sessions in this condition.

#### *Generalization Probes and Follow-Up*

A generalization probe was conducted for each participant in a natural setting. Sessions in this condition were conducted in a typical snack time during preschool for Drew and Travis. During the probe, approximately 3-4 other students were present with one instructor running a group snack time. Generalization probes for Jillian were conducted at a family snack time including her mother, sister, and a neighborhood friend. Procedures in the generalization session for Drew consisted of those similar to the alternate intervention we implemented in which the script icons were present. For Jillian and Travis, procedures were identical to baseline (i.e., no script present). Follow up sessions were conducted 1 and 2 weeks after research sessions stopped. Follow up sessions consisted of implementing the phase that the participants ended on. Therefore, the alternate intervention procedures were followed for Drew and baseline procedures for Jillian and Travis were used during these follow up sessions.

## CHAPTER IV

## RESULTS

## Pre-teaching

Within three sessions, Jillian completed the full script pretraining. The last word was then faded and Jillian mastered the script with the last word faded in three sessions as well. We then probed novel scripts to determine if the script was the stimulus controlling the response. We probed a novel script that was not a mand and unrelated to the study (i.e., "I like to play with \_\_\_\_"). Jillian mastered this probe on the first trial with the full script and with the last word faded (i.e., "I like to play \_\_\_\_"). After mastering this script, we began experimental sessions. However, after session two in the first script training session, Jillian was not following the auditory script and only filling in the preferred item. For example, the script stated, "Can I get some \_\_\_\_." Instead of repeating the script, Jillian would fill in the preferred item only by stating a single word response (i.e., cookie). Thus, we determined she needed to be retrained on how to use and follow the scripts, so we began script re-training. Retraining occurred after session two in the first script training condition (represented by the dashed line in Figure 1). This consisted of training intraverbal responses on the auditory scripts. For example, the auditory script stated, "A dog says" and instead of completing the statement (i.e., "woof"), Jillian was taught to repeat the words on the script while completing the statement; "A dog says woof." The mastery criterion for retraining was the same as pre-teaching. Jillian successfully mastered the first script, "A dog says \_\_\_\_," during the first retraining session. She also mastered the script with the last word faded in one session. We then probed a novel script, "What color is it?" which she mastered with the full script and with one word faded during the first session. Finally, we interchanged the two previous scripts across trials. Jillian repeated the target scripts 100% of trials (10/10).

Drew completed the auditory script pre-teaching in four sessions with the full script present. Once the last word was faded, he mastered the script in one session. A probe was conducted with a novel script (“I like to play with \_\_\_”); one that was not a target mand frame, to ensure the auditory script was controlling the response. Drew independently followed the novel auditory script 100% (10/10) of the trials the first session.

Pre-teaching with Travis consisted of teaching two different scripts, one mand frame, “I want \_\_\_,” and one unrelated statement, “Drew is my friend.” Travis mastered both full scripts in two sessions. Once the last word was faded, Travis mastered “Drew is my \_\_\_” in one session and “I \_\_\_” in two sessions. Similar to Jillian, Travis required re-training on following scripts. This training occurred after session six in the first script training condition (represented by the dashed line in Figure 1). The purpose for conducting retraining with Travis, however, was because he was not attending to what was stated on the auditory script, but rather stating his previously known mand frame after he pushed the voice recorder button. The same scripts as Jillian’s were used for Travis’s retraining. Travis successfully mastered the scripts, “A dog says \_\_\_” and “A cat says \_\_\_” in two sessions. Once the last word was faded from both, he mastered the scripts in one session. We then tested a novel script, “what is your name.” Travis responded to this script correctly 100% of trials (10/10) during the first session. At this point, we began experimental sessions again.

#### Scripted versus Unscripted Responses

Figure 1 displays the total number of scripted and unscripted mand frames used across all participants within each session. Data in sessions prior to any teaching (baseline and extinction alone) are represented by closed diamonds. Scripted (closed squares) and unscripted (open circles) mand frames are shown in the conditions once script training began.



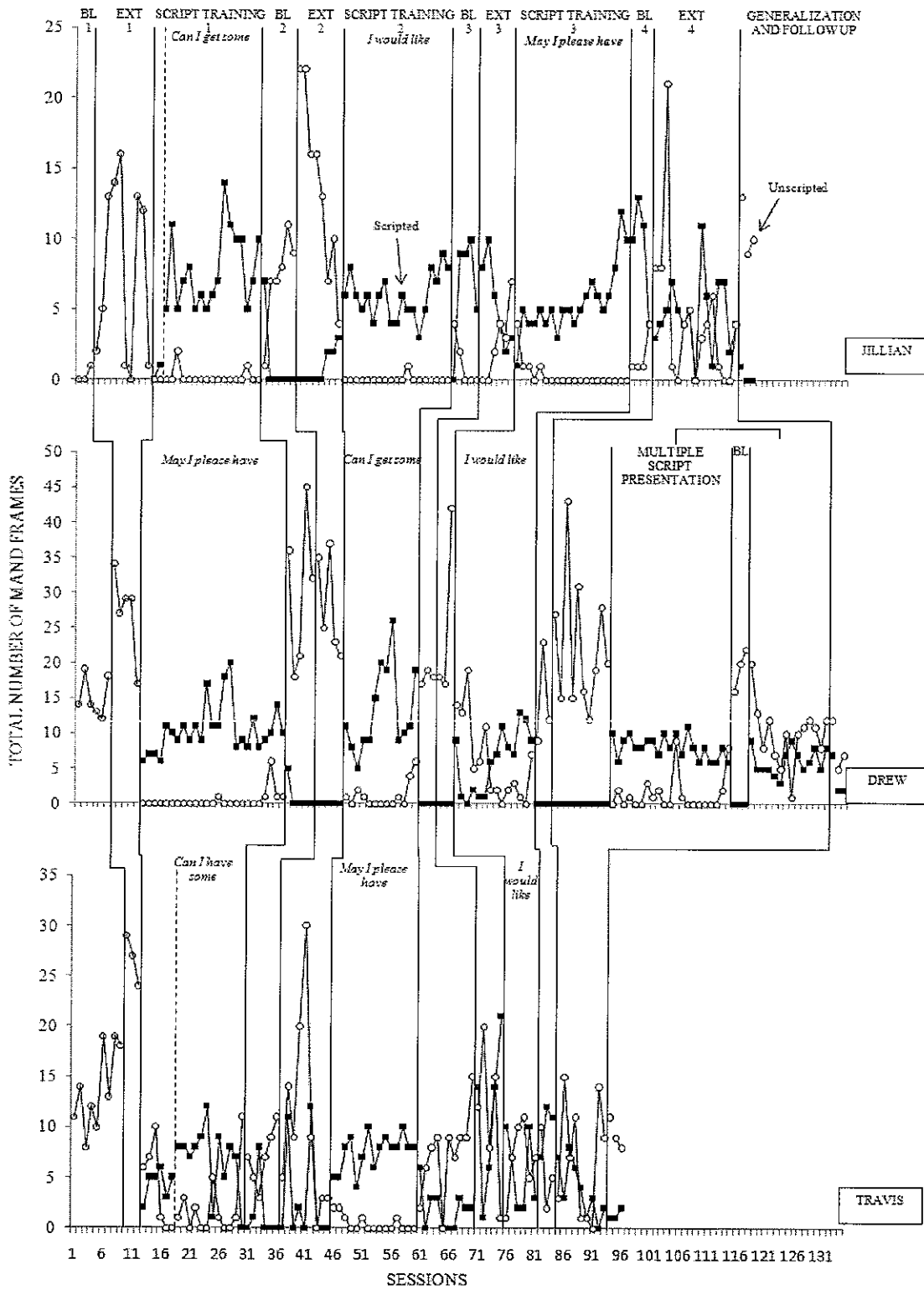


Figure 1. The results of the total number of scripted (closed squares) and unscripted (open circles) used by Jillian (top panel), Drew (middle panel), and Travis (bottom panel).

*Jillian*

As seen in the top panel of Figure 1, Jillian showed a consistent pattern of responding across the entire study. There are two important patterns to note in her data. First, there is a high rate of responding across all conditions. However, as seen on the graph, the total number of requests during the extinction conditions remained higher than other conditions. Second, as demonstrated by the open circles, the use of unscripted mand frames was infrequent during script training sessions. However, during those sessions in which scripts are not present, unscripted responding increased and, at times, was higher than the scripted responses (as seen in the first reversal to baseline and extinction conditions).

During Baseline 1, Jillian requested snack items only once during the third session. Once the first extinction sessions were implemented, Jillian manded more frequently (as many as 16 mands per session), but the trend of manding was variable; ranging from 0-16 mands frames per session. When the Script Training 1 phase began, Jillian continued to engage in little to no responding, script re-training was conducted and she quickly began to mand at high rates. With the exception of two sessions, Jillian did not use any unscripted mand frames during this phase. She manded for snack items using scripted frames from 5-14 requests, averaging about 7.5 mand scripted mand frames per session and showed some variability in the number of mands emitted. During the Baseline 2 condition, the total number of scripted data mand frames used decreased dramatically. During the first session of this phase, Jillian manded seven times using scripted mand frames, however she did not emit a single scripted mand frame in the following sessions. In contrast, a sharp increase in the total number of unscripted mand frames was seen in the second session of this phase. This trend continued to increase with Jillian using approximately 10 unscripted mand frames per session by the end of the condition. Another sharp increase in the total number of unscripted mand frames emitted was seen once the Extinction 2 phase began. In the first two sessions of this condition, Jillian emitted 22 unscripted mand frames; however a

steady decreasing trend began at session 41 (the third session in this phase). This decreasing trend continued until the last session of the phase in which she used only a total of four unscripted frames. The number of scripted mand frames used, however, maintained at zero for the first five sessions. In the sixth session of this phase, a slight increasing trend in the number of scripted mand frames was observed and continued during the last three sessions.

When the Script Training 2 phase began, both the number of scripted and unscripted mand frames used stabilized. In the beginning of this phase, Jillian showed a steady trend in the number of scripted frames used by emitting between four and seven scripted mand frames while not using unscripted frames at all (with the exception of session 58 when she emitted one). During the final four sessions of Script Training 2, Jillian did not use any unscripted mand frames, but increased the number of scripted frames used slight, using between eight and 11.

Unlike the patterns seen in Baseline 2, during Baseline 3 Jillian primarily used scripted mand frames. A sharp increase from 0-9 scripted frames emitted was seen from the first to second session in this phase. The number of scripted frames used remained high until the final phase in which scripted mand frames used decreased from 10 to five during the final two sessions. Also in contrast to the Baseline 2 condition, with the exception of the first two sessions, Jillian used any unscripted mand frames to request for snack items during the Baseline 3 condition. While the number of unscripted mand frames used by Jillian remained at zero to near zero rates once the Extinction 3 phase was introduced, her use of scripted mand frames increase during the first two sessions; using ten scripted mand frames during session 72. However, the increases in scripted mand frames did not maintain and a steady decrease in trend was seen in the number of scripted frames used throughout this condition; using between two and three scripted frames in the final sessions. However, as a decrease in the trend of scripted frames began, an increase in the trend of unscripted frames used was observed beginning in the third session of the Extinction 3 phase.

This increase continued to the final session of this phase in which Jillian used seven unscripted frames.

When the Script Training 3 phase was introduced, the number of scripted mand frames used increased slightly from the previous phase and stabilized with Jillian using around five during the first half of this phase. At session 88, the trend of scripted mand frames used began to increase from five to 12. However, with the exception of four sessions in the beginning of this phase, Jillian did not use any unscripted mand frames. When the Baseline 4 phase was introduced, the number of scripted mand frames used remained at levels consistent with the final sessions of the previous phase, ranging from 10-13. However, during the final session there was a sharp decrease in the data with Jillian only emitting four scripted mand frames. During the first three sessions of the baseline four phase, Jillian used one unscripted frame each session and in the fourth session increased the number of unscripted frames she used to four.

During the final phase, Extinction 4, Jillian showed variability in both the level and trend of the number of unscripted and scripted mand frames used. Jillian emitted between zero and 21 unscripted mand frames throughout this condition with no clear trend or level. Similar results were seen in the data for scripted mand frames as well, however, not as drastic. The number of scripted mand frames Jillian used per session during this condition ranged from zero to 11. During the generalization probe that was conducted in the natural setting, Jillian primarily used unscripted mand frames (11 in total) while only mand for a preferred item with a scripted frame once. Similar results were seen during the two follow up sessions with Jillian using between nine and ten unscripted frames per session and not using scripted frames at all.

#### *Drew*

The data for the total number of scripted and unscripted responses for Drew are represented in the second panel of Figure 1. Drew began this study by requesting a total of 13-19 times during the Baseline 1 condition. A sharp increase in the number of mands Drew emitted

was seen in the first session for the Extinction 1 condition with Drew manding for preferred items using mand frames 34 times. However, the data in this condition did not remain at those levels, showing a decreasing trend. During the final session of this phase, Drew requested 17 times which was near the level or responding seen in the Baseline 1 condition.

When the Script Training 1 condition was implemented, the number of unscripted mand frames used remained at near zero levels, with only one session in which Drew used more than one unscripted mand frame (session 34 he used 6 unscripted frames). The level of scripted mand frames used remained fairly consistent during this phase as well with some variability seen. During the majority of the sessions in the Script Training 1 condition, Drew used between six and 12 scripted mand frames. There were three sessions in which Drew manded for items using scripted frames 17-20 times. Otherwise, there were no striking trends or variability observed in this condition.

During the Baseline 2 condition, however, there was a dramatic increase in the level of unscripted mand frames with quite a bit of variability as well. Drew used 18-42 unscripted mand frames per session. In contrast, Drew did not use any scripted mand frames after the first session in which he emitted five scripted frames. The patterns for both scripted and unscripted mand frames used per session continued once the Extinction 2 condition was implemented. The use of unscripted mand frames remained at similar levels with Drew using between 21 and 37 unscripted frames, however a decreasing trend was seen during this phase. Drew did not use any scripted mand frames during this condition.

During the Script Training 2 condition, patterns in the data changed. Drew primarily used scripted mand frames; however there was some variability seen in the level of the number of scripted frames used per session. Drew emitted between five and 26 scripted frames showing a slight increasing trend. Similar to the Script Training 1 condition, Drew rarely used unscripted mand frames until the near end of the phase where he showed a slight increase using four to five

unscripted frames. When the conditions changed and Baseline 3 was implemented, again, the levels of both unscripted and scripted mand frames changed. Once the Baseline 3 condition was implemented the number of unscripted mand frames increased immediately to approximately 18 per session and remaining stable with almost no variability across the condition. Drew did not use any scripted mand frames during the phase. Similar patterns were seen in the Extinction 3 condition as well. Unscripted mand frames remained at levels similar to those seen in the previous session (approximately 18) with the exception of the final session in which he manded using an unscripted frames 42 times. Again, Drew did not use any scripted frames during this phase.

Slightly different results were seen in the Script Training 3 phase when compared to previous script training phases. During the six sessions of this phase, Drew used more unscripted responses; using as many as 19 during session 68. The levels of unscripted mand frames did not maintain, however, and showed a decreasing trend throughout the remainder of the phase using no more than three unscripted mand frames during the final sessions (with the exception session 79 in which he used 7 unscripted frames). The data for the number of scripted mand frames used throughout this phase showed an increasing trend with some variability. Drew used 0-13 scripted mand frames per session with the data stabilizing between nine and 13 scripted frames used during the last three sessions.

When Baseline 4 was introduced, Drew showed higher levels of unscripted mand frames used, but the data were variable ranging from nine to 23. Consistent with the previous baseline conditions, during Baseline 4, Drew did not emit any scripted mand frames. Again, similar patterns in both the use of scripted and unscripted mand frames were seen once Extinction 4 was implemented. The level of the number of unscripted mand frames increased slightly from the previous baseline phase, but it was still variable, ranging from 12-43 unscripted frames used.

And, once again, Drew did not use any scripted mand frames in any of the sessions during this phase.

When the Multiple Script Presentation condition was implemented the number of unscripted mand frames used decreased dramatically. With the exception of two sessions (session 104 and 113), Drew did not use more than three unscripted frames in a single session. Drew used between six and 11 scripted frames per session during the Multiple Script Presentation condition. The data for scripted mand frames was consistent and showed little variability throughout this phase. Once the condition ended and baseline conditions were implemented, Drew immediately went back to using only unscripted mand frames. The data for the number of unscripted frames used showed an increasing trend during this phase. Drew used 16-22 unscripted frames per session and did not use any scripted frames. When we reintroduced the Multiple Script Presentation Condition, the number of unscripted mand frames used began to decrease while the level of the number of scripted frames used increase from the previous baseline phase, remained fairly consistent. Unlike the previous conditions, there was no clear separation seen between the two data paths during this phase, which showed Drew was using both scripted and unscripted mand frames at near similar levels toward the end of this phase.

During the generalization probe to the natural setting, Drew used five scripted and 12 unscripted mand frames. Drew continued to use more unscripted than scripted mand frames during the follow up sessions; however the level of both decreased. Drew used five unscripted and two scripted mand frames during the first follow up session and seven unscripted and 2 scripted mand frames during the second follow up session.

Overall, Drew engaged in high frequencies of responding in both scripted and unscripted mand frames; using high rates of scripted mand frames during script training sessions and high rates of unscripted mand frames when scripts were not present. When scripts were present, Drew

responded primarily with the target scripts, while his unscripted responses remained low in frequency. However, during reversals to baseline and extinction conditions, Drew engaged in high rates of unscripted responses and minimal scripted responses. In fact, in all but session 37, Drew used only unscripted responses during all baseline and extinction conditions. The frequencies of both unscripted and scripted responses were quite variable across all conditions.

### *Travis*

The total frequency of scripted and unscripted responses for Travis is displayed in the third panel of Figure. 1. During Baseline 1 condition, an increasing trend was seen in the number of mands used per session. Travis manded for snack items between eight and 19 times per session and showed some variability across sessions. When the Extinction 1 condition was implemented, Travis began the condition by manding a total of 29 times during the first session. The data showed a decreasing trend across the three sessions in this phase, but the number of mands still remained higher in the Extinction 1 phase than seen in the Baseline 1 phase.

An increasing trend in the number of unscripted mand frames used was observed during the first three sessions of the Script Training 1 phase in which Travis emitted ten unscripted frames during session three. However, a decrease in the level of unscripted frames was seen beginning in session four during which Travis only emitted one mand frame. Furthermore, Travis did use more mand more than five times using unscripted frames for the remainder of the phase. Prior to re-training (identified by the dashed line), Travis used between two and six unscripted mand frames. After retraining a slight increasing trend was observed, however there was a dramatic decrease in scripted mand frames during session 26. This level in scripted mand frames did increase once again, but did not maintain and, during the final session, Travis did not use any scripted mand frames.

The number of unscripted data showed in the Baseline 2 condition began with a decreasing trend during the first three sessions. However, beginning with session 34, trend began



to increase and Travis used 11 total unscripted frames during the final session of this phase. With the exception of one session (session 33), Travis used near zero rates of scripted mand frames during the Baseline 2 conditions. During the Extinction 2 condition the data for unscripted mand frames used showed an increasing trend, with the data increasing to a total of 30 unscripted frames used. The trend and level did not maintain, however, and during session 42 the trend began to decrease with Travis using nine frames. Furthermore, during the following session, Travis did not use any unscripted frames and only three in the final two sessions for this phase. The number of scripted mand frames used by Travis during the Extinction 2 phase showed variable patterns; with Travis using 0-9 scripted mand frames. Although there was some variability shown in the number of scripted frames used during this condition, Travis primarily showed lower levels of scripted frames with Travis not using any scripted frames during seven sessions.

There was a clear separation in the data paths observed in the Script Training 2 condition with Travis primarily using scripted mand frames. During this phase, Travis used between four and ten scripted frames per session while showing stability in level and trend. Travis used unscripted frames minimally and did use more than two unscripted frames in a single session. When the Baseline 3 condition began, the data showed a steady increase in the trend of unscripted mand frames and showed little variability (with the exception of session 65). The data for the number of scripted frames used showed a slight decrease in trend and ranged from zero to six scripted mand frames used.

The data for scripted and unscripted mand frames used was much more variable during the Extinction 3 condition. The trend in the unscripted mand frames used showed a slight decreasing trend and ranged from one to 20 total mand frames per session. Scripted mand frames showed a slight increasing trend while ranging from one to 21 total scripted frames used per session. The data for scripted mand frames used during the Script Training 3 condition was just as

variable and continued to increase and decrease between two and ten total mand frames used per session. Travis began this phase, however, with the data showing an increasing trend in the number of unscripted mand frames used. He began the session with using one unscripted frame and after four sessions had increased the number of unscripted mand frames to 11. However, this trend did not maintain and Travis only used five and seven unscripted frames during the final two sessions of this phase.

During Baseline 4, the data for the number of unscripted mand frames Travis used showed a decreasing trend with Travis using a total of ten unscripted frames during the first session and decreased to between two and five unscripted mand frames used. In contrast, the data showed an increasing trend in the number of scripted frames used across the Baseline 4 condition. Travis used a total of seven scripted frames during the first session of this phase, and increased to a level of approximately 10 to 11 scripted frames.

Similar patterns in the data were observed for both scripted and unscripted mand frames used. Both data paths showed a decreasing trend across the condition. Travis used between zero and 15 unscripted frames in the beginning of the condition and zero and seven scripted mand frames. Although both data paths showed a decreasing trend, the total number of unscripted mand frames dramatically increased during the final two sessions to 14 and nine in sessions 92 and 93 respectively. The level in the total number of unscripted frames used maintain during the generalization probe to the natural setting and only decreasing slightly in the two follow up sessions during which Travis still emitted eight to nine unscripted frames. The level of the total number of scripted frames maintained near one during both the generalization probe and follow up sessions.

In summary, Travis's data are more variable than Jillian or Drew and, unlike the other two participants, there is no clear separation seen between scripted and unscripted mand frames. The second script training condition is the only phase in which he demonstrated any separation

between the data paths. In this phase, similar to the other participants, when the scripts were present, Travis primarily emitted scripted responses. Again, similar to Drew, Travis's data were variable across all conditions.

Tables 1-3 summarize the script-fading procedures for each participant. On the far left column is the script that was presented. The middle column represented the session number in which that script was introduced and the right column represented the number of sessions the script was in place until mastery.

Table 1 summarizes Jillian's script-fading data. As you can see from the data, it took 1-13 sessions for Jillian to master each script. Also, during training of the third script, "May I please have," the script was faded from the entire script directly to "May." This was done as a probe to determine if Jillian was learning the script even though she was not meeting the script-fading mastery criteria. Jillian successfully responded with this script, thus we continued with the fading process. Table 2 summarized Drew's script-fading data. It took Drew 1-10 sessions to master each script. Finally, Table 3 represents Travis's script-fading data. Travis mastered all script-fading levels in 1-10 sessions as well.

#### Number of Different Mand Frames

Figure 2 shows the data for the number of different mand frames used by each participant. Represented on this graph is the total number of different mand frames used per session along with the number of unscripted mand frames used.

#### *Jillian*

As shown in the top panel of Figure 2, Jillian did not use any complete mand frames during two of the three sessions and used only one frame for the third session of the Baseline 1 phase. During the extinction 1 phase, an increase in the total number of different mand frames

Table 1

*Jillian's Script-fading Data*

Script	Session introduced	Sessions to mastery
<i>Script 1: Can I please have ____</i>		
Can I please have	13	10
Can I please	23	1
Can I	24	1
Can	25	2
Blank button	27	3
Sticker only	30	1
<i>Script 2: May I have some ____</i>		
May I have some	46	3
May I have	49	3
May I	52	1
May	53	5
Blank button	58	1
Sticker only	59	2
<i>Script 3: I would like ____</i>		
I would like	76	1
I would	77	1
I	78	1
Blank button	79	1
Sticker only	80	2

Table 2

*Drew's Script-fading Data*

Script	Session introduced	Sessions to mastery
<i>Script 1: May I please have ____</i>		
May I please have	13	10
May I please	23	2
May I	25	3
May	28	1
Blank button	29	6
Sticker only	34	3
<i>Script 2: Can I get some ____</i>		
Can I get some	48	4
Can I get	52	2
Can I	54	1
Can	55	1
Blank button	64	1
Sticker only	65	4
<i>Script 3: I would like ____</i>		
I would like	75	2
I would	77	1
I	78	3
Blank button	81	2
Sticker only	83	6

Table 3

*Travis's Script-fading Data*

Script	Session introduced	Sessions to mastery
<i>Script 1: Can I please have ____</i>		
Can I please have	13	10
Can I please	23	1
Can I	24	1
Can	25	2
Blank button	27	3
Sticker only	30	1
<i>Script 2: May I have some ____</i>		
May I have some	46	3
May I have	49	3
May I	52	1
May	53	5
Blank button	58	1
Sticker only	59	2
<i>Script 3: I would like ____</i>		
I would like	76	1
I would	77	1
I	78	1
Blank button	79	1
Sticker only	80	2

used was observed in the first two sessions; with Jillian using up to four different mand frames in session five. However, this pattern of responding did not maintain and stabilized at only a level slightly higher than baseline (i.e., Jillian used between one and two different mand frames per session). Jillian primarily used the target script during the Script Training 1 condition. Jillian used between zero and three different mand frames across this phase, although she used only one mand frame with the exception of three sessions. During session 18, Jillian did use two different unscripted mand frames, but otherwise used no more than one unscripted mand frame per session.

During the Baseline 2 condition, the total number of different mand frames as well as the number of different unscripted frames used remained steady between one and two different frames. Similar patterns were seen the data paths during the Extinction 2 phase with the number of different unscripted response equaling the total number of different mand frames. However, both the total number of different mand frames and different unscripted mand frames began at a higher level (as many as four different mand frames) and showed a decreasing trend across the condition. The number of different unscripted frames decreased to one and Jillian ended this phase using two different mand frames. The decreasing trend was even less drastic for the total number of different mand frames with the data stabilizing between two and three frames.

When the Script Training 2 condition was implemented, data for both the total number of mand frames used and the number of different mand frames used stabilized and remained consistent across the condition. With the exception of session 59, Jillian emitted only one mand frame, all of which were scripted. It should be noted that modifications in the prompting procedures were made after session 59 (during the second script training phase). Gesture prompts replaced manual prompts beginning in session 60 because it was anecdotally reported that Jillian began to find the manual prompts reinforcing and would engage in behaviors such as hiding her arms behind her back and laughing when the research assistants would attempt to manually

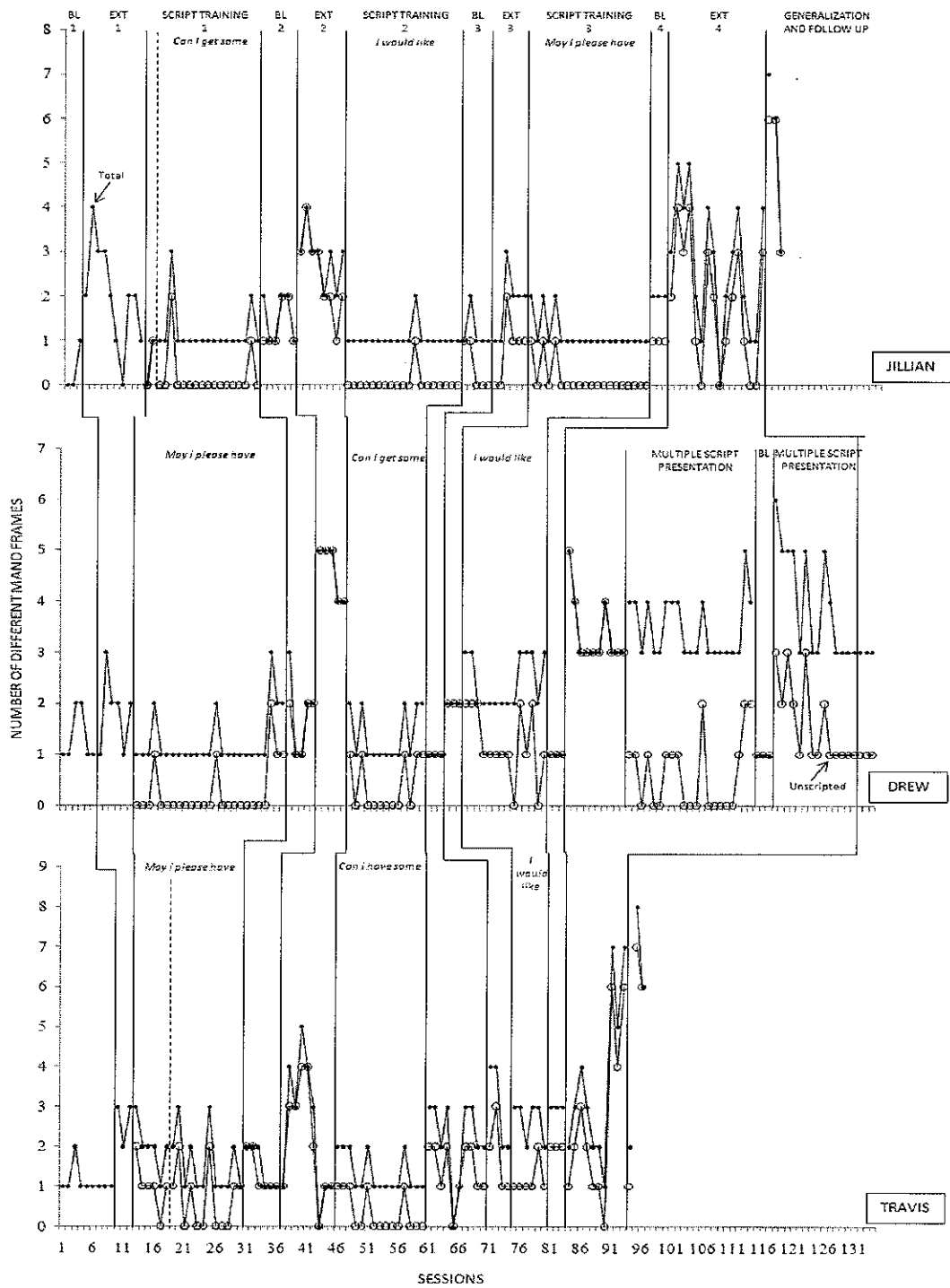


Figure 2. Results of the number of different mand frames used by Jillian (top panel), Drew (middle panel), and Travis (bottom panel). Closed circles represent the total number of different mand frames while the open circles represent the number of different unscripted mand frames.



prompt her to push the voice recorder button. It was noted through anecdotal reports from the research assistants that once gestural prompts in the form of a point toward the button were put in place, these behaviors quickly

During the Baseline 3 condition, the level and trend of both data paths remained consistent with those seen in the previous condition. Again, with the exception session 67, Jillian only used one scripted mand frame during each session. These patterns continued into the first two sessions of the Extinction 3 condition. However, during the third session of the Extinction 3 phase, there was an increase in both the total number of different mand frames and the number of different unscripted mand frames used. Jillian used a total of three different mand frames during session 73, two of which were unscripted. In the final three sessions of this phase, the data stabilized with Jillian using two different mand frames; one unscripted and one scripted.

When the Script Training 3 condition was implemented, Jillian's data showed some variability during the first five sessions during which she varied the number of different mand frames she used between one and two and the number of different unscripted frames varied between zero and one. During the remainder of the Script Training 3 condition, Jillian's manding responses remained consistent at one mand frame and zero unscripted frames. There was a slight increase in both the total number of different mand frames used and the number of different unscripted mand frames used during the subsequent phase, Baseline 4. During this phase, Jillian consistently used a total of two different mand frames and one unscripted mand frame.

While increases in both the total number of different mand frames and the number of different unscripted mand frames used was observed in the Extinction 4 phase, a significant amount of variability was observed as well. During this phase Jillian used as many as five different mand frames, however during one session she did not use any complete mand frames. The same pattern was seen in the number of different unscripted mand frames used, with Jillian using as many as four different mand frames as a few as zero. Although Jillian showed variability

in her responding, this pattern was fairly consistent and she continued to use as many as four different mand frames during the final sessions of this condition. During the generalization probe in the natural environment, Jillian during seven different mand frames, five of which were unscripted. This level of responding was greater than the levels seen in any other session throughout this study. These levels only decreased slightly to six total different mand frames during the first follow up session, but this level of responding did not maintained. The total number of different mand frames decreased further to only three different mand frames during the second follow up session. During both follow up sessions Jillian used unscripted mand frames only.

#### *Drew*

The middle panel of Figure 2 shows the number of different mand frames used by Drew. During baseline, Drew used between one and two different mand frames and maintained those levels during the initial extinction phase, with the exception of one session (session 8) during which Drew used three different mand frames. Similar to results demonstrated by Jillian, Drew primarily used the target script when the script was present during the Script Training 1 condition. Drew used one mand frame, which was the target script, for the majority of this phase. The total number of different mand frames increase to three during session 35 and stabilized at a total of two different mand frames in the final two sessions of this phase; using one scripted and one unscripted mand frame.

Drew began the Baseline 2 condition by using three different mand frames, two of which were unscripted. This level of responding did not maintain and the data for both scripted and unscripted decreased to only one. However, during the final two sessions, the level of both data paths increased to two. When the Extinction 2 condition was implemented, the total number of different mand frames used increased dramatically to five, all of which were unscripted. This

level maintained for three sessions although a slight decrease was observed during the final two sessions. During the Extinction 2 phase, Drew used unscripted mand frames only.

When the Script Training 2 condition was introduced, Drew produced results similar to those seen in the Script Training 1 condition. He showed slight variability using one to two total different mand frames and used between zero and one different unscripted mand frames. This pattern remained consistent across the condition. In the following condition, Baseline 3, Drew consistently used only one mand frame which was unscripted each session. A slight increase was seen in the level of different mand frames during the Extinction 3 condition with Drew using two different mand frames each session; all of which were unscripted.

The data in the Script Training 3 condition was more variable than previous condition. This variability was especially seen in the number of different unscripted responses. Drew used between two and three different mand frames throughout this session, but the number of different unscripted mand frames varied between zero and two. In the Baseline 4 condition following Script Training 3, Drew's responding decreased, but stabilized. Drew used only one mand frame, again, all of which were unscripted. Once the Extinction 4 condition was implemented, there was a large increase to a total of five different mand frames used. There was a slight decreasing trend observed in the first three sessions of this condition, with the data stabilizing at a level of 3 different mand frames.

Although the data for Drew showed that there was an overall increase in the number of different mand frames emitted from baseline to the final extinction phase, a more detailed analysis of the data showed that the differences, or variability, across the mand frames used in the final extinction phase were minimal and consisted only of minor variations on the frames (details of this analysis, presented in Figure 3, are discussed below). Thus, the multiple script presentation condition was implemented for Drew. When all three scripts were present during this phase, the number of different mand frames emitted maintained at a similar level to that seen in the final

extinction phase; with Drew using approximately three to four different mand frames. However, there was more variability seen in the number of different unscripted mand frames. During this phase, Drew used between zero and two different unscripted frames. Furthermore, as discussed in more detail below, the difference between the mand frames emitted was greater, thus more variability was demonstrated. However, once the stickers (the final fading phase of the multiple script presentation condition) were removed and a reversal to baseline was implemented, these results did not maintain and Drew immediately went back to using only one mand frame; the frame that he used had in his repertoire prior to the beginning of the study, "I want \_\_\_\_." Once the multiple script presentation condition was reimplemented, the variability increased to previous levels and the differences in the mand frames increased to as many as six different mand frames used. In the beginning of this phase, the level of the number of different unscripted responses also increased to between two and three, but decreased and stabilized at one. During the generalization probe to the natural setting and the follow up sessions, Drew maintained the same levels of responding using a total of three different mand frames and one unscripted frame.

### *Travis*

Travis's data are displayed on the bottom panel of Figure 2. During baseline, Travis primarily used one mand frame across all sessions (with the exception of session three). Similar to other participants, there was a slight increase in the number of different mand frames used during the extinction condition prior to any teaching, however, these increases were minimal with Travis using between two and three different mand frames. Travis's data showed variability both in the total number of different mand frames used and the number of different unscripted frames used. After a slight decreasing trend, the total number of different mand frames used consistently ranged from one to three. Similarly, the number of different unscripted mand frames consistently varied between zero and two.

When the Baseline 2 condition was implemented the total number of different mand frames used was two, all of which were unscripted. However, there was a slight decrease in the level during the final sessions of this condition and Travis's data stabilized at one different mand frame. Once the Extinction 2 phase was introduced, there was a steep increasing trend observed in both the total number of different mand frames and the number of unscripted mand frames used during the first three sessions of this condition. During session 40 Travis emitted a total of five different mand frames. However, during session 41, a decreasing trend began and continued until the data stabilized at one mand frame.

When the third script was introduced during Script Training 3, Travis consistently emitted one to two different mand frames and between zero and one different unscripted mand frames. When the Baseline 4 phase was implemented there was an increase in the level of both the number of different mand frames used and different unscripted frames; however the data were variable across the sessions in this condition. During the Baseline 4 phase, Travis used between zero (one session) and three different mand frames and varied between using zero and two different unscripted mand frames. An increase in the level of different mand frames used was observed during the Extinction 4 condition. Travis began this session by using four different mand frames (between two and three unscripted frames). The data then decreased and stabilized at a level of two different mand frames used and one unscripted frame used. During the Script Training 3 condition, the number of different mand frames used was stable with Travis using between two and three different frames. Furthermore, the number of different unscripted frames used was stable at one, with the exception of one session (session 79). When the Baseline 4 condition was implemented, Travis consistently used three different mand frames, two of which were unscripted. The data were not as consistent once the Extinction 4 condition began. There was an increasing trend during the first three sessions of this phase, increasing to four different mand frames (three unscripted). Following this increase, began a decreasing trend to the use of

only one mand frame. However, at session 91, the number of different mand frames Travis used increased dramatically to seven, six of which were unscripted. This level of different mand frames maintained at higher rates through the end of the condition, although during the generalization probe to the natural setting, Travis's use of different mand frames decreased to two. During the two follow up sessions, however, the level of responding increased to that seen in the final sessions of the Extinction 4 condition with Travis using eight and six different mand frames during session 95 and 96, respectively.

As stated previously, after examining the transcripts of the data shown in Figure 2, we decided to reanalyze the same data differently. When examining the number of different mand frames used by each participant, the data showed, for example, the participant used up to five different mand frames within one session. Although five different mand frames were used, those mand frames were only minor variations from one core mand frame. For example, when using the original definition to determine the number of different mand frames used, adding the word "please" or the instructor's name was considered in a different mand frame. Therefore, five different mand frames may be variations of the one core frame (i.e., "I want \_\_\_\_"), but including the instructor's name or please (i.e., "I want \_\_\_\_please" or "I want \_\_\_\_, (instructor's name)"). As this seemed to be artificially inflating the data, particularly for Drew, we decided to tighten our requirements for a mand frame to be different than those used previously. With this analysis, in addition to the previous requirements, a mand frame had to differ by more than the addition of the instructor's name, the word "please", or rearranging the words in a frame. These requirements were added because all participants demonstrated these verbal skills (i.e. using "please" when requesting and using instructors' names) prior to the study.

Results of the number of different mand frames using the new definitions for all participants are displayed in Figure 3. Similar to the previous graphs, the total number of different

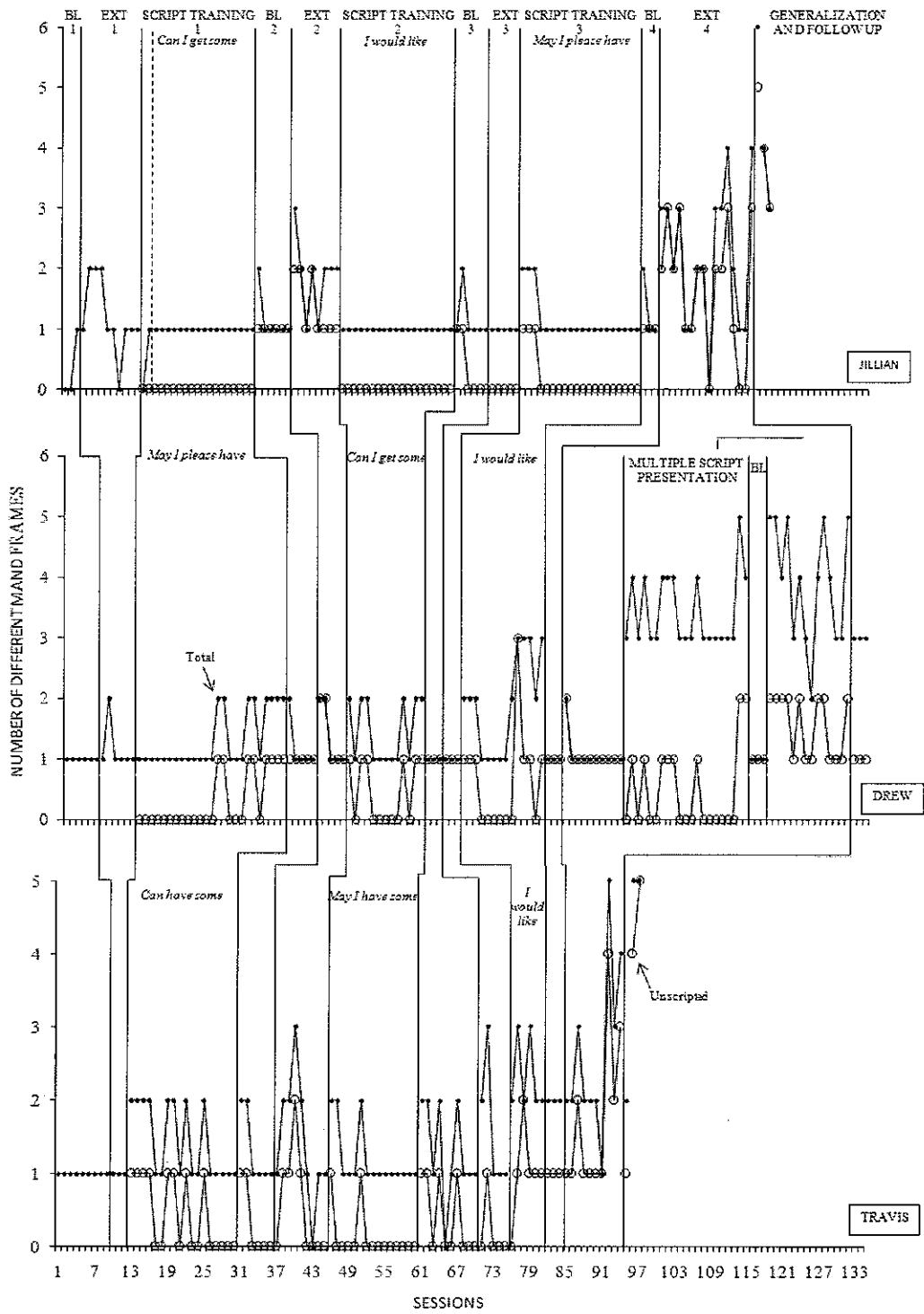


Figure 3. The results for the total number of different mand frames used (closed circles) and the number of different unscripted frames (open circles) for Jillian (top panel), Drew (middle panel), and Travis (bottom panel).

mand frames is represented by the closed triangles, scripted mand frames are represented by the open circles, and unscripted mand frames are represented by the open squares. As seen in the top panel, with the new requirements, Jillian used only one mand frame during all script training conditions. Slight increases in the number of different mand frames used were observed using the stricter definition of different mand frames. In the reversals to baseline and extinction phases, however these data were variable within and across sessions. It was not until the reversal to baseline following the third script training condition that we saw an increase in the number of different mand frames used (i.e., Jillian used up to three different mand frames during the final reversal to baseline and up to four different mand frames used in one session during the final extinction phase). Thus, there were changes in Jillian's data from the original definitions to the requirement; however, there was still a significant increase in the number of mand frames used.

The middle panel of Figure 3 represents the number of different mand frames used by Drew with the new definition. Drew's data is where the largest difference between the data from Figure 2 to Figure 3 is seen. Analyzing Drew's data with the tighter definition shows that he did not use more than two different mand frames in any conditions until the end of the third script training condition in which he began to use up to three different mand frames. However, that level of responding did not maintain in the baseline and extinction phases following. However, as seen in the graph, the number of different mand frames increased to as many as five once the alternative intervention was in place and maintained once the script was faded to the stickers only. However, as seen in the final reversal phase, these levels did not maintain once the stickers were removed, but we were able to replicate the findings once the alternative intervention was put in place again.

Travis's data are shown in the bottom panel of Figure 3. Similar to Drew, Travis used approximately 1-2 different mand frames throughout the majority of the study when analyzing the data with the new definitions. It was not until the third script training phase that Travis began



using between two and three different mand frames consistently. Furthermore, another increase was seen in the number of different mand frames in the final sessions of the final extinction phase in which, even with the tighter definitions, Travis still used up to five different mand frames. During the generalization probe, Travis still met criteria for two different mand frames.

#### Novel Mand Frames

Figure 4 shows the cumulative number of novel mand frames emitted across all conditions for each participant. Each time a mand frame that was not seen in any previous settings was emitted, a novel frame was recorded. Thus, when there is an increase in the data, a new frame was used that session. If the data path remains steady with no increase, it can be interpreted that there were no new frames emitted during that session. For the purpose of this analysis, we used the strict definitions; meaning a mand frame had to differ by more than the addition of the instructor's name, the word "please" or rearranging the word of the frame to be scored as a novel frame.

As seen in the top panel, Jillian began this study with using only one mand frame. Throughout the experimental sessions, Jillian emitted nine new mand frames. In addition, she used three novel frames during the generalization probe in the natural setting (see Appendix E). Novel mand frames for Drew are shown in the middle panel of Figure 4. Similar to Jillian, Drew began this study with using only one mand frame. However, throughout the study, he emitted ten novel mand frames, one of which was emitted during the generalization to the natural snack setting (see Appendix F). The cumulative number of novel mand frames emitted by Travis is shown in the bottom panel of Figure 4. Travis began with using only one frame and by the end of the study emitted 13 novel mand frames (see Appendix G).

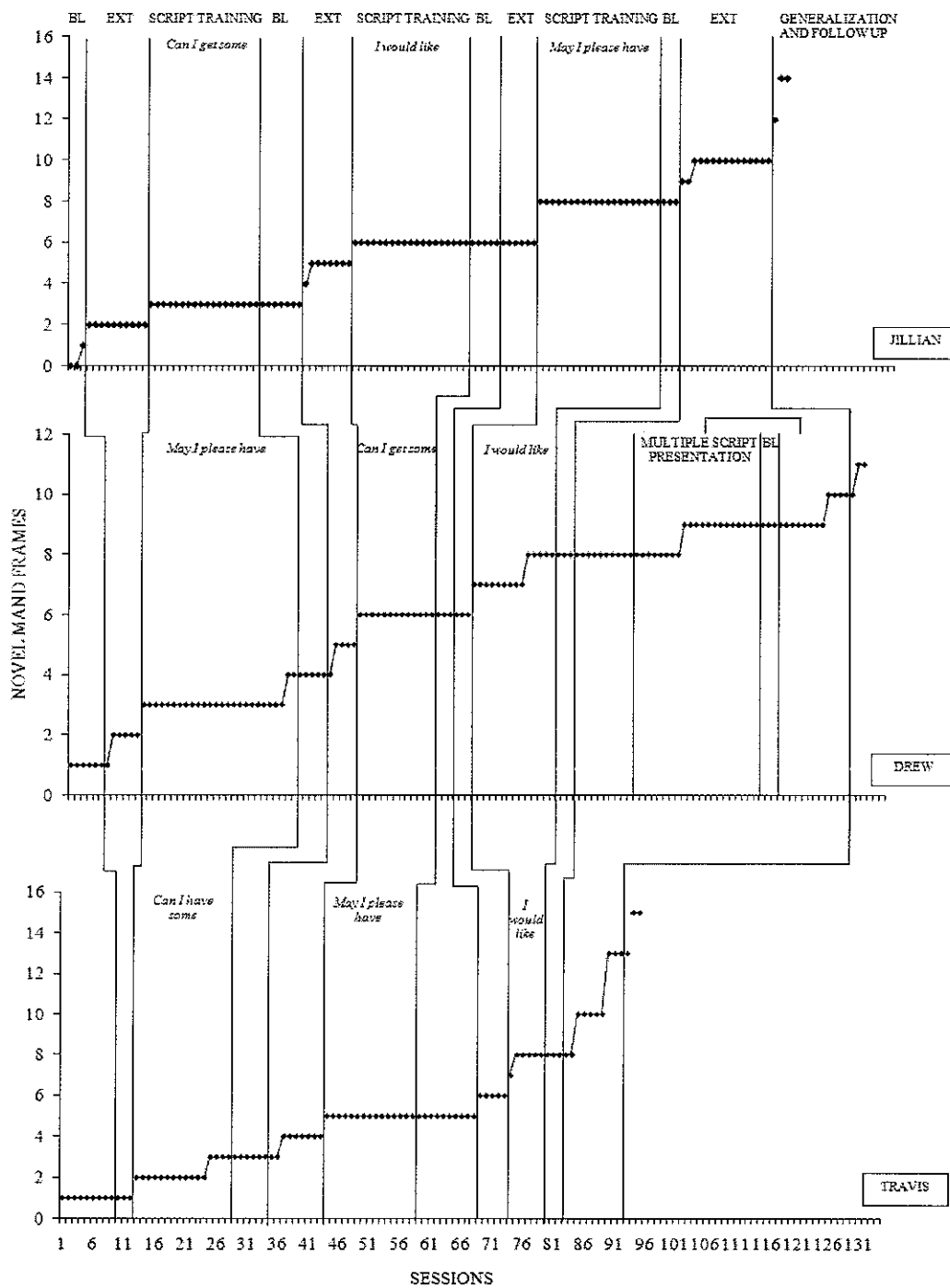


Figure 4. Results of the number of new or novel mand frames emitted across all sessions and conditions for Jillian (top panel), Drew (middle panel), and Travis (bottom panel).

## CHAPTER V

## DISCUSSION

The purpose of this study was to examine the effects of extinction and scripts and script-fading procedures on the response variability of mand frames used by young children with autism. As discussed previously, this study was designed to investigate (a) whether extinction alone increased the response variability of verbal behavior, specifically mand frames, prior to any teaching when participants showed a limited verbal repertoire; (b) whether teaching multiple mand frames via scripts and script-fading procedures to young children with autism was sufficient in increasing the response variability of mand frames used by young children with autism; (c) whether extinction in combination with teaching via scripts was more effective than extinction alone in increasing the response variability of mand frames; and (d) to what extent participants produced new or novel mand frames across all conditions. Response variability was originally measured by scoring the number of different mand frames used by the participants during each session using a definition similar to those used in previous script literature (Krantz & McClannahan, 1993, 1998). However, to analyze the extent to which these responses were different, we reanalyzed the data with a stricter definition to determine if there was a change in the amount of variability across mand frames.

The results of this study showed that there were increases in the number of different mand frames when extinction prior to training was implemented. However, the differences in the mand frames used during this phase were minor changes to a single core frame, and for all participants this core frame used was the one demonstrated in baseline. More notable changes in the number of different mand frames were seen, however, when extinction was implemented after participants were taught additional mand frames via scripts and script-fading procedures for two of the three participants. As seen in Figure 2, there was a sharp increase in the number of different mand frames used by Jillian (top panel) in the first session of the first extinction phase. However,

the data showed a decrease in the variability of mand frames stabilizing at levels similar to baseline. Travis's data also showed a slight increase in the number of different mand frames used once extinction was implemented, although still remaining at lower levels. Furthermore, once the data was reanalyzed using the stricter definitions, Travis's responding remained at exactly the same level as baseline when extinction was introduced. This demonstrated that Travis was not using completely different mand frames, but rather using small variations of the frames used in baseline (i.e., adding "please" to the frame "I want \_\_\_\_"). These results are different from what previous researchers have reported on the effects of extinction plus reinforcement on variability in children with autism (Grow et al., 2008; Lalli et al., 1994), although it should be noted that Grow et al. only reinforced one alternative response. Little research has examined the effects of extinction on verbal behavior. In the case of Grow et al., the authors used extinction procedures to increase variability during functional communication training, but the alternate responses being reinforced for each participant, were ones that were already present in the participants' repertoires. The results from the current investigation support the conclusion that extinction alone may not be sufficient in increasing the response variability of mand frames used by participants that demonstrate a limited verbal repertoire (i.e., they do not have multiple mand frames in their manding repertoire).

Although the data showed that implementing extinction procedures prior to any teaching increased response variability of mand frames used by using minor changes to one core frame, These differences are still promising. Including additions such as a person's name or the word *please*, are variations that may be seen in typical situations when a mand is not reinforced. For example, one may request to borrow a pencil from a friend by asking, "Can I use a pencil?" If the listener does not respond, the speaker may then attempt to get the listener's attention by using his or her name, "John, can I use a pencil?" which then may result in the reinforcing consequence (in

this case access to a pencil). Thus, these minor changes to a core frame are typical and therefore important to note as a variation.

Minor changes in a single core mand frame were observed for each participant during the extinction phase prior to teaching; however, promising conclusions can also be drawn from the implementation of scripts and script-fading procedures. Scripts and script-fading procedures proved to be an effective way of teaching new mand frames to all three participants. During each script training condition, we were able to completely fade each individual script for all participants. In addition, two of the three participants (Jillian and Travis) continued to emit previously taught mand frames once those scripts were completely faded throughout the remaining phases of the study (i.e., baseline and extinction phases following script training and future script-training phases). Furthermore, both Jillian and Travis continued to demonstrate high levels of variability of mand frames used once all three scripts were taught and completely faded. Once multiple scripts were taught, a greater degree of variability was observed. Both Jillian and Travis began to recombine parts of the script taught to create new core mand frames. For example, Jillian was taught the scripts, "May I please have" and "Can I get some." She then began to use the mand frame, "Can I have \_\_ please." These changes were greater than those seen in the extinction phase prior to teaching in which all participants continued to use the same core mand frame while making minor changes.

Drew's results were differed from the other participants, however. During script training conditions when one script was presented and systematically faded, we were able to fade scripts quickly for Drew. Once each script was completely faded and subsequent baseline and extinction conditions were introduced, Drew did not maintain the use of the taught scripts. During these phases, Drew primarily used the script that was in his repertoire prior to the start of the study ("I want \_\_"). The results for Drew are similar to previous script literature in that often responding did not maintain if the scripts were not present. For example, Krantz and McClannahan (1993)

were not able to completely fade the textual scripts used to teach participants to initiate social interactions. A single quotation mark or a single quotation mark plus the first letter of the script were needed to maintain interactions and to generalize responding across new conversation partners and settings. In this study the colored stickers were similar to the quotation mark in Krantz and McClannahan in that it seemed to be the controlling stimulus that prompted the participant to engage in the verbal response (in this case a variety of verbal responses).

Although the data showed that participants were able to learn new mand frames via scripts and script-fading procedures, there were interesting patterns of responding with regard to the number of different mand frames participants used during script training phases. During the three script training phases, all participants primarily used the mand frame that was being taught via an auditory script during that phase. Accordingly, they used few different mand frames in each session. Jillian's data on the top panel of Figure 2 illustrates this pattern. During all three script training phases, Jillian used only one mand frame (the target frame) with exceptions in only eight sessions combined. Although, Drew and Travis showed more variability in mand frames used than Jillian during the script training phases, neither used more than three different mand frames. Furthermore, as shown in their data in Figure 3 (strict definitions) both primarily used one to two different mand frames in each script training phase.

There are several possible explanations for why all participants showed less variability during script training conditions than during baseline and extinction phases. First, in their review of response variability research, Lee et al. (2007) reported that after implementing extinction procedures to increase response variability, continuous schedules of reinforcement tends to produce fewer responses. In the current investigation, a continuous schedule of reinforcement was in place during all script-training phases and all script training conditions immediately followed extinction phases. This phenomena may have contributed to the fewer responses used during the script training sessions that followed extinction for all participants.

Second, the scripts may have had too tight of control over the mand frames the participants used during training phases. As seen in the data for all participants in Figures 2 and 3, the mand frames observed by all participants tended to be scripted mand frames, meaning participants emitted the mand frames exactly as they were presented on the scripts. Rarely did any of the participants use modifications or elaborations of the script until the script was completely faded or until all the words were removed from the script (i.e. only the button or sticker was present). Therefore, the presence of the script may have actually inhibited the variability of mand frames used by each participant. Also, all three participants demonstrated a greater number of different mand frames used per session in the conditions in which no scripts were present; this supports the argument that the scripts themselves were controlling the participants' behavior such that they did not vary or alter their responses until after the scripts were faded.

Drew's data in the middle panel of both Figure 2 and 3 also support the notion that the scripts had tight control over participants' mand frames used, we can more closely examine. As stated previously, during script training phases Drew primarily used scripted responses. However, during the majority of the sessions in the baseline and extinction phases following script training, he primarily used variations of the unscripted mand frame that he had used during the first baseline condition. In other words, unless a script was present, Drew not only ceased to vary his mand frames, he rarely used any of the mand frames he learned via scripts. This may suggest that scripts can be used to teach different responses, but other interventions such as extinction may be needed to see response variability across those taught responses.

The lack of transfer of stimulus control from the script to the natural environment may have been associated with several procedures. First, the placement of the scripts may contribute the transfer of control. In a study conducted by Brown et al. (2008) textual scripts were placed directly on the item in which the scripts pertained to. For example, if the script read, "Coconut is chewy," the script was placed directly on a candy bar that contained coconut. Results of this

study demonstrated that scripts were completely faded and scripted and unscripted statements not only maintained for the item the script was directly paired with, but generalized to items for which scripts were never directly taught. In the current study, the scripts were placed on the participants' placemat during the snack sessions. However, it might have been more efficacious to place the scripts on a more concrete item such as the snack bins. Placing the script on the preferred item itself may have strengthened the pairing between the script and the natural environment. It should be noted, however, that the scripts used in Brown et al. were specifically paired with a particular stimulus (i.e., candy bar) during training and in the current investigation the scripts were not paired with a specific snack, but rather a stimulus (the placemat) that was consistently present throughout the study. Brown et al. may have obtained better stimulus control due to this pairing.

Second, the inability to completely fade the script for all participants may have been a product of our fading criteria. It is common to attempt to fade scripts as quickly as possible to prevent prompt dependence. However, having such as loose script-fading criteria in this study may have contributed to the lack of transfer of control from the script to items in the natural setting. It may be possible that the scripts were not paired with the items in the natural setting (i.e., the placement) for a long enough period of time. The quicker scripts are faded, the less time participants had to pair the controlling stimulus (scripts) with the neutral environmental stimulus (placement). Future researchers should examine the effects that differing fading criteria have on the maintenance and generalization of scripted and unscripted responses as well as the ability to completely fade the scripts.

A third possible factor that may have influenced the ability to fade the script completely is that we never reintroduced a previous script level if the participant was demonstrating problems with learning the script. Results may have been different if, for example, we reintroduced a previous fading level if a participant was not accurately following the script in place. We made a



strategic decision not to return to a previous fading level, however, because we wanted to allow for alterations or elaborations for the target script. If we had required the participant to state the script exactly, we might have restricted the amount of variability demonstrated.

While examining the results after script training began, it is important to note the differences seen in the data between Figure 1 and Figures 2 and 3. Figure 1 is a graph that shows the total number of scripted and unscripted mand frames used per session. This data analysis is similar to how previous authors have reported results of using scripts to teach social interactions. It shows the total number of scripted and unscripted responses made by each participant; however, it does not display the number of different mand frames used. In other words, it does not allow one to examine the variability across the mand frames. In contrast, Figure 2 shows the number of different frames used. For example, during session 40 in the second baseline phase Drew used a total of 44 mand frames (as seen in Figure 1). However, the same session in Figure 2 showed Drew used one mand frame, meaning he used the same mand frame 44 times to request snack items. Similar patterns are seen across Jillian and Travis's data as well, however not to the extent. This is important distinction to be made when determining if the use of scripts is effective in increasing response variability of verbal behavior. Perhaps teaching verbal behavior via scripts in the same manner as this study may actually produce more rote responding.

Another notable finding to note with regard to the effects of script-training on the response variability of mand frames used by each participant is that the number of mand frames taught appeared to have a slight impact on the number of different mand frames that Jillian and Drew used, and had a greater impact on the number of different frames Travis used. The number of different mand frames used by Travis increased during the second, third, and fourth baseline conditions after additional mand frames were taught. As seen in the middle panel of Figure 2, Travis used between one and two different mand frames during the second baseline phase after one new mand frame was taught. Following the second script training phase, during the third

baseline condition, Travis used between two and three different mand frames per session. Finally, during the last baseline phase, after all three scripts were taught, Travis consistently uses three different mand frames. And while the increases were not as great, Jillian and Drew show modest increases as well. These results may suggest that, although modestly, teaching multiple mand frames alone may increase the number of different mand frames used.

We cannot determine from this study whether teaching the scripts in a successive order was necessary. In previous studies, researchers who taught more than one script did so simultaneously. For example, Krantz and McClannahan (1993) taught 10 different statements during art activities all at once and in 1998 published a study in which they taught participants two bids for joint attention scripts, “Look,” and “Watch me,” within an activity schedule simultaneously. Brown et al. (2008) also taught a variety of scripts at once. Although the authors of these studies reported that there were increases in unscripted statements as the scripts were faded, they did not report the number of different statements used per session. Therefore, it is hard to make conclusions about whether teaching multiple scripts at once promote response variability. Future researchers should examine and compare the effects of teaching scripts in successive fashion to teaching script simultaneously on response variability.

In addition to participants showing slight increases in the number of different mand frames used as more mand frames were taught, increases in the number of different mand frames were observed for all participant during extinction phases after additional mand frames were taught using script-fading procedures. As seen in Figure 1, all participants showed an increase in the levels of different mand frames used during the Extinction 2, 3, and 4 phases. Both Jillian and Travis showed a large difference in the number of different mand frames used during the final sessions of the Extinction 4 phase. Jillian (top panel) increased the response variability of mand frames from using two different mand frames in the previous baseline condition to using as many as five different mand frames in the final extinction condition, but also showed variability in the

number of mand frames used throughout this phase. Travis (bottom panel) began the final extinction phase by using between two and four different mand frames, however at session 91 (the eighth session of this phase) Travis emitted seven different mand frames and maintained responding near that level for the remainder of the phase. Furthermore, when examining the same data in Figure 3, both Jillian's and Travis's data showed increases in the number of different mand frames used even with the strict definition, although at slightly lower levels.

Similar to Jillian and Travis, Drew (middle panel of Figure 1) showed high levels of the number of different mand frames used during the final extinction phase as well; using as many as five different mand frames. However, unlike the other two participants, an analysis of Drew's data with the strict definition (Figure 3) indicated that the number of different mand frames used during the final extinction phase drastically decreased. As seen in the middle panel of Figure 3, when the new definitions were implemented, the levels of Drew's responding decreased. For example, during session 84 (the first session of the final extinction phase) of Figure 2, Drew used five different mand frames. However, while analyzing the same data with the strict definition showed Drew only used two different mand frames, as seen in Figure 3. What this decrease in the number of different mand frames used from Figure 2 to Figure 3 means is Drew was using only slight variations of a core mand frame. For example, the mand frames Drew used that session were: (a) I want \_\_\_\_, (b) I want \_\_\_\_ please, (c) I want \_\_\_\_ (instructor's name), (d) (instructor's name), I want \_\_\_\_\_, and (e) I really want \_\_\_\_ please. When comparing the results of Figure 2 and 3, this change in Drew's data is representative of the majority of Drew's sessions. The differences in the number of different mand frames used that was seen when comparing Drew's data from the original definition to the strict definition of what constitutes variability, is an important finding. These differences suggest that the definition of variability is important to consider when interpreting response variability data. These findings warrant further investigation in the future while researching response variability.

As state previously Drew did not show large increases in the level of the number of different mand frames used during the final extinction phase (middle panel of Figure 3). Furthermore, all of the variations of mand frames he showed thus far were minor and were not detected when using the strict definitions. Because of the low level of different mand frames used once all phases of the current investigation were complete, we implemented a multiple script presentation phase. During this phase all three scripts were present at once. These scripts were faded to the last fading step in which the three stickers were present. Figure 2 and 3 show Drew's results during this phase. We were able to completely fade all three scripts using less fading steps (i.e. going from full script to first word, to stickers only) while seeing greater increases in the level of the different mand frames used. Drew used as many as six different mand frames during this session under the original definition which remain high (five different mand frames) when using the strict definition (Figure 3). This demonstrates that not only did the multiple script presentation increase the number of different mand frames Drew used, but produced greater differences in those frames. To ensure that the scripts were the stimuli controlling the variability seen in Drew's responding, we implemented a baseline phase in which no scripts were present and mand frames were reinforced on a continuous schedule. We immediately saw a decrease in the number of different mand frames used during this session with Drew only using one mand frame across the entire condition. We then reimplemented the multiple script presentation with the stickers only and saw the level of different mand frames used increase to level seen in the previous multiple script presentation phase. The increases and decreases in Drew's data further support the hypothesis that the scripts were the stimulus controlling his response variability of mand frames.

Once each participant successfully learned all scripts and demonstrated an increased level of the number of different mand frames use a generalization probe to the natural setting and maintenance checks were conducted. Results for both the generalization and follow up probes

were mixed. As seen in Figure 2, during the generalization probe to the natural setting, the number of different mand frames used by Jillian increased to seven, which was higher than seen during any of the previous conditions. Jillian maintained the higher level of different mand frames used during the one week follow up, however showed a decrease in the number of frames used during the two week follow up; using only three different mand frames. In contrast, during the original generalization probe to the natural setting, Travis showed little variability in his mand frames using only two different frames. But unlike Jillian, during the follow up probes, Travis's level of different mand frames used increased to levels seen in the final extinction phase; using between six and eight different frames.

A generalization probe and follow up sessions were conducted with Drew after we saw stability in the level of responding during the final multiple script presentation phase. During the generalization probe and follow sessions with Drew, we continued to present the three stickers on his placement. As seen in the middle panel of Figure 2, Drew's responding remained consistent with those seen in the final sessions for the last multiple script presentation phase using three different mand frames during the generalization probe and both follow up sessions.

A final analysis we conducted from the data of the current investigation was examining the number of new or novel mand frames each participant emitted across all sessions and conditions. These data are shown in Figure 4 and displayed in a cumulative record. As seen in the Figure 4 all participants began with the study with using one script frame. As new mand frames were taught and scripts were faded, all participants showed a large increase in the number of new mand frames emitted. All participants emitted at least ten new mand frames throughout this study. Taking into account we only taught the participants three different frames, it is clear that each participant used frames that were modifications or elaborations of previously taught scripts or used completely novel scripts. For example, the first script Jillian learned was "Can I get some \_\_\_\_" and the third script she learned was, "May I please have." During the generalization probe,

Jillian began using the mand frame, "Can I have." These results support past literature on scripts and script fading procedures in that many unscripted responses were used. Furthermore, the current investigation is an extension from the previous literature in that combining script training and extinction produced a greater number of unscripted responses, thus increasing response variability of mand frames used by all participants.

### Limitations

This study has implications for future research in the area of obtaining and increasing response variability in verbal responding with children with autism that demonstrate limited verbal repertoires. However, these data are preliminary and should be taken with caution due to several limitations. First, only three children participated, all of whom has similar language skills according to the results of the standardize test scores. This limits the general conclusions that can be drawn from this study. Future research should replicate this study with other participants possibly of a different age range or with students with differing levels of language abilities to determine if the results of the present study can be generalized to other populations.

Second, we demonstrated experimental control primarily by using a single subject multiple baseline design across participants. To demonstrate experimental control with this type of research design all participants begin in baseline conditions. Once steady responding is achieved under these conditions, the independent variable is applied to one participant while baseline conditions remain in effect for the other participants. When steady responding is obtained for the first participant while the independent variable is in place, the intervention is then applied to the second participant and so on (Cooper, Heron, & Heward, 2007). In this study, these procedures were followed and experimental control was demonstrated from baseline conditions to the implementation of the first independent variable, extinction. However, due to the clinical risks of exposing participants to extinction procedures for an extended period of time, we chose to

move participants into script training conditions as soon as they demonstrated steady responding in extinction. Future researchers may consider replicating this study while strengthening the experimental design.

Third, during this study the presence of a script or multiple scripts may have had too tight of stimulus control over the participants over the mand frames participants used. In general, this may not be a problem since scripts are designed to prompt students engage in social interactions. However, when looking at the effects of scripts on response variability, tight stimulus control may become more of an issue. As seen in Figure 2 and Figure 3, all participants primarily used only one mand frame during script training conditions. Furthermore, the mand frame used tended to be the target script for that condition. Rarely did any of the participants use modifications or elaborations of the script until it was completely faded or on the last fading step. Therefore, the presence of the script may have actually inhibited the variability of mand frames used by each participant. Also, all three participants demonstrated a greater number of different mand frames used per session in the conditions in which no scripts were present which strengthens the argument that the scripts themselves were controlling the participants' behavior so much that they were not varying or altering the scripts as expected until after the scripts were faded. This may suggest that scripts can be used to teach different responses, but other interventions such as extinction may be needed to see response variability across those taught responses.

Fourth, it has been demonstrated by past researchers that response variability can come under discriminative control. Page and Neuringer (1985) demonstrated that the variability of pigeons' key pecks could be controlled by environmental factors. The researchers did this by reinforcing response variability of key pecks in the presence of a green light, extinguishing variability or reinforcing key pecks on a continuous schedule under the presence of a red light. Result showed that the pigeons began to only respond with variability when the green light was present. In the current study, the presence of a script may have been a discriminative stimulus to

respond without variability. And the absence of the script (baseline and extinction conditions) may have been the discriminative stimulus to vary responding thus explaining the increase in the number of different mand frames used in the conditions following script training throughout the study.

Similarly, the stickers presented in the multiple script presentation condition may have had the opposite effect of the scripts in previous conditions. During this phase, all three stickers were present, which may have been acting as a discriminative stimulus for emitting all three mand frame responses. Furthermore, when the scripts were absent, Drew did not vary his responding suggesting that the absence of scripts signaled a continuous reinforcement schedule in which responses did not need to vary. Future researchers should attempt to examine how to gain discriminative control of response variability in the applied setting by using natural stimuli. In addition, further research is needed in finding ways to decrease the tight stimulus control that scripts have over responding.

Finally, the mand frames that were chosen to teach via scripts and script-fading procedures may have affected the amount of variability that was observed. The mand frames taught via scripts may have been linguistically more complex than the mand frames the participants were using during baseline. All participants were using simple statements to mand for items during baseline (i.e., "I want \_\_\_"). However, the frames taught were more complex in the verb and subject order (i.e., "May I please have \_\_\_" and "can I have some \_\_\_"). All participants may have been able to imitate or echo these frames, but it may be possible that due to the lack of understanding the sentence structure, it may have been more difficult for the participants to recombine or elaborate on these mand frames. It is suggested that future researchers replicate this study using mand frames that more closely match the participants' language ability.



## Implications and Conclusions

The present study is an extension on the continually growing amount of basic research published on response variability. There are several implications that can be made from this study that may guide future research in this area. First, the results of the current study suggests that extinction alone may not increase response variability in verbal behaviors as it has been demonstrated to in motor responses (Goetz and Baer, 1973; Harding et al., 2004). Thus, while attempting to increase variability in verbal behavior, educators and clinicians should begin by teaching a variety of responses prior to implementing any intervention directed specifically at increasing response variability.

Second, although extinction was not shown to be effective prior to teaching any additional mand frames, in two participants, it did increase response variability of mand frames used once the participants were taught additional frames. This suggests to clinicians and educators that a consequence based intervention such as extinction may not be effective in increasing variability in verbal responses alone with students that have a limited verbal repertoire. Furthermore, although it was demonstrated that an antecedent intervention (i.e., scripts and script-fading procedures) can be effective in teaching multiple verbal responses, it may not be effective in increasing the variability of those responses. As seen in the data from the current investigation, the consequence based intervention was necessary in combination with an antecedent intervention to produce greater increases in variability. This may be due partially due to the response requirement for each condition. Reinforcement was contingent upon variable responding only in extinction conditions whereas a continuous schedule of reinforcement was implemented in all other phases. Therefore, the participants may have been sensitive to the reinforcement contingencies in each session. Interestingly enough, however, two participants did maintain higher levels of variability in mand frames once the extinction sessions were removed and it was variability in responding was no longer required. This may suggest that, although a consequence

based intervention may be needed to increase response variability initially, there is a potential that the schedule of reinforcement could be thinned.

Third, these results suggest that using scripts and script fading procedures may be an effective way of teaching verbal responses, and may potentially be an effective way in increasing response variability in combination with a procedure such as extinction. Although, as Jillian and Travis learned more mand frames through scripts, the number of different mand frames used was increased in subsequent baseline sessions. In addition, once Jillian and Travis were taught additional mand frames, they rarely emitted the frame currently in their repertoire. This is significant in that teaching alternate responses through scripts may be an effective way of decreasing the use of a highly repetitive verbal response in students with autism regardless of the amount of variability used. This offers teachers, parents, and clinicians a systematic intervention shown to increase verbal responses of all sorts that will potentially decrease the rote patterns that are often seen in children with autism.

Fourth, although for two participants, there were increases in the number of different mand frames used during extinction conditions after teaching, further research should be conducted on the effectiveness and social validity of using extinction procedures in an applied setting. It was noted through anecdotal reports from the researchers that Travis exhibited concerning behaviors during the extinction conditions. During several extinction sessions Travis engaged in screaming and, on a few occasions, dropped to the floor. Although these behaviors were not so severe as to put himself or the researcher in danger, they were behaviors that may interfere with his learning or the learning of other students. Therefore, extinction procedures may not be the most efficient or accepted mode of increasing response variability. This may be especially true with students who have a tendency to engage in high rates of inappropriate behaviors or have a history of extinction induced inappropriate behavior. Future researchers should compare the effects of other procedures that have been shown to be effective in increasing

response variability to those found in extinction. Furthermore, researchers may want to compare whether other procedures produce less inappropriate behavior when compared to extinction; possible procedures in which participants contact a denser schedule of reinforcement (i.e. Lag schedules).

Fifth, there may have been a carryover effect demonstrated on the number of different mand frames used from the extinction conditions to the following condition. As stated previously, implementing extinction procedures to increase response variability often causes the behavior to become less variable during conditions in which continuous schedules of reinforcement are in place (Lee et al., 2007). As seen in Figure 2, the majority of phase changes in which a participant moved from extinction conditions to script training conditions, there was a decrease in the number of different mand frames used. Therefore, there may be a sequence effect contributing to the outcomes of the data. Future researchers should examine the effects of extinction procedures after a return to a continuous schedule of reinforcement in the applied setting.

Finally, the data of the present study showed that extinction was sufficient in increasing response variability after teaching additional mand frames via scripts for two participants. However, extensive generalization and maintenance checks were not conducted. All participants showed promising results during the maintenance checks; however those sessions were conducted no more than two weeks after ending the final condition. From the results of the current study, it is unknown if the increases in the variability of mand frames used would maintain over extended periods of time. As seen in the top panel of Figure 2, the level of different mand frames used by Jillian decreased by half within just one week. However Travis's data (bottom panel) showed he was able to maintain high levels of different mand frames at both follow up probes. It is important that researchers begin to examine the generalization and maintenance effects of these procedures to determine if they would be efficient for teacher and clinicians to use in the applied setting. Therefore, future researchers should examine way to slowly fade out extinction procedures while

systematically increasing the schedule of reinforcement; possibly by using procedures such as a lag schedule. Also, researchers should investigate whether conducting extinction booster sessions may increase the probability of participants maintaining higher levels of response variability. A continuous schedule of reinforcement was used during the generalization probes and follow up sessions of this study. It may be interesting for future researchers to determine if interspersing an extinction session outside of the natural setting will maintain or even increase the higher levels of variability.

The purpose of this study was to determine if procedures used in the basic literature to increase response variability would have the same effect in a more applied setting upon verbal behavior of children with autism. In addition, we examined already established interventions that are commonly used in the applied setting on response to determine if these procedures were sufficient in increasing response variability alone. Although the results were mixed, the outcomes of this study contributed to this limited literature. We have demonstrated that it is necessary to teach multiple verbal responses before extinction is effective in increasing the variability in responding. We also demonstrated that using scripts and script-fading procedures alone were not sufficient to increase response variability of mand frames. However, when the two procedures were combined and used together, variability increased.

Results of the current study add to the growing literature on conditions under which response variability can be increased with children with autism or other developmental disabilities. More specifically, this study furthers the investigations on conditions and procedures used to increase response variability in verbal behavior. The questions posed in this study attempt to fill the gaps about what we know about increasing response variability in the experimental literature as well as the applied literature that examined variability in other populations with other behaviors. We also attempted to answer questions about the effects of script fading procedures on variability, and whether this commonly used procedure may, in fact, increase variability alone.

This study provides a foundation for future research in many ways. First, we must determine if procedures similar to the ones used in the current study are appropriate and effective in an even more applied setting and if teachers are able to conduct interventions similar to this in their classroom while attending to several students. Second, we must determine the sustainability of the increases in response variability when using these procedures. Finally, we must continue to examine similar types of procedures to increase response variability not only with mands, but other verbal operants, such as the tacts and intraverbals, as well. It is our hope that the results of this study will begin a much needed line of research to determine effective ways in increasing response variability.

## REFERENCES

- American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4<sup>th</sup> ed.). Washington, DC: Author.
- Brown, J. L., Krantz, P. J., McClannahan, L. E., & Poulson, C. L. (2008). Using script fading to promote natural environment stimulus control of verbal interactions among youths with autism. *Research in Autism Spectrum Disorders, 2*, 480-497.
- Carcani-Rathwell, I., Rabe-Hasketh, S., & Satosh, P. (2006). Repetitive and stereotyped behaviors in pervasive developmental disorders. *Journal of Child Psychology and Psychiatry, 47*, 573-581.
- Carr, J. E., Nicolson, A. C., & Higbee, T. S. (2000). An evaluation of a brief multiple-stimulus preference assessment in a naturalistic context. *Journal of Applied Behavior Analysis, 33*, 353-357.
- Charlop-Christy, M. H., & Kelso, S. E. (2003). Teaching children with autism conversational speech using a cue card/written script program. *Education and Treatment of Children, 26*, 108-127.
- Cooper, J. O., Heron, T. E., & Heward, W. L. (2007). *Multiple baselines and changing criterion designs in Applied Behavior Analysis* (2<sup>nd</sup> ed). Upper Saddle River, NJ: Pearson.
- Duker, P. C., & Van Lent, C. (1991). Inducing variability in communicative gestures used by severely retarded individuals. *Journal of Applied Behavior Analysis, 24*, 379-386.
- Frith, U. (1972). Cognitive mechanisms in autism: Experiments with color and tone production. *Journal of Autism and Childhood Schizophrenia, 2*, 160-173.
- Goetz, E. M., & Baer, D. M. (1973). Social control of form diversity and the emergence of new forms in children's block building. *Journal of Applied Behavior Analysis, 6*, 209-217.
- Grow, L. L., Kelley, M. E., Roane, H. S., & Shillingsburg, M. A. (2008). Utility of extinction-induced response variability for the selection of mands. *Journal of Applied Behavior Analysis, 41*, 15-24.

- Harding, J. W., Wacker, D. P., Berg, W. K., Rick, G., & Lee, J. F. (2004). Promoting response variability and stimulus generalization in martial arts training. *Journal of Applied Behavior Analysis, 37*, 185-195.
- Individuals with Disabilities Education Improvement Act, 20 U.S.C. § 1400-1487 (2004).
- Krantz, P. J., & McClannahan, L. E. (1993). Teaching children with autism to initiate to peers. *Journal of Applied Behavior Analysis, 26*, 121-132
- Krantz, P. J., & McClannahan, L. E. (1998). Social interaction skills for children with autism: A script-fading procedure for beginning readers. *Journal of Applied Behavior Analysis, 31*, 191-202.
- Lalli, J. S., Zanolli, K., & Wohn, T. (1994). Using extinction to promote response variability in toy play. *Journal of Applied Behavior Analysis, 27*, 735-736,
- Lee, R., McComas, J., & Jawor, J. (2002). The effects of differential and lag reinforcement schedules on varied verbal responding by individuals with autism. *Journal of Applied Behavior Analysis, 35*, 391-402.
- Lee, R. L., Sturmey, P., & Fields, L. (2007). Schedule-induced and operant mechanisms that influence variability: A review and implications for future investigations. *The Psychological Record, 57*, 429-455.
- Lerman, D. C., Iwata, B. A., & Wallace, M. D. (1999). Side effects of extinction: Prevalence of bursting and aggression during the treatment of self-injurious behavior. *Journal of Applied Behavior Analysis, 32*, 1-8.
- MacDuff, J. L., Ledo, R., McClannahan, L. E., & Krantz, P. J. (2007). Using scripts and script-fading procedures to promote bids for joint attention by young children with autism. *Research in Autism Spectrum Disorders, 14*, 281-290.
- Machado, A. (1989). Operant conditioning of behavioral variability using a percentile reinforcement schedule. *Journal of the Experimental Analysis of Behavior, 52*, 155-166.
- McClannahan, L. E., & Krantz, P. J. (2005). *Teaching Conversation to Children with Autism: Scripts and Script Fading*. Bethesda, MD: Woodbine House.
- Miller, N., & Neuringer, A. (2000). Reinforcing variability in adolescents with autism. *Journal of Applied Behavior Analysis, 33*, 151-165.

- Page, S., & Neuringer, A. (1985). Variability is an operant. *Journal of Experimental Psychology, 11*, 429-452.
- Pryor, K. W., Haag, R., & O'Reilly, J. (1969). The creative porpoise: Training for novel behavior. *Journal of the Experimental Analysis of Behavior, 12*, 653-661.
- Richler, J., Bishop, S. L., Kleinke, J. R., & Lord, C. (2007). Restricted and repetitive behaviors in young children with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 37*, 73-85.
- Sarakoff, R. A., Taylor, B. A., & Poulson, C. L. (2001). Teaching children with autism to engage in conversational exchanges: Script fading with embedded textual stimuli. *Journal of Applied Behavior Analysis, 34*, 81-84.
- Schwartz, B. (1980). Development of complex, stereotyped behavior in pigeons. *Journal of Experimental Analysis of Behavior, 33*, 153-166.
- Schwartz, B. (1982). Failure to produce response variability with reinforcement. *Journal of Experimental Analysis of Behavior, 37*, 171-181.
- Skinner, B. F. (1957). *Verbal behavior*. New York: Appleton-Century-Crofts.
- Stevenson, C. L., Krantz, P. J., & McClannahan, L. E. (2000). Social interaction skill for children with autism: A script-fading procedure for nonreaders. *Behavioral Interventions, 15*, 1-20.
- Ward, R. D., Kynaston, A. D., Bailey, E. M., & Odum, A. L. (2007). Discriminative control of variability: Effects of successive stimulus reversals. *Behavioral Processes, 78*, 17-24.



APPENDICES

Appendix A

Data Sheet for Baseline Conditions

### An Evaluation of Script-Fading and Extinction Procedures on the Variability of Mand Forms Used by Children with Autism

#### Baseline Phase

- Watch the recorded session and write down verbatim each mand form used by a participant

#### MAND STATEMENTS

Mand:

**TOTAL:**

<b>REINFORCED:</b>	
<b>NUMBER OF DIFFERENT MAND FRAMES USED:</b>	

Appendix B

Data Sheet for Extinction Prior to Script Training Conditions



Appendix C

Data Sheet for Script Training Conditions

**An Evaluation of Script-Fading and Extinction Procedures on the Variability of Mand Forms Used by Children with Autism**  
**Script Fading Phase**

- Watch the recorded session and write down verbatim each mand form used by a participant
- Determine if each mand form is
  - Manually prompted, verbal prompted or independent(did you have to prompt him to follow the script?)
  - Scripted Mand:
  - Unscripted Mand
- Code each statement by checking the “S” for scripted Mands, “U” for unscripted mands, in the boxes next to the statement.

**MAND STATEMENTS**

<b>PROMPTS</b>	<b>S</b>	<b>U</b>	<b>Mand:</b>
I M V			
I M V			
I M V			
I M V			
I M V			
I M V			
I M V			
I M V			
I M V			
I M V			
I M V			
I M V			
I M V			
I M V			
I M V			
I M V			
I M V			
I M V			
I M V			
I M V			
I M V			

**TOTAL:**

<b>SCRIPTED:</b>	
<b>UNSCRIPTED:</b>	
<b>REINFORCED:</b>	
<b>NUMBER OF DIFFERENT MAND FRAMES USED:</b>	

Appendix D

Data Sheet for Extinction After Script Training Conditions





UNSCRIPTED	NOT REINFORCED	
SCRIPTED	REINFORCED	
UNSCRIPTED	NOT REINFORCED	
SCRIPTED	REINFORCED	
UNSCRIPTED	NOT REINFORCED	
SCRIPTS	REINFORCEMENT	Mand:
SCRIPTED	REINFORCED	
UNSCRIPTED	NOT REINFORCED	
SCRIPTED	REINFORCED	
UNSCRIPTED	NOT REINFORCED	
SCRIPTED	REINFORCED	
UNSCRIPTED	NOT REINFORCED	
SCRIPTED	REINFORCED	
UNSCRIPTED	NOT REINFORCED	
SCRIPTED	REINFORCED	
UNSCRIPTED	NOT REINFORCED	
SCRIPTED	REINFORCED	
UNSCRIPTED	NOT REINFORCED	
SCRIPTED	REINFORCED	
UNSCRIPTED	NOT REINFORCED	

**TOTAL:**

<b>SCRIPTED:</b>	
<b>UNSCRIPTED:</b>	
<b>REINFORCED:</b>	
<b>NUMBER OF DIFFERENT MAND FRAMES USED:</b>	

Appendix E

A List of the Mand Frames Used by Jillian

## Mand Frames Used by Jillian

---

<b>Mand Frame</b>	<b>Phase</b>
I need please	Baseline 1
I want	Extinction 1
I want __ please	
I need	
Can I get some	Script Training 1
Can I get some __ please	
Can I get another __ please	1
I want __ (researcher's name)	Baseline 2
I want to get	Extinction 2
Can I please have	
Can I please have __ (researcher's name	
I would like	Script Training 2
I would like __ please	
I would like __ (researcher's name_	Extinction 3
May I please have	Script Training 3
May I please have some	
May I please have __ (researcher's name)	
May I please have some __ (researcher's name)	
Can I have	Baseline 4
Get __ and put it right here	Extinction 4

---

Mand Frame	Phase
Get the the box of ____	Extinction 4
Get the box of ____ please (researcher's name)	
Take your hand and get the box of ____	
May I please have ____ again	
Can I have ____	
Can I have the ____ at the bottom	
May I have	
I want to have	
I want to have ____ too	Generalization Probe
I want to have another	
I want __ again	Follow up
Can I have ____ again please	

Appendix F

A List of Mand Frames Used by Drew

## Mand Frames Used by Drew

---

<b>Mand Frame</b>	<b>Phase</b>
I want ___ please	Baseline 1
I want	Extinction 1
Get me a	
May I please have	Script Training 1
I want a piece of ___	
I want ___ please (researcher's name)	Extinction 2
Please (researcher's name) I really want	
(researcher's name) I really want	
Can I have ___ (researcher's name)	
We want	
We want ___ please	
Can I get some	Script Training 2
I would like	Script Training 3
I would like ___ please	
Can I get ___ please	
(researcher's name) I want ___ please	Extinction 4
(researcher's name) can I have ___ please	
I want ___ (researcher's name)	
Please, (researcher's name), I want	
May I get some ___	Multiple Script Presentation

---

<b>Mand Frame</b>	<b>Phase</b>
May I get some __ please	Multiple Script Presentation
I would like some	
Can I have some	



Appendix G

A List of Mand Frames Used by Travis

## Mand Frames Used by Travis

Mand Frame	Phase
I want ___ please	Baseline 1
I want ___ (researcher's name)	
I want _____	Extinction 1
I want ___ please (researcher's name)	
Can I please have	Script Training 1
Can I please have ___ please	
Can I have	
Can I please have ___ (researcher's name)	Extinction 2
Give me	
Give me ___ (researcher's name)	
Give me ___ please (researcher's name)	
Can I have ___ please	
May I have some	Script Training 2
May I have some ___ please	
May I have some ___ (researcher's name)	Baseline 3
May I have some ___ please (researcher's name)	Extinction 3
Can I have some ___ please	
I would like	Script Training 3
I would like some	

Mand Frame	Phase
Give me some	Extinction 4
Give me some ___ please	
Can I have some ___ please	
I need ___ please	
I need ___ please	
I want some	
May I get some	Follow up
I want some ___ please	

Appendix H  
Informed Consent

**INFORMED CONSENT**  
**The Effects of Script-Fading Procedures and Extinction Procedures**  
**on the Variability of Mand Frames Used by**  
**Young Children with Autism**

**Introduction/ Purpose** Professor Thomas Higbee in the Department of Special Education and Rehabilitation at Utah State University is conducting a research study to find out more about increasing the variability of language used by young children with autism. You have been asked to allow your child to take part because he or she is currently a student at the ASSERT preschool, Logan Schools, or Park City Schools and meets the criteria to be involved in this study. There will be approximately 3-7 participants at these sites. There will be approximately 3-7 total participants in this research.

**Procedures** If you agree to allow your child to be in this research study, the following will happen to your child: Your child will be taken to a structured snack time. He or she will have the option of 3-5 preferred snack items. He or she will then be taught how to ask for those snack items in a number of ways (i.e. "I want \_\_\_\_", "Can I have \_\_\_\_ please", etc). Once your child learns a number of ways to request an item, he or she will then be reinforced by getting access to the item when he asks differently from the previous requests. Approximately 2-4 sessions will be conducted each day and it is estimated that the research sessions will continue for approximately 2-4 months and follow up sessions will be conducted 1 and 2 months after the last research session is completed.

**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 study involves minimal risk. There are no physical risks involved by participating. However, since this is an experimental treatment, there may be some unknown risks. The risks of this experimental treatment are minimal. To minimize the effects of unforeseeable risks, your child will be under supervision and in correspondence with the instructor and/or researcher.

**Benefits** There may or may not be any direct benefit to your child from these procedures. The investigator, however, may learn more about how to design and implement effective ways to teach children with autism how to vary their language. The information gained from this study may benefit students and other teachers and researchers in the future.

**Explanation & offer to answer questions** Dr. Thomas Higbee and/or Alison Betz has explained this research study to you and answered your questions. If you have other questions or research-related problems, you may reach Dr. Higbee at 797-1933

**Extra Cost(s)** No extra costs are required for participating in this study.

**Payment/Compensation** No monetary incentives or compensation will be offered for participation in this study.

**Voluntary nature of participation and right to withdraw without consequence** Participation in research is entirely voluntary, your child may refuse to participate or withdraw at any time without consequence or loss of benefits. Your child may be withdrawn from this study without his/her/parental consent by the investigator if your child moves from the district, is frequently absent, or chooses not to participate while in sessions.

**Confidentiality** Research records will be kept confidential, consistent with federal and state regulations. Only the investigator and Alison Betz will have access to the data and video tapes which will be kept in a locked file cabinet in a locked room. The data and any videotapes will be kept for a period not to exceed 3 years, and will then be destroyed (shredded or deleted). 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](mailto: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."

**Signature of PI & student or Co-PI**

\_\_\_\_\_

\_\_\_\_\_

Principal Investigator

Student Researcher *(or Co-PI)*

*(435-797-1933 )*

*(435-797-2381)*

**Signature of Parent** By signing below, I agree to allow my child to participate.

\_\_\_\_\_

\_\_\_\_\_

Parent or Guardian's signature

Date

## CURRICULUM VITAE

**Alison Betz, MA, BCBA**

273 West 200 North  
Logan, UT 84321

[alison.betz@aggiemail.usu.edu](mailto:alison.betz@aggiemail.usu.edu)  
734-233-4360

**Education**

- Fall 2005-present**                      **Ph.D. Candidate, Disabilities Discipline with a Specialization in Applied Behavior Analysis**  
Utah State University, Logan UT  
Expected Graduate Date: *May, 2009*  
Advisor: Thomas Higbee, Ph.D., BCBA
- Fall 2003-Spring 2005**                      **M.A., Applied Behavior Analysis with an Emphasis in Developmental Disabilities and Organizational Behavior Management**  
Western Michigan University, Kalamazoo, MI  
Master's Project: Using the Principles of Applied Behavior Analysis during Career Counseling with Undergraduate and Graduate Psychology Students  
Advisor: Richard Malott, Ph.D., BCBA
- Fall 1999-Spring 2003**                      **B.S., Psychology**  
Western Michigan University, Kalamazoo, MI

**Professional Certifications**

- 2005-present**  
Board Certified Behavior Analyst  
Certification number: 1-05-2135

**Teaching Experience**

- Utah State University**  
**2007, Fall**    **Instructor**  
Courses taught: Graduate Level Single Subject Research Design Methodologies, Journal Reading Group  
Doctoral Seminar: Relational Frame Theory (Designed course syllabus and co-led class wide discussion)
- Utah State University**  
**2006, Fall**    **Teaching Assistant**  
Teaching Assistant: Graduate Level Single Subject Research Design Methodologies  
Supervisor: Thomas Higbee, Ph.D., BCBA
- 2006, Spring**    **Teaching Assistant**  
Teaching Assistant: Introduction to Special Education  
Supervisor: Kimberly Snow, M.Ed



Western Michigan University – Kalamazoo, Michigan

2003, Fall – 2005, Spring                      Instructor

Course taught: Behavior Analysis Animal Laboratory Course, Concepts and Principles of Behavior Analysis

### Publications

Betz, A., Higbee, T., & Reagon, K. (2008). Using joint activity schedules to promote peer play with preschoolers with autism. *Journal of Applied Behavior Analysis, 41*, 237-241.

Fante, R., Gravina, N., Betz, A, & Austin, J. (in press). A structural and treatment analyses of safe and at-risk behaviors and postures performed by pharmacy employees. *Journal of Organizational Behavior Management*.

### Manuscripts Under Review

Penrod, B., Wallace, M.D., Reagon, K., Betz, A., & Higbee, T.S. A component analysis of a parent-conducted multi-component treatment for food selectivity. *Journal of Applied Behavior Analysis*.

Betz, A. Higbee, T., Slocum, T. An evaluation of evidence-based practice standards using activity schedules. *Exceptional Children*.

### Manuscripts in Preparation

Betz, A., Gravina, N., & Salzburg, C. (2008). The use of performance feedback on teachers' behavior in the classroom: A review of Literature from 1990-2008. (*manuscript in preparation*).

### Projects Underway

Betz, A. and Higbee, T. An evaluation of the generalization effects of mands for information with children with autism.

Betz, A. and Higbee, T. A comparison of the effects of scripts and script fading procedures, and extinction on the response variability of manding with children with autism.

Pollard, J., Betz, A., & Higbee, T. The effects of scripts and teacher responses on novel statements used by children with autism during bids for joint attention.

### Presentations

1. Betz, A., Higbee, T., Kelley, K., Sellers, T., & Pollard, J. (May, 2009). *The effects of extinction and script-fading procedures on the response variability of mand frames used by young children with autism*. Symposium conducted at the 35th annual convention of the Association for Behavior Analysis, Phoenix, AZ.
2. Betz, A., Pollard, J., & Higbee, T. S. (May 2009). *The generalization effects of mands for information used by preschool aged children with autism*. Symposium conducted at the 35th annual convention of the Association for Behavior Analysis, Phoenix, AZ.

3. **Betz, A.,** Higbee, T. & Slocum, T. (September, 2008). *An evaluation of evidence-based practice standards using activity schedules*. Poster presented at the annual Education Conference for the Association for Behavior Analysis.
4. **Betz, A.** (2008). *Let's Play! Teaching young students with disabilities to play*. Presentation/workshop conducted at the 6th annual Utah Conference on Effective Practices in Special Education and Rehabilitation.
5. **Betz, A,** Higbee, T., & Slocum, T. (2008). *An evaluation of evidence-based practice standards using activity schedules*. Symposium conducted at the 34th annual convention of the Association for Behavior Analysis, Chicago, IL.
6. **Betz, A.,** Higbee, T., & Reagon, K. (February, 2006). *Teaching preschoolers with autism to engage in peer play using joint activity schedules and script-fading procedures*. Symposium conducted at the 24<sup>th</sup> annual convention of the California Association for Behavior Analysis
7. **Betz, A.,** Higbee, T., & Reagon, K. (May, 2006). *Teaching preschoolers with autism to engage in peer play using joint activity schedules and script-fading procedures*. Symposium conducted at the 32nd annual convention of the Association for Behavior Analysis.
8. Fante, R., Gravina, A., & **Betz, A.** (2005). *Descriptive analysis of safe and at-risk behaviors and postures performed by pharmacy employees*. Poster presented at the Organizational Behavior Management Network Conference.
9. Malott, R., Takeshima, K, Helt, E., Weatherly, N, **Betz, A.,** & Rae, C. (2005). *BATS – An organically evolving, supportive, interactive learning environment*. Paper presented at the 19<sup>th</sup> annual convention of the Behavior Analysis Association of Michigan.
10. **Betz, A.,** & Malott, R. (2004). *Behavior change through self management - Running toward my goal: Using self management to increase daily running*. Symposium presented at the 30<sup>th</sup> annual convention of the Association for Behavior Analysis.
11. **Betz, A.,** Skundrich, J., Sigler, M., & Malott, R. (2004). *BACC: Using performance management to increase participation in an academic and career counseling system*. Poster presented at the annual 30<sup>th</sup> convention for the Association of Behavior Analysis

### Professional Experience

2008-present

Behavioral Consultant

Park City School District, Park City, UT

Duties: Train school psychologist, teachers, and paraprofessionals to implement Discrete trial training and other behavioral programs with students with autism, creating programs and curriculum for students, attending weekly staff meetings, conducting formal staff evaluations

**2007-2009****Behavior Analyst**

Chrysalis, Inc., Logan UT

Duties: Write and manage monthly progress reports for Chrysalis residents, create individual behavior plans for residents, conduct staff trainings

**2006-2008****Behavioral Consultant**

Washington District Public Preschool, St. George, UT

Duties: Oversaw ASSERT preschool replication site classroom, trained district teachers and paraprofessional, supervised teachers and staff, conducted formal staff evaluations, worked with district's autism specialist and behavior specialists to create curriculum and individual behavior plans, attended weekly staff meetings. Also assisted in creating and implementing an applied behavior analysis classroom level system for all special education preschool classrooms in the district

**2005-2008****Case Manager and Supervisor**

ASSERT Preschool, Logan, UT

Duties: Supervised instructors with working with children with autism, created curriculum and oversaw programming, documented and tracked students' progress, conducted parent and staff trainings, worked and trained in home with parents, created individual behavior plans for home and school, consulted with families outside of the ASSERT preschool on challenging behavior and academic deficits

**2001-2002, 2003-2005****Instructor**

Croyden Avenue School, Kalamazoo, MI

Duties: Implemented discrete trial training and other behavioral procedures with children with autism, analyzed and implemented changes in curriculum, implemented individual behavior plans, updated and analyzed student progress

**Editorial Experience****2009****Guest Reviewer***Journal of Applied Behavior Analysis***2008****Guest Reviewer***Journal of Applied Behavior Analysis***2007****Guest Reviewer***Journal of Applied Behavior Analysis, Fall, Vol 40***Grants**

Agency: U.S. Department of Education Office of Education Programs  
 Role: Assistant  
 Purpose: Obtain funding to train graduate students in culturally and linguistic diversity in special education  
 Duration: 4 years

Amount: \$794,674  
Status: Approved, but not funded

**Professional Memberships**

Association for Behavior Analysis (ABA)  
Association for Professional Behavior Analysts (APBA)  
California Association of Behavior Analysis (CAL-ABA)  
Organizational Behavior Management Network (OBM-Network)