

THE EFFECT OF TASK INTERSPERSAL ON LEARNING RATE FOR CHILDREN WITH
HIGH RATES OF ESCAPE-MAINTAINED BEHAVIOR

By

Addam Wawrzonek

A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

School Psychology – Doctor of Philosophy

2019

ABSTRACT

THE EFFECT OF TASK INTERSPERSAL ON LEARNING RATE FOR CHILDREN WITH HIGH RATES OF ESCAPE-MAINTAINED BEHAVIOR

By

Addam Wawrzonek

Task interspersal is a discrete trial training variant frequently employed for teaching skills to children with intellectual and developmental disabilities. This methodology involves interspersing trials of mastered targets with trials of acquisition targets during instruction. Early research on task interspersal has suggested that children required fewer trials to master skills when task interspersal was employed, relative to traditional discrete trial training where all targets were acquisition targets. More recent research, which measured learning as mastered targets per unit of time, has suggested that task interspersal may actually be a less efficient strategy due to the amount of additional time required to intersperse the mastered targets. Furthermore, other research has suggested that the increased ratio of reinforcement from mastered target responses may also decrease learning efficiency. On the other hand, research on a procedurally similar method known as the high-probability sequence has suggested that task interspersal may decrease escape-maintained behavior, which would in turn increase learning efficiency due to the increased time on task. However, there is a paucity of research examining the efficiency of task interspersal for children with high rates of escape-maintained behavior. Using an adapted alternating treatments, single-case design, the present study examined the effects of task interspersal and reinforcement ratios on learning efficiency for two children with high rates of escape maintained behavior and two children with low rates of escape maintained behavior. Results indicated that task interspersal did not result in more efficient learning for any of the children, but resulted in equal rates of learning relative to concurrent training for one

participant with high rates of escape behavior. This study adds to the literature which suggests that task interspersal presented on a high ratio of mastered to acquisition targets is less time efficient relative to concurrent training.

ACKNOWLEDGEMENTS

Thank you to all those who have worked so hard and tirelessly to support me in my growth and education. To all of the students in my program who have offered their time, guidance, or just an ear for social support; keep up all your hard work. The challenge is difficult, but if it was easy, everyone would do it. To the faculty and staff for their resilience in continuing to push me with just the right amount of pressure, and for their flexibility and understanding in the face of my less than perfect executive functioning skills. To my guidance committee; I had the opportunity to be supported by a committee who each had a hand not only in the development of my dissertation, but also in my growth as a clinician and student in every step of my graduate program. As I write this I am working in a field that until now was beyond my wildest dreams; thank you for helping make my dreams come true. To my family, who continued to support every decision I made, good or bad, knowing (or hoping) that each experience was another to learn from; your unconditional love and support is something that many children are not blessed to have. To Christian, whose incredible brilliance and character continues to push and inspire me every day.

And last but not least, to my wife Rebecca, who has been on this wild ride with me from the start. Instead of a honeymoon, a week after our wedding I was interviewing for this very program. Since then, you have picked me up every time I have fallen, wiped away every tear, and silently dealt with all the hardship that came our way without a single complaint. Even now, after I called you Rebecca in a work that will be available for public viewing, you still have yet to kill me; I will never understand why.

Reach Higher

TABLE OF CONTENTS

LIST OF TABLES	viii
LIST OF FIGURES	ix
Chapter 1: Introduction	1
Chapter 2: literature review	5
Introduction.....	5
Autism Spectrum Disorder	5
Diagnosis of autism spectrum disorder.....	6
Intervention for autism spectrum disorder.....	7
Applied Behavior Analysis	9
Core principles of ABA.....	10
The three term contingency.....	11
Motivating operations.....	11
Discrete trial training.....	12
<i>Discrete trial training variants.</i>	14
Common Barriers in ASD Intervention	16
The importance of efficiency and the problem of escape.....	17
Antecedent Interventions for Escape	18
Task interspersal.....	19
<i>Acquisition of targets.</i>	21
<i>Target maintenance.</i>	23
<i>Student Preference.</i>	23
<i>Ratio of interspersed targets.</i>	24
<i>Criticisms of task interspersal.</i>	25
<i>Task interspersal and efficiency.</i>	28
<i>Task interspersal as an abolishing operation for escape.</i>	28
Purpose of the Present Study	31
Research Questions.....	31
Rationale for Single Subject Design	33
Single case research methodology.....	33
Chapter 3: Methods.....	38
Introduction.....	38
Experimental Design.....	38
Recruitment.....	39
Setting	39
Inclusionary Criteria	39
Recruitment Materials.....	40
<i>Gilliam Autism Rating Scale, third edition (GARS-3).</i>	40
<i>Verbal Behavior Milestones Assessment and Placement Program.</i>	40
<i>Mullen Scales for Early Learning (MSEL).</i>	41
<i>Vineland Adaptive Behavior Scales, 3rd edition (Vineland-3).</i>	41
<i>Other materials.</i>	41
Participants.....	42
Functional Behavior Assessment	43

Functional Behavior Assessment Screening Form (FBASF).....	43
Functional Based, Semi-structured Interview.....	43
Observations.....	44
Preference Assessment.....	44
Functional Behavior Assessment Results.....	45
Daren.....	45
Ralphie.....	45
Brett.....	46
Lizzy.....	46
Functional Analysis.....	47
Escape Condition.....	48
Control Condition.....	48
Procedural integrity.....	48
Inter-observer agreement.....	49
Functional Analysis Results.....	49
Daren.....	50
Ralphie.....	50
Brett.....	51
Lizzy.....	52
Experiment.....	52
Design.....	53
Setting.....	53
Materials.....	53
Measures.....	53
Independent Variable.....	54
Dependent Variables.....	54
<i>Percent correct independent responses</i>	54
<i>Sessions to mastery</i>	54
<i>Rate of Escape-maintained Behavior</i>	54
<i>Rate of acquisition</i>	55
<i>Cumulative duration</i>	55
<i>Maintenance Probes</i>	55
<i>Procedural Integrity</i>	55
<i>Inter-Observer Agreement</i>	56
Procedure.....	56
<i>Targets</i>	56
<i>Pre-intervention Probes</i>	56
<i>Quasi-Random Assignment</i>	56
<i>General Methods</i>	57
<i>Condition Probes</i>	57
<i>Presentation of targets</i>	57
<i>Teaching Procedure</i>	57
<i>Errorless Learning</i>	58
Conditions.....	59
<i>Concurrent Training (CT)</i>	59
<i>3:1 Task Interspersal (TI)</i>	59
<i>Social Validity</i>	59
Chapter 4: Results.....	61
Daren (high escape group).....	61
Ralphie (high escape group).....	62

Brett (low escape group).....	64
Lizzy (low escape group).....	66
Chapter 5: Discussion	69
Research Questions.....	69
General Discussion	71
Research Implications.....	72
Clinical Implications.....	74
Limitations and Future Directions	76
APPENDICES	80
Appendix A: Social Validity Scale.....	82
Appendix B: Participant VB-MAPP Scores	82
REFERENCES	107

LIST OF TABLES

Table 1: Participant Demographics.....	100
Table 2: Acquisition Targets by Participant	101
Table 3: Daren Social Validity	102
Table 4: Ralphie Social Validity	103
Table 5: Brett Social Validity	104
Table 6: Lizzy Social Validity	105
Table 7: Inter-observer Agreement and Procedural Integrity	106

LIST OF FIGURES

Figure 1: Reinforcement and Punishment.....	86
Figure 2: Discrete Trial Training Sequence.....	87
Figure 3: Daren – Escape Maintained Behavior Graph	88
Figure 4: Ralphie – Escape Maintained Behavior Graph.....	89
Figure 5: Brett – Escape Maintained Behavior Graph.....	90
Figure 6: Lizzy – Escape Maintained Behavior Graph.....	91
Figure 7: Daren – Rate of Acquisition Graph	92
Figure 8: Ralphie – Rate of Acquisition Graph	94
Figure 9: Brett – Rate of Acquisition Graph.....	96
Figure 10: Lizzy – Rate of Acquisition Graph.....	98

Chapter 1: Introduction

Autism Spectrum Disorder (ASD) is a pervasive developmental disorder which has been rapidly growing in prevalence of diagnoses in the past decade. Current estimates suggest that 1 in 68 children will be diagnosed with ASD (Centers for Disease Control and Prevention, 2014). With the increase in prevalence has grown an increase in costs for families, schools, and public funding (Ganz, 2007). Research has demonstrated that with good, evidence-based interventions, the costs of supporting individuals with ASD can be dramatically decreased by helping them live more independent lives (Jarbrink & Knapp, 2001).

One of the most common evidence-based intervention methodologies for children with ASD is Applied Behavior Analysis (ABA). A recent report by the National Autism Center indicated that approximately 90% of interventions for individuals with ASD meeting the highest standards for evidence-based treatment are derived “entirely” or “predominantly” from ABA and related behavioral literature (National Autism Center, 2015). Although the literature as a whole has provided substantial research to the treatment of ASD, ABA is not one intervention, but rather an umbrella term describing a field consisting of well-established methodologies (Cooper, Heron and Heward, 2007). ABA is still a growing field, and many of its components are still being studied.

Discrete trial training (DTT) is one component of ABA that has robust support in the literature. DTT is a teaching strategy which breaks down learning into individual learn units, which supports children with ASD by creating a clear, precise and consistent learning environment (Smith, 2001). In DTT, complex behaviors are broken down into individual units, or “targets” and taught in “trials,” which are repeated until a child becomes fluent in the skill. Each trial consists of an instruction, a prompt to aid accuracy, and a consequence for correct responding (praise, high fives, etc.), or an error correction for incorrect responding to redirect the child to the correct response. The end of each trial is followed by a brief pause before the start of the next to provide a clear separation of learn units for the child.

DTT includes a number of variants which can be used to increase learning efficiency. One of the more commonly used variants employed by practitioners in the field is a method called task interspersal (Love, Carr, Almason, & Petursdottir, 2009). Task interspersal is similar to traditional DTT as described above, with one crucial difference. Before each trial, a child is given three trials of targets which they have already mastered (Miltenberger, 2006). In this way, a child is responding to three easy tasks before responding to a hard task.

Research has shown that task interspersal is effective at facilitating the learning of new targets, and is preferred by students over more traditional discrete trial training methods (see Clinton & Clees, 2015). Individuals who had mastered targets interspersed with unknown targets were able to learn those targets in fewer trials compared to DTT. However, additional studies comparing task interspersal to traditional DTT determined that the extra time required for a child to be presented with and respond to all the mastered targets resulted in less efficient learning, as measured by targets mastered per unit of time (Cates, Skinner, Watson, Meadows, Weaver & Jackson, 2003; Nicholson, 2013).

Interspersal has also been shown to affect efficiency of learning depending on how the interspersed mastered targets are reinforced. Charlop, Kurtz, and Milstein (1992) conducted a study which examined the effects of reinforcing mastered targets during task interspersal on learning. They found that when the mastered targets are reinforced with highly desirable items, learning efficiency decreased. However, a replication of the study by Chong and Carr (2005) failed to find these same results. Chong and Carr (2005) hypothesized that the children in the Charlop et al. (1992) study had high rates of escape-maintained behavior because they found the demands to be aversive; by reinforcing easy items, those children became less motivated to work on hard items. The participants in the Chong and Carr (2005) study, on the other hand, had been in school for a longer period of time, and may have not been as adverse to demands.

Efficiency of learning is a topic of specific concern in special education research. Skinner (2008) noted that learning should not be conceptualized as “failure to learn,” but rather, a “failure to learn

specific skills or behaviors as rapidly as expected” (p. 310). As children with special needs are already behind their typically developing peers, they need to demonstrate higher rates of learning in order to demonstrate progress to a degree which will allow for greater independence (Gettinger & Miller, 2014). However, for children with ASD, particularly those with more significant impairments, there are a number of barriers which decrease learning efficiency.

One of the most commonly reported challenges from practitioners and educators working with children with ASD is that the children engage in high rates of escape-maintained behavior (Olly, 1992). Escape-maintained behavior is behavior that a child engages in to avoid having to complete a task or demand which they find aversive. The high rates of escape behavior result in a great deal of lost instructional time, which in turn results in inefficient learning (Koegel, Koegel, Shoshan & McNerney, 1999).

A number of interventions have been developed in order to reduce escape-maintained behavior. One intervention that has robust support in the literature is the high-probability, or high-p sequence (Mace et al., 1988). The high-p sequence is used to increase compliance to demands. First, the practitioner identifies a demand to which a child refuses to comply. Next, that demand is preceded by three rapid demands that a child have a high probability of complying to, typically activities a child enjoys. After the child complies with the three high probability demands, the low probability demand is given. Research has shown that children are much more likely to comply with the low probability demand following this sequence (Lee, 2005).

Procedurally, the high-p sequence is almost identical to task interspersal. Both involve asking a child to engage in a rapid series of quick, easy demands or targets before introducing a harder demand or target, and both have been shown to increase the likelihood of a correct response to the harder demand or target. The difference between the two procedures is that the high-p sequence is used to increase responding to a demand that a child can already do, but is refusing to do, while task interspersal is used to increase responding of a skill still being learned.

Advocates of task interspersal have proposed that the benefit of the procedure is the reduction of escape-maintained behavior, and not in the direct facilitation of learning (Laraway, Snyckerski, Michael, and Poling, 2003). If such were the case, task interspersal may increase efficiency, but only in children who engage in high rates of escape-maintained behavior. By reducing escape, more time is spent on instruction, which in turn would result in a higher rate of learning. However, no research to date has measured the rate of learning when task interspersal is employed on children who engage in escape.

Using an alternating treatments design, the present study will compare task interspersal procedure and a traditional discrete trial training procedure for rate of learning for children with autism. This study will expand on the literature by examining the methods' effects on children who engage in high rates of escape-maintained behavior prior to the start of intervention.

Chapter 2: literature review

Introduction

In order to address the need for this study, the following sections will describe (a) autism spectrum disorder and its characteristics, (b) important concepts of Applied Behavior Analysis relevant to this study, (c) common barriers to ASD intervention, (d) the importance of efficiency and the problems of escape behavior in ASD intervention, (e) interventions for escape, and (f) task interspersal. The purpose of the study will then be described, followed by the research questions, and then a rationale for single subject design.

Autism Spectrum Disorder

Autism Spectrum Disorder (ASD) is a pervasive developmental disorder that is classified by deficits in social skills, deficits in language and communication, and stereotyped/repetitive behaviors and interests (APA, 2013). ASD is a heterogeneous disorder with a wide variety of presentations. It is one of the fastest growing developmental disabilities, with a prevalence rate of 1 in 68 children (Centers for Disease Control and Prevention, 2014). Autism is much more common in boys than girls, with the prevalence in boys being 1 in 42, compared to girls, who are diagnosed at a prevalence of 1 in 189.

Given the wide variety of presentations seen in individuals with the diagnosis, the disorder is currently conceptualized as a “spectrum.” On one end of the spectrum are individuals with more significant impairments. Thirty eight percent of individuals with ASD have a comorbid intellectual disability, and an estimated 20% never develop a language (Baio, 2012). Many children demonstrate limited development in basic functional adaptive skills, poor motor development, and a lack of the basic skills involved in learning, such as visual discrimination, listener responding, and object identification. On the other end of the spectrum are individuals often labeled “high functioning autism.” Those who fall into this category are able to function within society with deficits limited to social interaction, social communication, or social reciprocity (Newson & Hovanitz, 2008). It is important to note that while the

spectrum model provides a useful representation for assessment and diagnostic purposes, the linear nature of the model still does not capture the full range of possible symptoms that may be expressed by those with the disorder (Huerta & Lord, 2012).

Diagnosis of autism spectrum disorder. While the diagnostic criteria for ASD has gone through some significant changes since its conception, there are a number of primary deficits which have remained constant throughout the years. Deficits in social interaction and language/communication have been considered core deficits since the disorder was first conceived by Kanner in 1943 (Mash & Barkley, 2008). Wing and Gould (1979) created what came to be known as the autism triad when they characterized the disorder of consisting of deficits in social interaction, social communication and imagination. Later diagnostic criteria dropped the imagination and replaced it with repetitive/stereotyped behaviors, though deficits in imagination and pretend play are still considered core symptoms (Doherty, 2012). The current Diagnostic and Statistical Manual for Mental Disorders (DSM 5) collapsed social communication and interaction into a single construct, kept repetitive and stereotyped behaviors as a second construct, and made language delays a specifier. The language delay specifier was created in order to differentiate between individuals high functioning autism, whom typically do not demonstrate a language delay, and those with more significant impairments, for whom language delays are more common (APA, 2013).

Within the area of social communication deficits, the DSM 5 notes the three most common deficits: deficits in socioemotional reciprocity, deficits in non-verbal communication, and deficits in social relationships (APA, 2013). Frequently noted behaviors within socioemotional reciprocity include failure to initiate social interaction, lack of sharing, and no back and forth conversation. Within the non-verbal domain, individuals with ASD commonly have poor eye contact, fail to use or interpret gestures, and have blunted, or exaggerated facial expressions. They also struggle to maintain relationships, or fail to seek them out altogether, and struggle to adjust their behavior to different social contexts.

Within repetitive/stereotyped behaviors, the DSM 5 notes repetitive motor movements, need for sameness, restricted interests, and hyper/hypo sensitivity to sensory input (APA, 2013). Repetitive motor movements can range from hand flapping, to spinning, to lining up toys. Need for sameness reflects an individual's rigidity in thinking and need for predictability. Restricted interests refers to a fixation on topics or objects to an abnormal degree.

Diagnosis of ASD is made by trained and licensed psychologists, psychiatrists and physicians, and typically involves a team of other professionals, such as speech and language pathologists, occupational therapists, and physical therapists, who specialize in the core deficits identified in ASD (Zager, Wehmeyer & Simpson, 2012). Diagnostic decisions are made based on numerous data sources, including medical history, standardized testing, family interviews, and direct behavioral observations. In addition to assessment for diagnostic purposes, clinicians also assess for specific skill strengths and weaknesses to better inform intervention.

Intervention for autism spectrum disorder. The rapid escalation of children being diagnosed with ASD over the past twenty years has placed a serious financial burden on families, medical systems, schools, and public social service agencies, while state and federal funding has been unable to wholly support the sudden increase in financial needs (National Autism Center, 2009). The estimated societal costs for a single individual diagnosed with ASD across their lifetime is approximately 3.2 million dollars (Ganz, 2007). Fortunately, effective, evidence-based treatment can reduce these costs by up to an estimated 65% (Jarbrink & Knapp, 2001). Unfortunately, identifying good, evidence-based treatments is difficult, and many practitioners use interventions that lack a robust research base (Smith, 2005).

In an attempt to rectify the challenges of identifying and categorizing evidence-based interventions, the National Autism Center conducted a large scale review of the literature on interventions for individuals with autism, titled the National Standard's Report (National Autism Center, 2009). This report established a rigorous set of criteria along a five point "Scientific Merit Rating Scale" for determining if a treatment had enough established evidence to qualify as "evidence-based." These

criterion were either derived from, or share standards with, established standards for school psychology and special education (Horner et al., 2005; Kratochwill et al., 2010). This scale had criteria for both group-based designs as well as single case research designs.

Both group and single case designs were expected to have high procedural fidelity measured across at least 25% of all administrations, meet Inter-observer Agreement (IOA) of at least 80%, have proof of diagnosis from a qualified professional to be confirmed by at least one psychometrically valid instrument, and have objective data collection, including collection of maintenance data and generalization across settings, stimuli, and individuals. Additionally, a group based design met the highest rating if it had two or more groups of randomly assigned participants with an n large enough to meet sufficient power, collected data using observation based or standardized methods using instruments with high psychometric properties, and used a blind or double blind design. A single case design required a minimum of three comparisons of control and treatment conditions, with a minimum of five data points per condition across at least three participants, as well as at least 90% IOA collected for a minimum of 25% of observations, with data collected for every observation or trial.

The National Standard's Report identified a number of different interventions across various disciplines which met their standards for evidence-based practice. Of the studies meeting criteria, approximately 66% were developed exclusively from the Applied Behavioral Analytic (ABA) literature or related behavioral literature (National Autism Center, 2009). Seventy five percent of the remaining 1/3 of the studies came "predominantly from the behavioral literature" (p. 93). This indicates that all together, approximately 90% of studies meeting the criteria for evidence-based interventions were derived either entirely or predominantly from ABA methodologies, or methodologies derived from ABA principles and theories.

The National Standard's Report released its phase 2 data in 2015, which included more recent studies, as well as data on interventions for individuals 22 years of age and older. The report indicated that as of its publication, ABA based practices remained among the most effective approaches for the

education and intervention of individuals with autism (National Autism Center, 2015). Additionally, the amount of children with ASD who are receiving ABA services have been growing rapidly. A 2006 survey by Green and colleagues found that 56% of children with ASD were receiving regular services from certified ABA practitioners (Green et al., 2006). While many of the principles of ABA are well established, and many of the interventions offered have demonstrated effectiveness in the literature, it is still a growing and evolving science that continues to require quality evaluation and research of its methodologies (Cooper, Heron & Heward, 2014).

Applied Behavior Analysis

Applied Behavior Analytic techniques have a long history in the treatment of Autism Spectrum Disorder, with robust support in the literature. However, ABA is not one treatment methodology, but rather refers to a number of principles and methodologies historically derived from the experimental analysis of behavior and related fields (Cooper, Heron & Heward, 2014). While an examination and evaluation of all the principles that fall under the umbrella of ABA is beyond the scope of this review, it is important to review the principles that are most applicable to the present study.

There are several core principles of ABA that underlie most, if not all intervention strategies employed by practitioners. These principles include reinforcement, punishment, extinction, and stimulus control (Cooper, Heron & Heward, 2014), and are based on empirically proven demonstrations on the functional relations of associated variables (Zanger, Wehmeyer & Simpson, 2012). The term functional indicates that the manipulation of variables related to a behavior using those principles serves to increase or decrease the probability of the future occurrence of that behavior. In addition to the above principles, the principle of Motivating Operations (MO), the three term contingency, and the practice of Discrete Trial Training (DTT) will also be reviewed for the purposes of the present study. The above principles have been repeatedly shown to be effective in the education of all children, including children with ASD, when manipulated correctly (Horner, Carr, Strain, Todd & Reed, 2002).

Core principles of ABA. Reinforcement and punishment are two of the most fundamental principles of ABA. Reinforcement refers to a stimulus which follows a behavior and increases the future probability of that behavior, while punishment refers to a stimulus which follows a behavior and decreases the future probability of that behavior (Cooper, Heron & Heward, 2014). These two terms are accompanied by the modifiers “positive” and “negative.” Positive refers to the addition of a stimulus following a behavior, while negative refers to the removal of a stimulus following a behavior. Thus, one can have positive reinforcement, negative reinforcement, positive punishment, or negative punishment. See Figure 1 for a description and example of these four principles. These modifiers refer to the addition or removal of stimuli, and are not qualitative descriptors of desirable or undesirable consequences. In general, reinforcement and punishment refer to the consequences following a behavior; we manipulate the stimuli to which an individual is exposed to as a result of a behavior in order to increase or decrease the future probability of a behavior.

According to ABA principles, if a behavior is predictably maintained over time, it means that there is either a positive or a negative reinforcer present that is maintaining it. The principle of extinction refers to the removal of a reinforcer that is maintaining a behavior in order to reduce (and eventually eliminate) the future probability of that behavior (Cooper, Heron & Heward, 2014). When first initiated, extinction is typically followed by an extinction burst, which is a sudden increase in the behavior, followed by a decrease of the behavior.

Stimulus control refers to when the rate, latency, duration or amplitude of a behavior is altered by the presence of an antecedent stimulus (Cooper, Heron & Heward, 2014). More simply, it is when the presentation of a stimulus prior to a behavior has a predictable effect on that behavior. One of the most salient principles of stimulus control in ABA intervention is the Discriminative Stimulus (abbreviated “Sd”). The Sd is a stimulus which signals to an individual that a reinforcer is available contingent on a behavior (Cooper et al., 2014). In education, a teacher asking a student “what is this?” when pointing to a

picture of a dog is an Sd for the student, indicating that if they say “dog,” they will get a high five, an approving nod, or some other reinforcing consequence.

The three term contingency. The three term contingency is an important principle in understanding the functional relations of the manipulable variables surrounding a behavior (Zanger, Wehmeyer & Simpson, 2012). The three terms of this principle are antecedents, behavior and consequence. The behavior refers to a measurable, observable action performed by an individual. Antecedents refer to all associated stimuli which occur before the behavior and affect the behavior along a measurable property, while consequences refer to all associated stimuli which occur after the behavior and affect a measurable characteristic of the future occurrence of that behavior. The three term contingency is important because, while we cannot directly manipulate the behavior of another individual, we can indirectly manipulate that behavior by knowing the antecedent and consequence variables and their relation to the behavior, and then changing those variables in order to predictably change the behavior. This is what is meant by the functional relation of the behavior and its associated variables, as noted above.

Motivating operations. Motivating Operations (MO) are antecedent events which alter the value of a reinforcer (Michael, 2007). By altering the value of a reinforcer, MOs can indirectly influence the probability of the future occurrence of a behavior. An establishing operation (EO) is an MO that increases the value of a reinforcer, and thus makes behaviors which are influenced by that reinforcer more likely to occur. On the other hand, abolishing operations (AO) decrease the value of a reinforcer, resulting in a decrease in the probability of associated behaviors.

There is a large body of research demonstrating the phenomenon of motivating operations, though most of it focuses on individuals with cognitive and developmental disabilities (Klatt, Sherman & Sheldon, 2000). For example, Vollmer and Iwata demonstrated that individuals who had not had access to certain reinforcers (food, attention, or music) over a period of time were more likely to engage in behaviors to obtain those reinforcers than when they had access to those items previously across a short

time period. This effect has been replicated numerous times in the literature to both increase and decrease the value of the associated reinforcers (Laraway, Snyderski, Michael, & Poling, 2003).

Motivating operations are also useful for reducing the probability of challenging behaviors without applying extinction or punishment by reducing the strength of the reinforcers associated with challenging behaviors, particularly during instruction. Escape-maintained behavior and aggression have been successfully reduced via an abolishing operation through numerous different antecedent strategies, including presenting demands as requests (Peyton, Lindauer, & Richman, 2005), delivering instruction from a familiar as opposed to an unfamiliar adult (Butler & Luiselli, 2007), or providing more explicit instruction on how to complete a task/reducing the task difficulty (Reichle & McComas, 2004). Such strategies are effective at reducing problematic behavior without creating a hostile environment through punishment strategies, which often serve to condition the instructor and educational environment as an aversive stimulus (Michael, 2000). For a comprehensive review on AO strategies in reducing problem behavior, see Langthorne, McGill and Oliver, (2014).

Discrete trial training. While it is not synonymous with ABA, discrete trial training (DTT) is one of the most frequently used models of intervention in ABA services, in which new skills are taught on a structured, methodical trial-by-trial basis. DTT is an evidence-based, systematic approach to instruction which breaks instruction into controlled, distinct trials (Smith, 2001). The purpose of DTT is to establish clear stimulus-behavior-consequence relations where learning can occur. Trials are broken up into distinct learn units to further provide clear, distinct relationships, with prompting and prompt fading used to establish early behavior-consequence relationships and provide fast contact with reinforcement. DTT breaks down teaching trials into five distinct steps (see Figure 2). Each trial is comprised of a cue (discriminative stimulus), a prompt (demonstration of the correct answer), a response (the child's behavior), the consequence (reinforcement or error correction), and an inter-trial interval (distinct separation of learning units).

Discrete Trial Training has robust support in the literature, and has consistently been shown to not only increase learning in children with autism, but to provide sustained skill maintenance over time (Smith, 1999). The effectiveness of DTT has been well documented; numerous studies provide strong evidence for the application of DTT across a wide variety of skills, including visual and auditory discrimination, imitation, receptive and expressive language, reading, writing, mathematics, social communication and functional adaptive skills (Smith, 1999; Smith, 2000; Smith, Groen & Wynne, 2000, Green, Brennan & Fein, 2002; Howard, Sparkman, Cohen, Green & Stanislaw, 2005; Matson, Benavidez, Compton, Paclawskyj & Baglio, 1996; Lovaas, 1987; McEachin, Smith & Lovaas, 1993; Sallows & Graupner, 2005; Eikeseth, Smith, Jahr & Eldevick, 2002; Weiss, 1999).

Smith (2000) posited that there are three primary reasons as to why DTT is such an effective tool for children with disabilities. First, short, concise trials allow for many learning opportunities to occur in a short period. Second, DTT typically involves one-on-one teaching, so that instruction procedures can be tailored to the learner. Finally, DTT trials are precise, clean learn units with clear antecedents, prompts and consequences, and have clear beginnings and endings. The precise nature of a DTT trial makes it easier for a learner with disabilities to develop associations between the components (antecedents, behaviors and consequences) of the instructional material.

While DTT maintains strong support within the literature and the ABA community, it is not without its criticism. First, given its precise nature, there is evidence to suggest that DTT can result in stimulus control that is too specific, which may hinder generalization of the learned skills (Committee on Educational Interventions for Children with Autism, 2001). Furthermore, traditional DTT is conducted in a controlled setting with limited distracting stimuli. Although this may serve to control learner attention by reducing distractors, it can further inhibit generalization (Cowan & Allen, 2007). Another concern is that DTT's repetitive, rigid structure can lead to the DTT environment and procedure becoming classically conditioned as an aversive set of stimuli, leading to an increase in problematic behavior in the student as a function of escape (Steege, Mace, Perry & Longenecker, 2007).

A number of strategies can be implemented to control for the above concerns, while still maintaining the core principles of DTT. In order to avoid the faulty stimulus control which can result due to a rigidly presented DTT structure, a more flexible DTT approach, with a wider variety of targets taught within a session, more frequent breaks, and functional relations between the target skill and reinforcers, can be implemented in order to promote generalization (Heflin & Isabell, 2012). Methods such as distributed practice, in which trials are spread out over longer periods of time as opposed to taught in massed chunks, can still follow the five components of DTT while reducing fatigue and aversive conditioning, with the additional benefit of increasing maintenance of mastered targets (Cepeda et al., 2006). Generalization can be facilitated by using reinforcers that are a functional, natural consequence of the behavior being targeted (Delprato, 2001; Ingersoll, 2010). For example, a clinician can teach a child to say “cracker” by conducting DTT during snack time with the student’s preferred crackers just out of reach. Teaching skills in the environments in which they are expected to occur also serves to promote generalization once the clinician and the intervention are removed.

In summary, DTT continues to receive large scale support within the special education and clinical communities for treatment of children with ASD; at the same time, researchers are exploring ways to enhance DTT to address these concerns, such as through naturalistic training, while still maintaining the core benefits of the practice (Zager, Wehmeyer & Simpson, 2012). Still, though naturalistic DTT may reduce aversive conditioning of the environment and enhance generalizability of skills, critics argue that it also results in less efficient learning, as trials are spread out or mixed in with other activities, and students typically dictate the pace of instruction. This does not mean that traditional DTT and more naturalistic variants are at odds; Cowan & Allen (2007) argue that best practices would be to adapt instruction to the learner based on a continuing analysis of the learner’s needs, using both traditional and naturalistic methods to best support the individual.

Discrete trial training variants. While there are numerous variables within discrete trial training that can be manipulated in order to affect learning, pertinent to this study is the manipulation of the

presentation of acquisition targets. Acquisition targets are the specific targets of the skillset that are being taught. The most rudimentary and foundational presentation of acquisition targets is the constant task arrangement (as reviewed in Nicholson, 2013). Constant task arrangements refers to procedures in which all presented targets during a session are acquisition targets. There are three basic variants to the constant task arrangement: serial training, concurrent training and cumulative training.

Serial training refers to an arrangement in which only a single acquisition target is taught during a session, in which that target is presented each and every trial (Schroeder & Baer, 1972). In serial training, a session is typically predetermined by a number of trials. Subsequent sessions may target alternate acquisition targets, or may return to the same target, but within any individual session, only one target is taught. Sessions continue until mastery criterion is reached, at which point a new target is introduced.

Concurrent training involves teaching multiple acquisition targets within a single session (Schroeder & Baer, 1972). The targets may be randomized in presentation, or in a specified order, but the each consecutive trial target differs from the previous trial target. Research has demonstrated that concurrent training is more efficient in teaching multiple targets over a short period of time relative to serial training, and better promotes target discrimination (Rowan & Pear, 1985; Dunlap, 1984; Winterling, Dunlap & O’Neil, 1987). Consequently, serial training alone is not typically employed unless individual factors (ex: failure to acquire targets with concurrent training) demand a reduction in task difficulty (Cuvo, Davis & Gluck, 1991). It is important to note that concurrent training is more frequently referred to as “interspersed” training (ex: see Skinner, 2002) or massed trial training (ex: see Rapp & Gunby, 2016). However, the present study is examining a different intervention procedure known as task interspersal (to be discussed later). Furthermore, massed trial training has also been used to describe serial training (ex: Cepeda, Pashler, Vul, Wixted, & Rohrer, 2006). In order to avoid confusion, this procedure will be referred to as concurrent training for the remainder of this study.

Cumulative training is a combination of concurrent training and serial training (Cuvo et al., 1991). In cumulative training, individual targets are first taught using serial training, but multiple targets

are taught across sessions. Once each target has reached mastery criteria, they are combined into the same sessions in order to then promote discrimination. Cuvo et al. (1991) demonstrated that both cumulative training and concurrent training are relatively similar in effectiveness and efficiency. However, they noted that concurrent training begins implements discrimination training more immediately, and thus may be better suited in order to avoid stimulus overgeneralization.

Common Barriers in ASD Intervention

Given the heterogeneity of the autism phenotype, there is a large amount of variability in what challenges educators and clinicians can expect to face. Simpson, Miles and LaCava (2008) documented the most frequently reported and researched barriers when implementing interventions. Such challenges include stimulus overselectivity, difficulties with sustained attention, self-stimulatory behaviors, self-injurious behavior and aggression, and motivation and escape-maintained behaviors.

Stimulus overselectivity refers to a form of faulty stimulus control, in which a student will attend to the incorrect antecedent stimulus during instruction (ex, left/right preference), or will attend to prompting as opposed to the target stimulus, resulting in prompt dependence, or will fail to generalize a stimulus to multiple exemplars (Koegel & Koegel, 1985; Lovaas, Koegel & Schreibman, 1979). Difficulties in attention frequently occur when an individual becomes hyper focused on one stimulus in the environment and ignores all others (Dunlap, Koegel & Burke, 1981, Koegel & Koegel, 1985; Schreibman, Kohlenberg & Britten, 1986). Self-stimulatory behaviors, which are a classical diagnostic symptom of ASD, frequently result in the failure to attend to any instruction, resulting in a breakdown of learning (Simpson & Regan, 1986; Varni, Lovaas, Koegel & Everett, 1979). Self-injurious behaviors and aggression cause significant disruption across all environments, result in an interruption of learning, and frequently require more intrusive treatment (Dawson, Matson & Cherry, 1998).

One of the most commonly reported barriers to learning, however, is challenges with motivation and escape-maintained behavior (Olly, 1992). Escape-maintained behavior is any behavior that results in the temporary removal or avoidance of task demands. Many of the other documented challenges above

are likely a function of escape (Simpson et al., 2008). For example, self-stimulatory behaviors may serve as a soothing mechanism to reduce anxiety in adverse conditions (Simpson & Regan, 1986). What is observed or reported as inattention is frequently a function of avoidance from an undesirable task (Langthorne, McGill & Oliver, 2013). Self-injurious behaviors and aggression likewise frequently result in the removal or avoidance of a task, and thus are similarly a function of escape (Langthorne et al., 2013). In fact, 33% to 48% of self-injurious and aggressive behaviors serve as a function of escape for persons with developmental disabilities (Derby et al., 1992; Iwata et al., 1994).

The importance of efficiency and the problem of escape. In a review of potential variants of discrete trial training aimed at reducing escape-maintained behavior, Skinner (2008) pointed out that one of the most frequently reported methods for measuring efficiency was learning level. Learning level is a direct measure of behavior, and is most often expressed as targets mastered, or trials to criterion, or sessions to mastery. Unfortunately, these measures at best marginally factor time into the measure. He noted that problems with learning should not be conceptualized as “failure to learn,” but rather, a “failure to learn specific skills or behaviors as rapidly as expected. (p. 310).

High rates of escape-maintained behavior in children with ASD result in numerous, compounding complications for educators as well as for the students themselves. Frequent escape from tasks results in less time engaged in academic instruction, resulting in less efficient learning (Koegel, Koegel, Shoshan & McNerney, 1999). Wharton-McDonald, Pressley and Hampston (1998) reported that struggling individuals in classrooms may miss upwards of 65% of instruction due to escape-maintained behavior, and hypothesized that those with more severe disabilities miss significantly more. Students with disabilities are typically already at a disadvantage in regards to achievement; and need to demonstrate more efficient learning, not less, in order to close the achievement gap between them and their typically developing peers (Gettinger & Miller, 2014). Sustained attending during instructional time is even more important for individuals with autism than typically developing children, as individuals with autism frequently fail to learn functional and adaptive skills naturally through less structured, social

environments (Smith, 2001). Unfortunately, the portion of the ASD population which engages in the most escape-maintained behavior are those with the most significant impairments (Matson, Wilkins, & Macken, 2009).

High rates of escape-maintained behavior have a significant impact on learning efficiency. In order to develop functional and adaptive skills in order to maintain an independent lifestyle, students with ASD need to demonstrate higher rates of learning efficiency during instructional time relative to typically developing children. In developing interventions to increase targeted skills, it is not only the responsibility of the clinician or educator to ensure learning occurs, but to also ensure learning occurs with appropriate efficiency.

Moreover, escape-maintained behavior is frequently addressed with consequence based interventions, which may reduce the behavior for that specific environment, but can serve to condition instruction as an aversive stimulus (Michael, 2000). This can often serve as an establishing operation to increase the value of escape in future instructional environments, making escape more likely, and thus learning less efficient (Miltenberger, 2006). An alternative strategy would be to establish an abolishing operation for the value of escape.

Antecedent Interventions for Escape

There are numerous functional strategies which can be employed to reduce escape-maintained behavior. The most commonly used strategies include extinction, differential reinforcement, punishment, and antecedent control (Miltenberger, 2006). Extinction typically involves blocking and redirecting escape-maintained behavior so that the demand is not successfully removed or avoided when the individual engages in the behavior (ex. Iwata, Pace, Cowdery & Miltenberger, 1994). Differential reinforcement involves reinforcing alternative replacement behaviors that still serve the same function (escape or temporary break), but are more socially appropriate (ex. Steege et al., 1990). Punishment strategies involve providing an undesirable consequence contingent upon the escape behavior, though these are typically not employed as a primary approach as punishment frequently includes the side effect

of conditioning the environment and instructor as aversive (Michael, 2000). Finally, antecedent interventions include a variety of strategies, though most involve manipulating the motivating operant for escape in order to reduce its reinforcing value (Miltenberger, 2006).

While all of the above strategies have their merits and will produce the desired effect, recent findings in the literature have demonstrated a number of advantages to antecedent based interventions relative to consequence based interventions or extinction. In a review of the literature on antecedent interventions, Cowan, Abel and Candel (2017) identified the following four benefits. First, antecedent strategies are employed prior to problematic behavior, which prevents the behavior from occurring in the first place and thus makes it less likely to contact reinforcement. Second, they are less aversive than punishment based interventions, and additionally prevent an escalation of behavior via extinction burst. Third, research had demonstrated that antecedent interventions employed in school environments reduced problematic behavior across all students (Sugai & Horner, 2006). Finally, antecedent strategies are correlated with increased attending to instruction and achievement (Kern and Clemens 2007; Lane et al. 2009).

Recent large scale reviews of evidence-based treatments have further supported the use of antecedent based interventions. The National Standard's Report Phase 2 indicated that antecedent interventions are among those interventions which display the highest degree of research rigor (National Autism Center, 2015). Additionally, Wong et al. (2015) reported that research on antecedent interventions maintain some of the most robust support. It should be noted, however, that while "antecedent interventions" broadly share strong evidence-based support, specific interventions still need to be evaluated on their own merit, as the wide range of antecedent interventions poses a challenge of isolating the specific variables within each that are effective (Cowan et al., 2017).

Task interspersal. One of the more common antecedent interventions employed by both educators and clinicians is task interspersal (TI; Miltenberger, 2006). Task interspersal is a procedure in which trials of known or mastered targets are mixed in with trials of acquisition targets during discrete

trial training. Task interspersal is widely used among practitioners. A survey of behavioral practitioners and educators indicated that 71% of respondents used some form of task interspersal when teaching acquisition targets to students (Love, Carr, Almason, & Petursdottir, 2009).

There are a number of variables which can be manipulated within task interspersal. These include the ratio of targets to unknown targets, the type of reinforcement used for each target, the number of different targets, and so on. In a review of the literature, Nicholson (2013) identified three primary variants of task interspersal. These variants include additive interspersal, substitutive interspersal and incremental rehearsal.

Additive interspersal is the most common procedure studied in the literature, and involves adding a number of known targets to the procedure prior to each presentation of an acquisition target (ex. Burns, 2005). The number of interspersed mastered targets is typically expressed as a ratio; for example, presenting three mastered targets prior to a single unknown target would be expressed as 3:1 task interspersal. The most common ratio used in the research literature is a ratio of 1:1 (Nicholson, 2013). However, as Nicholson (2013) found, there is a difference in the ratios used relative to the level of functioning of the participants. Studies examining TI for children in general education settings or children with only mild deficits typically use a 1:1 ratio, or will employ a higher ratio of unknown targets to known targets (ex. 1:3 or one mastered target for every three acquisition targets). Studies examining TI with participants with more significant impairments typically employ a higher ratio of mastered to acquisition targets. The effects of ratio will be discussed below.

Substitutive interspersal is similar to additive interspersal, but instead of adding mastered targets prior to acquisition targets, a number acquisition targets are removed and replaced with mastered targets (ex. Skinner, 2002). For example, if a student is learning to read ten new words, five words will be removed and replaced with mastered words. This type of interspersal is more frequently employed as a form of negative reinforcement to increase sustained attention to task, where difficult targets are replaced with easy targets contingent on work completion (ex. Cooke et al., 1993).

Incremental rehearsal is a strategy in which known targets are incrementally added or increased to acquisition targets. A number of known targets are slowly interspersed on an incremental schedule until a predetermined ratio is met, at which point a new acquisition target is also folded in, and the incremental interspersal begins anew with two acquisition targets, and so on (ex. Burns & Boice, 2009). An example sequence would be as follows: Mastered 1 – Acquisition 1 – Mastered 1 – Mastered 2 – Acquisition 1 – Mastered 1 – Mastered 2 – Mastered 3 – Acquisition 1, and so on.

Task interspersal has a demonstrated number of benefits in the literature. It has been shown to facilitate acquisition of new targets, as well as improve maintenance of targets learned and interspersed. Additionally, students have reported a preference for task interspersal relative to constant task arrangements (i.e., acquisition targets only). Task interspersal has been shown to be effective across a wide variety of skill domains, and for both higher function individuals as well as individuals with more significant deficits. On the other hand, task interspersal is not without its criticisms. The following sections will discuss the findings which support task interspersal, followed by the most salient concerns raised against the procedure.

Acquisition of targets. A number of studies have shown that task interspersal is a useful tool for facilitating the acquisition of new targets. In the seminal set of studies of Task Interspersal, Neef, Iwata and Page (1977) and Neef, Iwata and Page (1980) used an alternating treatments design to measure the acquisition and maintenance of spelling words in children with intellectual disabilities. Baseline data was collected using a constant task arrangement with traditional reinforcement and error correction procedures. During the experimental phase, mastered targets were interspersed with 10 acquisition targets using a 1:1 ratio under one condition, while a second condition taught 10 targets using a constant task arrangement with a high rate of reinforcement. Across all participants, more words were acquired per session in the interspersal condition relative to baseline and the high reinforcement, constant task condition. This was the first series of single subject designs to demonstrate that task interspersal not only facilitated acquisition of targets, but that a higher rate of reinforcement alone was not enough to account

for the increased acquisition. Additionally, Neef et al (1980) included a preference assessment in which the students selected which procedure to do first each session. All students demonstrated a high preference for the interspersal condition, selecting it over the constant condition 75-100% of trials across participants.

Other studies have demonstrated similar results. Dunlap (1984) used an alternating treatments design with task interspersal and a constant task arrangement to teach spelling, matching and imitation tasks to five children with ASD. In addition, observers rated the participants' affect during each condition as a measure of preference for instructional method. Results indicated fewer trials to criterion during the interspersal procedure. Additionally, measures of affect during the interspersal procedure were higher, suggesting that the students showed a preference for that procedure. Similarly, Rowan and Pear (1985) compared a 1:1 interspersal condition to a constant arrangement to teach tacting to three children with disabilities. In addition to acquisition, they measured maintenance and generalization of skills. Results indicated fewer trials to criterion in the interspersal condition. However, no difference was found in maintenance and generalization between conditions.

The results of these studies have been replicated numerous times across a variety of skills and populations. Research has indicated that task interspersal facilitates acquisition of spelling and reading tasks (Koegel & Koegel, 1986; Cooke, Guzakas, Presley & Kerr, 1993; Browder & Shear, 1996; Burns Dean & Foley, 2004; Teeple & Skinner, 2004; Burns & Kimosh, 2005; Burns & Boice, 2009), mathematics tasks (Cuvo, Davis & Gluk, 1991; Cooke, Guzakas, Presley & Kerr, 1993; Cooke & Reichard, 1996; Burns, 2005; Wildmon, Skinner, Watson, and Garrett, 2004; Lee, Stansbery, Kubina, & Wannarka, 2005), visual discrimination tasks (Charlop, Kurtz, and Milstein, 1992), motor skills (Weber and Thrope, 1989, Chong and Carr, 2005), manding and tacting (Sanchez-Fort, Brady, and Davis, 1995; Chong and Carr, 2005; Volkert, Lerman, Trosclair, Addison, and Kodak, 2008, Ormsby and Belfiore, 2009), matching (Dunlap, 1984) and social initiation with peers (Davis, Brady, Hamilton, McEvoy, and Williams, 1994). Task interspersal has also been shown to be effective across a variety of populations,

including ASD (Dunlap, 1984; Rowan and Pear, 1985; Weber and Thrope, 1989; Charlop, Kurtz, and Milstein, 1992; Davis, Brady, Hamilton, McEvoy, and Williams, 1994; Chong and Carr, 2005; Jung, Sainato, and Davis, 2008; Volkert, Lerman, Trosclair, Addison, and Kodak, 2008; Ormsby and Belfiore, 2009), Intellectual Disabilities (Neef, Iwata, and Page, 1977; Weber and Thrope, 1989; Cuvo, Davis and Gluck, 1991; Browder and Shear, 1996; Burns and Kimosh, 2005), and specific learning disabilities (Cooke, Guzaukas, Presley, and Kerr, 1993; Cooke and Reichard, 1996; Wildmon, Skinner, Watson, and Garrett, 2004; Davis, Brady, Hamilton, McEvoy, and Williams, 1994; Burns, Dean, and Foley, 2004; Burns, 2005; Lee et al., 2005).

Target maintenance. Task interspersal has also demonstrated some evidence in maintenance of targets over time. Nicholson (2013) found that targets interspersed using a 3:1 ratio demonstrated better maintenance than targets with a 1:1 ratio or targets taught under a constant task arrangement. Henrickson, Rapp and Ashbeck (2015) similarly found that a 3:1 ratio resulted in better higher levels of maintenance relative to a 1:1 ratio or a constant arrangement. On the other hand, Majdalani and colleagues found no differences in maintenance across multiple task interspersal ratios or constant arrangements.

Unfortunately, evidence on the effects of interspersal on maintenance is limited, as the majority of studies have been conducted with the primary purpose of measuring facilitation of acquisition. Rapp and Gunby (2016) hypothesize, however, that task interspersal could be an efficient method for teaching acquisition targets and practicing maintenance within a single session by interspersing recently learned targets with acquisition targets.

Student Preference. Numerous studies have indicated that when given a choice, students prefer task interspersal procedures over constant arrangements. As noted above, Dunlap (1984) found higher ratings of effect of participants during interspersal procedures. Koegel and Koegel (1986) found similarly higher ratings of affect during a task interspersal procedure for a student with significant impairments due to a stroke. Cooke and Reichard (1996) directly surveyed participants with specific learning disabilities on their preference for each condition, and found all students preferred task interspersal. Similar results

for preference were found in Teeple and Skinner (2004) and Wildmon, Skinner, Watson, and Garrett (2004). These results indicate that task interspersal may indirectly reduce escape-maintained behaviors, as students report task interspersal to be less aversive; however, direct measures of escape during task interspersal have yet to be studied directly.

Ratio of interspersed targets. A number of studies have attempted to identify the optimal ratio of interspersed targets to acquisition targets for optimal learning. Research to date has produced mixed results, but have examined the ratios across a wide variety of variables. Gickling and Armstrong (1978) studied task interspersal ratios for children with reading difficulties and found that the most effective ratio was a 3:1 known to acquisition. On the other hand, Roberts, Turko & Shapiro (1991) examined various ratios (9:1, 4:1, 3:2 and 1:1) for struggling readers and found 1:1 to be the most optimal. However, in a follow-up study, they included ratios with more acquisition targets in addition to higher rates of mastered targets, and found that a 1:4 ratio, with more acquisition targets, produced the most efficient learning. Similarly, in a study of interspersal for children learning math facts Cooke and Reichard (1996) found that a higher ratio of acquisition targets (3:7) produced the most efficient learning. Nicholson (2013), in a series of three experiments, compared multiple ratios of task interspersal (3:1, 1:1, 1:3) and a constant arrangement condition to teach tacting to children with autism. Results consistently indicated that the 1:3 ratio was the most efficient, though a constant arrangement with no interspersal was more efficient than any interspersal ratio. Nicholson's results suggest that interspersal may be overall less efficient, and constant arrangements may produce the fastest rate of learning.

There are a number of variables which may explain the variability in the data regarding the optimal ratio for task interspersal. First, task interspersal has been used across a number of different populations, including ASD, intellectual disability, specific learning disability, and for students in general education (Clinton & Clees, 2015). Individual differences in behavior across groups can significantly impact learning. For example, children with ASD are likely to engage in more escape-maintained behavior or stereotypy (Olly, 1992), and thus may require a higher number of easy targets to keep them

on task. Similarly, the difficulty of the target task may also influence the optimal ratio. Gickling and Armstrong (1978) found that a higher rate of mastered targets produced the most efficient learning for a group of students who were not meeting grade level criteria in reading. On the other hand, Turko & Shapiro (1991) found a higher ratio of unknown targets was most efficient; however, all of the participants in this study were average to low average readers. Finally, the defined measure of “efficiency” itself will have an effect on the interpretation of the results. Prior to Cates, Skinner, Watson, Meadows, Weaver and Jackson (2003), efficiency was measured by trials to mastery. Cates et al. (2003), and subsequently Nicholson (2013) measured efficiency as number of mastered targets per unit of time. This learning “rate” measure captures time as a specific factor, and is a more accurate representation of efficiency (as discussed below).

Criticisms of task interspersal. Although a number of studies have demonstrated numerous benefits of task interspersal, other studies have shown mixed results. In regards to facilitation of learning, a number of studies have suggested task interspersal is less effective relative to constant arrangements. Volkert and colleagues (2008) found that a constant arrangement resulted in the acquisition of new targets over fewer trials for three children with autism. Follow up experiments found the same or mixed results. Majdalany et al. (2014) similarly found that constant arrangements required the fewest trials to reach mastery relative to interspersal for teaching tacts to children with ASD. Henrickson et al. (2015) found that neither task interspersal nor a constant arrangement produced faster learning (as measured by trials to criterion), and concluded that the additional time required for task interspersal may make it less efficient. Forbes et al. (2013) examined interspersal and constant arrangement strategies for teaching sight words to children with specific learning disabilities, and yoked all conditions by time. The results indicated fewer words mastered overall for interspersal procedures.

Similar to the variables which may have effected optimal ratios, a number of variables may explain the mixed results reviewed above. Task difficulty may play a role in how effective task interspersal is relative to constant arrangements. A review by Clinton and Clees (2015) indicated that task

interspersal resulted in fewer trials to criterion for studies which skills which were at a frustrational level (in regards to academic tasks) or for children with more significant disabilities (in regards to functional adaptive tasks). Majdalany et al. (2014) taught labels of countries to children with extensive verbal repertoires, which may reflect greater verbal learning abilities in those subjects relative to children with more significant impairments, and may then account for the discrepancy in their findings relative to the rest of the literature. On the other hand, Volkert and colleagues (2008) studied TI for children with more significant impairments. In order to account for the findings by Volkert et al. (2008), another explanation may require a better understanding of the mechanisms under which TI operates. TI may serve to decrease escape-maintained behavior (discussed below), which may lead to fewer trials to criterion by increasing attention to instruction during each trial. In such a case, TI may only be efficient for children who are engaging in high rates of escape-maintained behavior or stereotypy. Volkert et al. (2008) indicated that they paired TI with methods for increasing on-task behavior, which may have led to a ceiling effect or otherwise removed any effect TI may have had. Unfortunately, Volker et al. (2008) did not report direct data on engagement, so such effects can only be hypothesized. Finally, until recently, efficiency has been reported as a measure of trials to criterion. Recent studies indicating that TI is less efficient instead reported rates of learning, which more directly measure time as a factor. Given the above criticisms, it is important to both understand the underlying mechanisms which may mediate the effects of task interspersal (namely, reduction of escape), and to better account for time as a direct measure of rate of learning.

Task Interspersal and Efficiency. Although there are a greater number of studies that indicate task interspersal increases learning relative to constant arrangements, the majority of these studies measured learning by trials to criterion, sessions to mastery, or words mastered per session (learning level; Skinner, 2008). While such approaches are typically appropriate for comparing various treatments, they do not account for the length of an individual session. When comparing treatment modalities in order

to determine efficiency of learning, it is essential that either the condition sessions are yoked for time, or that time is factored directly into the measure of the dependent variable.

Skinner (2008) proposed the use of the metric cumulative learn rate when measuring efficiency of learning. Learn rate can be conceptualized as the number of targets learned divided by a unit of time. By examining data pathways using a cumulative learn rate, one can use visual analysis to evaluate the slope of two different conditions for learn rate across sessions, wherein a steeper slope will indicate a faster learn rate. A number of studies have used this metric to evaluate the efficiency of task interspersal, typically using targets mastered per minute as an expression of efficiency, calculated using the following formula.

$$\frac{\text{Targets Mastered} \times 60}{\text{Session Duration in Seconds}}$$

Cates, Skinner, Watson, Meadows, Weaver and Jackson (2003) first used this method to evaluate learning efficiency of task interspersal procedures for teaching spelling to second grade students. They used a drill and practice procedure with a 3:1 interspersal ratio, a 1:1 interspersal ratio, and a constant arrangement. Results indicated that the constant arrangement had the highest rate of learning (words mastered per minute), while the 3:1 interspersal ratio had the lowest. They hypothesized that while previous research indicated that task interspersal facilitates learning, the amount of extra time required to intersperse mastered targets may negate any benefit.

Nicholson (2013) conducted a series of three experiments to teach tacts to children with autism using various interspersal ratios and a constant arrangement. This study included a 3:1 ratio, 1:1 ratio, 1:3 ratio, and a constant condition. Results were similar to the Cates et al. study, in that the 3:1 ratio produced the lowest words mastered per minute, followed by the 1:1, then the 1:3, while the constant arrangement produced the highest words mastered per minute. These results supported the previous study, in that the amount of time spent interspersing targets may make the procedure less efficient.

In summary, there is a great deal of evidence that suggests task interspersal facilitates learning, in that students require fewer trials to reach mastery. It has been demonstrated to be effective for a wide variety of skills and populations. Additionally, students prefer task interspersal procedures over constant arrangements. However, the amount of extra time per session required to implement interspersal procedures may result in a slower rate of learning overall, making the procedure less efficient than constant arrangements. Despite the recent findings on efficiency, task interspersal may still serve to increase learning efficiency in students who find treatment aversive by serving as an abolishing operation for the value of escape.

Task interspersal as an abolishing operation for escape. As an intervention practice targeting efficiency of learning alone, task interspersal may result in a slower rate of learning relative to a constant arrangement of acquisition targets. However, like medication, every intervention has its intended purpose, but also carries numerous side effects (Luiselli, 2006). Advocates for task interspersal have argued that task interspersal may serve to increase motivation and decrease escape-maintained behavior (Skinner, 2002). To understand why this would occur, it is important to understand the foundations of task interspersal.

Task interspersal grew out of a related body of literature known as behavior momentum (as reviewed in Lee, 2005). Behavior momentum was a theory proposed by Nevin, Mandell, and Atak (1983) to explain behavioral persistence and behavioral change under various environmental conditions. The metaphor of “momentum” stems from Newtonian physics, in which a body moving through space will not change trajectory or velocity unless acted on by another force, and in which bodies of greater mass or velocity require more energy to impose change. Nevin and his colleagues argued that behavior functions in the same way, in that an individual engaged in a behavior will continue to engage in a behavior until outside variables enact a change. This change may come in the form of a consequence (for example, a child stops screaming when given a cookie) or an antecedent (hunger satiation makes a cookie less

reinforcing, so a child stops screaming). The greater the strength of a behavior, the greater the strength of the influencing variable is required to change that behavior.

Out of behavior momentum came a series of studies by Mace and colleagues (1988) now known as the high-probability, or high-p sequence. The high-p sequence is a method which is used to increase compliance and reduce escape-maintained behaviors, wherein an individual is asked to complete a rapid series of three to four high probability behaviors; following the completion of these behaviors, the individual is asked to complete a low probability behavior (Lee, 2005). When preceded by a series of high probability behaviors, compliance to the low probability demand is much more likely to occur than if the demand occurred by itself. Additionally, escape-maintained behaviors that were observed to follow the demand in baseline phases are less likely to occur (Mace et al., 1988). They argued that compliance to a rapid series of high probability demands increased the probability of all compliance, building up “momentum” for all future compliance.

A great deal of research has indicated that compliance to low-p requests is improved when they follow a series of brief, highly preferred or highly probable activities (Davis & Reichle, 1996; Horner, Day, Sprague, O’Brian, & Heathfield, 1991; Mace et al., 1988). The exact mechanisms for the high-p sequence are still a subject of debate (see Brandon & Houlihan, 1997; Houlihan & Brandon, 1996; Nevin, 1996), but the effect itself is well established.

Task interspersal is procedurally very similar to the high-p sequence. Both use a series of highly probable behaviors to increase the likelihood of a low probability behavior. The difference between task interspersal and the high-p sequence is that high-p sequences attempt to increase the probability of a behavior that is already mastered, while task interspersal attempts to facilitate the probability of a behavior that is still under acquisition (i.e., facilitate learning). Experts have argued that the underlying mechanisms for the high-p sequence are the same as those for task interspersal.

The benefits of task interspersal, then, may not be a facilitation of skill acquisition directly, but instead may increase compliance and decrease escape, which subsequently leads to more learning. A number of theories have been proposed to better explain this phenomenon. Skinner (2002) proposed the discrete task completion hypothesis, wherein repeated completion of a task paired with reinforcement for completion results in work completion becoming classically conditioned to be automatically reinforcing. Laraway, Snyderski, Michael, and Poling, (2003) proposed a similar hypothesis, suggesting that task interspersal serves as an abolishing operation for escape. Difficult tasks are naturally more aversive, making escape more desirable. By presenting a higher proportion of less aversive, easy tasks, escape becomes less desirable. Numerous studies on task interspersal have indicated that students prefer it to constant arrangement procedures (see above). In a number of studies, students with the language to do so directly stated that constant procedures were more aversive, as in Cooke and Reichard (1996). Data on student preference serves to support the abolishing operation hypothesis, as the students' reports of preference indicate that task interspersal is less aversive, and thus escape is less valuable during these tasks.

If task interspersal serves as an abolishing operation for escape, then it stands to reason that its benefits would be most apparent for individuals with high rates of escape. To date, however, only two studies have attempted to measure rates of escape-maintained behavior during task interspersal. Henrickson et al. (2015) and Nicholson (2013) both found comparable levels of escape-maintained behavior across all conditions. However, both indicated that all participants engaged in minimal escape-maintained behavior in baseline already, so that if there were any effects, they could not be observed. Volkert et al. (2008) used an extinction procedure for escape, but did not report results on behavioral data.

Overall, there is a paucity of research examining the effects of task interspersal on escape-maintained behavior. Given the amount of instructional time lost due to escape-maintained behavior (Wharton-McDonald, Pressley & Hampston, 1998), task interspersal may prove to be more efficient than constant procedures for the subset of the population who are not attending to begin with. If so, then it

would demonstrate that task interspersal is in fact an efficient and valuable procedure, but for specific individuals. Additional research is needed on the efficiency of task interspersal relative to constant procedures for individuals who engage in high rates of escape-maintained behavior.

Purpose of the Present Study

The purpose of the present study was to determine the efficiency of task interspersal for teaching novel skills to children with autism with both high rates and low rates of escape maintained behavior. First, a number of studies have suggested that task interspersal is less efficient than traditional concurrent training methods in teaching novel acquisition tasks. However, given task interspersal's procedural similarity to the high-p sequence, it may serve to reduce escape-maintained behaviors during instruction. The reduction of escape-maintained behavior may subsequently lead to more time spent on instruction, and thus be a more efficient strategy for individuals who engage in high rates of behaviors with the function of escape. In order to address these concerns, the present study will be guided by the following research questions.

Research Questions.

Question 1: What is the effect of task interspersal on the rate of acquisition of novel skills relative to rate of acquisition of novel skills during concurrent training for children with high rates of escape-maintained behavior?

Previous literature has suggested that task interspersal is less time efficient than concurrent training, though evidence has been mixed (Rapp & Gunby, 2016). Research has yet to compare the two methodologies for subjects who engage in high rates of escape maintained behavior, however. Laraway, Snyckerski, Michael, and Poling, (2003) suggested that task interspersal may serve as an abolishing operation for the reinforcing quality of escape, and in turn increase overall learning efficiency. It is hypothesized that for children with high rates of escape maintained behavior, a concurrent training procedure will be less efficient as instructional time (and consequently, learning) will be lost.

Question 2: What is the effect of task interspersal on the rate of escape-maintained behavior during the presentation of novel targets relative to the rate of escape-maintained behavior during concurrent training for children with high rates of escape-maintained behavior?

While task interspersal has been conceptualized as a procedure intended to increase response accuracy to novel targets, it shares its theoretical foundations with behavior momentum (Clinton & Clees, 2015). Both use a rapid presentation of mastered, high probability targets to increase the likelihood of the desired target response. Behavior momentum has robust research demonstrating its efficacy at increasing compliance to low probability behaviors (Cowen, Abel & Candel, 2017). As task interspersal is procedurally similar to behavior momentum, it is hypothesized that it will result in a decrease in escape maintained behavior relative to concurrent training procedures.

Question 3: What are the differential effects of task interspersal and concurrent training on the rate of acquisition of novel skills for children with high rates of escape maintained behavior relative to children with low rates of escape maintained behavior?

Recent literature comparing rates of learning over time for task interspersal and concurrent training have indicated that task interspersal is less time efficient relative to concurrent training (Rapp & Gunby, 2016). However, these studies either included participants who demonstrated low rates of problem behavior (as in Nicholson, 2013), or did not report any data on problematic behavior (as in Volkert et al., 2008). Given that task interspersal is procedurally similar to behavior momentum and the high-p sequence, any increase in learning efficiency may be dependent on the reduction of problematic behavior. It is hypothesized that children with low rates of escape-maintained behavior will demonstrate greater learning efficiency during concurrent training, while children with high rates of escape maintained behavior will demonstrate greater learning efficiency with task interspersal.

Rationale for Single Subject Design

In order to answer the above research questions, a single subject experimental design will be employed. Specifically, an alternating treatment design will be used to compare three different treatment conditions. Visual analysis will be employed in order to answer the research questions above. The purpose of this section is to briefly explain single case research methodology, the standards of practice, and the procedures for visual analysis.

Single case research methodology. Single case research methodology, also referred to as single subject experimental design, is an experimental examination of the causal relationships between independent and dependent variables (Horner et al., 2005). It employs within and between subject comparisons in order to establish internal validity, and requires systematic replication within the study, as well as across studies, in order to enhance external validity (Martdia, Nelson, & Marchand-Martella, 1999). Horner et al. (2005) outlines seven critical components of single subject design: (a) the individual as a unit of analysis, (b) participant and setting description, (c) dependent variable, (e) independent variable (f) baseline/comparison condition, and (g) visual analysis.

The first important concept of single subject design is that the individual is the unit of analysis. While a good design will include multiple participants, each participant serves as their own control. A measurable quality of that individual is evaluated prior to and after the application of an independent variable. Replication of the application of the independent variable is necessary to demonstrate experimental control, which can be done using a variety of designs. The most common design is the A-B-A-B design, in which an independent variable is applied and removed repeatedly. Consistency of data across similar conditions (with a difference between alternate conditions) serves to establish experimental control and a causal relationship.

Second, a good design requires operational descriptions of participants, settings, and processes for selection. This step is crucial for replication and comparison across studies. As replication across

studies serves to enhance external validity, specific descriptors of these variables are essential to ensure high quality replication is possible.

Third, the dependent variables which are measured must be clear and operationally defined. In order to establish both internal and external validity, these need to be specific, and defined clearly by topography or function. Horner et al. recommends the following characteristics. First, the definition of the dependent variables must be operationally defined as to allow for both valid and consistent assessment of the behavior and replication of the process. A dependent variable must be defined to such a degree that regardless of who is observing the behavior, all individuals observing would collect the same data. This can be determined by meeting Horner et al.'s second criteria for the dependent variable, which is that it must be assessed for consistency. This is done by collecting inter-observer agreement (IOA) data, in which two or more observers independently record data and compare results. Typical acceptability for IOA is a minimum of 80% agreement. Third, dependent variables are measured repeatedly within and between conditions. Repeated measures are necessary within conditions to establish consistency of responding, and between conditions in order to establish an effect of the independent variable.

Next, is the independent variable, which is the variable manipulated by the experimenter in order to produce an effect. Frequently, this is an intervention. The independent variable must also be precisely and operationally defined for the purpose of replication. It must also be actively manipulated by the experimenter (ex. Gender cannot be manipulated), so that experimental control can be established. To establish internal validity, procedural fidelity must be collected to ensure manipulation of the independent variable occurred as described. Agreement for procedural fidelity is typically accepted at a minimum of 80%.

Baseline/comparison conditions describe the data points within each phase as delineated by a manipulation of the independent variable. Baseline refers to the data collected during which the independent variable was not present, while conditions refer to data collected under different manipulations of the independent variable. Data should be collected within each baseline and condition so

that a clear pattern of consistent behavior is established. Honer et al. recommends minimum of five data points per condition, though typically more are necessary to establish consistent responding.

Experimental control is established and allows for confirmation of a functional relationship between manipulation of an independent variable and change in the dependent variable with consistent and repeated demonstrations of the effect. Experimental control is determined via the following methods: “(a) the introduction and withdrawal (or reversal) of the independent variable; (b) the staggered introduction of the independent variable at different points in time (e.g., multiple baseline); or (c) the iterative manipulation of the independent variable (or levels of the independent variable) across observation periods (e.g., alternating treatments designs)” (Horner et al., 2005, p. 168).

The primary method of determining causal effect of the independent variable in single subject design is visual analysis. Kratochwill et al. (2010) lays out four steps in conducting visual analysis: (1) a predictable and stable baseline should be established, (2) the data should be examined to identify within phase or within condition patterns, (3) to determine an effect of the independent variable, the data between phases or conditions should be examined in order to identify a clear and predicted difference between the phases or conditions, and (4) data should be combined from steps 1-3 in order to show at least three demonstrations of the effect at different points in time.

Additionally, six features of the graph are to be examined in order to determine within and between phase/condition patterns during visual analysis. These six features are level, trend, variability, immediacy of effect, overlap, and consistency of data patterns across similar phases. Level refers to the mean score as measured on the Y-axis of the data points. In baseline, a stable baseline should be established, with little variability of the data on the Y-axis, while during intervention, the data path should deviate from the level in a predictable direction. Larger amounts of variability during baseline may require more data points in order to establish a stable baseline, though depending on the behavior, larger variability in the baseline can be acceptable if it is predictable. Trend refers to the direction of the data points around the line of best fit in a given phase. A clear trend in one direction can indicate an effect if

the trend deviates from baseline and/or other conditions and phases. Variability refers to the mean and standard deviation of data points around the line of best fit in a phase. More variability suggests less experimental control, and thus less of a predictable effect. Immediacy of effect describes how rapidly the onset of change occurs between phase changes or conditions. A more rapid change indicates a stronger effect of the independent variable. Overlap refers to the extent in which data points share the same level and trend between phases or conditions. Greater overlap suggests a smaller or no effect of the independent variable. Lastly, consistency of data in similar phases requires examining the data paths of phases that share a condition within a participant and across participants. A consistency in the level, trend and variability indicates greater experimental control. Consistency of data across phases is less applicable with non-reversible dependent measures (such as skill acquisition) because a return to baseline phase cannot be initiated. In alternating treatment designs, consistency of data is either determined across multiple baselines or participants.

If visual analysis indicates a difference between conditions or phases, Kratochwill et al. (2010) recommends calculating effect size in order to quantitatively represent meaningful significance. The effect size test statistic used depends on the design. A number of effect size statistics have been proposed for single subject design, though the utility and appropriateness of each is still an area of contentious debate among single subject researchers (Parker, Vannest & Davis, 2011).

The Tau-U effect size statistic is a commonly used statistic which is derived from non-overlap effect size calculators (Parker, Vannest, Davis & Sauber, 2011). Non-overlap techniques involve calculating the number of all contrasted pairs of data points between a baseline phase and a condition phase. The resulting statistic indicates the percent of separation between two data paths. In order to interpret the meaningfulness of the separation, however, it is also important to compare the average of each data path. The Tau-u effect size differs from other non-overlap calculations as it also calculates for potential trends in baseline data (ex, improvement in the behavior without intervention).

Tau-u is calculated using the following methods. First, all data points in one phase are contrasted with all data points the other phase. The number of contrasts can be calculated by multiplying the total n data points of one phase with the total n data points of the other. For example, if an AB design had 15 baseline data points and 20 intervention data points, there would be a total of 300 contrasts. Next, each contrasted pair is coded as either a positive change (+), a negative change (-) or tied (T). Next, percent non-overlap, S_{novlap} (both phases) and baseline trend, S_{trend} (only Phase A) are calculated using a Kendall Rank Correlation module (KRC; #pos - #neg). Finally, the Tau-u statistic is calculated as follows: $(S_{novlap} - S_{trend}) / \#Pairs$ (Parker, Vannest, Davis & Sauber, 2011). This will provide a number between -1.00 and 1.00 indicating the percent of non-overlapping data points while accounting for baseline trend.

Chapter 3: Methods

Introduction

The following chapter will describe in detail the methods used for the study. This study was conducted in three phases: the recruitment phase, a functional behavior assessment and functional analysis of problem behavior, and the intervention. This chapter is organized into three sections, with one section covering each phase. The first section covers the recruitment phase, which will cover recruitment strategies and initial participant data collection for exclusionary criteria. The second section will cover the pre-experimental assessment phase, which will include the measures, materials and procedures for the skills-based assessment and functional analysis of the reported problematic behavior. The third section will cover the proposed experiment, which will include a description of the experimental design, as well as the measures, materials, operationally defined dependent and independent variables, and procedures of the study. See figure 3 for a graphic describing the three phases, the purposes and procedures for each phase, and the criterion to move to each consecutive phase.

Experimental Design. The design selected for the present study was a single case, parallel treatments design (Gast & Ledford, 2014). The parallel treatments design was devised in order to compare instructional strategies for non-reversible behaviors (Gast & Wolery, 1988). It can be conceptualized as two concurrent multiple probe designs, with each examining a different strategy on a set of targets from the same behavioral domain (ex: tacting, matching, etc.), where targets are of equal difficulty. All other variables with the exception of treatment are held constant, and the application of each intervention is alternated during the same phase, so that no treatment is presented twice consecutively. Once mastery criterion for a set of targets is met, a second set of targets for each strategy is probed, and the procedure begins again with these new targets. Best practices for demonstrating experimental control is to demonstrate a consistent pattern of responding (ex: rate of learning) across at least three sets of targets.

Recruitment

Setting

Participants were recruited from an Early Childhood Special Education classroom in the mid-Michigan area. All participants were recruited from the same classroom. Students were either enrolled in the morning session (8:30-11:30) or the afternoon session (12:30-3:30). Both sessions had one teacher and two paraprofessionals. The morning session had eight enrolled students, while the afternoon session had three enrolled students. The study took place in the classroom during the functional behavior assessment, and in an adjacent empty room during the intervention. Both settings included a child sized table and chairs. During all sessions, the examiner was seated beside the participants.

Inclusionary Criteria

Participants had to meet following inclusionary criteria: (a) between the ages of 3:0 and 5:11, (b) have a clinical diagnosis of autism spectrum disorder (ASD), or qualify for special education services under an autism eligibility or an early childhood developmental delay (ECDD) eligibility, (c) a Gilliam Autism Rating Scale, 3rd edition (GARS-3) composite score of 55 or greater, indicating probable autism, (d) must have had exposure to a clinical or academic setting with a minimum of three hours per day, four days per week for at least one year, and have worked with the referring teacher or clinician for a minimum of six months, and (e) half of participants must engage in problem behavior for approximately 50% of one-on-one instruction, as measured by a brief functional analysis for escape maintained behavior. Four participants were recruited and completed the study. Two participants met the criteria for high rates of escape maintained behavior, and two had low rates of escape maintained behavior. A fifth participant was recruited but was removed from the study prior to completion due to an increase in physical aggression during the intervention component of the study and in the classroom.

Recruitment Materials

The following materials were be used for recruitment and data collection of participant characteristics. First, a resource packet including information and purpose of the study for parents and teachers was be distributed for the purposes of recruitment. A consent form was provided for parents who were interested, including a more specific description of the study, procedures, advantages and potential disadvantages, compensation, data collection and storage information, participant rights, and a consent signature page. Individuals who consented to the study received a demographics form in order to collect additional information on participant medical and psychological history, including diagnoses, medication, and family history, as well as basic parent demographics including age, education, and employment information. Information on the participant's current academic or clinical services, including type and duration of services was collected for inclusionary purposes. Finally, this demographics form also included a section to attach documentation of the participant's medical diagnosis of autism. In addition to these materials, the following instruments were used for participant characteristics following consent.

Gilliam Autism Rating Scale, third edition (GARS-3). The GARS-3 is a norm-referenced assessment tool used in identifying ASD in children ages 2 to 22 years old. It also helps in describing the severity of the disorder. The instrument consists of 42 items across three domains: Stereotyped Behavior, Communication and Social Interaction, and provides an autism index score with a mean of 100 and a standard deviation of 15. Reliability coefficients range from .80 to .90 across all subscales and the autism index score (Gilliam, 2006).

Verbal Behavior Milestones Assessment and Placement Program. The VB-MAPP is a criterion based assessment which directly assesses early behavior milestones in functional and adaptive communication relative to expected developmental milestones from 0 to 48 months of age. The assessment takes approximately two to three hours to complete. The participant is probed for specific, criterion based skills ascending in difficulty to determine their level of competency in each skill. The VB-MAPP differs from more standardized assessments in that it is more specific to the skills and behaviors

being measured, as opposed to measuring broader psycho-social constructs. Given the specificity of the skills assessed, there is limited research on the reliability and validity of the instrument (Gould, Dixon, Najdowski, Smith, & Tarbox, 2011). However, it is one of the most common tools in early assessment as it identifies specific skill deficits to be targeted for intervention. This instrument was selected for its specificity in the identification of target skills for the present study.

Mullen Scales for Early Learning (MSEL). The Mullen Scales for Early Learning is a standardized instrument which measures general cognitive, motor, and language ability (Mullen, 1995). It provides a global cognitive measure, as well as subscale measures across five domains: gross motor, fine motor, visual perception, expressive language and receptive language. The test requires an estimated 45-60 minutes to administer. Reliability is greater than 80% for three of the subscales, and is .79 and .75 for the visual reception and fine motor subscales, respectively. Construct, concurrent and criterion validity range from .72 to .85.

Vineland Adaptive Behavior Scales, 3rd edition (Vineland-3). The Vineland-3 is a behavior rating scale which measures functional adaptive behavior across five domains. (Sparrow, Cicchetti & Saulnier, 2016). Domains include communication, daily living skills, socialization, motor skills and maladaptive behaviors. Each domain is comprised of a number of skill-based items relative to that domain, rated on a three point Likert rating scale. Reliability ranges from .74 to .93 across all domains for both comprehensive and domain level forms.

Other materials. Additional materials included Narrative Antecedent, Behavior, Consequence datasheets (Steege & Watson, 2009), partial interval time sampling data sheets, functional assessment data sheets (Hanley, 2012), paired choice preference assessment data sheets (Fisher et al., 1992), Inter-observer Agreement (IOA) datasheets, Procedural Integrity (PI) datasheets, VB-MAPP assessment kit with stimuli for probing each skill, preferred items and activities identified by parents and clinicians, non-preferred instructional activities identified by parents and clinicians, and child-sized table and chairs.

Additionally, a video camera was used to record all sessions in order to document intervention and later collect procedural integrity and inter-observer agreement data.

Participants

A Summary of participant demographics can be found in Table 1, and VB-MAPP scores for each participant can be found in Appendix B. Participant demographics were as follows.

Daren was a 4-year old, Caucasian male with a special education eligibility for ECDD. His Mullen Composite score of 78 was in the borderline range, while his Vineland-3 composite score of 61 was in the very low range. His overall VB-MAPP score was a 71.5, with most skills falling in the level 2 range (18-30 months). His GARS-3 composite score of 93 fell in the “very likely” range, requiring substantial support.

Ralphie was a 3-year, 7-month old, Caucasian male with a special education eligibility for ECDD. Additionally, he had a medical history significant for premature birth (25 weeks). His Mullen Composite score of 61 was in the very low range, while his Vineland-3 composite score of 89 was in the low average range. His overall VB-MAPP score was 116.5, with most skills falling in the level 3 range (30-48 months). His GARS-3 composite score of 59 fell in the “probable” range, with minimal support required. It is important to note that Ralphie’s composite score on the Mullen is likely not representative of his true cognitive abilities. Ralphie engaged in high rates of problem behavior during the assessment, and so did not respond to many of the targets. Given his higher VB-MAPP and Vineland scores, the Mullen is predicted to be an underestimate of his true cognitive abilities.

Brett was a 4-year, 2-month old, Caucasian male with a special education eligibility for ASD. Additionally, he had a medical history significant for ASD. His Mullen Composite score of 73 fell in the borderline range, while his Vineland-3 composite score of 72 also fell in the borderline range. His overall VB-MAPP score was 119, with skills falling between the level 2 (18-30 months) and level 3 (30-48 months) range.

Lizzy was a 4-year, 7-month old, Hispanic female with a special education eligibility for ECDD. Additionally, she had a medical history significant for speech and language delay. Her Mullen Composite score of 64 fell in the very low range, while her Vineland-3 Composite score of 77 fell in the borderline range. Her overall VB-MAPP score was 116, with most skills falling between the level 2 (18-30 months) and level 3 (30-48 months) range. Her GARS-3 Composite score of 79 was in the “very likely” range, requiring substantial support.

Functional Behavior Assessment

The purpose of the present study was to examine the effects of a task interspersal procedure on the rate of escape maintained behavior during instruction. Thus, a functional behavior assessment (FBA) was conducted in order to determine the function of problem behaviors as reported by the teacher. The FBA included (a) the Functional Behavior Assessment Screening Form, (b) a functional based, semi-structured interview, (c) a direct observation of the problematic behavior in an instructional setting to inform the functional behavior assessment.

Functional Behavior Assessment Screening Form (FBASF). The FBASF is an open-ended questionnaire developed by Steege & Watson (2009) which is used to identify student strengths, problematic behaviors and communication skills. This instrument was selected as it takes 10 minutes or less to complete, and serves as a screener for a broad range of potential problematic behaviors, which will be more directly and rigorously assessed during the pre-experimental assessment phase. This form was modified with an additional question asking the primary teacher to estimate the amount of academic or intervention time during which the participant engages in the problematic behavior.

Functional Based, Semi-structured Interview. Best practice of functional behavior assessment (FBA) first includes a semi-structured interview in order to collect data regarding the behavior, associated antecedents and consequences, and functional adaptive/communicative skills of the child (Cooper, Heron & Heward, 2014). The primary classroom teacher was given the Open-Ended Functional Assessment Interview (Hanley, 2012). This semi-structured interview takes approximately 30 minutes, and is

designed to collect qualitative, descriptive data on the interviewee's perceptions of a child's current abilities, preferred and non-preferred activities, topography of problem behavior, severity of problem behavior, and relevant antecedents and consequences (Hanley et al., 2014). Information collected during the interview is used to operationally define behaviors of interest, provide contextual data in developing and testing hypotheses for functional analysis, and identifying potential reinforcers for future procedures.

Observations. As part of the functional behavior assessment, the participant was observed in their typical, one-on-one environment with their primary instructor. This observation included a narrative antecedent, behavior, consequence (ABC) observation (Steege & Watson, 2007), in which the participant was observed for one, twenty minute instructional session. This session was selected based on data from the FBASF and the semi-structured interview indicating when the problematic behavior described was most likely to occur. A narrative ABC observation records each occurrence of the behavior, observed related antecedents, and observed related consequences to the behavior. Additionally, the observer records behaviors that are topographically similar to the behavior as described by the interviewee. The purpose of a narrative ABC recording is to provide direct observational data in order to operationally define the behavior of interest, as well as to collect direct, observational data on relevant antecedents and consequences (Steege & Watson, 2007). Based on the data collected from the FBASF, the semi-structured interview, and the narrative ABC observation, the behavior was operationally defined for each individual participant, based on following the guidelines in Cooper, Heron & Heward (2014) for a topographically based operational definition. Finally, partial-interval time sampling with 10 second intervals was conducted to measure percent of problem behavior as individually defined above. The purpose of this measure is to measure rate of potential escape maintained behavior in children with reported low rates of escape maintained behavior in order to confirm that no type of potentially escape maintained behavior is occurring at rates above 20% of observed intervals.

Preference Assessment. In addition to the FBA, a paired choice preference assessment was conducted to establish a hierarchy of reinforcer quality. Research has established high concurrent validity,

as well as test re-test reliability for this procedure (Fisher et al., 1992). The procedure was conducted as follows, adapted from the protocol established by Fisher et al., but with fewer stimuli. Based on reports by parents and clinicians/teachers, six reinforcers were selected. The participant was seated at a children's table opposite from the experimenter. Two reinforcers were presented to the participant in a left-right orientation, and the participant is asked to select one. When the participant selects one, the other was removed, and the participant's selection was recorded. The participant was allowed twenty seconds access to the reinforcer, at which point it was removed. This continued until all items have been paired with each other item twice in order to control for left-right preference. Selections were then rank ordered, with two items being identified as high preference, two items being identified as medium preference, and two items being identified as low preference.

Functional Behavior Assessment Results

Daren. The primary teacher indicated that Daren's problem behaviors during work included screaming, crying, pounding on the table, throwing materials, turning away from the instructor, saying "no," and leaving the table. The most relevant antecedents were transitions from play to any work demand, and prolonged work demands (the teacher noted he will work without problems for approximately five minutes). Consequences typically involved teachers in the classroom providing multiple prompts to continue and physical redirection to the table. If a task is not complete before transitioning to the next scheduled activity, the teachers would either require Daren to first complete the task, or transition, depending on the next activity. The teacher estimated that Daren engages in problem behavior for more than 50% of instruction time. During the observation, Daren engaged in problem behavior for 26/74 intervals (34.13%). Problem behavior most frequently included saying "no," and turning away from the instructor.

Ralphie. The primary teacher indicated that Ralphie's problem behaviors during work included leaving the table, screaming, throwing materials, saying no, and turning his body away from the teacher. The most relevant antecedents were any transitions, and any work demand, regardless of difficulty.

Consequences typically involved teachers in the classroom providing multiple prompts to continue and physical redirection to the table. If a task is not complete before transitioning to the next scheduled activity, the teachers would either require Ralphie to first complete the task, or transition, depending on the next activity. The teacher estimated that Ralphie engages in problem behavior for more than 50% of instruction time. During the observation, Ralphie engaged in problem behavior for 22/60 intervals (36.67%). Problem behavior most frequently included saying “no,” running away from the table, and throwing task materials.

Brett. The primary teacher indicated that Brett’s problem behaviors during work included screaming, crying, saying “no” or “I don’t want to,” and leaving the table. The most relevant antecedents were demands which Brett struggles with, which most often include fine motor tasks such as peg boards and shape sorter tasks. Consequences typically involved teachers in the classroom providing multiple prompts to continue and physical redirection to the table. If a task is not complete before transitioning to the next scheduled activity, the task is removed and Brett is asked to transition. The teacher noted that Brett rarely engages in problem behavior, estimating the occurrence to be less than 10% of instruction time. During the observation, Brett engaged in problem behavior for 1/53 intervals (1.88%). During this instance, Brett was presented with a matching task. Brett turned his body away from the task. The teacher verbally redirected Brett, after which Brett began working on the task.

Lizzy. The primary teacher indicated that Lizzy’s problem behaviors included crying, leaving the table, singing (defined by the teacher as babbling in a sing-song tone), and playing with her fingers. The most relevant antecedents were demands which Lizzy struggles with, which most often include labeling tasks. Consequences typically involved teachers providing multiple prompts to continue and redirection to the table. If a task is not complete before transitioning to the next scheduled activity, the task is removed and Lizzy is asked to transition. The teacher noted that Lizzy occasionally engages in problem behavior, estimating the occurrence to be between 10% and 20% of instruction time. During the observation, Lizzy

engaged in problem behavior for 5/60 intervals (8.3%). Problem behavior included speaking non-sense words in a sing-song tone, and walking (alternating like steps) index and middle fingers along the table.

Functional Analysis

In order to empirically derive the function of the operationally defined behavior, a functional analysis (FA) was conducted for each participant following the protocols established by Iwata et al., (2000). As the purpose of this functional analysis is to determine if escape is one function of the behavior, only an escape and a control condition were utilized. Escape is often accompanied by secondary functions, though for the purpose of this study, it was not necessary to determine if secondary functions exist, as long as escape is one function of the problematic behavior.

The procedure for the functional assessment was as follows. The dependent variable for the functional assessment was be the percentage of intervals in which the operationally defined behavior occurs as measured by a partial interval time sampling procedure using 10 second intervals. The independent variable was the condition. The conditions were escape and control (Iwata et al., 2000). During each session, all non-targeted, non-problematic behaviors were ignored. All conditions began with the student being led into the classroom individual work space, with child sized tables and chairs, and being seated at the table.

Procedures continued until a stable rate of responding is elicited in each condition, with a minimum of three sessions per condition. In order to determine if escape was a function of the behavior, a visual analysis of the data in each condition was conducted. Escape was determined to be a function of the behavior if there was a clear difference in level and trend between the two conditions, with consistent data, minimal variability, and minimal overlap between the two conditions.

Additionally, the functional analysis was used to establish a baseline level of problematic behavior during the escape condition. In order to establish baseline level of behavior, the percent of

intervals during which direct instruction was provided in which the individual engaged in escape will be calculated.

Escape Condition. During the escape condition, the participant is told to complete an undesirable activity (as determined by FBA assessment data), during which the experimenter provides direct instruction and prompting, without reinforcement for correct responding. The undesirable activity is removed for 15 seconds following the occurrence of the target behavior, but the experimenter does not provide any additional attention. Following 15 seconds of escape, the task is returned and the Sd for the task is represented.

Control Condition. During the control condition, the participant is given full access to a highly preferred item and constant attention throughout the entire session. All instances of the target behavior are ignored.

Each condition was be presented once or twice per day, for a total of two to four conditions per day. The order of the presentation of conditions each day was randomized using an excel algorithm. Functional analysis continued until the participant established consistent responding to the control condition and at least one other condition (Horner et al., 2005). Participants who engaged in the operationally defined behavior during approximately 50% of observed intervals once behavior was stable were put into the high escape group, while those who engaged in approximately 30% or less were put into the low escape group.

Procedural integrity. In order to meet the standards of a single subject design as set by Kratochwill et al. (2010) and Horner et al. (2005), procedural integrity (PI) was collected on 30% of all FA sessions. Procedural integrity is defined as “the extent to which the independent variable is implemented and carried out as planned (Cooper, Heron & Heward, 2014, p. 235).” The experimenter randomly selected 30% of all FA sessions and provided a secondary observer trained in the protocols with video recordings of those sessions, as well as a categorical checklist of each step of the FA procedures.

Procedural integrity is acceptable when 80% of procedures have been followed as prescribed (Pereplechikova & Kazdin, 2005). Procedural integrity was within acceptable limits for all participants. See table 7 for procedural integrity data.

Inter-observer agreement. In order to meet the standards of a single subject design as set by Kratochwill et al. (2010) and Horner et al. (2005), inter-observer agreement (IOA) was collected on 30% of all FA sessions and 30% of all partial interval time sampling observations of the behavior in one-on-one instructional settings. IOA is defined as “the degree to which two or more independent observers report the same observed values after measuring the same events (Cooper, Heron & Heward, p. 113).” The experimenter randomly selected 30% of all FA sessions and all partial interval time sampling observations and provided a secondary observer trained in the protocols and measures with video recordings of those sessions, as well as a data-sheet for each observation. To calculate IOA, the experimenter used the Exact Count per Interval IOA method from Cooper, Heron & Heward (2007), which is calculated by dividing the number of intervals of shared agreement by the total number of observed intervals and multiplying by 100 to obtain a percent agreement. 80% IOA is acceptable when 80% of observed data-points are in agreement. IOA was within acceptable limits for all participants. See table 7 for procedural integrity data.

Functional Analysis Results

The definitions of escape maintained behavior were defined individually for each participant based on the teacher interview and behavioral observation. The functional assessment results are as follows. For three of the participants, there was a clear separation of the data paths of the two conditions, demonstrating that the behaviors as defined were a function of escape. Brett did not demonstrate a clear separation of data paths, as he did not engage in escape maintained behavior during either condition. Of the four participants, two (Daren and Ralphie) engaged in escape maintained behavior for an average of 50% or greater of observed intervals once behavior was stable. The other two participants (Brett and Lizzy) engaged in escape maintained behavior for fewer than 30% of observed intervals on average.

Based on this data, Daren and Ralphie were placed in the high escape group, while Brett and Lizzy were placed in the low escape group.

Daren. Daren's escape maintained behavior was defined as follows: *Student turns head/body greater than 90 degrees from therapist, pushes body away from table, stands and moves in a direction away from activity, cries (scream, moan or wail with or without tears), says "no" or a similar verbal refusal, grabbing/pulling stimuli from therapist hands, throws or pushes stimuli away from body. Non-examples include reaching for an activity stimulus under the table, sitting on therapists lap, responding to task demands while standing but not moving away from activity.* During the control condition, Daren was given access to a ball maze toy and attention from the examiner. During the escape condition, Daren worked on labeling numbers.

Results from the functional analysis can be found in Figure 3 under the *functional analysis* phase of the graph. The results indicated a clear separation of data paths between the two conditions. Stability across both conditions was achieved by the eighth session for the control condition and the ninth session for the escape condition. During the control condition, Daren engaged in low rates of escape maintained behavior ($M = 1.11$, Range = 0 – 6.67), with an average of 0 percent escape behavior across the last four sessions. During the escape condition, Daren engaged in high rates of escape maintained behavior ($M = 38.03$, Range = 6.66 – 55). Rates of escape were variable during the first six sessions, but became stable during the last three, with an average of 52.54, and a range of 50 – 55 percent of observed intervals.

Ralphie. Ralphie's escape maintained behavior was defined as follows: *Student turns head/body greater than 90 degrees from therapist, pushes body away from table, stands and moves in a direction away from activity, cries (scream, moan or wail with or without tears), says "no" or a similar verbal refusal, grabbing/pulling stimuli from therapist hands, throws or pushes stimuli away from body. Non-examples include reaching for an activity stimulus under the table, sitting on therapists lap, responding to task demands while standing but not moving away from activity.* During the control condition, Ralphie

was given access to a ball maze toy and attention from the examiner. During the escape condition, Ralphie worked on labeling numbers.

Results from the functional analysis can be found in Figure 4 under the *functional analysis* phase of the graph. The results indicated a clear separation of data paths between the two conditions. Stability across both conditions was achieved by the fourth session for both conditions. During the control condition, Ralphie engaged in low rates of escape ($M = 3.33$, Range = 0 – 10). During the escape condition, Ralphie engaged in high rates of escape ($M = 55.08$, Range = 34.61 – 66.67). Rates became stable during the last three sessions, with an average of 61.90 and a range of 52.38 – 66.67 percent of observed intervals.

Brett. Brett's escape maintained behavior was defined as follows: *Student turns head/body greater than 90 degrees from therapist, pushes body away from table, stands and moves in a direction away from activity, cries (scream, moan or wail with or without tears), says "no" or a similar verbal refusal, grabbing/pulling stimuli from therapist hands, throws or pushes stimuli away from body. Non-examples include reaching for an activity stimulus under the table, sitting on therapists lap, responding to task demands while standing but not moving away from activity.* During the control condition, Brett was given access to a ball maze toy and attention from the examiner. During the escape condition, Brett worked on labeling numbers.

Results from the functional analysis can be found in Figure 5 under the *functional analysis* phase of the graph. The results did not indicate a clear separation of data paths across conditions, as Brett did not engage in high rates of escape in either condition. This is consistent with teacher reports of Brett's behavior. Stability was achieved by the third session across both conditions. During the control condition, Brett did not engage in the defined behavior in any observed intervals ($M = 0$, Range = 0 – 0). During the escape condition, Brett engaged in low rates of the defined behavior ($M = 0.68$, Range = 0 – 3.44). Given this outcome, the function of the defined behavior cannot be confidently hypothesized to be escape. Brett

was placed in the low rates of escape group, but results related to the function of observed behavior as defined must be interpreted with caution.

Lizzy. Lizzy's escape maintained behavior was defined as follows: *Student turns head/body greater than 90 degrees from therapist, pushes body away from table, stands and moves in a direction away from activity, cries (scream, moan or wail with or without tears), says "no" or a similar verbal refusal, grabbing/pulling stimuli from therapist hands. Engages in stereotypy/scripting including speaking non-sense words in a sing-song tone and/or walking (alternating like steps) index and middle fingers along the table or through the air. Non-examples include reaching for an activity stimulus under the table, sitting on therapists lap, responding to task Sd while standing but not moving away from activity, saying correct response in sing-song tone.* During the control condition, Lizzy was given access to Play-Doh and attention from the examiner. During the escape condition, Lizzy worked on labeling numbers.

Results from the functional analysis can be found in Figure 6 under the *functional analysis* phase of the graph. The results indicated a clear separation of data paths between the two conditions. Stability in the control condition was achieved by the third session. Stability was not met for the escape condition, as an upward trend was observed during the final session. However, the functional analysis was discontinued due to the participant's extended absence following session three. Therefore, the data indicates that the behavior is a function of escape, but a consistent baseline was not established to determine the rate of the behavior. During the control condition, Lizzy did not engage in escape maintained behavior during any intervals ($M = 0$, Range = 0 – 0). During the escape condition, Lizzy engaged in moderate rates of escape maintained behavior ($M = 29.15$, Range = 23.33 – 40).

Experiment

The following section describes the experimental design for the current study. This section will review the measures, materials, operationally defined dependent and independent variables, and procedures of the interventions.

Design. The design selected for this study was a single case, parallel treatments design. This design alternated between two intervention conditions (task interspersal and concurrent training) across three phases, phase A, B and C, in order to demonstrate replication. Each phase consisted of a baseline probe and intervention. Six acquisition targets were taught in each phase, with three targets per condition, matched for difficulty. A phase continued until mastery criterion was met for one of the conditions, at which point that phase will end, and the next phase will begin. Mastery criterion was defined as 90% or greater correct independent responding within a session.

Setting. The setting for the experimental phase was an empty room adjacent to the primary classroom. It consisted of a child sized table and two child sized chairs. Selected reinforcers were placed within eye sight but out of arms reach of the participant, directly across the table. A 12-piece token board was placed directly in front of the participant.

Materials. Materials included 52 laminated alphabet flash cards (26 upper case, 26 lower case) that were 3” by 3” in size, with a white background and black letters printed in size 160 Century Gothic font, pre-intervention probe data sheets, condition probe data sheets, preference assessment data sheets, intervention data sheets, selected reinforcers, pens, and a timer. Additionally, each individual had three mastered activities that were provided by the teacher and probed for mastery before the onset of the study to serve as the interspersed targets. These are listed below under targets for each individual. A video camera was used to record all sessions in order to document intervention and later collect procedural integrity and inter-observer agreement data.

Measures. Several measures were collected in order to determine effectiveness and efficiency of the intervention conditions, to determine when targets have been mastered, and to measure escape-maintained behavior. These measures included trial data, duration of session, and escape-maintained behavior data.

Independent Variable. The independent variable for the present study was the intervention conditions employed. Two conditions were been selected. The first condition was a concurrent trial procedure (Rowan & Pear, 1985), hereafter referred to as the concurrent condition. The second condition was an additive task interspersal procedure in which three mastered targets are interspersed for every one acquisition target, and interspersed mastered targets are reinforced with praise only, hereafter referred to as the TI condition.

Dependent Variables. Several dependent measures were used in order to determine the effectiveness and efficiency of each intervention condition. These dependent measures are percent of correct independent responses per session, sessions to mastery, rate of escape-maintained behavior, and cumulative duration.

Percent correct independent responses. Every trial within a session was scored. This is a measure of a participant's performance on any given trial. The possible codes for performance were correct independent (+), correct with prompt (+P), incorrect (-), incorrect after prompt (P-), and no response (NR). Additionally, the level of prompt in the prompt fading procedure was coded when prompting occurs (Coded P1, P2, and P3). Only correct independent responses were counted towards mastery; however, correct responses with prompting were used to determine when to fade prompts (see prompt fading, below). Mastery criteria was determined based on percent independent responding for a set of three targets, at a level of 90% accuracy (11/12 correct). This indicates that a student responded correctly to 4/4 presentations for two targets and at least 3/4 presentations of the third target.

Sessions to mastery. Sessions to mastery indicated the total number of sessions, which are comprised of four presentations of three targets, until mastery criteria was reached for one condition.

Rate of Escape-maintained Behavior. Escape-maintained behavior was a measure of the operationally defined behavior determined to serve as a function of escape based on the FBA and FA (see above). This was measured using a partial interval recording system with 10 second intervals. Intervals

began at the initiation of the first instruction, and completed at the completion of the last trial. Partial interval recording is a behavioral measurement system in which a duration of time is divided into equal intervals (10-s), and an individual is observed for instances of behavior during each interval. If the defined behavior occurs at any point during an interval, that interval is marked with a (+), otherwise it is marked with a (-). The measure is computed by dividing the total number of intervals in which the behavior occurred (+) by the total number of intervals observed. The resulting measure is a percent of intervals during which a behavior was observed, ranging from 0% to 100%. Partial interval recording is a reliable and valid way to measure behavior which cannot be calculated by event based recording (counting) due to the behavior lasting for variable lengths of time, and/or having no clearly definable beginning or end (Cooper, Heron & Heward, 2014).

Rate of acquisition. Rate of acquisition was calculated as the average increase in percent correct per minute, or the slope of the trend line of each data path. The rate of acquisition was compared across conditions to determine which condition produced a faster rate of learning.

Cumulative duration. Cumulative duration consisted of the total time spent in a single condition. The total duration of each consecutive session was measured, and then the total duration of all previous sessions was added to a given session to calculate the cumulative duration of treatment for each session.

Maintenance Probes. Tests for maintenance of mastered targets were conducted approximately two weeks after all sessions were completed for any given data set. These sessions were conducted in the same manner as the Concurrent Training Condition. The percentage of correct trials were calculated per condition.

Procedural Integrity. In order to meet the standards of a single subject design as set by Kratochwill et al. (2010) and Horner et al. (2005), procedural integrity (PI) was collected on 30% of all experimental sessions. Procedural integrity followed the same guidelines as described in the pre-

experimental assessment phase, above. Procedural integrity was within acceptable limits for all participants. See table 7 for procedural integrity data.

Inter-Observer Agreement. In order to meet the standards of a single subject design as set by Kratochwill et al. (2010) and Horner et al. (2005), inter-observer agreement (IOA) was collected on 30% of all sessions for trial data and escape-maintained behavior. Inter-observer agreement followed the same guidelines as described in the pre-experimental assessment phase, above. IOA was within acceptable limits for all participants. See table 7 for procedural integrity data.

Procedure. The following section describes the procedures of the experiment. This includes (a) general methods, which will be employed across all conditions, and (b) a description of each condition.

Targets. Based on participant VB-MAPP scores as well as input from the primary teacher, the targets selected for the intervention were tacting letter names for Brett and Lizzy and tacting letter sounds for Daren and Ralphie.

Pre-intervention Probes. Prior to the start of the experiment, an assessment was conducted to identify specific targets that each participant did not respond to correctly, referred to as acquisition targets. The assessment sessions consisted of 26 trials each. Sessions continued until 18 acquisition targets were identified. During the pre-experimental assessment, no prompts or error correction was provided. If a participant gave a correct response to a target, they were provided with praise. Each target was probed twice during this phase. If a child failed to respond correctly to both presentations, the target was selected for intervention.

Quasi-Random Assignment. Once 18 acquisition targets were identified, nine targets were assigned to each condition, with three targets being assigned to one of three phases, using a random sort algorithm in Microsoft Excel. Each phase included a set six targets, with three targets per condition. Targets in each set of a phase were taught together in that phase, with a separate set of three being taught in each condition. This six sets will include set A-Task Interspersal (A-TI), set A-Concurrent Training

(A-CT), set B-TI, set B-CT, and set C-TI, set C-CT. See Table 2 for a full list of mastery and acquisition targets by participant.

General Methods. Two to six sessions were run per day, four to five times per week. All conditions were run the same number of times in a day, but were randomized as to the order of presentation of the conditions each day. Conditions were run consecutively, with a brief break between conditions. A single set continued until mastery criteria was met for one of the conditions (11/12 correct independent responses). At that point, that set ended, and a new set, with two new sets of three targets, were probed before beginning intervention. This continued until mastery criteria was met for a condition in set C.

Condition Probes. Prior to the introduction of a new set, the six targets for that phase (three per condition) were probed as part of the baseline probe condition. The purpose of these probes was to ensure that all newly added targets were still unknown targets, and that no learning has occurred for that target outside of instruction before it was introduced. These were conducted similar to the methods for the pre-intervention probes (above). If the participant provided a correct response on any of the two probes, that target was randomly replaced by another unknown target.

Presentation of targets. In each condition, three acquisition targets were taught per session, with four presentations of each target, for a total of twelve trials. Targets were randomized in groups of three, so that each target was randomly presented once in a group before any one was presented again.

Teaching Procedure. At the beginning of the session, the experimenter instructed the participant to sit at the table, and sat adjacent to the participant. Once the participant was seated, the experimenter delivered the first discriminative stimulus (Sd), or the set of three interspersed mastered targets for the task interspersal conditions. The Sd for tacting letter names was “what letter,” while the Sd for tacting letter sounds was “[letter] goes...” The experimenter then used the appropriate prompt fading procedure, as described in prompt fading, below. The participant was given five seconds to respond following the

prompt (or following the end of the Sd if on the independent phase). If the participant responded with the correct answer, either prompted or independently, they are provided with a token and labeled praise (ex. “that is a G, good work!”). If a participant provided an incorrect response or no response, the experimenter prompted the correct answer using a neutral tone of voice, and did not provide reinforcement or praise. The experimenter then provided a five second inter-trial interval and recorded data, and then proceeded to the next trial. This continued until all twelve trials had been completed.

Errorless Learning. Errorless learning in the form of most-to-least prompting was used for all conditions during instruction. Errorless learning refers to a prompting procedure in which a child is taught a new target or skill beginning with the most intrusive prompting and reducing prompting over time based on specific criteria until the student is able to respond independently. The purpose of errorless learning is to reduce the number of errors made in responses. Errorless learning has been shown to produce the most efficient learning in children with disabilities across numerous studies, and additionally reduces undesirable behaviors by making the learning environment less aversive (Graff & Green, 2004).

The errorless learning used for all participants was the time delay procedure, as described in MacDuff, Krantz and McClannahan (2001) Verbal prompts with a time delay involve presenting the Sd, and following with an echoic prompt on a time delay, starting with a short time delay, and increasing the time delay as the student becomes more successful (Wolery et al., 1992). For example, when teaching a child to label a dog, the instructor will present a toy dog, say “What is it?” and following a three second delay, will say “Dog.” The time delay for this procedure was a four step time delay, with a 0-s phase, a 2-s phase, and 4-s phase, and an independent phase. Prompts were faded systematically per session, with prompts being faded for a session where a student provides 11/12 correct prompted responses, and were reintroduced for a decrease in correct prompted responses for two consecutive sessions within an individual condition.

Conditions. The present experiment included two instructional conditions: (a) a concurrent training condition, (b) and a 3:1 task interspersal condition in which interspersed mastered targets are reinforced with praise only.

Concurrent Training (CT). The concurrent training condition followed the procedures as described above with no additional changes. The three acquisition targets were presented four times each in random order, with the provided prompt fading and error correction. This condition was selected as it is the most frequently used discrete trial training method in ABA for early learners with autism, and has robust support in the literature (as reviewed in Nicholson, 2013).

3:1 Task Interspersal (TI). This condition followed the procedures as described above, with the following changes. Prior to the presentation of each acquisition target, three known targets were randomly presented using the same methodology. Correct responses to the mastered targets were reinforced with praise only. Incorrect or no responses were prompted after a five second delay. The ratio for this condition (3:1) was selected due to its similarity to the high P response sequence, and is the most frequently used ratio in studies of task interspersal for children with more significant impairments (see Clinton & Clees, 2015).

Social Validity. Research has suggested that task interspersal is preferred over traditional DTT by students and teachers alike. However, there is limited research on preference for students with high rates of escape-maintained behavior. The present study used a qualitative survey in order to collect data on student preference and to measure social validity.

Student preference was assessed using the following methods. A survey was distributed to the primary teacher and two paraprofessionals in the classroom. Teachers were provided with four 2-minute video clips per participant: two of the Concurrent condition, and two of the Task Interspersal condition. Video clips were selected randomly from two groups of clips of sessions conducted. The first group was comprised of the first 1/3 of sessions, while the second group was comprised of the last 1/3 of sessions.

This was to measure ratings of affect from when the student began intervention to when the student had had significant exposure to each intervention, as it was hypothesized that problematic behavior would decrease in any intervention as a function of time (ex: a student will likely engage in more problematic behavior in session 1 of task interspersal than in session 30, as they will have learned to discriminate each session by then). Video clips were presented to each respondent in random order. Respondents were not told which video belongs to which condition.

Following each video clip, teachers were asked to read 10 statements regarding the student and teacher affect (in the video) regarding behavior and engagement. They then rated their level of agreement on a 7-point Likert scale (Strongly agree, agree, somewhat agree, neither agree nor disagree, somewhat disagree, disagree, strongly disagree). Each rating was associated with a score, with “strongly agree” receiving a score of 7, and strongly disagree receiving a score of 1. Appendix A provides an example rating scale that was provided to raters.

Chapter 4: Results

Daren (high escape group)

Data for escape maintained behavior for Daren can be found in Figure 3 for sets A, B and C. During set A, there was a clear separation of the data paths, with high rates of escape maintained behavior present during the Concurrent condition ($M = 79.16$, Range = 0 – 100), and low rates of escape maintained behavior during the Interspersal condition ($M = 24.30$, Range = 0 – 60). Both data paths had significant variability across sessions. However, this pattern of responding was not replicated across set B and set C, as escape maintained behavior decreased across both conditions to low levels. During set B, there was no separation of the data paths, with low rates of escape behavior in both the Concurrent condition ($M = 14.28$, Range = 0 – 28.57) and the Interspersal condition ($M = 9.69$, Range = 0 - 23.52). Responding was similar in set C, with no separation of the data paths, and low rates of escape behavior in both the Concurrent condition ($M = 8.33$, Range = 0 – 25), and the Interspersal condition ($M = 3.73$, Range = 0 – 11.11).

Data for rate of acquisition for Daren can be found in Figure 7 for sets A, B, and C. During set A (top panel), Daren mastered targets from both conditions after 6 sessions. More time (in seconds) was spent per session in the Interspersal condition ($M = 290.33s$, Range = 197s – 417s) than the Concurrent condition ($M = 103.67s$, Range = 55s – 164s). Additionally, the rate of learning was more efficient in the Concurrent condition, with an average increase of 9.52% correct per minute, relative to the Interspersal condition, with an average increase of 2.21% correct per minute.

During set B (middle panel), Daren mastered targets from the Concurrent condition in fewer sessions relative to the Interspersal condition. More time in seconds was spent per session in the Interspersal condition ($M = 170.33s$, Range = 150s – 180s) than in the Concurrent condition ($M = 69s$, Range = 61s – 75s). Additionally, the rate of learning was more efficient in the Concurrent condition, with an average increase of 45.46% correct per minute, relative to the interspersal condition, with an average of 13.79% correct per minute.

During set C (bottom panel), Daren mastered targets from both conditions after 3 sessions. More time in seconds was spent per session in the Interspersal condition ($M = 170.33s$, Range = 158s – 180s) than in the Concurrent condition ($M = 69s$, Range = 61s-75s). Additionally, the rate of learning was more efficient in the Concurrent condition, with an average increase of 37.65% correct per minute, relative to the Interspersal condition, with an average increase of 15.36% correct per minute.

During set A maintenance, Daren had 12/12 (100%) independent correct responses during the Concurrent condition, and 9/12 (75%) during the Interspersal condition. In the Interspersal condition, Daren missed “U” in three of four trials. During set B maintenance, Daren had 12/12 (100%) independent correct responses during the Concurrent condition, and 9/12 (75%) during the Interspersal condition. In the interspersal condition, Daren missed “C” in three of four trials. During set C maintenance, Daren had 12/12 (100%) independent correct responses during the Concurrent condition, and 8/12 (66.67%) during the Interspersal condition. In the Interspersal condition, Daren missed “G” in all four trials.

A summary of social validity can be found in Table 3. Across all five items regarding student preference, the teachers reported higher overall scores for the Interspersal condition than the Concurrent condition. Across all five items regarding teacher preference, the teachers reported higher overall scores for the Interspersal condition than for the Concurrent condition.

Ralphie (high escape group)

Data for escape maintained behavior for Ralphie can be found in Figure 4 for sets A, B and C. During set A, there was a clear separation of the data paths, with moderate rates of escape maintained behavior present during the Concurrent condition ($M = 46.47$, Range = 0 – 100), and low rates of escape maintained behavior during the Interspersal condition ($M = 23.76$, Range = 14.28 – 34.78). Escape maintained behavior remained relatively stable in the Interspersal condition, while the Concurrent condition demonstrated more variability. However, this pattern of responding was not replicated across set B and set C. During set B, there was no separation of the data paths, with moderate rates of escape behavior in both the Concurrent condition ($M = 33.87$, Range = 0 – 57.14) and the Interspersal condition

($M = 33.24$, Range = 15 – 52.17). Escape maintained behavior decreased to low levels for both conditions in set C, with no separation of the data paths, and low rates of escape behavior in both the Concurrent condition ($M = 8.88$, Range = 0 – 16.67), and the Interspersal condition ($M = 15.20$, Range = 5 – 26.31).

Data for rate of acquisition for Ralphie can be found in figure 8 for sets A, B, and C. During set A (top panel), Ralphie mastered targets in fewer sessions in the Interspersal condition. More time (in seconds) was spent per session in the Interspersal condition ($M = 219.5s$, Range = 200s – 227s) than the Concurrent condition ($M = 123.83s$, Range = 85s – 198s). There was no clear separation of data paths for rate of learning across the two conditions, with an average increase of 4.80% correct per minute for the Concurrent condition, and an average increase of 4.95% correct per minute for the Interspersal condition, suggesting rate of learning was similar across both conditions.

During set B (middle panel), Ralphie mastered targets from the Interspersal condition in fewer sessions relative to the Concurrent condition. More time in seconds was spent per session in the Interspersal condition ($M = 206.42s$, Range = 178s – 247s) than in the Concurrent condition ($M = 109.28s$, Range = 76s – 164s). Similar to set A, there was no clear separation of data paths for rate of learning across the two conditions, with an average increase of 4.74% correct per minute for the Concurrent condition, and an average increase of 4.50% correct per minute for the Interspersal condition, suggesting rate of learning was similar across both conditions.

During set C (bottom panel), Ralphie mastered targets from the Concurrent condition in fewer sessions relative to the Interspersal Condition. More time in seconds was spent per session in the Interspersal condition ($M = 195s$, Range = 181s – 207s) than in the Concurrent condition ($M = 132.66s$, Range = 93s-195s). Additionally, the rate of learning was more efficient in the Concurrent condition, with an average increase of 20.95% correct per minute, relative to the Interspersal condition, with an average increase of 10.06% correct per minute.

During set A maintenance, Ralphie had 12/12 (100%) independent correct responses during the Concurrent condition, and 11/12 (91.67%) during the Interspersal condition. In the Interspersal condition, Ralphie missed “P” in one out of four trials. During set B maintenance, Ralphie had 6/12 (50%) independent correct responses during the Concurrent condition, and 8/12 (66.67%) during the Interspersal condition. In the concurrent condition, Ralphie missed “U” in one out of four trials, “K” in two out of four trials, and “H” in three out of four trials. In the interspersal condition, Ralphie missed “C” in all four trials. During set C maintenance, Ralphie had 12/12 (100%) independent correct responses during the Concurrent condition, and 12/12 (100%) during the Interspersal condition.

A summary of social validity can be found in table 4. Across all five items regarding student preference, the teachers reported higher overall scores for the Concurrent condition than the Interspersal condition. Regarding teacher preference, the teachers reported higher scores for the Concurrent condition for two of the five items (*9. the teacher does not have to do extra work to keep the student engaged; 10. this is a good use of the teachers time*) and equal scores for the other three items.

Brett (low escape group)

Data for escape maintained behavior for Brett can be found in Figure 5 for sets A, B and C. During set A, there was no clear separation of the data paths, with low rates of escape maintained behavior present during both the Concurrent condition ($M = 10.61$, Range = 0 – 33.33), as well as the Interspersal condition ($M = 12.01$, Range = 5.26 – 22.72). During set B, there was no separation of the data paths, with low rates of escape behavior in both the Concurrent condition ($M = 11.30$, Range = 0 – 33.33) and the Interspersal condition ($M = 15.03$, Range = 5.26 – 31.81). Escape maintained behavior remained at low levels for both conditions in set C, with no separation of the data paths, for the Concurrent condition ($M = 11.23$, Range = 0 – 38.46), and the Interspersal condition ($M = 9.28$, Range = 5 – 21.16).

Data for rate of acquisition for Brett can be found in figure 9 for sets A, B, and C. During set A (top panel), Brett mastered targets in fewer sessions in the Concurrent condition. More time in seconds

was spent per session in the Interspersal condition ($M = 196.62s$, Range = 165s – 238s) than the Concurrent condition ($M = 91.12s$, Range = 67s – 144s). There was a clear separation of data paths for rate of learning across the two conditions, with an average increase of 7.21% correct per minute for the Concurrent condition, and an average increase of 2.08% correct per minute for the Interspersal condition.

During set B (middle panel), Brett mastered targets from the Concurrent condition in fewer sessions relative to the Interspersal condition. More time in seconds was spent per session in the Interspersal condition ($M = 202.11s$, Range = 171s – 222s) than in the Concurrent condition ($M = 76.22s$, Range = 37s – 103s). There was a clear separation of data paths for rate of learning across the two conditions, with an average increase of 6.56% correct per minute for the Concurrent condition, and an average increase of 2.37% correct per minute for the Interspersal condition.

During set C (bottom panel), Brett mastered targets from the Interspersal condition in fewer sessions relative to the Concurrent condition. More time in seconds was spent per session in the Interspersal condition ($M = 191.27s$, Range = 154s – 243s) than in the Concurrent condition ($M = 101s$, Range = 82s-128s). There was no clear separation of data paths for rate of learning across the two conditions, with an average increase of 1.38% correct per minute for the Concurrent condition, and an average increase of 2.34% correct per minute for the Interspersal condition, suggesting rate of learning was similar across both conditions.

During set A maintenance, Brett had 8/12 (66.67%) independent correct responses during the Concurrent condition, and 4/12 (33.33%) during the Interspersal condition. In the Concurrent condition, Brett missed all four trials of “U”. In the Interspersal condition, Brett missed both “J” and “K” in all four trials. During set B maintenance, Brett had 6/12 (50%) independent correct responses during the Concurrent condition, and 4/12 (33.33%) during the Interspersal condition. In the concurrent condition, Brett missed “P” in one out of four trials, “X” in one out of four trials, and “V” in four out of four trials. In the interspersal condition, Brett missed both “F” and “H” in all four trials. During set C maintenance, Brett had 4/12 (33.33%) independent correct responses during the Concurrent condition, and 8/12

(66.67%) during the Interspersal condition. In the concurrent condition, Brett missed both “f” and “n” in all four trials. During the Interspersal Condition, Brett missed “r” in all four conditions.

A summary of social validity can be found in table 5. Across all five items regarding student preference, the teachers reported higher overall scores for the Interspersal condition than the Concurrent condition. Across all five items regarding teacher preference, the teachers reported higher overall scores for the Interspersal condition than the Concurrent condition.

Lizzy (low escape group)

Data for escape maintained behavior for Lizzy can be found in Figure 6 for sets A, B and C. During set A, there was no clear separation of the data paths, with moderate rates of escape maintained behavior present during both the Concurrent condition ($M = 35.63$, Range = 0 – 69.23), as well as the Interspersal condition ($M = 32.82$, Range = 13.04 – 60.02). Additionally, both data paths displayed a clear upward trend, with escape maintained behavior increasing across subsequent sessions. During set B, there was a clear separation of the data paths, with high rates of escape behavior in the Concurrent condition ($M = 60.42$, Range = 33.33 – 93.75), and moderate escape maintained behavior in the Interspersal condition ($M = 35.80$, Range = 19.44 – 54.05). This pattern of responding was not replicated in set C, where there was no clear separation of data paths, with moderate escape maintained behavior in the Concurrent condition ($M = 39.92$, Range = 9.75 – 75.86), as well as the Interspersal condition ($M = 41.13$, Range = 9.09 – 61.53). Additionally, there was significant variability in both data paths.

Data for rate of acquisition for Lizzy can be found in figure 10 for sets A, B, and C. During set A (top panel), Lizzy mastered targets in fewer sessions in the Concurrent condition. More time in seconds was spent per session in the Interspersal condition ($M = 293.33s$, Range = 218s – 382s) than the Concurrent condition ($M = 130.33s$, Range = 113s – 160s). There was a clear separation of data paths for rate of learning across the two conditions, with an average increase of 2.49% correct per minute for the Concurrent condition, and an average increase of 0.33% correct per minute for the Interspersal condition.

During set B (middle panel), Lizzy mastered targets from the Interspersal condition in fewer sessions relative to the Concurrent condition. More time in seconds was spent per session in the Interspersal condition ($M = 356.16s$, Range = 278s – 405s) than in the Concurrent condition ($M = 137.67s$, Range = 92s – 159s). There was a clear separation of data paths for rate of learning across the two conditions, with an average increase of 3.55% correct per minute for the Concurrent condition, and an average increase of 2.92% correct per minute for the Interspersal condition.

During set C (bottom panel), Lizzy mastered targets from the Interspersal condition in fewer sessions relative to the Concurrent condition. More time in seconds was spent per session in the Interspersal condition ($M = 442.90s$, Range = 362s – 648s) than in the Concurrent condition ($M = 144.09s$, Range = 104s-169s). There was a clear separation of data paths for rate of learning across the two conditions, with an average increase of 0.00% correct per minute for the Concurrent condition, and an average increase of 0.63% correct per minute for the Interspersal condition.

During set A maintenance, Lizzy had 3/12 (25%) independent correct responses during the Concurrent condition, and 4/12 (33.33%) during the Interspersal condition. In the Concurrent condition, Lizzy correctly identified “K” two out of four trials, and correctly identified “M” one out of four trials. In the Interspersal condition, Lizzy correctly identified “Z” in all four trials. During set B maintenance, Lizzy had 1/12 (8.33%) independent correct responses during the Concurrent condition, and 4/12 (33.33%) during the Interspersal condition. In the concurrent condition, Lizzy correctly identified “j” in one out of four trials. In the interspersal condition, Lizzy identified “b” in three out of four trials, and “l” in one out of four trials. During set C maintenance, Lizzy had 4/12 (33.33%) independent correct responses during the Concurrent condition, and 4/12 (33.33%) during the Interspersal condition. In the concurrent condition, Lizzy identified “a” and “h” each in two out of four trials. During the Interspersal Condition, Lizzy identified “r” in all four conditions.

A summary of social validity can be found in table 6. For three items regarding student preference, the teachers reported higher overall scores for the Interspersal condition than the Concurrent

condition (1. *The student is engaged*; 2. *The student is happy*; 3. *The student likes the skill being taught*) and two items with higher overall scores for the Concurrent condition (4. *The student is learning the skills*; 5. *This is a good use of the student's time*). For four items regarding teacher preference, the teachers reported higher overall scores for the Concurrent condition (6. *The teacher is engaged*; 7. *The teacher is happy*; 8. *The teacher likes teaching the skill being taught*; 10. *This is a good use of the teacher's time*) and one item with higher overall scores for the Interspersal condition (9. *The teacher does not have to do extra work to keep the student engaged*).

Chapter 5: Discussion

The purpose of this study was to determine the effects of task interspersal on rates of escape maintained behavior, and subsequently, rate of learning, relative to concurrent discrete trial training procedures. Previous studies have found that, given the additional time required to implement interspersed mastered targets during instruction, task interspersal leads to a slower rate of learning when compared to concurrent training (Nicholson, 2013; Forbes et al., 2013, Henrickson et al., 2015). However, none of these studies collected data on rates of escape maintained behavior. Given task interspersal's procedural similarities to the high-P sequence from behavior momentum theory, the benefits of the procedure may be related to the reduction of escape maintained behavior, and consequently, the amount of time a student spends engaged in learning. Therefore, task interspersal may increase learning efficiency for students who are not engaged with instruction using more typical instructional approaches.

Research Questions

Question 1: What is the effect of task interspersal on the rate of acquisition of novel skills relative to rate of acquisition of novel skills during concurrent training for children with high rates of escape-maintained behavior?

There was no clear evidence that task interspersal increased rate of learning relative to concurrent training for participants with high rates of escape maintained behavior. For one participant (Daren), Concurrent training was more efficient across all three sets relative to Interspersal. On the other hand, rate of learning for Ralphie was equivalent in both conditions for Set A and set B, even though interspersal required more time to implement. This suggests that more learning was occurring in the interspersal condition to a point in which it became as efficient as the concurrent condition. However, this pattern of responding was not replicated in the third condition.

Furthermore, Ralphie mastered the interspersal targets for Set A and B in fewer sessions relative to the concurrent targets. Given that the conditions were yoked for number of sessions, concurrent training for Set A and B for Ralphie was ended when the interspersal targets were mastered, resulting in

concurrent training targets that were not yet mastered, but with less time spent in the concurrent condition. Since it cannot be assumed that learning is linear, it is possible that the concurrent targets required more sessions relative to the interspersal targets, but less instructional time overall, which may have resulted in more efficient learning. Had the conditions been yoked for time, more definitive conclusions could be drawn.

Finally, for both participants, escape maintained behavior reduced to low levels across both conditions by the third set of targets, indicating that some uncontrolled variable was effecting behavior, which may have also affected rate of learning. These limitations are discussed in more detail below. Regardless, given the inconsistency in the data across and within participant responding, it cannot be concluded that task interspersal resulted in more efficient learning relative to concurrent training.

Question 2: What is the effect of task interspersal on the rate of escape-maintained behavior during the presentation of novel targets relative to the rate of escape-maintained behavior during concurrent training for children with high rates of escape-maintained behavior?

There was no clear evidence that task interspersal decreased rates of escape maintained behavior relative to concurrent training. For both Daren and Ralphie, rates of escape maintained behavior were higher in concurrent training during set A. However, this pattern of responding was not consistent across set B and set C, where rates of escape maintained behavior were similar across both conditions. Additionally, rates of escape maintained behavior decreased to low levels across both conditions by set C. It is important to note that, for all four participants, new problem behaviors emerged during intervention that were not captured in the original definition or in the functional analysis. These behaviors were not counted in escape maintained data in order to avoid observer drift, though they may have resulted in inaccurate escape behavior data. This limitation will be discussed further below.

Question 3: What are the differential effects of task interspersal and concurrent training on the rate of acquisition of novel skills for children with high rates of escape maintained behavior relative to children with low rates of escape maintained behavior?

For both participants with low rates of escape behavior (Brett and Lizzy), concurrent training resulted in more efficient learning relative to task interspersal. Additionally, there were no differences in escape maintained behavior across conditions for these participants. However, rates of escape maintained behavior increased across both conditions from set A to set C. This contrasts with the participants with high rates of initial escape behavior, who demonstrated decreases in escape maintained behavior from set A to set C. With the exception of set A and B for Ralphie, task interspersal as implemented in this study was less efficient across all participants. Ralphie's rate of learning in set A and B may suggest that task interspersal has some effect on learning efficiency for specific individuals with high rates of problem behavior, but these findings are inconclusive without more consistent responding within and across participants.

General Discussion

The present study contributes to the literature in a number of ways. First, this is the only study to the author's knowledge to evaluate the effects of task interspersal on rates of escape maintained behavior for students with high initial rates of escape. Additionally, this study provides further evidence that the specific task interspersal procedure utilized with these participants, that is, a high ratio of mastered to novel targets presented before every trial, results in less efficient learning when compared to concurrent training. These findings do not suggest that task interspersal as a whole is not a useful procedure, but provides further insight on how the procedure should be used and adapted to provide the best results for learners.

Research Implications

Previous studies examining the rate of learning for interspersal procedures have utilized parallel treatments designs examining cumulative learn rate, which is a measure of cumulative number of targets mastered per unit of time (Cates et al., 2003; Nicholson, 2013). While such a design effectively captures the rate of learning across both methods, it is difficult to replicate across sets with any one individual, as it requires a high number of targets within any individual set to establish a slope, as it is examining cumulative mastered targets. For example, Nicholson (2013) required 20 targets per condition across three conditions for a total of 60 targets in one demonstration. Without the benefit of replication across multiple sets, such a design is vulnerable to a small number of rapidly mastered targets artificially inflating any given slope.

The present design provides an alternative method for measuring efficiency of learning by measuring accuracy per session across cumulative time spent in session with replication across multiple sets of a small number of targets. Utilizing this design requires fewer targets (three per condition in any one set), which allows for more practical replication across multiple sets. This design is more robust to variability from target difficulty given the ability to replicate findings within participants. On the other hand, this design is vulnerable to variability within any one session, potentially resulting in a less observable slope of learning. Furthermore, if difficulty per target is not sufficiently controlled for, any one target within a set that is too difficult can prevent mastery within the entire set.

In regards to escape maintained behavior, few studies have measured escape maintained behavior as it relates to task interspersal. Nicholson (2013) and Henrickson et al. (2015) both found comparable rates of problem behavior across concurrent and interspersal conditions. However, these two studies found low rates of problem behavior in baseline, so any effects on behavior would not be observable in treatment. Additionally, these two studies did not include a functional analysis, and so any effects on behavior could not be related to a function of escape. The present study found initial effects on escape maintained behavior for both participants with high rates of escape (Daren and Ralphie), in that the

interspersal condition had significantly lower rates of escape in set A. However, this was not replicated in set B and set C, which had comparable rates of escape across both conditions. On the other hand, for both Daren and Ralphie, escape behavior decreased across both conditions, and occurred at low rates by set C.

The initial response for both participants in set A suggests interspersal may serve to decrease escape, and the lack of replication across additional sets may be a fault of the study design. The design of the present study was a parallel treatments design, in which participants were exposed to alternating conditions, with only short breaks in between. One limitation of this design is that it is vulnerable to carry over effects, in which the effects of one treatment remain when the second treatment is implemented (Horner et al., 2005). Previous literature on the high-p sequence utilized parallel treatments without carry over effects (ex: Mace et al., 1988), but the length of the interval between treatments was much longer than the present study. While it cannot be concluded that interspersal had an effect on escape from this data alone, future studies can implement an alternative design, such as an ABAB reversal design, to avoid potential carry over effects. Such designs are not robust to the effects of temporal events on behavior, but can help to differentiate the effects of concurrent training and interspersal on escape behavior.

From the findings of the study, it cannot be concluded that interspersal procedures decrease escape maintained behavior. However, given the limitations listed above, there is a need for additional research on this subject. Should task interspersal demonstrate a specific treatment effect for this population, it could be utilized to decrease escape maintained behavior and time on task. In the present study, escape maintained behavior decreased and time on task increased for both students with high rates of escape; however, the rate of change was similar across both conditions, and so a causal attribution cannot be concluded for the escape condition.

One important limitation which restricted conclusive findings was that the study yoked conditions by sessions to mastery, so that once mastery was met in one condition, targets were also removed from the other condition. While this is the most common design used in previous interspersal studies, it did not allow for the demonstration of the effect related to time when more learning was occurring in the

interspersal condition. If interspersal reached mastery first, the concurrent condition was not given an opportunity to attempt to reach mastery in a shorter amount of time. Future studies should yoke conditions by cumulative time, so that once one condition completes, the other condition should continue until it either runs for the same length of time or until it also reaches mastery, whichever comes first. This will ensure that if one condition requires more time but results in mastery across fewer sessions, the other condition is still able to continue its trend in order to best compare the two conditions, as the measure is dependent on unit of time as opposed to number of sessions.

Clinical Implications

A number of studies have demonstrated that task interspersal is a less efficient learning method relative to concurrent training (Nicholson, 2013; Henrickson et al, 2015; Majdalany et al., 2014; Forbes et al., 2013). The present study adds to the growing body of research to support this claim. Across three of the four participants, interspersal procedures were consistently less efficient. As Skinner (2008) noted, deficits in learning should be conceptualized with regards to learning efficiency. Given the significant achievement gap in this population relative to their typically developing peers (Gettinger & Miller, 2014), any instructional methods that reduce efficiency of learning only serves to widen this gap. Given the consistent findings across studies, clinicians and educators concerned with efficiency of learning should consider using either much thinner ratios of mastered to novel targets (such as 1:3 as in Wildmon, Skinner, Watson, and Garrett, 2004), or use concurrent procedures. However, there are a number of considerations related to interspersal that still highlight its importance.

First, task interspersal is an important component of interventions targeting skill development in early learners. Best practice in early intervention is to continue to periodically represent mastered targets throughout intervention in order to ensure mastered targets are maintained and not lost (Corsello, 2005). Furthermore, research has demonstrated that periodically interspersing mastered targets with unrelated, novel targets results in better maintenance than teaching maintenance targets during their own session (as reviewed in Clinton & Clees, 2015). Thus, regardless of learning efficiency of novel targets, task

interspersal is an important component of intervention for the maintenance of mastered skills. However, less is known regarding how frequently targets need to be interspersed to maintain mastery, which can be conceptualized as the effect of different interspersal ratios on maintenance of mastered targets. Future research would benefit from comparing the effect of different interspersal ratios not on the novel targets, but on the mastered targets over longer periods of time.

Furthermore, the interspersal procedure examined in this study, that is, a 3:1 ratio of mastered to novel targets, has been shown to be inefficient, but other ratios may be more beneficial, not only for learning efficiency, but on problem behavior. Most studies examining interspersal for more impaired populations utilize high ratios similar to the present study (as reviewed in Clinton & Clees, 2015). However, other studies have utilized much thinner ratios. For example, Wildmon, Skinner, Watson, and Garrett (2004) taught math problems to students with specific learning disability in math using a ratio of 5:15 (or 1:3) mastered to novel targets, and found students completed more problems in the interspersal condition than the control. It is possible that the high ratio used in the present study was too high of a dose, and lower ratios may be more effective at reducing escape maintained behavior.

Alternatively, interspersal may be better utilized as a response to escape maintained behavior, as opposed to a prescribed ratio. During the observation of the functional behavior assessment in the current study, the teacher was anecdotally observed using task interspersal on Ralphie when he stopped responding to her prompts. She noted to the experimenter that she uses it when students stop paying attention (or have a low response latency), and stated that she finds it effective at increasing responding when used in that way. To the author's knowledge, all studies of task interspersal have used prescribed ratios, as opposed to a reaction to low response latency.

It is also important to consider how student preference affects not only current learning efficiency, but future learning efficiency. Numerous studies have demonstrated that student prefer task interspersal procedures over concurrent procedures, and that concurrent procedures are more aversive (ex: Dunlap, 1984; Koegel and Koegel, 1986; Cooke and Reichard, 1996; Teeple and Skinner, 2004; and

Wildmon, Skinner, Watson, and Garrett, 2004). If students find concurrent procedures more aversive, then these procedures may then serve to condition the academic environment and the learning stimuli to be aversive, which in turn may increase escape maintained behaviors and decrease learning efficiency. It is important, therefore, to maintain a preferred environment to ensure continued efficiency of learning, even if it lowers efficiency in the short term. However, research on the effects of concurrent and interspersal procedures on escape behavior in the short and long term are lacking.

From the social validity measure of the study, the teacher's reported that the students appeared to prefer the task interspersal procedures over the concurrent procedures. Furthermore, they reported that the therapist was better able to implement the interspersal procedures, and that the interspersal procedures were a better use of instructional time. This indicates that the teachers not only believed that the students preferred task interspersal, but also that the teacher's preferred task interspersal. Looking beyond efficiency of learning, it is also important to consider the generalizability of the instructional method to learning in more natural, less structured environments. While a method may increase efficiency within a single setting, the method of instruction can actually decrease generalization to other settings by creating faulty stimulus control between the Sd/environment and the behavior (as discussed in Grow & LeBlanc, 2013). Task interspersal more closely resembles naturalistic learning, which has instructors or caregivers providing varied prompts across different difficulties to teach multiple skills at once. Concurrent training, on the other hand, is more structured and prescribed, and has greater potential to limit generalization due to strict stimulus control.

Limitations and Future Directions

In addition to the limitations and future research discussed above, the present study had a number of other limitations to consider. First, the study was limited to four children with ECDD or ASD in an early learning center; future research would benefit from examining different populations. Fluency of mastered targets was also not measured directly, which could affect response effort, thus increasing the aversion to the task. The design itself was vulnerable to carry over effects, which may explain why escape

maintained behavior decreased across both conditions. Finally, there were confounds related to problem behavior definition and the selection of acquisition targets.

The present study only examined the efficiency of interspersal for four four-year-old students with early childhood developmental delay in an early childhood special education classroom. The previous studies cited above examining efficiency had participants with similar characteristics. However, interspersal has been shown to effectively decrease trials to mastery across many different populations, including ASD, intellectual disability, specific learning disability, and for students in general education (Clinton & Clees, 2015). It is important to examine learning efficiency within these populations as well.

Additionally, the current study used multiple, different mastered targets from an unrelated skill as the interspersal targets, as the targets from the current skill may have been mastered by the study definition, but participants still may not have been fluent (i.e., higher latency to independent response). While previous research had shown that task interspersal is effective even with targets from a different response class (see Clinton & Clees, 2015), there is limited research on the effect of targets that are mastered, but have different probabilities of response. That is, a student may know the correct response, but will not provide it when prompted. The present study varied the interspersed mastered targets based on student response, selecting new targets when the students stopped responding to older targets. The study did not control for changing the interspersed targets across sets or conditions, which may have effected rate of escape behavior. Future studies would benefit from measuring probability of response to mastered targets, and establishing a specific criterion for changing targets.

As discussed above, the design of the study may have produced carry over effects across conditions, which may explain why both Daren and Ralphie's overall escape behavior decreased across sets in both conditions. An ABAB reversal design may help prevent carry over effects in future research. Alternatively, the temporal reduction in escape behavior across both conditions may have been a result of the errorless learning procedure. Errorless learning has been shown to reduce problematic behavior and decrease latency to responding (Graff & Green, 2004). The classroom did not utilize strict, errorless

learning procedures in one-on-one instruction. The change from the classroom procedures to the experimental procedures may have produced the reduction in behavior overall. Future studies should utilize students who have shown high rates of escape maintained behavior even when errorless learning is implemented.

Another confound for the present study was that other problem behaviors emerged during treatment across all participants that were not observed in the functional analysis. These behaviors were not included in the data as they were not evaluated for function and would also result in observer drift, but may still have been escape maintained. This is a limitation in defining behaviors topographically in order to capture the function of behaviors, as other behaviors may emerge in a hierarchy that serve the same function but observationally appear different (Iwata, Kahng, Wallace, & Lindberg, 2000). One alternative to measuring specific behavior topographies would be to measure on task and off task behavior. This is easier to capture, and can be conceptualized by the student's orientation of eye gaze. While it is not a perfect measure of attention to task, it can still reliably capture and represent escape maintained behavior (as in Star, Cushing, Lane & Fox, 2006). Another potential measure to better capture the effects of interspersal on behavior would be to measure latency to response. While this could not be measured in a functional analysis, it could still capture the effects of interspersal relative to concurrent training on attending to task demands, and may better differentiate the effects on behavior between the two conditions.

It is also important to note that the token economy system was not discretely taught to the participants. Of the four participants, only Brett had previous exposure to a strict token economy system through previous ABA intervention. The other three had some exposure in the classroom, but it was not known if they had learned the contingencies. The decision not to teach the token economy separately was based on the participants' level of language and cognitive abilities, as well as teacher input. It was presumed that the students would be able to identify and learn the contingencies with limited exposure. None-the-less, it is possible that escape maintained behavior and learning efficiency in set A were

affected by the process of learning the contingencies, which is a confound when comparing results across sets B and C.

Finally, the target selection of tacting letter names and sounds was an important limitation. As part of the experiment, the teacher did not conduct any instruction on letter names with the participants during the duration of the study. However, as part of early morning group routine, the class sang the A-B-C song, which may have incidentally resulted in learning. All targets in the present study were probed before implementation of each condition and were not used if students produced any correct responses, but it is still possible that outside learning occurred during any given set of targets.

In summary, the present study examined the rate of escape maintained behavior and efficiency of learning under task interspersal and concurrent training conditions. Across three participants, task interspersal was less efficient, and in one participant it was as efficient as concurrent training. There was some differentiation in escape maintained behavior, but overall reduction of escape maintained behavior temporally made it difficult to replicate the effect across sets. This suggests that, with respect to learning efficiency, interspersal procedures with high ratios of mastered to novel targets can be detrimental to rate of learning; however, other benefits of task interspersal, such as maintenance training and student preference, still support its use. More research is still needed on the exact effects of these benefits on future learning efficiency or on maintenance of other targets. Future research should also examine different interspersal procedures related to ratios of mastered to novel targets to determine if thinner ratios produce more observable effects on escape maintained behavior.

APPENDICES

Appendix A: Social Validity Scale

Teacher:	Student:	Video:

Thank you for your time and participation with this study. Please watch the attached video, and then read the directions and answer the questions below.

Directions: Below are statements related to the video you just watched. Please read each statement, then circle the response below which best represents your perspective to each question.

1. The Student is engaged with the work						
Strongly Agree	Agree	Somewhat Agree	Neither Agree or Disagree	Somewhat Disagree	Disagree	Strongly Disagree
2. The student is happy						
Strongly Agree	Agree	Somewhat Agree	Neither Agree or Disagree	Somewhat Disagree	Disagree	Strongly Disagree
3. The student likes learning the skill being taught						
Strongly Agree	Agree	Somewhat Agree	Neither Agree or Disagree	Somewhat Disagree	Disagree	Strongly Disagree
4. The student is learning the skill being taught						
Strongly Agree	Agree	Somewhat Agree	Neither Agree or Disagree	Somewhat Disagree	Disagree	Strongly Disagree
5. This is a good use of the student's time						
Strongly Agree	Agree	Somewhat Agree	Neither Agree or Disagree	Somewhat Disagree	Disagree	Strongly Disagree
6. The teacher is engaged with the work						
Strongly Agree	Agree	Somewhat Agree	Neither Agree or Disagree	Somewhat Disagree	Disagree	Strongly Disagree
7. The teacher is happy						
Strongly Agree	Agree	Somewhat Agree	Neither Agree or Disagree	Somewhat Disagree	Disagree	Strongly Disagree
8. The teacher likes teaching the skill being taught						
Strongly Agree	Agree	Somewhat Agree	Neither Agree or Disagree	Somewhat Disagree	Disagree	Strongly Disagree
9. The teacher does not have to do any extra work to keep the student engaged						
Strongly Agree	Agree	Somewhat Agree	Neither Agree or Disagree	Somewhat Disagree	Disagree	Strongly Disagree
10. This is a good use of the teacher's time						
Strongly Agree	Agree	Somewhat Agree	Neither Agree or Disagree	Somewhat Disagree	Disagree	Strongly Disagree

Please provide any additional comments or concerns in the space provided below:

Appendix B: Participant VB-MAPP Scores

												Key:	Score	Date	Color	Tester
Child's name		Daren										1st test:	71.5	4/5/2018		AW
Date of birth		4/2/2014										2nd test:				
												3rd test:				
LEVEL 3																
	Mand	Tact	Listener	VP/MTS	Math	Reading	Writing	Social/play	LRFFC	IV	Group	Ling.				
15																
14																
13																
12																
11																
LEVEL 2																
	Mand	Tact	Listener	VP/MTS	Imitation	Echoic	Play	Social	LRFFC	IV	Group/CR	Ling.				
10																
9																
8																
7																
6																
LEVEL 1																
	Mand	Tact	Listener	VP/MTS	Imitation	Echoic	Play	Social	Vocal							
5																
4																
3																
2																
1																

Appendix B (cont'd)

[illegible]

Appendix B (cont'd)

[illegible]

Appendix B (cont'd)

[illegible]

Figure 1: Reinforcement and Punishment

	Reinforcement (future behavior increased) • A Stimulus is added following a behavior • Future probability of that behavior is increased or maintained	Punishment (future behavior decreased) • A Stimulus is added following a behavior • Future probability of that behavior is decreased
Positive (stimulus added)	Example: A child says please when asking for a cookie (behavior). The child receives a cookie (added stimulus). In the future, the child says please more often when asking for a cookie (increased probability).	Example: A child throws a pencil at a peer (behavior). The peer hits the child back (added stimulus). In the future, the child stops throwing pencils at that peer (decreased probability).
Negative (stimulus removed)	• A Stimulus is removed or avoided following a behavior • Future probability of that behavior is increased or maintained Example: A child screams and runs away during behavioral intervention (behavior). The clinician removes the work to stop the child from screaming (removed/avoided stimulus). In the future, the child screams and runs more during intervention (increased probability).	• A Stimulus is removed following a behavior • Future probability of that behavior is decreased Example: An individual drives home drunk from the bar (behavior). The individual gets arrested and temporarily loses their license (removed stimulus). In the future, the individual stops driving home after drinking (decreased probability).

Figure 2: Discrete Trial Training Sequence

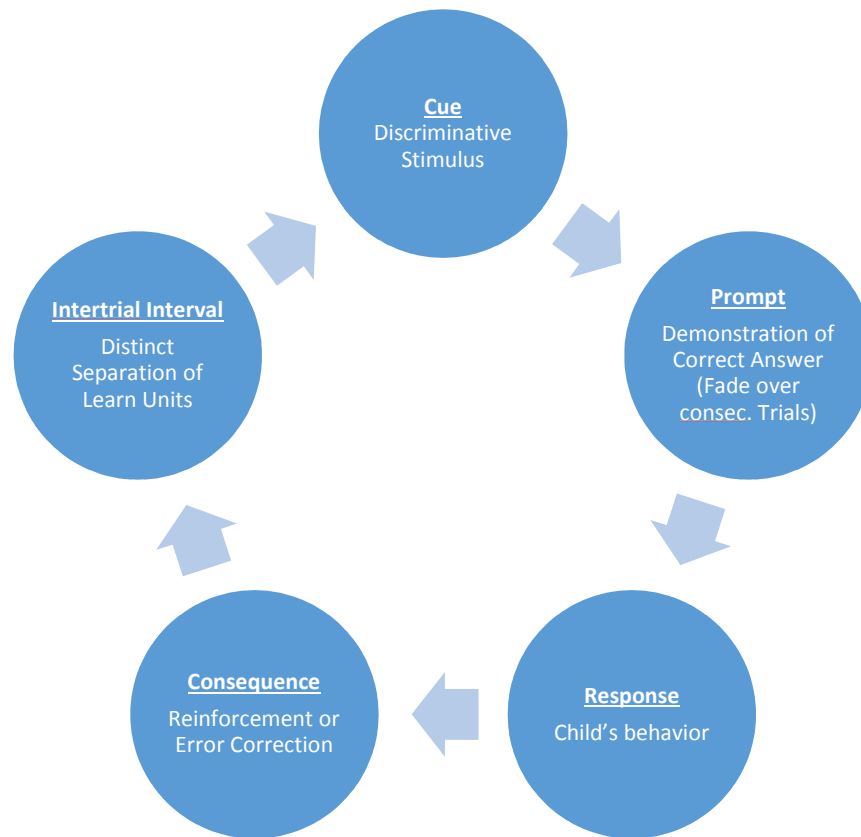


Figure 3: Daren – Escape Maintained Behavior Graph

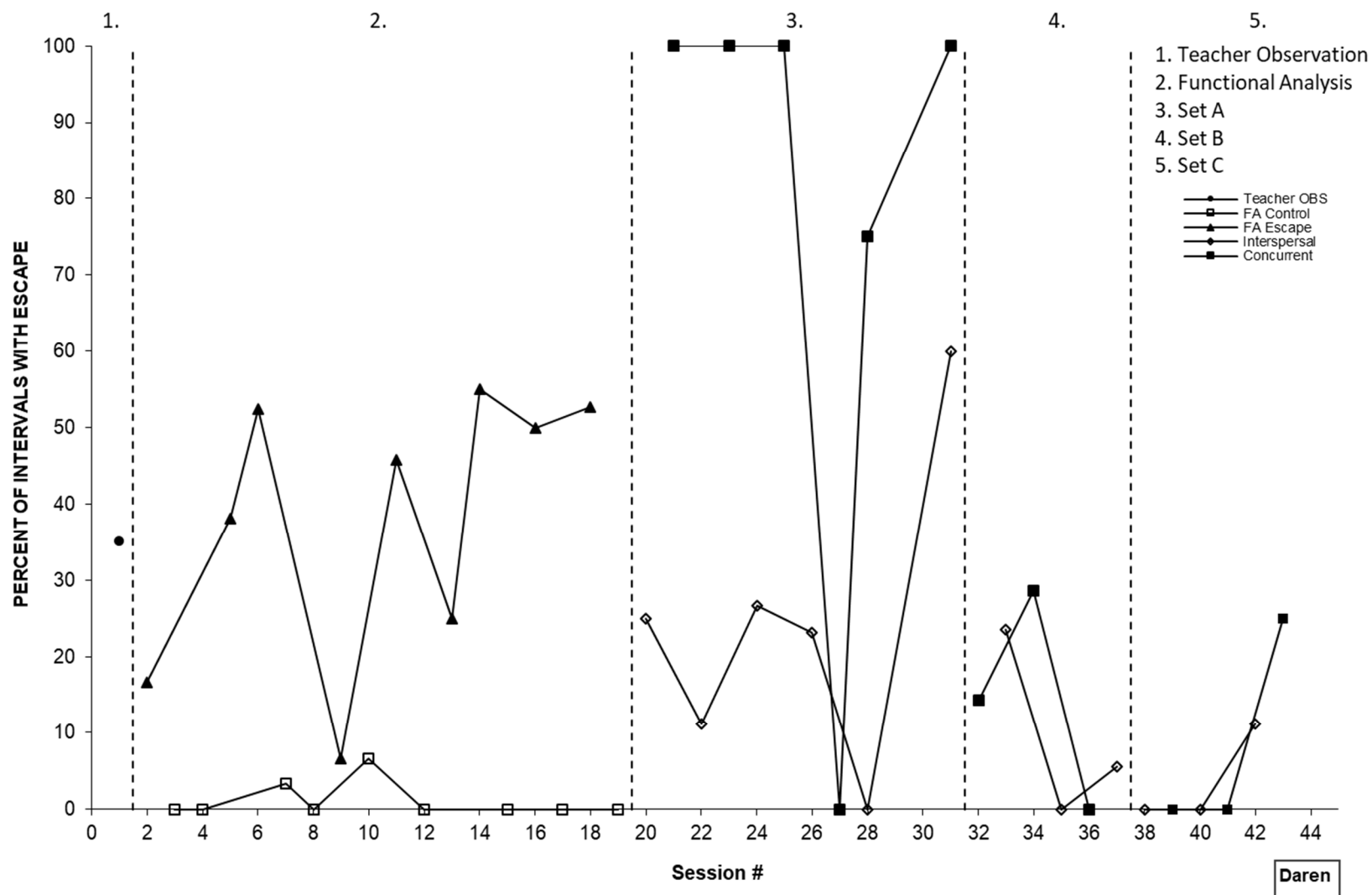


Figure 4: Ralphie – Escape Maintained Behavior Graph

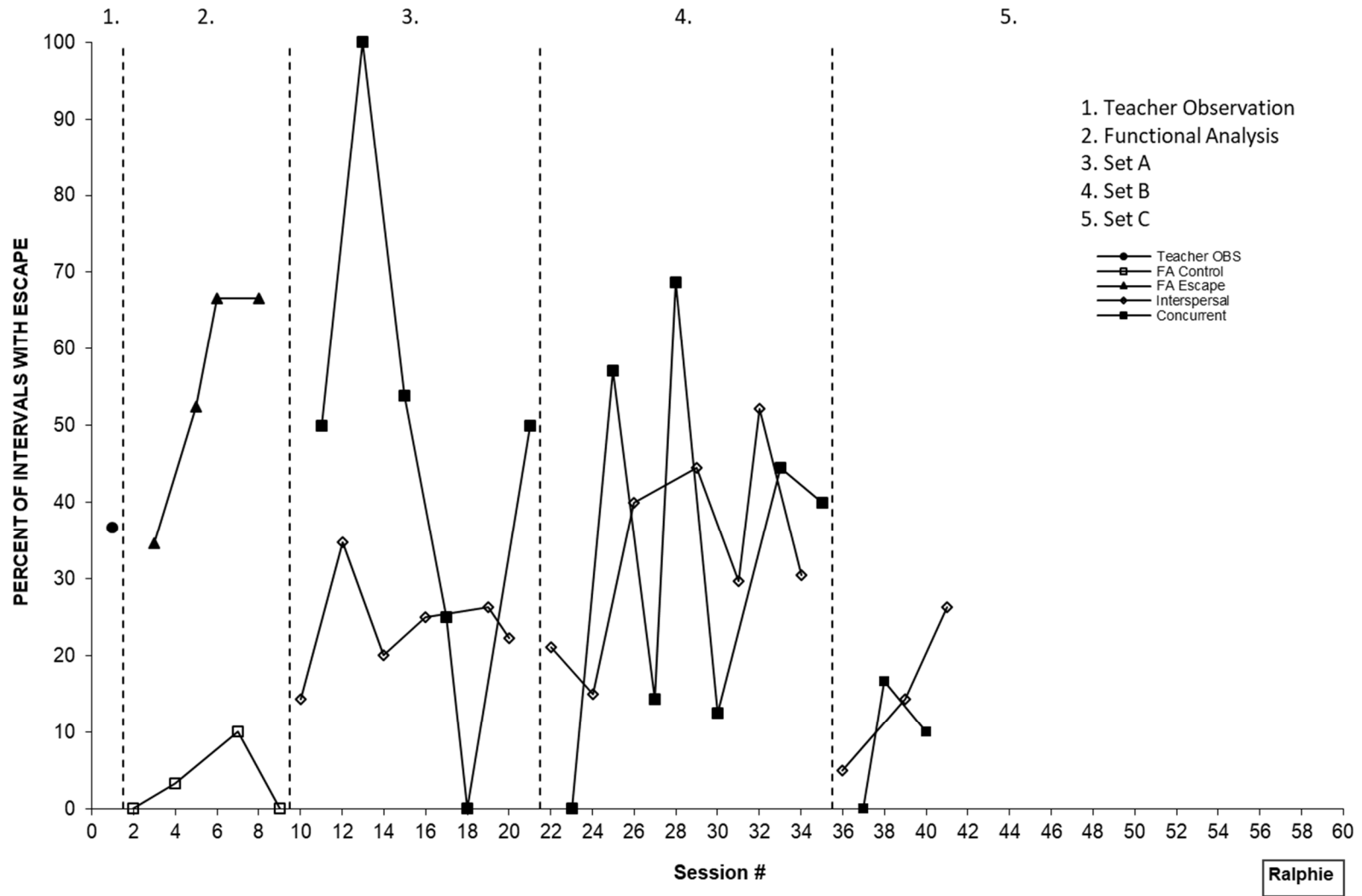


Figure 5: Brett – Escape Maintained Behavior Graph

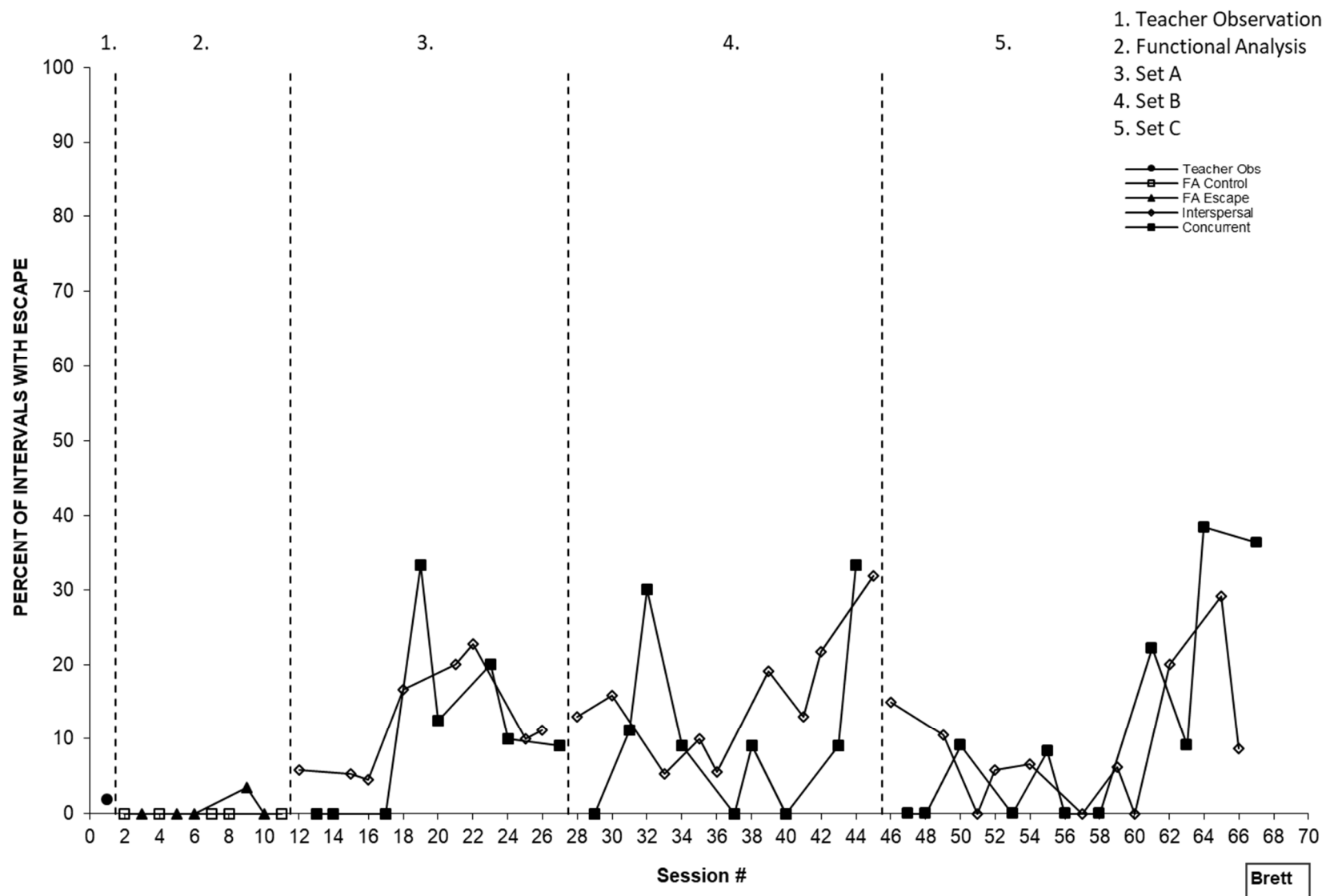


Figure 6: Lizzy – Escape Maintained Behavior Graph

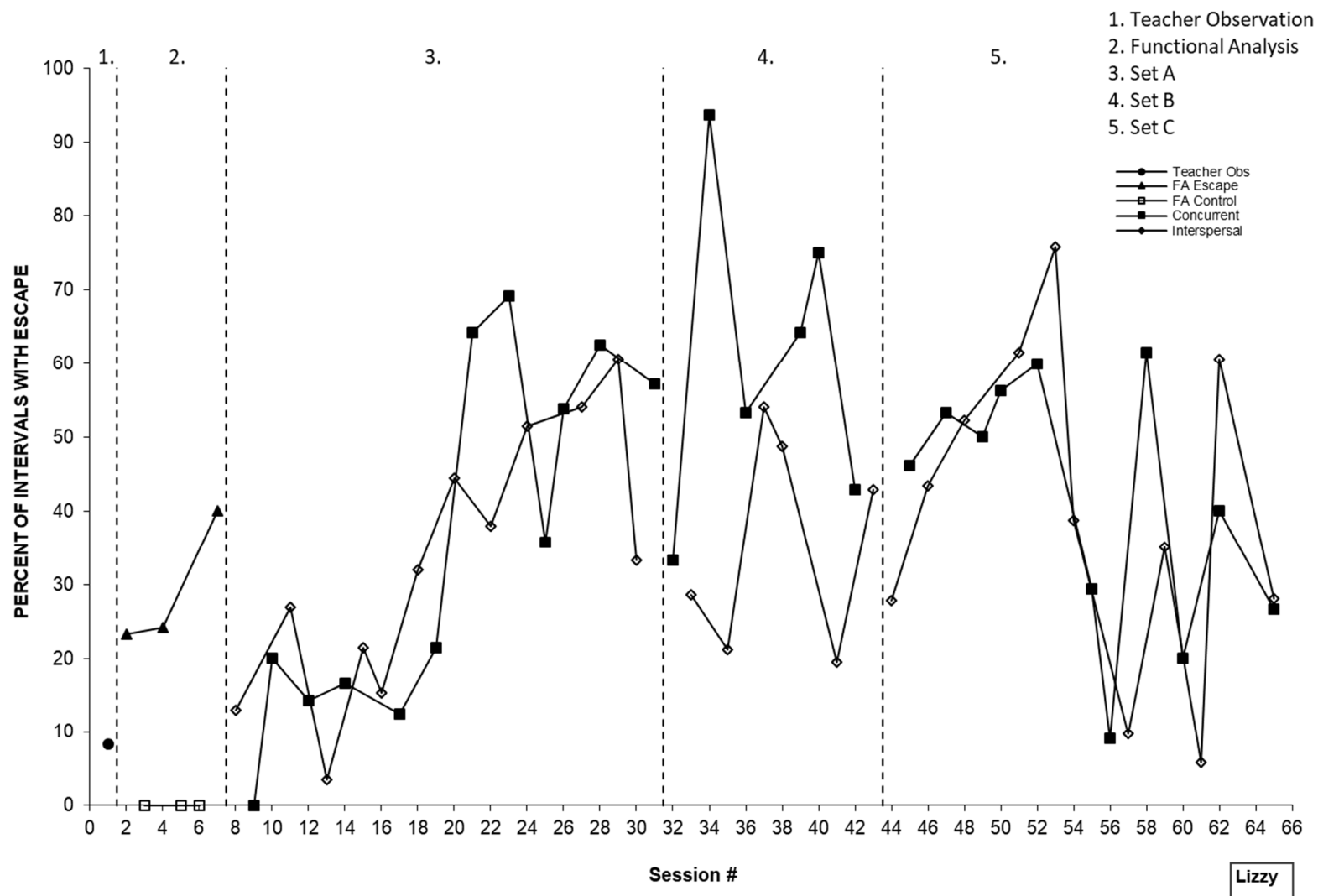


Figure 7: Daren – Rate of Acquisition Graph

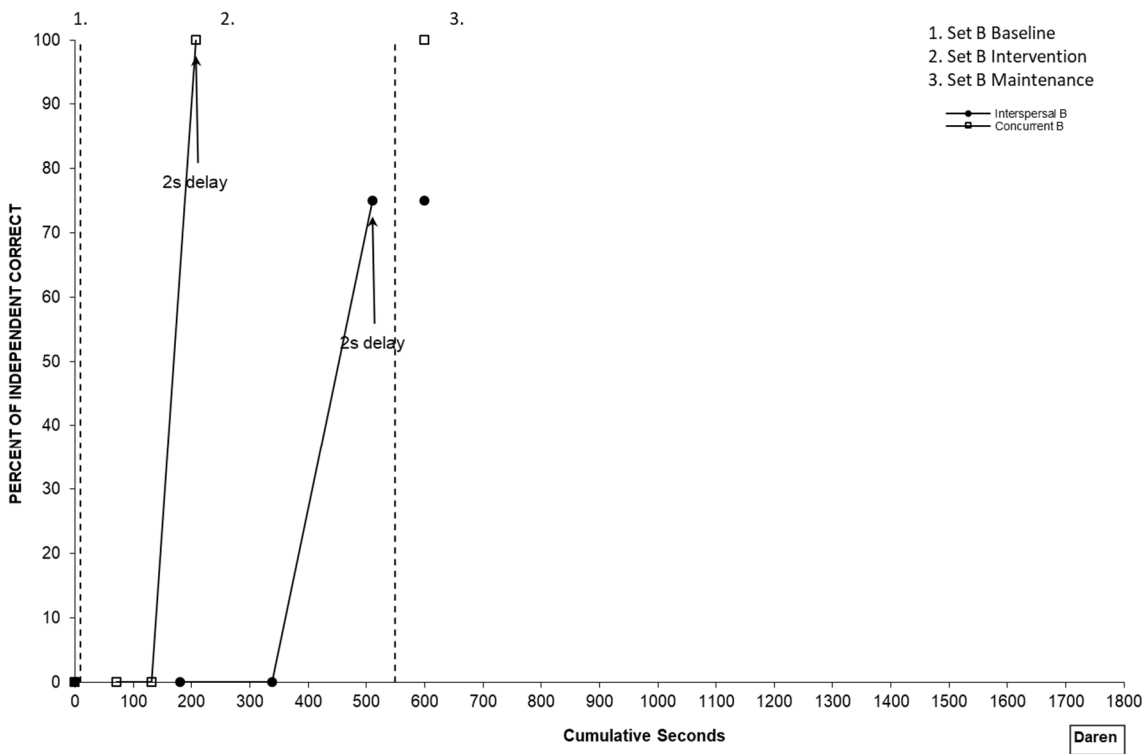
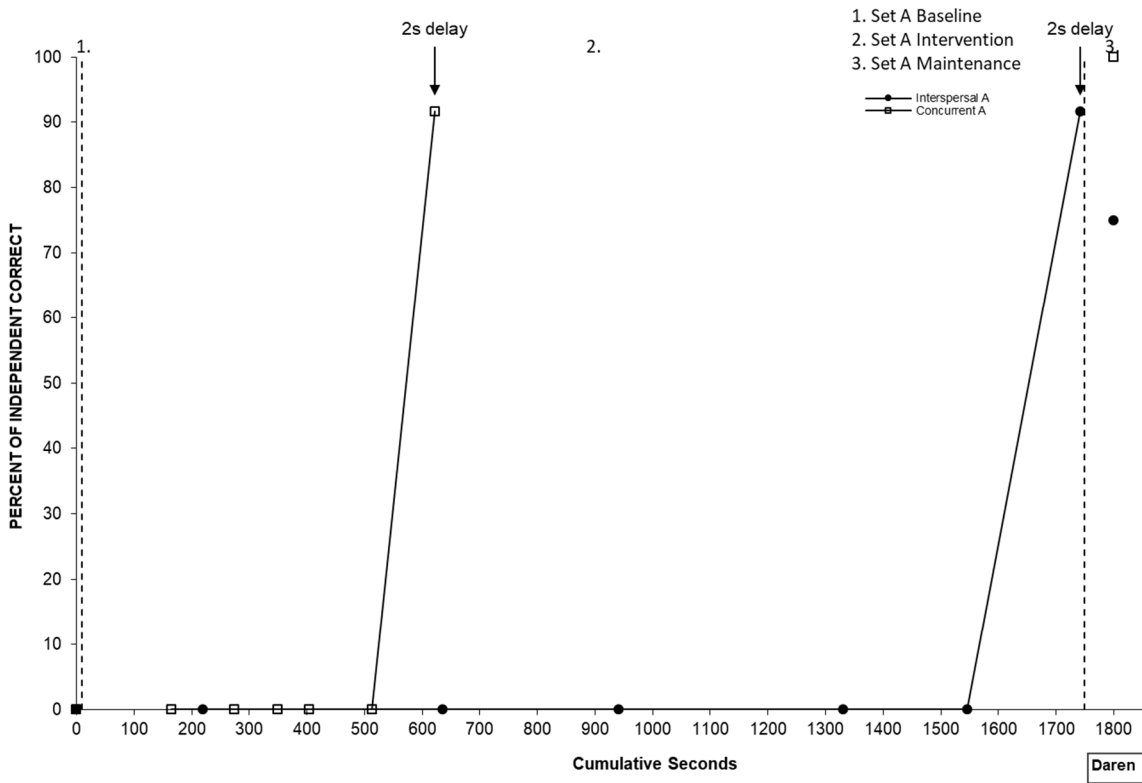


Figure 7 (cont'd)

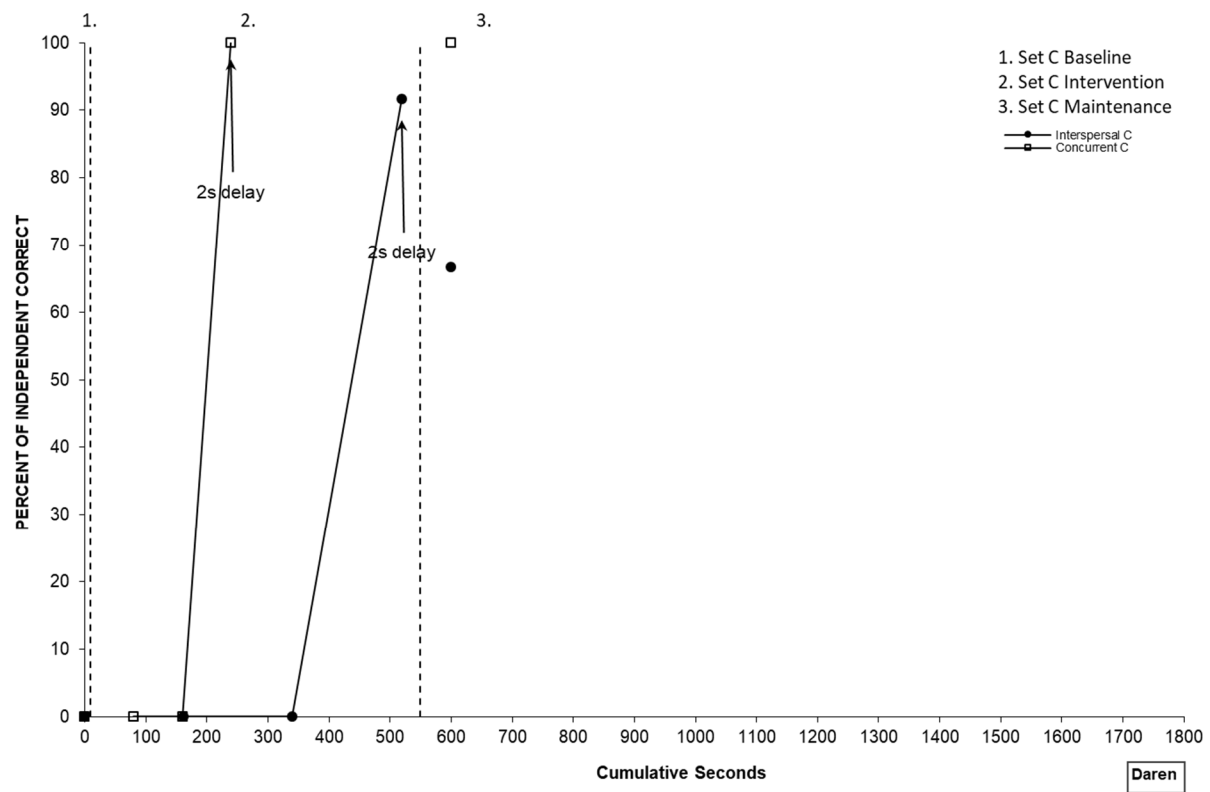


Figure 8: Ralphie – Rate of Acquisition Graph

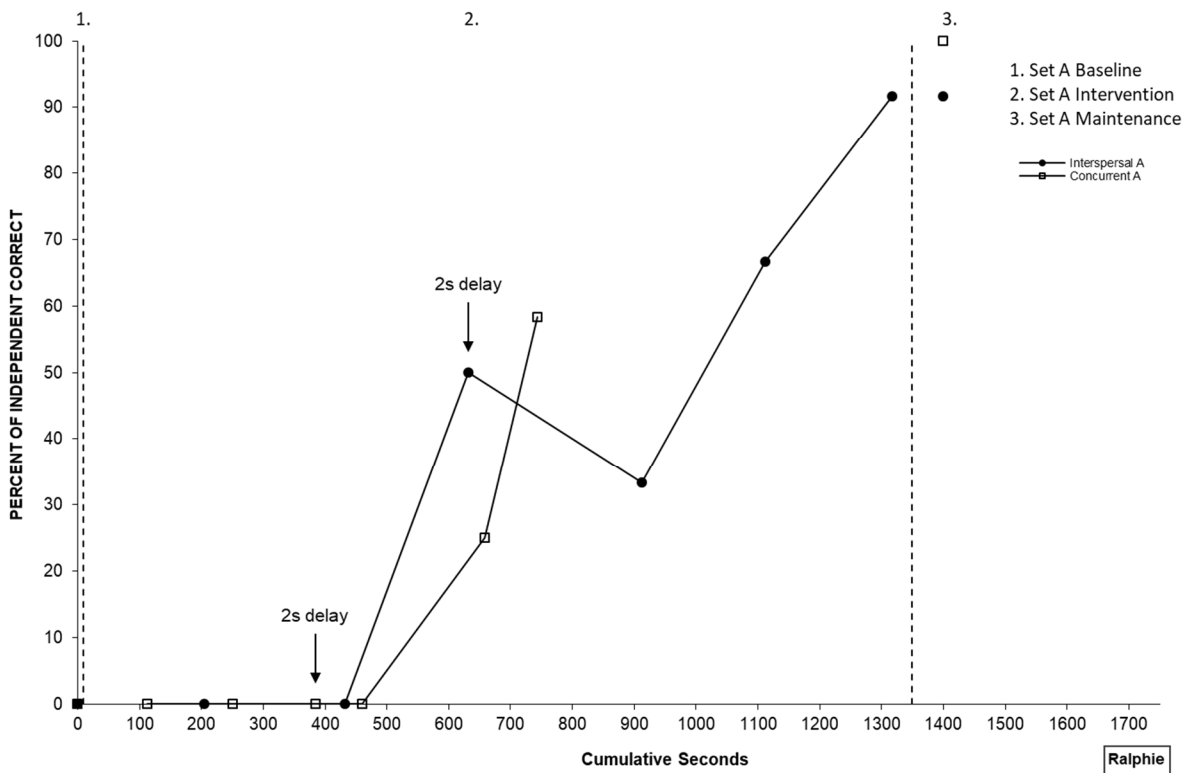
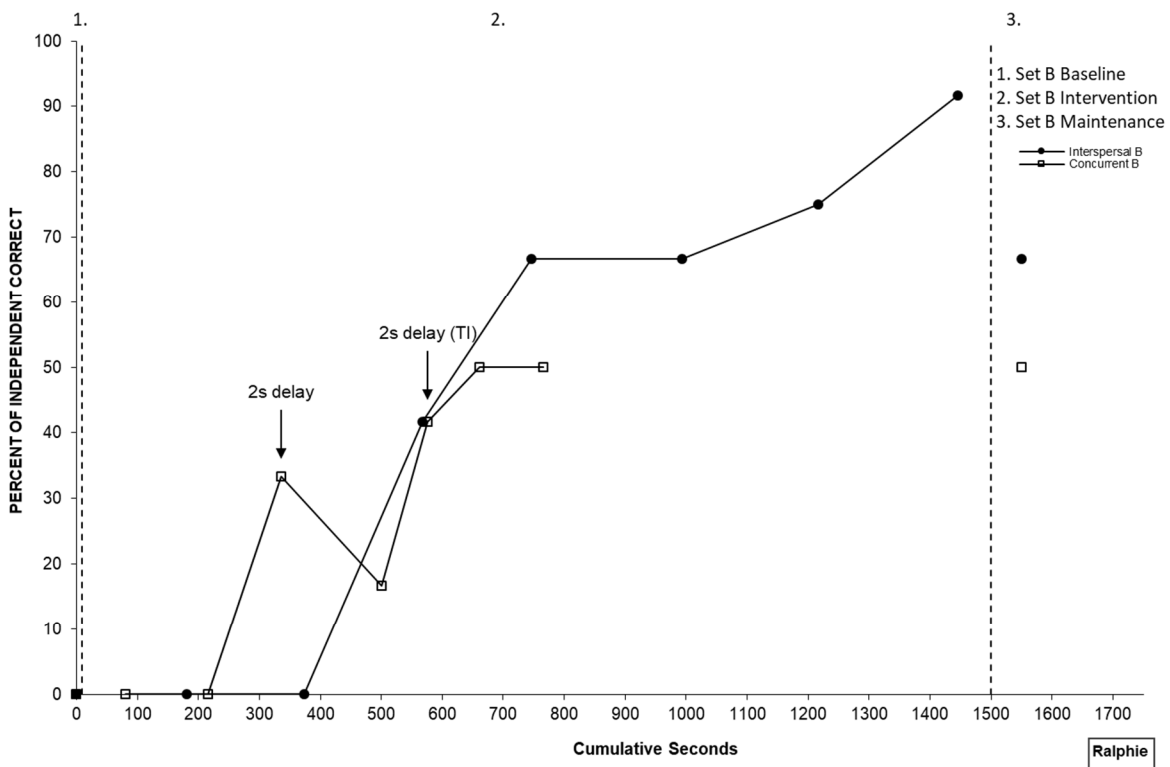


Figure 8 (cont'd)

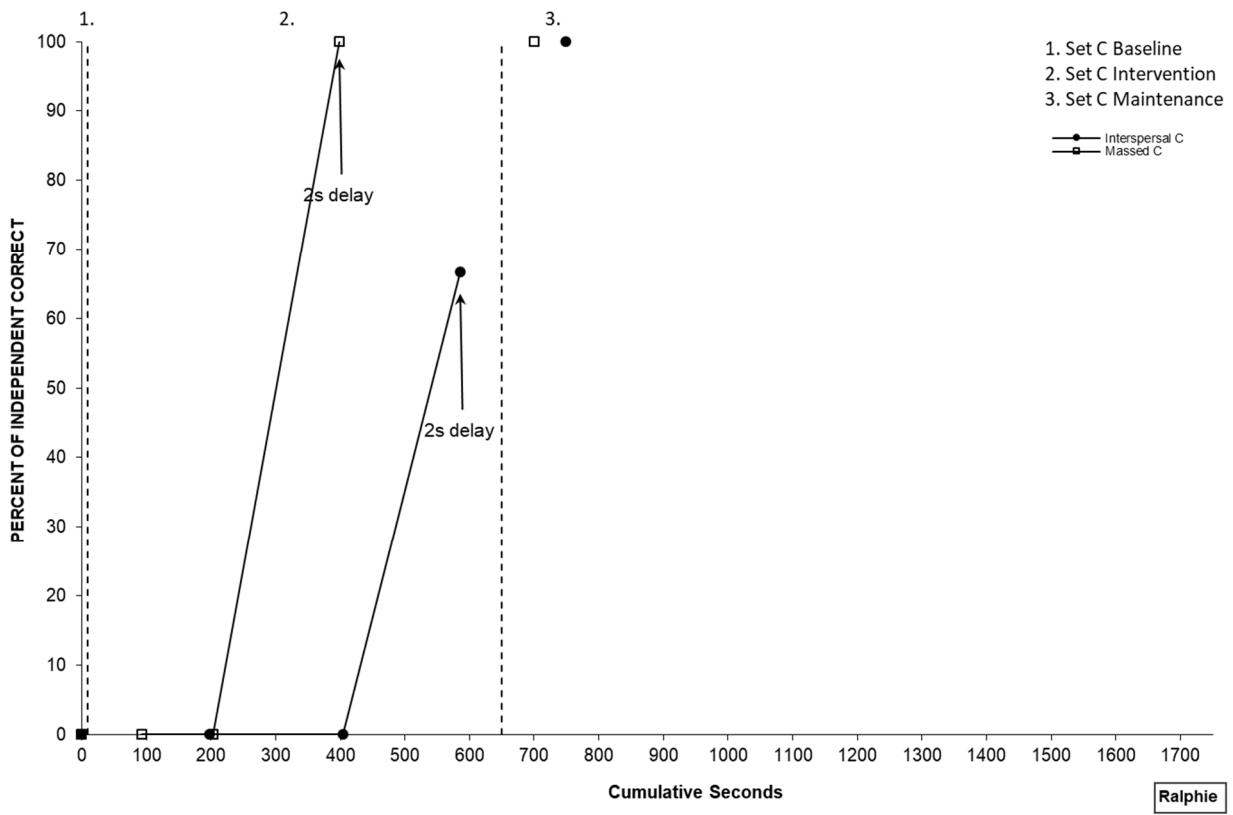


Figure 9: Brett – Rate of Acquisition Graph

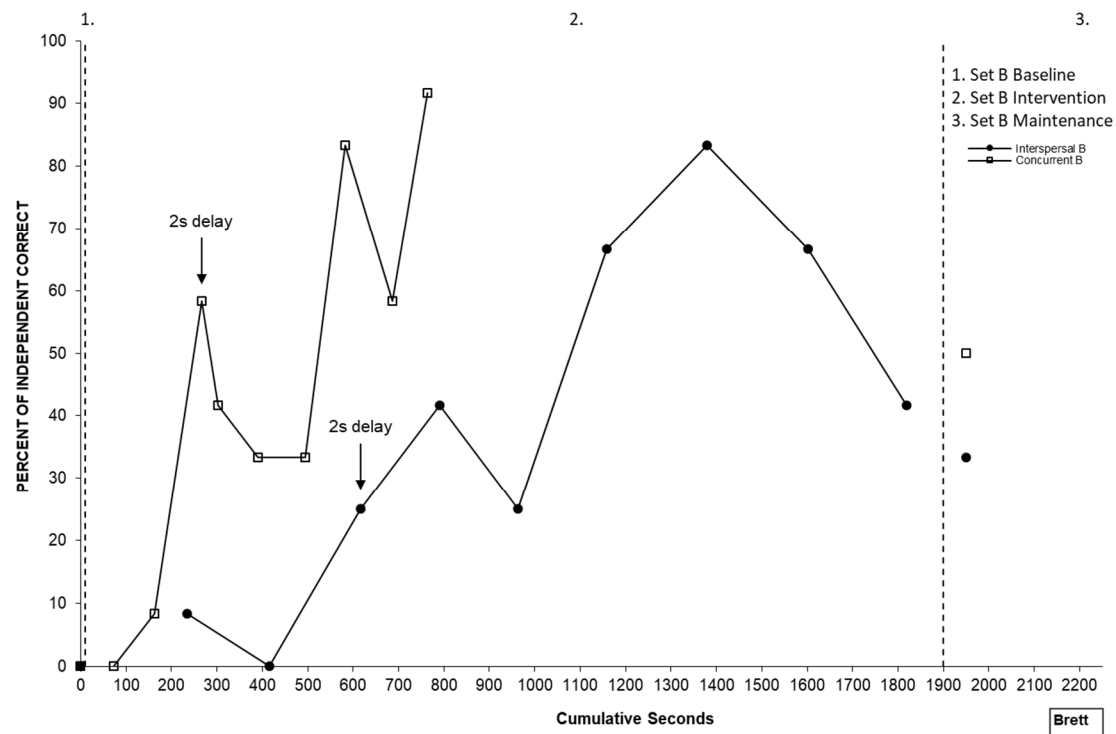
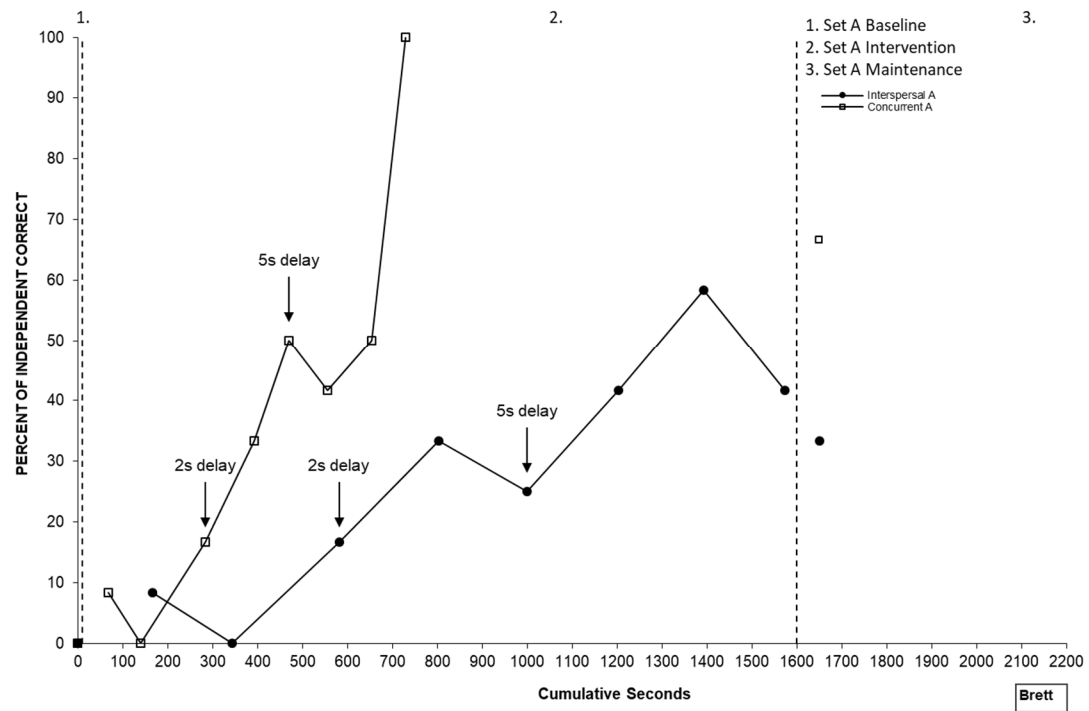


Figure 9 (cont'd)

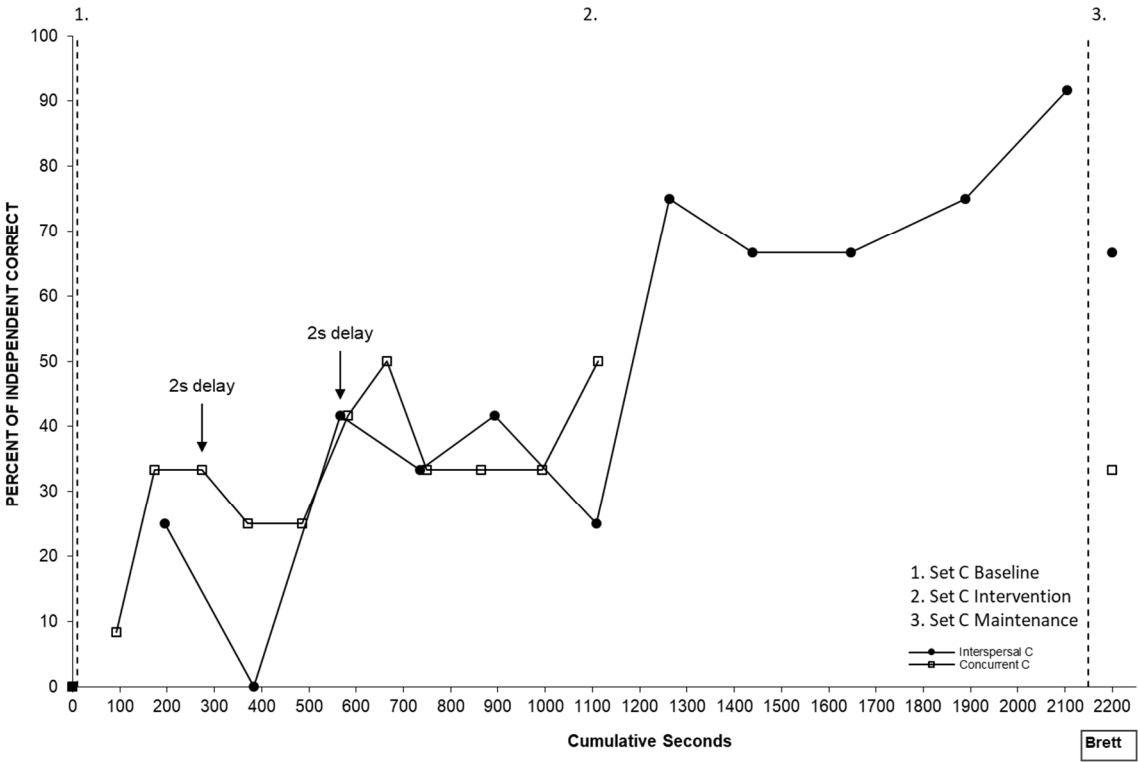


Figure 10: Lizzy – Rate of Acquisition Graph

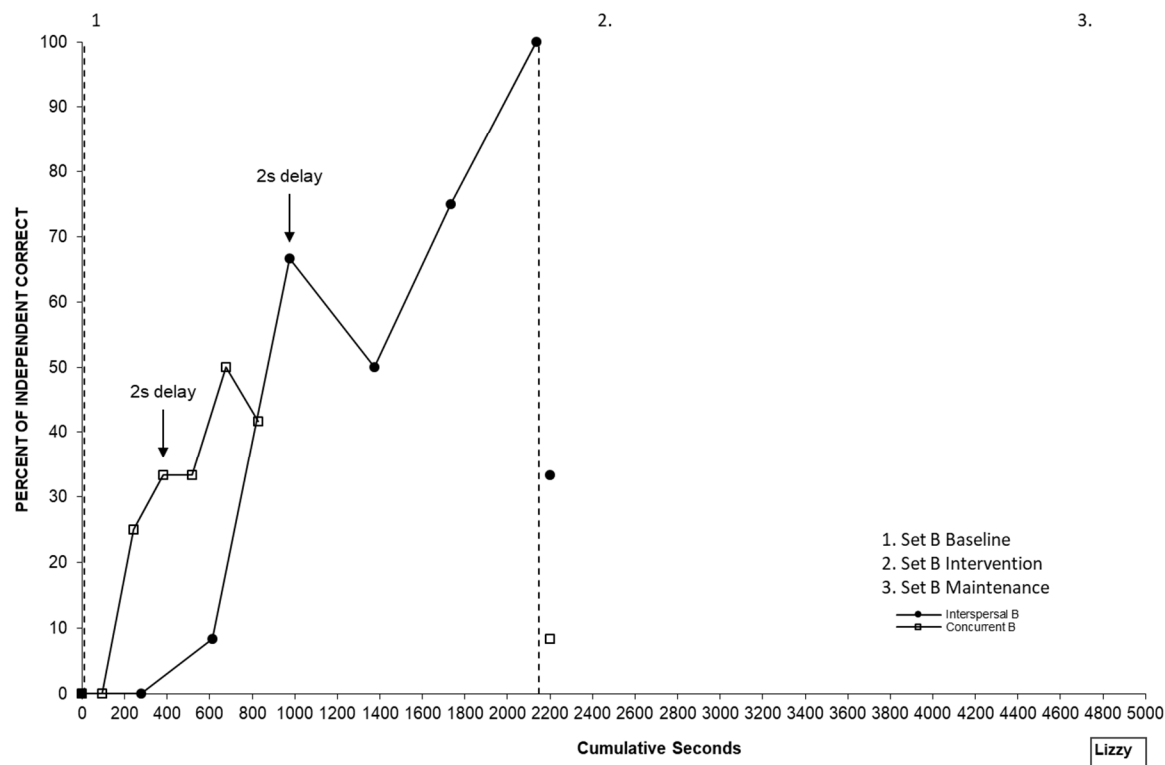
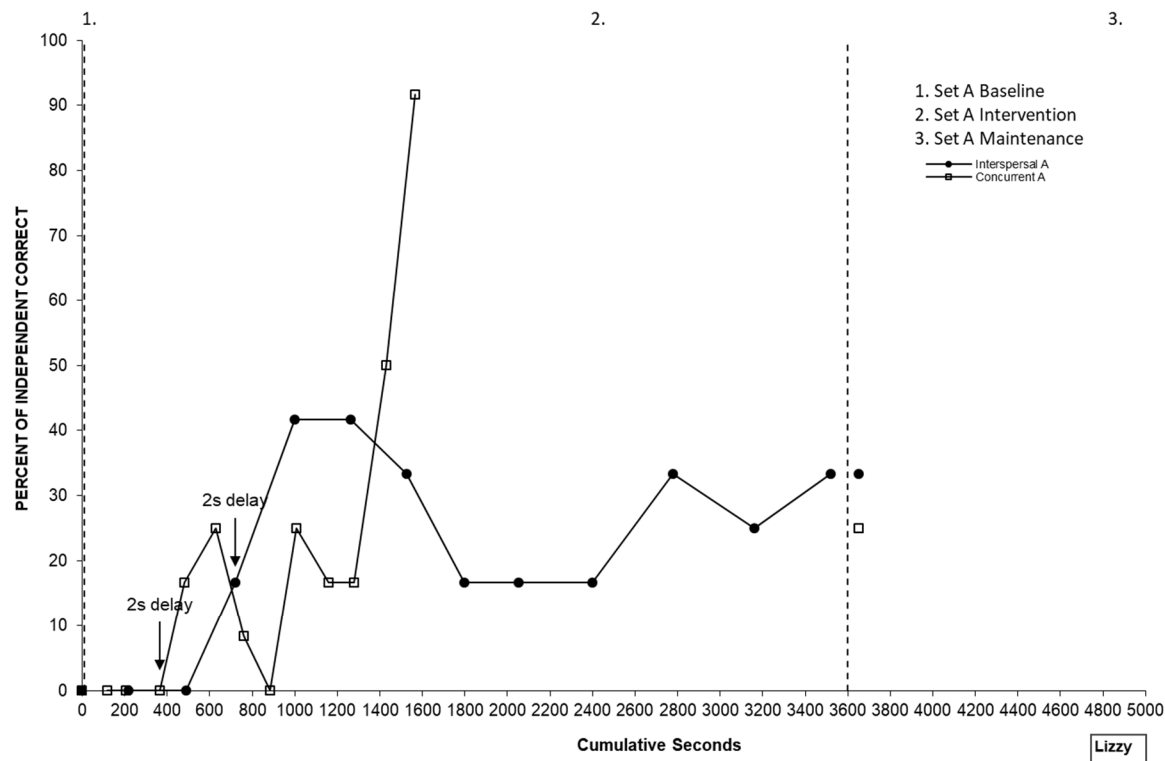


Figure 10 (cont'd)

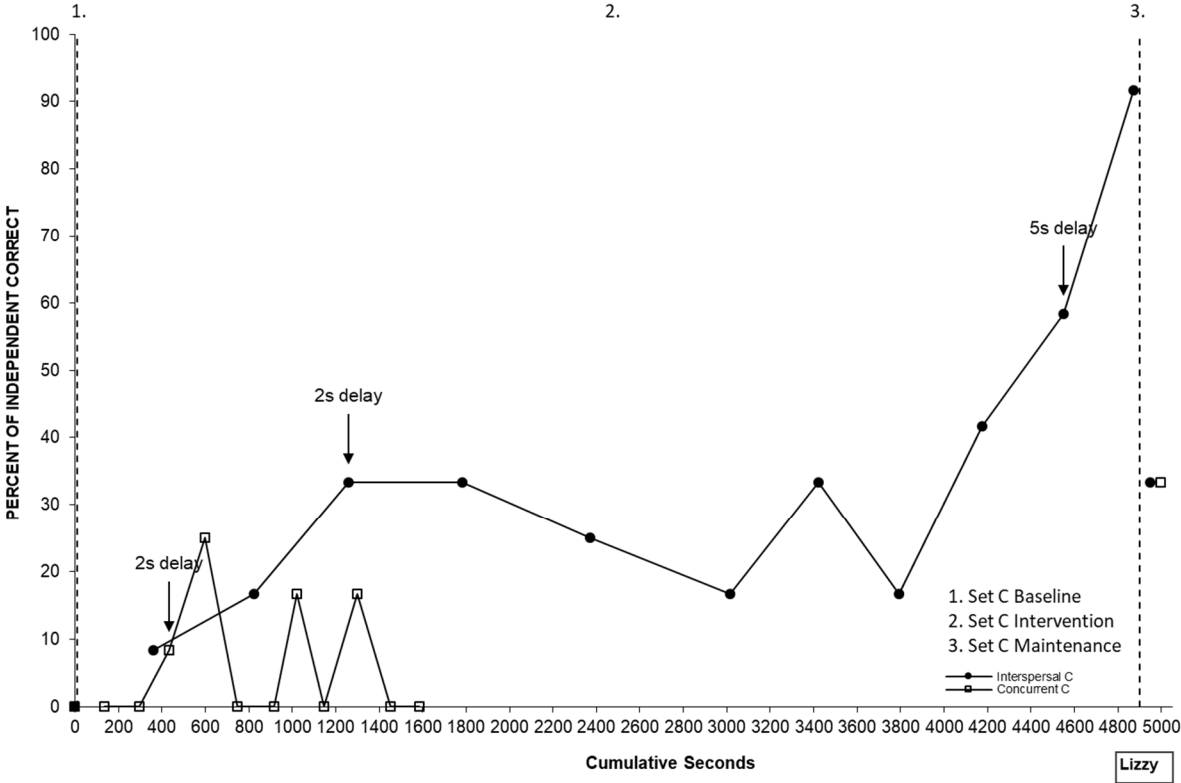


Table 1: Participant Demographics

Participant demographics

<u>Name/ gender</u>	<u>Age</u>	<u>VB- MAPP Total</u>	<u>Mullen Composite*</u>	<u>Mullen Visual Reception**</u>	<u>Mullen Fine Motor**</u>	<u>Mullen Receptive Language**</u>	<u>Mullen Expressive Language**</u>	<u>Vineland Composite*</u>	<u>Vineland Communication*</u>	<u>Vineland Daily Living Skills*</u>	<u>Vineland Socialization*</u>	<u>Vineland Motor Skills*</u>	<u>GARS 3 Composite***</u>
Brett (m)	50mo	119	73	44	20	36	43	72	73	84	61	82	125
Lizzy (f)	55mo	116	64	36	34	31	20	77	76	80	84	89	79
Daren (m)	48mo	71.5	78	43	28	49	35	61	60	62	58	65	93
Ralphie (m)	43mo	116.5	61	37	20	25	31	89	98	87	94	85	59

Standard Score, ** T-score, *GARS 3 Autism Index (>55 indicates probable autism)*

Table 2: Acquisition Targets by Participant

<i>Participant Target List</i>								
<u>Participant</u>	<u>Skill domain</u>	<u>A-TI</u>	<u>A-CT</u>	<u>B-TI</u>	<u>B-CT</u>	<u>Targets</u>		<u>Interspersed Mastered Targets</u>
Daren	Tacting letter sounds	K, B, T	M, D, U	C, N, F	W, H, P	G, V, S	L, Z, J	Peg color sorter, Tacting numbers (1-10), Matching identical pictures
Ralphie	Tacting letter sounds	W, P, N	T, M, D	K, H, U	C, B, F	Z, L, G	V, S, J	Tacting numbers (1-10), Tacting colors, Peg color sorter
Brett	Tacting letter names	J, I, K	U, T, N	F, H, D	P, V, X	r, t, g	f, n, i	Tacting colors, Peg color sorter, Matching identical pictures
Lizzy	Tacting letter names	Z, Y, R	U, M, K	j, p, g	m, l, b	h, a, t	r, q, e	Tacting colors, Peg color sorter, Tacting numbers

Table 3: Daren Social Validity

<i>Daren Social Validity</i>				
	Concurrent mean	Concurrent Range	Interspersal Mean	Interspersal Range
1: The student is engaged with the work	5.83	3-7	7.00	7-7
2: The student is happy	3.67	1-7	6.50	6-7
3: The student likes learning the skill being taught	3.83	1-6	6.67	6-7
4: The student is learning the skill being taught	5.17	1-7	7.00	7-7
5: This is a good use of the student's time	5.17	1-7	6.83	6-7
6: The teacher is engaged with the work	6.50	6-7	7.00	7-7-
7: The teacher is happy	5.67	4-7	6.83	6-7
8: The teacher likes teaching the skills being taught	6.17	4-7	6.83	6-7
9: The teacher does not have to do extra work to keep the student engaged	4.17	2-7	6.83	6-7
10: This is a good use of the teacher's time	5.83	3-7	6.67	6-7

Table 4: Ralphie Social Validity

<i>Ralphie Social Validity</i>				
	Concurrent mean	Concurrent Range	Interspersal Mean	Interspersal Range
1: The student is engaged with the work	6.17	6-7	4.33	2-6
2: The student is happy	6.17	6-7	5.33	2-7
3: The student likes learning the skill being taught	6.33	6-7	4.83	3-7
4: The student is learning the skill being taught	6.17	6-7	5.17	3-7
5: This is a good use of the student's time	6.00	6-6	5.33	2-7
6: The teacher is engaged with the work	6.17	6-7	6.17	6-7
7: The teacher is happy	6.00	6-6	6.00	5-7
8: The teacher likes teaching the skills being taught	6.00	6-6	6.00	5-7
9: The teacher does not have to do extra work to keep the student engaged	6.00	6-6	3.67	2-5
10: This is a good use of the teacher's time	6.00	6-6	4.83	2-6

Table 5: Brett Social Validity

<i>Brett Social Validity</i>				
	Concurrent mean	Concurrent Range	Interspersal Mean	Interspersal Range
1: The student is engaged with the work	5.33	5-6	6.67	6-7
2: The student is happy	4.50	3-6	6.33	5-7
3: The student likes learning the skill being taught	4.83	4-6	6.00	5-7
4: The student is learning the skill being taught	5.00	4-6	6.50	5-7
5: This is a good use of the student's time	5.33	4-6	6.17	5-7
6: The teacher is engaged with the work	5.50	4-6	6.50	6-7
7: The teacher is happy	5.50	4-6	6.33	6-7
8: The teacher likes teaching the skills being taught	5.50	4-6	6.00	4-7
9: The teacher does not have to do extra work to keep the student engaged	4.67	3-6	5.83	5-7
10: This is a good use of the teacher's time	5.33	4-6	6.00	5-7

Table 6: Lizzy Social Validity

<i>Lizzy Social Validity</i>				
	Concurrent mean	Concurrent Range	Interspersal Mean	Interspersal Range
1: The student is engaged with the work	2.83	2-5	3.17	2-5
2: The student is happy	4.67	3-6	5.00	2-6
3: The student likes learning the skill being taught	3.17	2-4	3.50	2-5
4: The student is learning the skill being taught	5.00	4-6	3.67	2-5
5: This is a good use of the student's time	5.50	4-6	4.33	2-6
6: The teacher is engaged with the work	6.17	6-7	6.00	6-6
7: The teacher is happy	6.00	5-7	5.33	4-6
8: The teacher likes teaching the skills being taught	5.00	4-6	4.83	2-6
9: The teacher does not have to do extra work to keep the student engaged	2.83	2-4	3.17	2-5
10: This is a good use of the teacher's time	5.00	4-7	4.83	2-6

Table 7: Inter-observer Agreement and Procedural Integrity*IOA and PI*

Participant	FA PI	FA Behavior IOA	Treatment PI	Treatment Behavior IOA	Treatment Accuracy IOA
Brett	100 (range: 100-100)	100 (range: 100-100)	99.63 (range: 97.91-100)	90.87 (range: 80-100)	94.87 (range: 75-100)
Lizzy	96.67 (range: 93.33-100)	88.33 (range: 76.66-100)	99.25 (range: 97.91-100)	80.95 (range: 64.86-93.33)	95.83 (range: 83.33-100)
Daren	100 (range: 100-100)	97.22 (range: 93.33-100)	99.78 (range: 98.48-100)	95.56 (range: 85.71-100)	97.61 (range: 91.67-100)
Ralphie	100 (range: 100-100)	85 (range: 80-90)	99.62 (range: 97.72-100)	84.65 (range: 73.68-100)	100 (range: 100-100)

REFERENCES

REFERENCES

- American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders: DSM-5. Washington, D.C: *American Psychiatric Association*.
- Baio, J. (2012). Prevalence of Autism Spectrum Disorders: Autism and Developmental Disabilities Monitoring Network, 14 Sites, United States, 2008. Morbidity and Mortality Weekly Report. Surveillance Summaries. Volume 61, Number 3. *Centers for Disease Control and Prevention*.
- Brandon, P. K., & Houlihan, D. (1997). Applying behavioral theory to practice: An examination of the behavioral momentum metaphor. *Behavioral Interventions*, 12(3), 113-131.
- Browder, D. M., & Shear, S. M. (1996). Interspersal of known items in a treatment package to teach sight words to students with behavior disorders. *The Journal of Special Education*, 29(4), 400-413.
- Burns, M. K. (2005). Using incremental rehearsal to increase fluency of single-digit multiplication facts with children identified as learning disabled in mathematics computation. *Education and Treatment of Children*, 237-249.
- Burns, M. K., & Boice, C. H. (2009). Comparison of the relationship between words retained and intelligence for three instructional strategies among students with below-average IQ. *School Psychology Review*, 38(2), 284.
- Burns, M. K., Dean, V. J., & Foley, S. (2004). Preteaching unknown key words with incremental rehearsal to improve reading fluency and comprehension with children identified as reading disabled. *Journal of school psychology*, 42(4), 303-314.
- Burns, M. K., & Kimosh, A. (2005). Using incremental rehearsal to teach sight-words to adult students with moderate mental retardation. *Journal of Evidence Based Practices for Schools*, 6, 135-148.
- Butler, L. R., & Luiselli, J. K. (2007). Escape-maintained problem behavior in a child with autism: Antecedent functional analysis and intervention evaluation of noncontingent escape and instructional fading. *Journal of Positive Behavior Interventions*, 9(4), 195-202.
- Cates, G. L., Skinner, C. H., Watson, T. W., Meadows, T. J., Weaver, A., Jackson, B. (2003). Instructional Effectiveness and Instructional Efficiency as Considerations for Databased Decision Making: An Evaluation of Interspersing Procedures. *School Psychology Review*, 32(4), 101-616.
- Centers for Disease Control and Prevention. (2014). Autism spectrum disorders: Data and statistics. Retrieved August 30, 2017.
- Cepeda, N. J., Pashler, H., Vul, E., Wixted, J. T., & Rohrer, D. (2006). Distributed practice in verbal recall tasks: A review and quantitative synthesis. *Psychological bulletin*, 132(3), 354.
- Charlop, M. H., Kurtz, P. F., & Milstein, J. P. (1992). Too much reinforcement, too little behavior: Assessing task interspersal procedures in conjunction with different reinforcement schedules with autistic children. *Journal of Applied Behavior Analysis*, 25(4), 795-808.
- Chong, I. M., & Carr, J. E. (2005). An investigation of the potentially adverse effects of task interspersal. *Behavioral Interventions*, 20(4), 285-300.
- Clinton, E., & Clees, T. J. (2015). High-Preference Strategies and other Interspersal Procedures for Learners with Disabilities: A Review of the Literature. *The Journal of Special Education Apprenticeship*, 4(2), 4.

- Cooke, N. L., Guzaukas, R., Pressley, J. S., & Kerr, K. (1993). Effects of using a ratio of new items to review items during drill and practice: Three experiments. *Education and Treatment of Children*, 213-234.
- Cooke, N. L., & Reichard, S. M. (1996). The Effects of Different Interspersal Drill Ratios on Acquisition and Generalization of Multiplication and Division Facts. *Education and Treatment of Children*, 124-142.
- Cooper, J. O., Heron, T. E., & Heward, W. L. (2014). *Applied Behavior Analysis*. Pearson Educational International.
- Corsello, C. M. (2005). Early intervention in autism. *Infants & Young Children*, 18(2), 74-85.
- Cowan, R. J., Abel, L., & Candel, L. (2017). A Meta-Analysis of Single-Subject Research on Behavioral Momentum to Enhance Success in Students with Autism. *Journal of autism and developmental disorders*, 47(5), 1464-1477.
- Cuvo, A. J., Davis, P. K., & Gluck, M. S. (1991). Cumulative and interspersal task sequencing in self-paced training for persons with mild handicaps. *Mental retardation*, 29(6), 335.
- Davis, C. A., Brady, M. P., Hamilton, R., McEvoy, M. A., & Williams, R. E. (1994). Effects of high probability requests on the social interactions of young children with severe disabilities. *Journal of Applied Behavior Analysis*, 27(4), 619-637.
- Davis, C. A., & Reichle, J. (1996). Variant and invariant high probability requests: increasing appropriate behaviors in children with emotional behavioral disorders. *Journal of Applied Behavior Analysis*, 29(4), 471-482.
- Dawson, J. E., Matson, J. L., & Cherry, K. E. (1998). An analysis of maladaptive behaviors in persons with autism, PDD-NOS, and mental retardation. *Research in Developmental Disabilities*, 19(5), 439-448.
- DeLeon, I. G., & Iwata, B. A. (1996). Evaluation of a multiple stimulus presentation format for assessing reinforcer preferences. *Journal of Applied Behavior Analysis*, 29(4), 519-533.
- Delprato, D. J. (2001). Comparisons of discrete-trial and normalized behavioral language intervention for young children with autism. *Journal of autism and developmental disorders*, 31(3), 315-325.
- Derby, K. M., Wacker, D. P., Sasso, G., Steege, M., Northup, J., Cigrand, K., & Asmus, J. (1992). Brief functional assessment techniques to evaluate aberrant behavior in an outpatient setting: A summary of 79 cases. *Journal of Applied Behavior Analysis*, 25(3), 713-721.
- Dunlap, G. (1984). The influence of task variation and maintenance tasks on the learning and affect of autistic children. *Journal of Experimental Child Psychology*, 37(1), 41-64.
- Dunlap, G., Koegel, R. L., & Burke, J. C. (1981). Educational implications of stimulus overselectivity in autistic children. *Exceptional Education Quarterly*, 2(3), 37-49.
- Eikeseth, S., Smith, T., Jahr, E., & Eldevik, S. (2002). Intensive behavioral intervention at school for 4-to 7-year-old children with autism. *Behavior Modification*, 26, 49-68.
- Fisher, W., Piazza, C. C., Bowman, L. G., Hagopian, L. P., Owens, J. C., & Slevin, I. (1992). A comparison of two approaches for identifying reinforcers for persons with severe and profound disabilities. *Journal of applied Behavior analysis*, 25(2), 491-498.
- Ganz, M. L. (2007). The lifetime distribution of the incremental societal costs of autism. *Archives of pediatrics & adolescent medicine*, 161(4), 343-349.

- Gettinger, M., & Miller, K. (2014). Best practices in increasing academic engaged time. In A. Thomas & P. Harrison (Eds.), *Best practices in school psychology: Student level services* (6th ed., pp. 19 – 36). Bethesda, MD: National Association of School Psychologists.
- Gickling, E. E., & Armstrong, D. L. (1978). Levels of instructional difficulty as related to on-task behavior, task completion, and comprehension. *Journal of Learning Disabilities*, 11(9), 559-566.
- Gilliam, J. E. (2006). *Gilliam autism rating scale* (2nd ed.). Austin: Pro-Ed
- Gould, E., Dixon, D. R., Najdowski, A. C., Smith, M. N., & Tarbox, J. (2011). A review of assessments for determining the content of early intensive behavioral intervention programs for autism spectrum disorders. *Research in Autism Spectrum Disorders*, 5(3), 990-1002.
- Graff, R. B., & Green, G. (2004). Two methods for teaching simple visual discriminations to learners with severe disabilities. *Research in developmental disabilities*, 25(3), 295-307.
- Green, G., Brennan, L. C., & Fein, D. (2002). Intensive behavioral treatment for a toddler at high risk for autism. *Behavior Modification*, 26(1), 69-102.
- Green, V. A., Pituch, K. A., Itchon, J., Choi, A., O'Reilly, M., & Sigafoos, J. (2006). Internet survey of treatments used by parents of children with autism. *Research in developmental disabilities*, 27(1), 70-84.
- Grow, L., & LeBlanc, L. (2013). Teaching receptive language skills. *Behavior analysis in practice*, 6(1), 56-75.
- Hanley, G. P. (2012). Functional assessment of problem behavior: Dispelling myths, overcoming implementation obstacles, and developing new lore. *Behavior Analysis in Practice*, 5(1), 54-72.
- Hanley, G. P., Jin, C. S., Vanselow, N. R., & Hanratty, L. A. (2014). Producing meaningful improvements in problem behavior of children with autism via synthesized analyses and treatments. *Journal of Applied Behavior Analysis*, 47(1), 16-36.
- Heflin, L. J., & Isbell, J. S. (2012). Education Through the Developmental Stages. *Educating Students with Autism Spectrum Disorders: Research-Based Principles and Practices*.
- Henrickson, M. L., Rapp, J. T., & Ashbeck, H. A. (2015). Teaching with massed versus interspersed trials: Effects on acquisition, maintenance, and problem behavior. *Behavioral Interventions*, 30(1), 36-50.
- Horner, R. H., Carr, E. G., Halle, J., McGee, G., Odom, S., & Wolery, M. (2005). The use of single-subject research to identify evidence-based practice in special education. *Exceptional children*, 71(2), 165-179.
- Horner, R. H., Carr, E. G., Strain, P. S., Todd, A. W., & Reed, H. K. (2002). Problem behavior interventions for young children with autism: A research synthesis. *Journal of autism and developmental disorders*, 32(5), 423-446.
- Horner, R. H., Day, H. M., Sprague, J. R., O'Brien, M., & Heathfield, L. T. (1991). Interspersed requests: A nonaversive procedure for reducing aggression and self-injury during instruction. *Journal of Applied Behavior Analysis*, 24(2), 265-278.
- Houlihan, D., & Brandon, P. K. (1996). Compliant in a moment: A commentary on Nevin. *Journal of Applied Behavior Analysis*, 29(4), 549-555.

- Howard, J. S., Sparkman, C. R., Cohen, H. G., Green, G., & Stanislaw, H. (2005). A comparison of intensive behavior analytic and eclectic treatments for young children with autism. *Research in developmental disabilities*, 26(4), 359-383.
- Huerta, M., & Lord, C. (2012). Diagnostic evaluation of autism spectrum disorders. *Pediatric Clinics of North America*, 59(1), 103-111.
- Ingersoll, B. R. (2010). Teaching social communication: A comparison of naturalistic behavioral and development, social pragmatic approaches for children with autism spectrum disorders. *Journal of Positive Behavior Interventions*, 12(1), 33-43.
- Iwata, B. A., DeLeon, I. G., & Roscoe, E. M. (2013). Reliability and validity of the functional analysis screening tool. *Journal of Applied Behavior Analysis*, 46(1), 271-284.
- Iwata, B. A., Dorsey, M. F., Slifer, K. J., Bauman, K. E., & Richman, G. S. (1994). Toward a functional analysis of self-injury. *Journal of applied behavior analysis*, 27(2), 197-209.
- Iwata, B. A., Kahng, S., Wallace, M. D., & Lindberg, J. S. (2000). The functional analysis model of behavioral assessment. In J. Austin & J. E. Carr (Eds.), *Handbook of applied behavior analysis* (pp. 61-90). Reno, NV: Context Press.
- Iwata, B. A., Pace, G. M., Cowdery, G. E., & Miltenberger, R. G. (1994). What makes extinction work: An analysis of procedural form and function. *Journal of Applied Behavior Analysis*, 27(1), 131-144.
- Iwata, B. A., Wong, S. E., Riordan, M. M., Dorsey, M. F., & Lau, M. M. (1982). Assessment and training of clinical interviewing skills: Analogue analysis and field replication. *Journal of Applied Behavior Analysis*, 15(2), 191-203.
- Järbrink, K., & Knapp, M. (2001). The economic impact of autism in Britain. *Autism*, 5(1), 7-22.
- Kazdin, A. E. (2011). *Single-case research designs: Methods for clinical and applied settings*. Oxford University Press.
- Kern, L., & Clemens, N. H. (2007). Antecedent strategies to promote appropriate classroom behavior. *Psychology in the Schools*, 44(1), 65-75.
- Klatt, K. P., Sherman, J. A., & Sheldon, J. B. (2000). Effects of deprivation on engagement in preferred activities by persons with developmental disabilities. *Journal of Applied Behavior Analysis*, 33(4), 495-506.
- Koegel, L. K., & Koegel, R. L. (1986). The effects of interspersed maintenance tasks on academic performance in a severe childhood stroke victim. *Journal of Applied Behavior Analysis*, 19(4), 425-430.
- Koegel, L. K., Koegel, R. L., Shoshan, Y., & McNerney, E. (1999). Pivotal response intervention II: Preliminary long-term outcome data. *Journal of the Association for Persons with Severe Handicaps*, 24(3), 186-198.
- Kratochwill, T. R., Hitchcock, J., Horner, R. H., Levin, J. R., Odom, S. L., Rindskopf, D. M., & Shadish, W. R. (2010). Single-case designs technical documentation. *What works clearinghouse*.
- Kratochwill, T. R., Hitchcock, J. H., Horner, R. H., Levin, J. R., Odom, S. L., Rindskopf, D. M., & Shadish, W. R. (2013). Single-case intervention research design standards. *Remedial and Special Education*, 34(1), 26-38.

- Lane, K. L., Kalberg, J. R., & Shepcaro, J. C. (2009). An examination of the evidence base for function-based interventions for students with emotional and/or behavioral disorders attending middle and high schools. *Exceptional Children*, 75(3), 321-340.
- Langthorne, P., McGill, P., & Oliver, C. (2014). The motivating operation and negatively reinforced problem behavior: A systematic review. *Behavior modification*, 38(1), 107-159.
- Laraway, S., Snyckerski, S., Michael, J., & Poling, A. (2003). Motivating operations and terms to describe them: Some further refinements. *Journal of Applied behavior analysis*, 36(3), 407-414.
- Lee, D. L. (2005). Increasing compliance: A quantitative synthesis of applied research on high-probability request sequences. *Exceptionality*, 13(3), 141-154.
- Lee, D. L., Stansbery, S., Kubina, R., & Wannarka, R. (2005). Explicit Instruction With or Without High-p Sequences: Which is More Effective to Teach Multiplication Facts? *Journal of Behavioral Education*, 14(4), 267-281.
- Lord, C., & McGee, J. P. Committee on Educational Interventions for Children with Autism. (2001). *Educating children with autism*.
- Lovaas, O. I. (1987). Behavioral treatment and normal educational and intellectual functioning in young autistic children. *Journal of consulting and clinical psychology*, 55(1), 3.
- Lovaas, O. I., Koegel, R. L., & Schreibman, L. (1979). Stimulus overselectivity in autism: a review of research. *Psychological bulletin*, 86(6), 1236.
- Love, J. R., Carr, J. E., Almason, S. M., & Petursdottir, A. I. (2009). Early and intensive behavioral intervention for autism: A survey of clinical practices. *Research in Autism Spectrum Disorders*, 3(2), 421-428.
- Luiselli, J. K. (2006). *Antecedent Assessment and Intervention: Supporting Children and Adults with Developmental Disabilities in Community Settings*. Brookes Publishing Company. PO Box 10624, Baltimore, MD 21285.
- Lydon, S., Healy, O., O'Reilly, M. F., & Lang, R. (2012). Variations in functional analysis methodology: A systematic review. *Journal of Developmental and Physical Disabilities*, 24(3), 301-326.
- MacDuff, G. S., Krantz, P. J., & McClannahan, L. E. (2001). Prompts and prompt-fading strategies for people with autism. *Making a difference: Behavioral intervention for autism*, 37-50.
- Mace, F. C., Hock, M. L., Lalli, J. S., West, B. J., Belfiore, P., Pinter, E., & Brown, D. K. (1988). Behavioral momentum in the treatment of noncompliance. *Journal of Applied Behavior Analysis*, 21(2), 123-141.
- Majdalany, L. M., Wilder, D. A., Greif, A., Mathisen, D., & Saini, V. (2014). Comparing massed trial instruction, distributed trial instruction, and task interspersal to teach facts to children with autism spectrum disorders. *Journal of applied behavior analysis*, 47(3), 657-662.
- Martella, R. C., Nelson, J. R., & Marchand-Martella, N. E. (1999). *Research methods: Learning to become a critical research consumer*. Allyn & Bacon.
- Mash, E. J., & Barkley, R. A. (Eds.). (2008). *Treatment of childhood disorders*. Guilford press.
- Matson, J. L., Benavidez, D. A., Compton, L. S., Paclawskyj, T., & Baglio, C. (1996). Behavioral treatment of autistic persons: A review of research from 1980 to the present. *Research in developmental disabilities*, 17(6), 433-465.

- Matson, J. L., Wilkins, J., & Macken, J. (2009). The relationship of challenging behaviors to severity and symptoms of autism spectrum disorders. *Journal of Mental Health Research in Intellectual Disabilities*, 2(1), 29-44.
- McEachin, J. J., Smith, T., & Ivar Lovaas, O. (1993). Long-term outcome for children with autism who received early intensive behavioral treatment. *American Journal of Mental Retardation*, 97, 359-359.
- Michael, J. (2000). Implications and refinements of the establishing operation concept. *Journal of Applied Behavior Analysis*, 33(4), 401-410.
- Michael, J. (2007). Motivating operations. *Applied behavior analysis*, 2, 374-391.
- Miltenberger, R. G. (2006). Antecedent interventions for challenging behaviors maintained by escape from instructional activities. *Antecedent assessment & intervention: Supporting children & adults with developmental disabilities in community settings*, 101-124.
- Mullen, E. M. (1995). *Mullen scales of early learning*. Circle Pines, MN: AGS.
- National Autism Center. (2009). National Standard's Report. Randolph, MA: National Autism Center. Retrieved August 30, 2017.
- Neef, N. A., Iwata, B. A., & Page, T. J. (1977). The effects of known-item interspersal on acquisition and retention of spelling and sightreading words. *Journal of Applied Behavior Analysis*, 10(4), 738-738.
- Neef, N. A., Iwata, B. A., & Page, T. J. (1980). The effects of interspersal training versus high-density reinforcement on spelling acquisition and retention. *Journal of Applied Behavior Analysis*, 13(1), 153-158.
- Newsom, C., & Hovanitz, C. A. (2006). Autistic spectrum disorders. *Treatment of childhood disorders*, 3, 455-511.
- Nevin, J. A. (1996). The momentum of compliance. *Journal of Applied Behavior Analysis*, 29(4), 535-547.
- Nevin, J. A., Mandell, C., & Atak, J. R. (1983). The analysis of behavioral momentum. *Journal of the Experimental analysis of behavior*, 39(1), 49-59.
- Nicholson, C. A. (2013). An analysis of variables affecting task interspersal among children with autism (doctoral dissertation). Retrieved from Dissertation Abstracts International on August 30, 2017.
- Ormsby, L. M., & Belfiore, P. J. (2009). The task-interspersal procedure has relative effects for teaching object labeling to preschool children with autism or developmental/language delay. *Evidence-Based Communication Assessment and Intervention*, 3(1), 38-42.
- Perepletchikova, F., & Kazdin, A. E. (2005). Treatment integrity and therapeutic change: Issues and research recommendations. *Clinical Psychology: Science and Practice*, 12(4), 365-383.
- Peyton, R. T., Lindauer, S. E., & Richman, D. M. (2005). The effects of directive and nondirective prompts on noncompliant vocal behavior exhibited by a child with autism. *Journal of applied behavior analysis*, 38(2), 251-255.
- Rapp, J. T., & Gunby, K. (2016). Task interspersal for individuals with autism and other neurodevelopmental disorders. *Journal of applied behavior analysis*, 49(3), 730-734.

- Reichle, J., & McComas, J. (2004). Conditional use of a request for assistance. *Disability and Rehabilitation*, 26(21-22), 1255-1262.
- Rowan, V. C., & Pear, J. J. (1985). A comparison of the effects of interspersal and concurrent training sequences on acquisition, retention, and generalization of picture names. *Applied Research in Mental Retardation*, 6(2), 127-145.
- Sallows, G. O., & Graupner, T. D. (2005). Intensive behavioral treatment for children with autism: Four-year outcome and predictors. *American Journal on Mental Retardation*, 110(6), 417-438.
- Sanchez-Fort, M. R., Brady, M. P., & Davis, C. A. (1995). Using high-probability requests to increase low-probability communication behavior in young children with severe disabilities. *Education and Training in Mental Retardation and Developmental Disabilities*, 151-165.
- Schreibman, L., Kohlenberg, B. S., & Britten, K. R. (1986). Differential responding to content and intonation components of a complex auditory stimulus by nonverbal and echolalic autistic children. *Analysis and Intervention in Developmental Disabilities*, 6(1-2), 109-125.
- Schroeder, G. L., & Baer, D. M. (1972). Effects of concurrent and serial training on generalized vocal imitation in retarded children. *Developmental Psychology*, 6(2), 293.
- Simpson, R. L., & Regan, M. (Eds.). (1986). *Management of autistic behavior: Information service for educators*. Aspen Publishers.
- Skinner, C. H. (2003). Instructional Effectiveness and Instructional Efficiency as Considerations for Databased Decision Making: An Evaluation of Interspersing Procedures. *School Psychology Review*, 32(4), 101-616.
- Skinner, C. H. (2008). Theoretical and applied implications of precisely measuring learning rates. *School Psychology Review*, 37(3), 309-314.
- Smith, T. (1999). Outcome of early intervention for children with autism. *Clinical Psychology: Science and Practice*, 6(1), 33-49.
- Smith, T. (2001). Discrete trial training in the treatment of autism. *Focus on autism and other developmental disabilities*, 16(2), 86-92.
- Smith, T. (2005). The appeal of unvalidated treatments. In *controversial therapies for developmental disabilities: Fad, fashion, and science in professional practice*. JW Jacobson, RM Foxx, & JA Mulick.
- Smith, T., Groen, A. D., & Wynn, J. W. (2000). Randomized trial of intensive early intervention for children with pervasive developmental disorder. *American Journal on Mental Retardation*, 105(4), 269-285.
- Sparrow, S. S., Cicchetti, D. V., & Saulnier, C. A. (2016). *Vineland-3: Vineland Adaptive Behavior Scales*. Circle Pines, MN: PsychCorp.
- Stahr, B., Cushing, D., Lane, K., & Fox, J. (2006). Efficacy of a function-based intervention in decreasing off-task behavior exhibited by a student with ADHD. *Journal of Positive Behavior Interventions*, 8(4), 201-211.
- Steege, M. W., Wacker, D. P., Cigrand, K. C., Berg, W. K., Novak, C. G., Reimers, T. M., ... & DeRaad, A. (1990). Use of negative reinforcement in the treatment of self-injurious behavior. *Journal of Applied Behavior Analysis*, 23(4), 459-467.

- Sugai, G., & Horner, R. R. (2006). A promising approach for expanding and sustaining school-wide positive behavior support. *School psychology review*, 35(2), 245.
- Sundberg, M. L. (2008). VB-MAPP Verbal Behavior Milestones Assessment and Placement Program: a language and social skills assessment program for children with autism or other developmental disabilities: guide. Mark Sundberg.
- Teeple, D. F., & Skinner, C. H. (2004). Enhancing grammar assignment perceptions by increasing assignment demands: Extending additive interspersal research to students with emotional and behavioral disorders. *Journal of Emotional and Behavioral Disorders*, 12(2), 120-127.
- Tews, L. (2007). Early Intervention for Children with Autism: Methodologies Critique. *Developmental Disabilities Bulletin*, 35, 148-168.
- Varni, J. W., Lovaas, O. I., Koegel, R. L., & Everett, N. L. (1979). An analysis of observational learning in autistic and normal children. *Journal of Abnormal Child Psychology*, 7(1), 31-43.
- Volkert, V. M., Lerman, D. C., Trosclair, N., Addison, L., & Kodak, T. (2008). An exploratory analysis of task interspersal procedures while teaching object labels to children with autism. *Journal of Applied Behavior Analysis*, 41(3), 335-350.
- Weber, R. C., & Thorpe, J. (1989). Comparison of task variation and constant task methods for severely disabled in physical education. *Adapted Physical Activity Quarterly*, 6(4), 338-353.
- Weiss, M. J. (1999). Differential rates of skill acquisition and outcomes of early intensive behavioral intervention for autism. *Behavioral Interventions*, 14(1), 3-22.
- Wharton-McDonald, R., Pressley, M., & Hampston, J. M. (1998). Literacy instruction in nine first-grade classrooms: Teacher characteristics and student achievement. *The Elementary School Journal*, 99(2), 101-128.
- Wildmon, M. E., Skinner, C. H., Watson, T. S., & Garrett, L. S. (2004). Enhancing assignment perceptions in students with mathematics learning disabilities by including more work: An extension of interspersal research. *School Psychology Quarterly*, 19(2), 106.
- Winterling, V., Dunlap, G., & O'Neill, R. E. (1987). The influence of task variation on the aberrant behaviors of autistic students. *Education and Treatment of Children*, 105-119.
- Wing, L., & Gould, J. (1979). Severe impairments of social interaction and associated abnormalities in children: *Epidemiology and classification*. *Journal of autism and developmental disorders*, 9(1), 11-29.
- Wolery, M., Holcombe, A., Cybriwsky, C., Doyle, P. M., Schuster, J. W., Ault, M. J., & Gast, D. L. (1992). Constant time delay with discrete responses: A review of effectiveness and demographic, procedural, and methodological parameters. *Research in Developmental Disabilities*, 13(3), 239-266.
- Wong, C., Odom, S. L., Hume, K. A., Cox, A. W., Fettig, A., Kucharczyk, S., ... & Schultz, T. R. (2015). Evidence-based practices for children, youth, and young adults with autism spectrum disorder: A comprehensive review. *Journal of Autism and Developmental Disorders*, 45(7), 1951-1966.
- Zager, D. B., Wehmeyer, M. L., & Simpson, R. L. (Eds.). (2012). *Educating students with autism spectrum disorders: Research-based principles and practices*. Routledge.