VARYING INTERTRIAL INTERVAL DURING GROUP INSTRUCTION FOR CHILDREN WITH AUTISM SPECTRUM DISORDER

By

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ABSTRACT

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Individuals with autism spectrum disorder often have challenges attending and learning during group instruction. Previous research has shown that pacing can influence engagement and learning during one-to-one instruction, though less is known about how pacing impacts children with ASD during group instruction. This study evaluated the effects of intertrial interval length on the occurrence of problem behavior and accurate responding during Direct Instruction delivered in a small-group format. An alternating treatments design with a baseline was used. The results demonstrated variability between the participants for each phase and dependent variable suggesting that ITI length may not be an important factor for all individuals.

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KEY TO SYMBOLS

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KEY TO ABBREVIATIONS

ASD	Autism Spectrum Disorder
ITI	Intertrial Interval
EIBI	Early Intensive Behavioral Intervention
ABA	Applied Behavior Analysis
VB-MAPP	Verbal Behavior Milestones Assessment and Placement Program
IOA	Interobserver Agreement
MSWO	Multiple Stimulus Without Replacement

Introduction

Group instructional arrangements represent the vast majority of active learning time for children in schools and learners must acquire new skills when in these teaching arrangements to be successful in school settings (Sharan, Acerkman, & Hertz-Lazarowitz, 1979). Children are expected to sit appropriately, attend to the instructor, ignore distractions, and learn new concepts or skills simultaneous to other children in the classroom. Although most school-aged children sufficiently attend and learn in group formats without explicit instruction to do so, children with autism spectrum disorder (ASD) often demonstrate many behavioral excesses and deficits that are likely to interfere with learning in group arrangements (Leach & Duffy, 2009; Wetherby, Woods, Allen, Cleary, Dickinson & Lord, 2004). Behavioral deficits include delays in language, attending, and social interactions, while behavioral excesses may include stereotypic or repetitive behaviors, leaving the instructional area, and screaming or yelling (Goldman, Wang, Salgado, Greene, Kim, & Rapin, 2008; Thurm, Lord, Lee, & Newschaffer, 2007). To date, there is insufficient research to guide practitioners regarding effective group instruction for children with ASD.

The vast majority of evidence-based practices used to teach individuals with ASD, focus on teaching in a one-to-one ratio (Eikeseth, 2009). Children learn new materials and concepts in a one to one ratio, yet may not be taught to attend and work in a group setting and are unlikely to generalize skills acquired from one-to-one instruction to group settings (Brown & Bebko, 2011). If individuals with ASD are not explicitly taught to learn in group settings prior to entering kindergarten, they are at great risk of falling behind in school as most teaching and learning requires attending to and learning during group instruction (Sharon et al., 1979).

Strategies that reduce behavioral excesses that may interfere with learning in a group setting and that teach new skills during group instruction are needed to improve educational outcomes for children with ASD (Carnahan, Musti-Rao, & Bailey, 2009).

During one to one instruction, discrete trial training is one of the most common strategies implemented. One of the main components of discrete trial training is the pacing of instruction (Devlin & Harber, 2004). An approach frequently used to adjust instructional pacing in ASD intervention research is to vary the length of the intertrial interval (Munk & Repp, 1994). Intertrial interval (ITI) is the time between the learner's last response and the delivery of the next instruction. Identifying optimal ITI during group instruction is important for young children whose responding may be influenced by pacing.

Koegel, Dunlap, and Dyer (1980) conducted early research on the effects of ITI on skill acquisition during one-to-one instruction for individuals with ASD. Three children (8-year-old boy, 7-year-old girl, and 11-year-old boy) diagnosed with ASD were included. The authors compared a short ITI (maximum range of 1 s to 4 s) to a long ITI (maximum range 4 s to 26 s). The ranges were based on each participant; however, the long ITI was four to five times longer than the short ITI for each participant. Each participant had different tasks that they had to complete during the study such as sequencing, verbal imitation, number discrimination, and color labeling. Each task was assessed in both condition lengths. For all participants, the short interval produced more correct responses and faster acquisition of the target skills than the long interval.

Roxburgh and Carbone (2012) conducted a study with two participants who were diagnosed with ASD. They evaluated the effects of three fixed intertrial intervals (1 s, 5 s, and

10 s) during one-to-one discrete trial training. They looked at the percentage of correct responses as well as the frequency of problem behavior because as responding decreases, it is often replaced with non-attending or other problem behavior. During each condition, participants were required to tact, respond intraverbally, respond as listeners, and to match stimuli. Instructional trials included a mix of novel and mastered items. If problem behavior occurred it was blocked but the ITI remained constant across the session (i.e., problem behavior did not interrupt the assigned interval length). The results showed that both participants exhibited a lower frequency of problem behavior in the fast ITI (1 s) compared to the medium and long ITI. Data for the percentage of correct responding was high across conditions and overlapped greatly. The outcomes suggest responding may be similar regardless of ITI length. However, the reduction in problem behavior during the short ITI sessions might allow the instructor to provide more learning trials during a session, while maintaining a high rate of responding. This suggests fast-paced instruction has potential as a more efficient approach than slower paced instruction for children with ASD. Additionally, a decrease in problem behavior would also decrease the number of distractions for other students in a group instructional arrangement.

Similarly, Cariveau, Kodak, and Campbell (2016) found that shorter ITI lengths may impact skill acquisition, as well as problem behavior, for children with ASD. The authors used an alternating treatment design with a multiple probe design and included a baseline, which demonstrated additional experimental control. The ITI lengths were short (2 s), progressive (starting at 2 s and progressively increased to 20 s) and long (20 s). Target skills varied across participants with one participant responding intraverbally and another tacting. The results

demonstrated a functional relation between ITI and the frequency of problem behavior for both participants. The rate of problem behavior was reduced in the short ITI for both participants. In addition, both participants needed fewer trials in the short ITI to meet mastery criteria.

Although it is necessary to study the characteristics of one to one instruction, group instruction must not be neglected as this is the learning environment that many individuals with ASD will encounter in the school setting. Flores and colleagues (2013) focused their research on group learning with children with ASD. They evaluated the effectiveness of *Language for Learning* (Engelmann & Osborn, 1999) for seven children in first through seventh grade with ASD. *Language for Learning* (Engelmann & Osborn, 1999) is a Direct Instruction program that is designed for teaching language concepts (e.g., vocabulary and sentence structure) to typically developing children or children with mild to moderate disabilities in preschool to second grade. The participants were placed into groups of two to four learners based on each students' assessment scores. Sessions were administered daily and lasted 30 min. The instructor followed the program scripts as written, without modification. The results demonstrated that children showed statistically significant improvement in performance on program level assessments. This suggests that *Language for Learning* can be implemented without modification for some individuals with ASD. However, it's likely that some children, particularly younger children who are more severely affected by ASD, may need modifications or training of prerequisite skills in order to progress through the curriculum.

Tincani and Crozier (2008) administered *Language for Learning* (Engelmann & Osborn, 1999) in a one-to-one format to two participants with language delays, one diagnosed with ASD

and one with no diagnosis but who exhibited frequent problem behavior. The authors evaluated the effects of a brief and extended wait time on the percentage of correct responses and the percentage of 5-s intervals with problem behavior during small group instruction. Wait time was operationally defined as the time between the delivery of the discriminative stimulus and the delivery of the signal to respond. A brief wait time lasted 1 s while an extended wait time lasted 4 s. The results demonstrated that brief wait time led to a slight increase in correct responding and a decrease in problem behavior. Similar to faster ITI, brief wait time allows the teacher to provide more instructions and therefore gives students more learning trials.

It is important to determine how individual teaching characteristics, such as ITI, affect overall teaching. When individual characteristics are examined, it provides clinicians and researchers better information on how to effectively teach individuals with and without disabilities. This in turn, may lead to increased skill acquisition, decreased problem behavior, or better attending. When the teaching characteristics are combined, these outcomes can be even more pronounced.

Previous research shows benefits of faster paced instruction (e.g., shorter ITI) for reductions in problem behavior (Roxburgh & Carbone, 2012; Cariveau, Kodak, & Campbell, 2016) and in some cases on correct responding (Koegel, Dunlap, & Dyer, 1980) for children with ASD in one-to-one instructional arrangements. Although these are important findings, the majority of children with ASD receive instruction within small to large group arrangements. Given the benefits of shorter ITI length during one-to-one instruction, faster-paced instruction may be particularly useful during group instruction for children with ASD, though research has yet to examine the potential benefits of manipulating ITI during group instruction. Therefore,

the current study aims to evaluate the effects of ITI length on the frequency of problem behaviors and percentage of correct responding during group instruction for children with ASD.

Method

Participants

The participants were three preschool children who received a medical diagnosis of ASD. Georgia was four years old, Lauren was three years old, and Brandon was four years old when the study began. The children were enrolled in an early intensive behavioral intervention (EIBI) program where they received 30 hours per week of applied behavior analysis (ABA) therapy. Criteria for participating included: (a) exhibited problematic behaviors that interfered with instructional routines, (b) demonstrated ability to sit at a table or facing instructor on the floor for five or more minutes at a time, (c) could orient body toward a speaker when name was called, (d) attended to the instructor or stimuli during one-to-one instruction, (e) tacted pictures and objects, (f) responded intraverbally to simple questions, and (g) and points functioned as a conditioned reinforcer. Point cards were conditioned prior to the start of the study with each participant earning 10 points before obtaining a reinforcer.

Near the start of the study each participant had recently been administered the Verbal Behavior Milestones Assessment and Placement Program (VB-MAPP; Sundberg, 2009). Georgia's overall score on the VB-MAPP was 97.0 on the milestones assessment with her language scores falling primarily in level two. She could mand for missing items, mand spontaneously, and emit new mands without specific training. She could tact noun-verb combinations as well as over 200 nouns and/or verbs. As a listener, she could select the correct item from an array of six stimuli, perform motor actions on command, and follow two-component noun-verb instructions (e.g., show me the baby sleeping). Georgia also selected items by feature, function, or class (e.g., You sit on a…, find an animal…). She completed fill in

the blank phrases (e.g., song fill-ins, animal sounds, you sleep in a…, shoes and….) and responded to "What is your name?". In addition, during group instruction she could sit in a small group for five minutes without disruptive behavior. Georgia communicated in simple sentences.

Lauren scored a 73.5 on the VB-MAPP on the milestones assessment. Her language skills were in level two. She could mand spontaneously for others to complete actions and emit mands that contain two or more words. She could tact over 200 nouns and/or verbs. She could select the correct item from an array of six and perform motor actions on command. She could fill in phrases to common songs and make animal noises when instructed. During group instruction she could sit in a small group for 10 minutes. Lauren communicated in one to two word utterances.

Brandon scored a 117.5 on the VB-MAPP on the milestones assessment. His language skills were in level three. He could mand for information using WH questions, mand for missing items, and emits new mands without specific mand training. He could tact the color, shape, and function of objects when asked and had a tact vocabulary of over 500 words. He could select the correct item from an array of six, performed motor actions on command, and followed two-component noun-verb instructions (e.g., show me the baby sleeping). Brandon demonstrated a listener repertoire of over 600 words. He responded as a listener when the feature, function, or class of an item is described (e.g., You sit on a…, find an animal…). He selected items from a book based on two verbal components (e.g., do you see a brown animal?). He completed fill in the blank phrases and correctly responded to "What is your name?". He also answered what, who, and where questions. In addition, during group

instruction he could sit in a small group for five minutes without disruptive behavior. Brandon communicated in mostly simple sentences but could communicate with complex sentences. He was also able to engage in simple conversations.

Setting

Sessions were conducted in the early intervention room. This room was designed similarly to an early childhood classroom. The area where instruction occurred contained a large semi-circle shaped table, child sized chairs at the table and adult sized chairs positioned directly behind the child chairs for behavior technicians to sit and deliver prompts or other support as needed. The instructor sat across the table from the children. The rest of the classroom contained child sized furniture, toys, shelving units, and a kitchen area. A total of eight children and eight behavior technicians were in the classroom while sessions were conducted. The children and behavior technicians who were not currently participating in a group were situated at other tables around the classroom where they worked on individual learning goals.

Materials

All participants used a point card during each session and phase. The point card was a laminated half sheet of paper with boxes numbered one through ten (Appendix A). The supporting behavior technician used the point card to provide tally marks with a dry erase marker for correct responses. Points could be traded in for a preferred edible periodically during sessions. A digital clock was used to keep track of the intertrial interval for each session. A Go Pro™ and a Sony HD Camcorder were used to video record each session. A researcher-

created data sheet (Appendices B & C) was used during baseline and all intervention phases to record correct and incorrect responses for each participant.

In addition to the materials listed above, the Direct Instruction: *Language for Learning* (Engelmann & Osborn, 1999) curriculum was used during each session in baseline and the first intervention phase. During phases two and three, the researcher created and used a script consisting of mastered tasks to guide session implementation (see Appendix D). Picture cards, measuring four by six inches, that participants could label were also used during phases two and three.

Measurement of Dependent Variables

The primary dependent measure was interfering behavior and was based on each participant's behaviors that interfered with attending and learning during group instruction. These behaviors included: eloping from the table, engaging in vocal stereotypy, engaging in motor stereotypy, crying/screaming, and looking away from the instructor and teaching materials for more than 3 seconds at a time. A list of behaviors and their definitions can be found in Appendix E.

Interfering behavior was scored during the first 5-min, after delivery of the initial instruction, of each session using partial interval recording during 10-s intervals. The first 5-min was chosen to ensure a consistent observation period across all sessions. The experimenter divided the 5-min recording into 10-s intervals, then coded whether problem behavior occurred at any point during the 10-s interval.

The secondary dependent measure was the percentage of accurate responding to the language skills targeted within lessons. Data were collected for the entire *Language for*

Learning (Engelmann & Osborn, 1999) lesson and for the first 30 instructions in the mastered task sessions and turned into a percentage. Responses during the *Language for* Learning sessions, consisted of listener responding, tacts, and intraverbals. Responses during the mastered task sessions consisted of listener responding, imitation, tacts, and intraverbals. For all session types, each trial was scored to identify whether the child performed the correct response. Once the trials were scored, the percentage was determined by dividing the number of correct responses by the total number of opportunities and then multiplying by 100.

All data were collected from video recordings of the group sessions to ensure proper timing of each interval. The session was video recorded and the occurrence of interfering behavior and accurate responding was coded prior to implementation of the next experimental session.

Interobserver Agreement

A second observer was trained to code videos of group instruction from sessions recorded prior to the present investigation. An overview of the primary and secondary dependent measures was provided. The observer was then given old videos to code until obtaining 90% reliability with the first author. The second independent observer collected data on 30% of the recorded sessions, for each phase, to establish interobserver agreement. The 5-min recording was divided into 10-s intervals. Each observer scored problem behavior as occurring or not occurring. Agreement was defined as both observers marking problem behavior as occurring in the interval or both observers marking problem behavior as not occurring in the interval. A disagreement was defined as one observer marking problem behavior as occurring in the interval and the other marking problem behavior as not occurring

in the interval. Point-by-point agreement for each session was determined by dividing the number of trials with agreement for the occurrence of problem behavior by the total number of intervals and converting the result to a percentage (Gast & Ledford, 2014). The mean interobserver agreement (IOA) for problem behavior for Georgia, Lauren, and Brandon was 90% (Range: 73%-100%), 84% (Range: 70%-100%), 88% (Range: 63%-100%), respectively.

When assessing reliability of accurate responding, each observer scored each trial that occurred for the entire *Language for Learning (*Engelmann & Osborn, 1999) lesson or the first 30 instructions for the mastered task lesson. A trial was scored anytime the teacher delivered a verbal discriminative stimulus or provided a gestural model, as in imitation. An agreement was defined as both observers marking the same trial as correct or incorrect. A disagreement was defined as the observers scoring the same trial differently. Interobserver agreement was calculated by dividing the number of trials with agreement by the total number of trials and converting the result to a percentage. The mean IOA for Georgia, Lauren, and Brandon for accurate responding was 95% (Range: 91%-100%), 97% (Range: 88%-100%), and 95% (Range: 88%-100%), respectively.

Session duration was also calculated for each session in which IOA was taken for problem behavior to ensure the observers were coding the same sections of the video recording. Time began when the experimenter initiated the first trial and ended five min later. Each observer recorded the time on the video when the experimenter initiated the first trial and the time on the video when 5-min had elapsed. Agreement was defined as recording the same video start and end time. A disagreement was defined as recording the video time with

any discrepancy. There was an average agreement of 67% for start time with a range of 0% to 100%.

Experimental Design

The effects of varied ITI's on the frequency of problem behavior and correct responding were evaluated using an alternating treatments design with a baseline set at an ITI of 6 s. This design involves quick and repeated manipulations of the independent variables (Gast & Ledford, 2014). The ITI lengths during intervention, 2 s and 10 s, were randomly alternated each session. This design has potential to demonstrate a functional relation if there is evidence of separation between the data series representing varied levels of ITI, which are alternated across sessions. The absence of separation between the data series indicates that changing the ITI has no effect on participant responding.

Group Arrangement

The participants were placed into one small group for the entire study. The group progressed through the *Language for Learning* (Engelmann & Osborn, 1999) lessons by meeting mastery criteria or a maximum of four days on one lesson. Mastery criteria required each participant demonstrate 80% independent correct responding. This could occur across multiple sessions (i.e. each participant did not have to meet mastery on the same day).

Procedures

Pre-Teaching. Each participant was pre-taught *Language for Learning* (Engelmann & Osborn, 1999) lessons during one to one instruction until the participants demonstrated independent responding. The participants were pre-taught the lessons in order to accurately adhere to the ITI time without needing to adjust for prompting as well as more appropriately

measure independent responding. Three lessons were pre-taught and then those lessons were implemented during baseline or the varied ITI phase. Participants were pre-taught using a graduated guidance protocol until demonstrating independent responding for each exercise within a *Language for Learning* lesson. Multiple sessions could occur in one day for the pre-teaching stage with a minimum of one hour between sessions.

Baseline. Prior to starting each group session, behavior technicians administered a brief multiple stimulus without replacement (MSWO) preference assessment (DeLeon & Iwata, 1996) to each child so that the participants' preferred edible items could be identified and delivered as putative reinforcers during the session. The brief MSWO consisted of providing the child with five edible options (e.g., a piece of cookie, cheeto, veggie straw, fruit snack, and skittle) and a behavior technician instructing the child to "choose one". The child selected and consumed one item while the technician rearranged the remaining options without replacing the previously selected item. The technician then presented the four remaining options for the child to choose. If the child did not make a selection, the technician rearranged the items and provided the choice again.

The technicians brought the top two preferred items to the group setting for use during the instructional lesson for each child. The instructor then called all children to the group and began the *Language for Learning* (Engelmann & Osborn, 1999) lesson by providing the first instruction. After reading an instruction, the experimenter signaled the children to respond by snapping her fingers. The signal is a requirement of the script, however, the signal can come in various forms such as clapping or lowering of the hand. Snapping was chosen for its ease to produce a sound while allowing the facilitator to manage instructional materials. After the

signal was given, the children had 3 s to respond. If the child responded correctly within 3 s of the signal (snapping), the child received a point (a tally mark) and it was scored as correct. If the child responded incorrectly within 3 s of the signal, the child did not receive a point, and the response was scored as incorrect. If the child responded after 3 s of the signal, the child did not receive a point and it was scored as incorrect.

The *Language for Learning* (Engelmann & Osborn, 1999) lesson continued until the facilitator delivered all learning opportunities in all exercises within the lesson. At any point during the lesson, if a child obtained 10 points, the facilitator gave the child the item selected during the preference assessment. The child could continue earning preferred items each time he or she earned 10 additional points. Upon completion of the *Language for Learning* lesson, children who met a minimum threshold of 70% for the lesson were released to engage in a preferred activity. A minimum threshold was chosen so that the participants obtained differential outcomes based on their performance in the session. This reduced inadvertently reinforcing poor responding. Seventy percent was chosen as the threshold so that it was slightly lower than mastery criteria but still encouraged higher rates of responding. Children who did not meet accuracy criteria were dismissed from the group table to complete tasks assigned by their behavior technician.

The experimenter administered all sessions during the baseline condition, in which the ITI was always 6 s. The ITI time was defined as the time between the last response and the next instruction. The baseline ITI was determined by calculating average ITI times from videos of the *Language for Learning* (Engelmann & Osborn, 1999) group conducted with children similar to those enrolled in the study. Instruction was presented with a 6-s interval between the 3-s

response window and the presentation of the next trial. The instructor adhered to the ITI by counting privately after the participant emitted a response. Baseline continued until participants' mean interfering behavior occurred in greater than 50% of intervals.

Phase 1: *Language for Learning* varied ITI condition. The treatment condition was identical to baseline except for the manipulation of the ITI. Sessions alternated between a short ITI length and a long ITI length. In the short ITI, the experimenter presented instruction with a 2 s interval between the participants' response and the presentation of the next trial. During the long ITI, the experimenter presented instruction with a 10 s interval between the participants' response and the presentation of the next trial. The sequence of the short and long ITI sessions were randomly selected. This occurred by assigning a number one to the short ITI and a number two to the long ITI and then using a random number generator to determine which of the two ITIs should be administered. Whichever number appeared in the random number generator, that session length was implemented and then the other ITI length was implemented the next day. The randomization sequence was then repeated prior to the subsequent session. For example, if the number 2 appeared on the generator, then the long ITI was implemented first and then the short ITI was implemented the following day. Phase 1 was administered across four alternations. At which time interfering behavior was evaluated for each of the participants. Despite small differences between ITI conditions, there was still a relatively high occurrence of interfering behavior (i.e., M > 50%) for all participants in both conditions. Therefore, participants were transitioned to a second intervention phase in which mastered tasks replaced *Language for Learning.*

Phase 2: Mastered task varied ITI condition. The mastered task treatment phase was similar to Phase 1, except the researcher read a mastered task script rather than the *Language for Learning* (Engelmann & Osborn, 1999) script. The mastered task script was created by the researcher and included tasks that all three participants had previously mastered (i.e., all three participants had to be able to independently respond for the instruction to be included in the script). This change was made to rule out potential problem behavior as a result of difficult academic tasks, which could have also contributed to reduced rates of reinforcement. Prior to starting each group session, behavior technicians administered an MSWO as described above. The mastered task phase was identical to the *Language for Learning* phase (e.g., top two preferred items, points for correct responding, snap as signal to respond to vocal or gestural discriminative stimulus, 3 s response window, contingent reinforcement), except for the content in the lessons coming from the mastered task script as opposed to the *Language for Learning* script. Each mastered task lesson continued until the facilitator delivered 30-50 instructions based on the ITI being implemented to ensure that each session was at least five minutes in length. Upon completion of 30-50 instructions, children who met the predetermined accuracy criterion for the lesson (i.e., 70% correct for 30 instructions) were released to engage in a preferred activity. Children who did not meet accuracy criteria were dismissed from the group table to complete tasks assigned by their behavior technician. ITI lengths and alternation were identical to procedures used during the preceding phase.

Phase 3: Individual mastered task varied ITI condition. This phase was identical to phase 2 except each session was implemented individually with each participant rather than in a group setting. The researcher conducted each session in the same classroom. The child was

seated at an individual child sized table with the supporting behavior technician positioned behind. This phase was included in order to determine if the results from the previous phases were due to the participants not having the necessary pre-requisite skills for participating in group instruction.

Procedural Integrity

A graduate student was trained to code procedural integrity data. A procedural integrity checklist was developed by the first author. The second observer was then given videos of similar children not involved in the present investigation to code until obtaining 90% reliability with the first author. The second independent observer collected data on 30% of the recorded sessions to determine procedural integrity. The mean for procedural integrity was 95% with a range of 80% to 100%.

Results

Visual analysis was used to interpret the results of this study, with an emphasis on evaluating the separation in data series, as well as trend and overlap across conditions and phases. Overall, all participants demonstrated a lower mean problem behavior and higher mean accurate responding during the short ITI condition compared to the long ITI condition. However, clear separation between the data series was not observed during the group intervention with *Language for Learning* (Engelmann & Osborn, 1999). A similar outcome occurred during the second group instruction phase, which involved mastered tasks, and the individual mastered task phase. Results are presented for individual participants below.

During baseline, Georgia demonstrated a mean of 87% of intervals with problem behavior (Range: 73% to 100%) and an increasing trend (see figure 1). During the *Language for Learning* (Engelmann & Osborn, 1999) group phase, mean percentage of problem behavior during the short and long ITI was 81% (Range: 70% to 97%) and 91% (Range: 66% to 100%), respectively, with minimal separation between data series. Problem behavior was decreasing during the short ITI and increasing during the long ITI. During the mastered task group phase, problem behavior decreased during the short ITI to a mean of 68% (Range: 40% to 83%) and during the long ITI to 88% (Range: 73% to 100%), with minimal separation between data series. For the mastered task individual phase, problem behavior had some separation in data series. The short ITI had a mean of 62% (Range: 43% to 90%) and an increasing trend. Yet, problem behavior during the long ITI had a mean of 84% (Range: 63% to 97%) with an increasing trend.

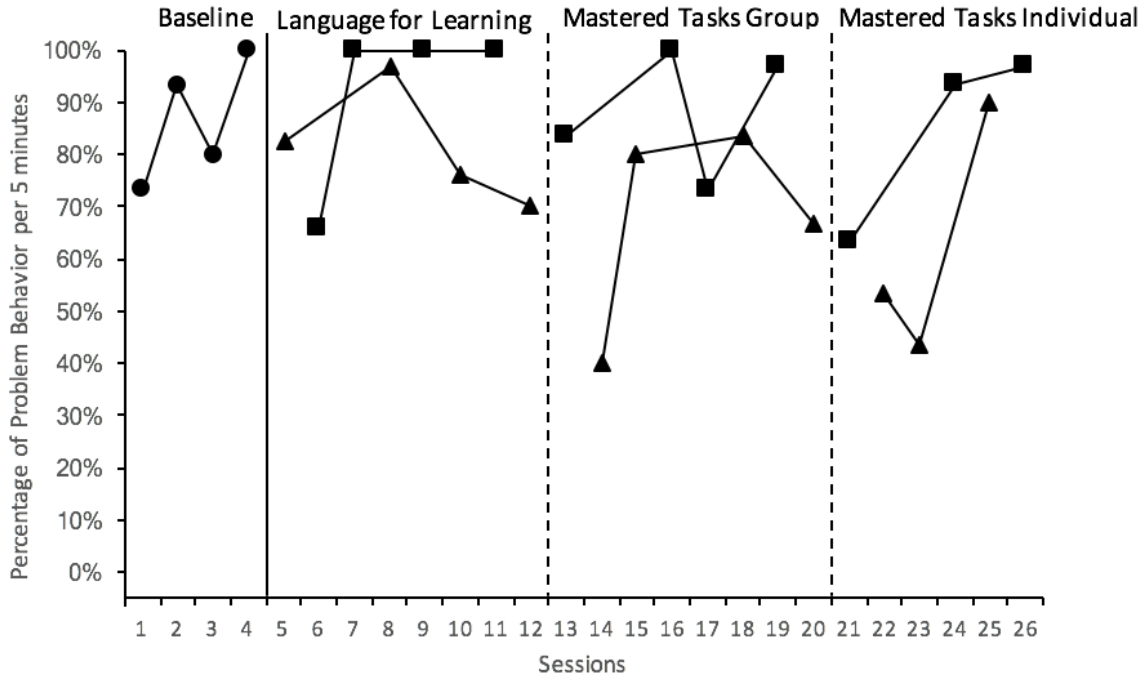

Figure 1. Participant one, Georgia, percentage of problem behavior per 5-minute session

During baseline, Georgia demonstrated a mean of 18% for accurate responding (Range: 10% to 29%) and a decreasing trend (see figure 2). During the *Language for Learning* (Engelmann & Osborn, 1999) group phase, mean percentage of accurate responding during the short and long ITI was 20% (Range: 14% to 25%) and 17% (Range: 13% to 29%), respectively. Accurate responding was increasing during the short ITI and decreasing during the long ITI. During the mastered task group phase, accurate responding increased during the short ITI to a mean of 63% (Range: 50% to 70%) and during the long ITI to 41% (Range: 13% to 73%). For the mastered task individual phase, accurate responding had some separation in data series. The short ITI had a mean of 61% (Range: 30% to 80%) and a decreasing trend. Yet, accurate responding during the long ITI had a mean of 39% (Range: 13% to 78%) with a decreasing trend.

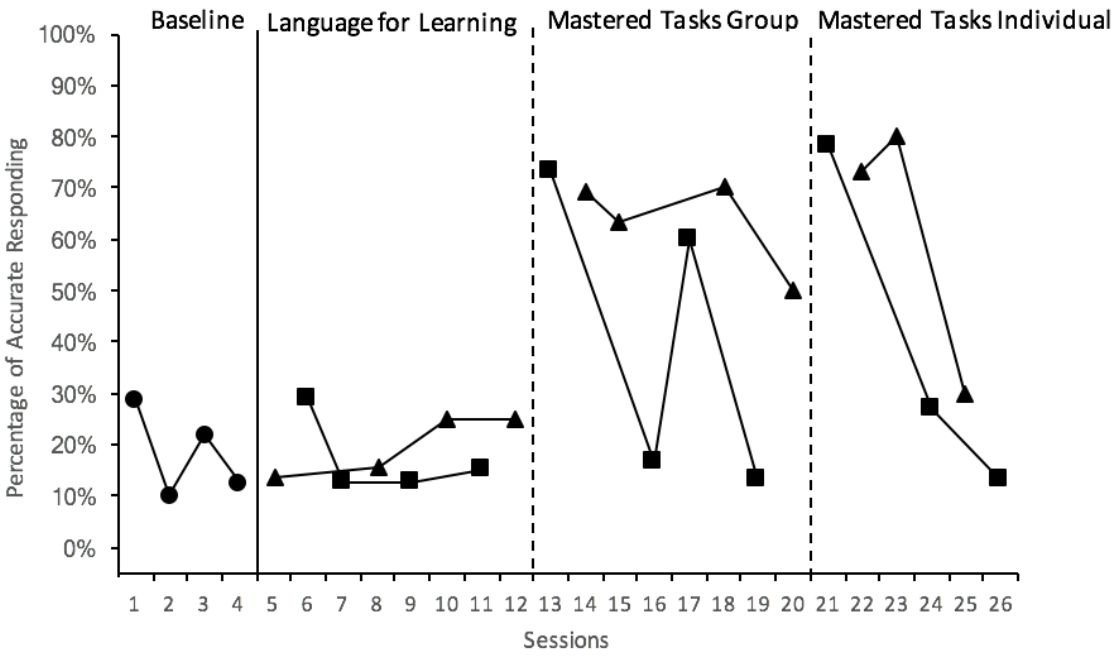

Figure 2. Participant one, Georgia, percentage of accurate responding

Lauren demonstrated a baseline mean of 58% of intervals with problem behavior (Range: 40% to 77%) and an increasing trend (see figure 3). During the *Language for Learning* (Engelmann & Osborn, 1999) group phase, mean percentage of problem behavior during the short and long ITI was 51% (Range: 22% to 68%) and 75% (Range: 70% to 87%), respectively. Problem behavior was increasing during the short ITI and decreasing during the long ITI. During the mastered task group phase, problem behavior increased during the short ITI to a mean of 73% (Range: 60% to 83%) and during the long ITI to 88% (Range: 77% to 97%). For the mastered task individual phase, problem behavior had minimal separation in data series. The short ITI had a mean of 63% (Range: 53% to 73%) and an increasing trend. Yet, problem behavior during the long ITI had a mean of 76% (Range: 73% to 80%) with a flat trend.

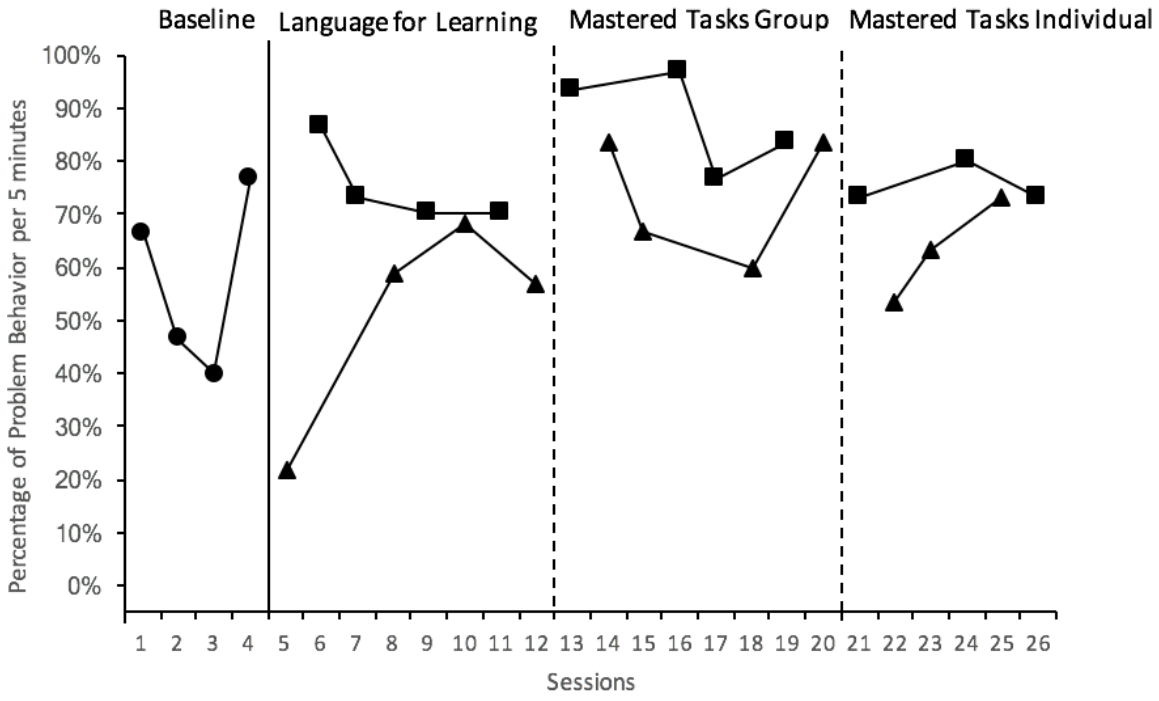

Figure 3. Participant two, Lauren, percentage of problem behavior per 5-minute session

During baseline, Lauren demonstrated a mean of 66% accurate responding (Range: 59% to 80%) and a decreasing trend (see figure 4). During the *Language for Learning* (Engelmann & Osborn, 1999) group phase, mean percentage of accurate responding during the short and long ITI was 72% (Range: 60% to 88%) and 51% (Range: 28% to 71%), respectively. Accurate responding was flat during the short ITI and the long ITI. During the mastered task group phase, accurate responding increased during the short ITI to a mean of 73% (Range: 33% to 88%) and during the long ITI to 70% (Range: 47% to 83%). For the mastered task individual phase, accurate responding had minimal separation in data series. The short ITI had a mean of 87% (Range: 83% to 90%) and an increasing trend. Yet, accurate responding during the long ITI had a mean of 82% (Range: 63% to 100%) with a decreasing trend.

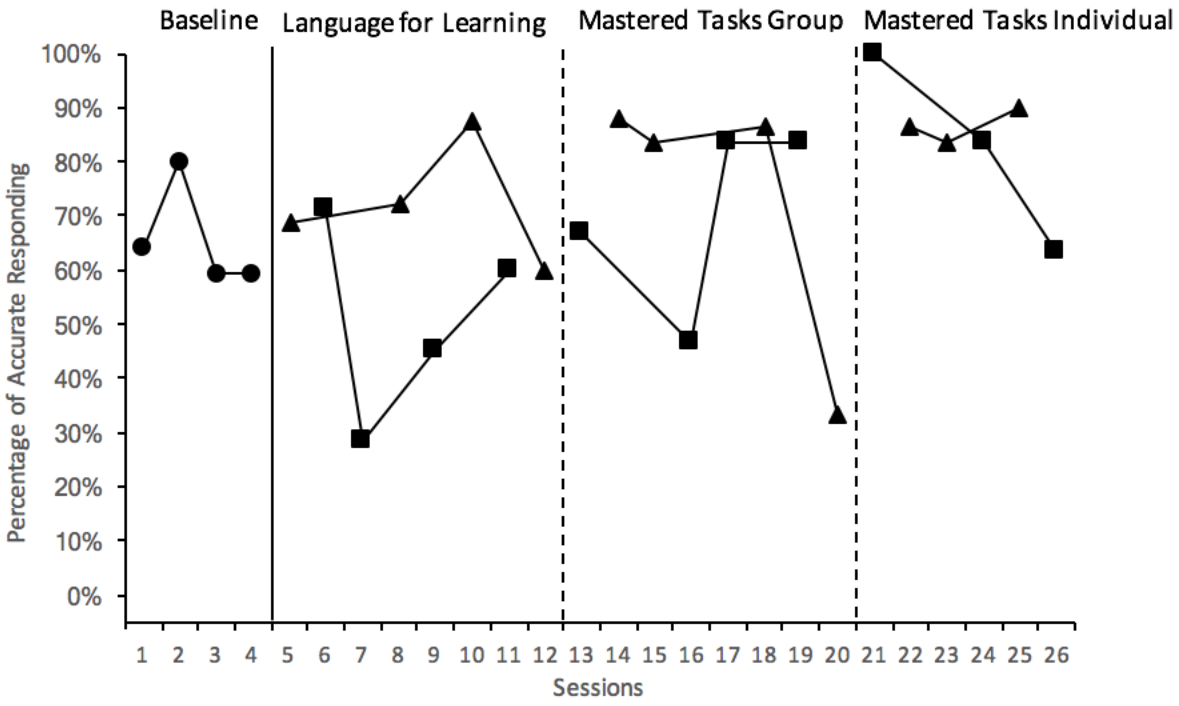

Figure 4. Participant two, Lauren, percentage of accurate responding

During baseline, Brandon demonstrated a mean of 76% of intervals with problem behavior (Range: 60% to 83%) and a decreasing trend (see figure 5). It is important to note that during the fourth session in baseline, the camera recording the session was moved by a nonparticipant. When it was readjusted, it was positioned in a way in which Brandon could not be seen. Thus problem behavior for this session could not be recorded for this participant. During the *Language for Learning* (Engelmann & Osborn, 1999) group phase, mean percentage of problem behavior during the short and long ITI was 74% (Range: 48% to 86%) and 89% (Range: 75% to 100%), respectively. Problem behavior was increasing during the short ITI and decreasing during the long ITI. During the mastered task group phase, problem behavior increased during the short ITI to a mean of 90% (Range: 80% to 97%) and during the long ITI to

93% (Range: 87% to 100%). For the mastered task individual phase, problem behavior had some separation in data series. The short ITI had a mean of 62% (Range: 50% to 73%) and an increasing trend. Yet, problem behavior during the long ITI had a mean of 74% (Range: 60% to 93%) with a decreasing trend.

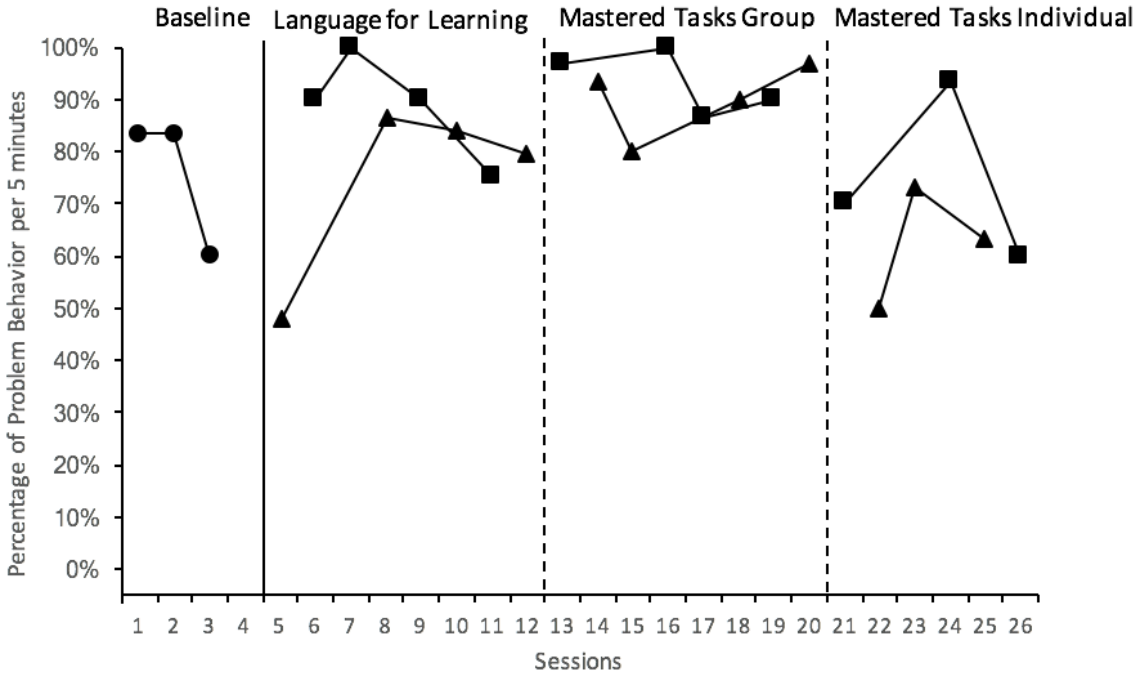

Figure 5. Participant three, Brandon, percentage of problem behavior per 5-minute session

During baseline, Brandon demonstrated a mean of 28% for accurate responding (Range: 16% to 53%) and an increasing trend (see figure 6). During the *Language for Learning* (Engelmann & Osborn, 1999) group phase, mean percentage of accurate responding during the short and long ITI was 41% (Range: 10% to 68%) and 14% (Range: 5% to 23%), respectively. Accurate responding was increasing during the short ITI and the long ITI. During the mastered task group phase, accurate responding decreased during the short ITI to a mean of 26% (Range:

7% to 43%) and during the long ITI to 23% (Range: 3% to 40%). For the mastered task individual phase, accurate responding had some separation in data series. The short ITI had a mean of 64% (Range: 57% to 70%) and an increasing trend. Yet, accurate responding during the long ITI had a mean of 58% (Range: 40% to 77%) with an increasing trend.

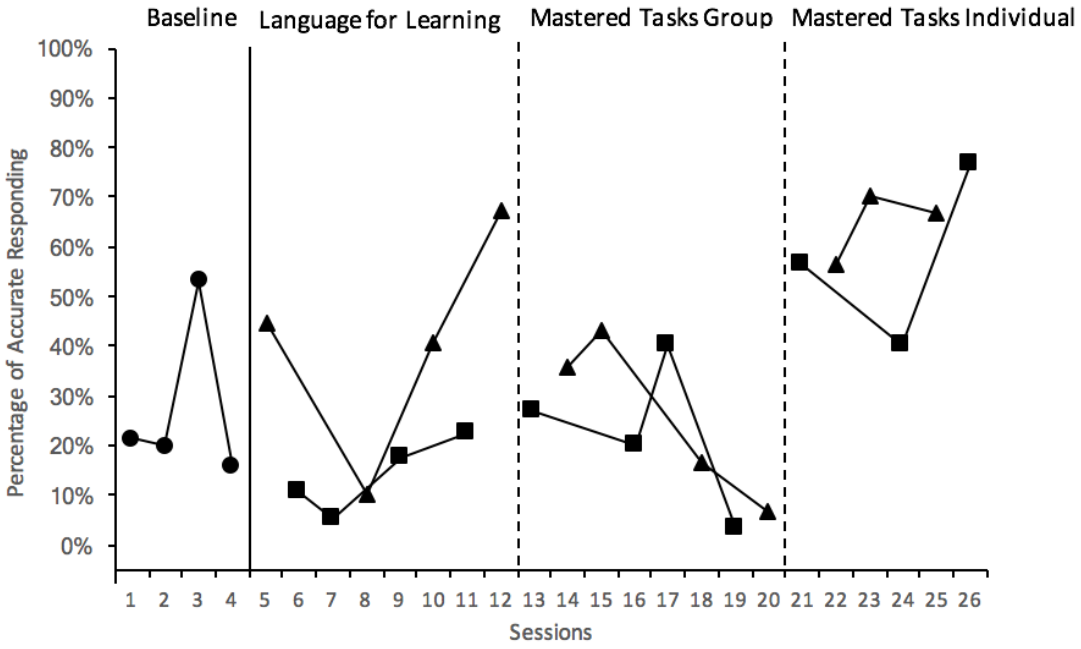

Figure 6. Participant three, Brandon, percentage of accurate responding

Discussion

The present study sought to evaluate the effects of ITI length on the frequency of problem behaviors and percentage of correct responding during group instruction for children with ASD. For this group of participants, ITI length appeared to have little to no effect on problem behavior during group instruction or individual instruction. These results do not align with pervious literature on the effects of ITI length (e.g., Cariveau et al., 2016; Roxburgh & Carbone, 2012).

All participants engaged in high rates of problem behavior during baseline, with two out of three demonstrating an upward trend. During the *Language for Learning* phase (Engelmann & Osborn, 1999), Georgia demonstrated some separation between the short and long ITI conditions, with lower levels of problem behavior during the short ITI condition. However, her problem behavior was still relatively high and interfered with instruction. Lauren and Brandon engaged in similarly high rates of problem behavior in both conditions, suggesting a relatively small impact of the shorter ITI on problem behavior during *Language for Learning*. Similar outcomes were observed for problem behavior across the participants in both the mastered task and individual phases.

The findings for problem behavior differ from the results reported by Roxburgh and Carbone (2012). The authors reported that both participants exhibited a lower frequency of problem behavior during the fast ITI. However, during the present study, the percentage of problem behavior was variable across all participants and phases. This difference in outcomes, could be a result of how problem behavior was measured in each study. Roxburgh and Carbone used frequency to measure problem behavior, whereas, this study used partial interval

recording with percentage of intervals engaged in problem behavior as a summary metric. Percentage of problem behavior may be more sensitive to measuring problem behavior especially when it comes to behaviors that can continue for a period of time (e.g., eloping, flopping on the floor, or vocal stereotypy). In addition, Roxburgh and Carbone examined the rates of problem behavior by function across the ITI lengths. Behaviors maintained by an automatic function were the primary behaviors that were impacted by the ITI manipulation. Thus if participants in the present investigation engaged in problem behaviors for escape, attention, or tangibles, the ITI may have less of an impact on the occurrence of problem behavior.

Two out of three participants engaged in low rates of accurate responding during baseline. During the *Language for Learning* phase (Engelmann & Osborn, 1999), Lauren and Brandon demonstrated some separation between the short and long ITI conditions, with higher levels of accurate responding during the short ITI condition. Georgia engaged in low rates of accurate responding in both conditions. This suggests a small impact of the shorter ITI on accurate responding during *Language for Learning*. Similar outcomes were observed for accurate responding across the participants in both the mastered task and individual phases.

The findings for accurate responding differ to some extent from the results reported by Koegel and colleagues (1980), who reported that participants sometimes exhibited an increase in the rate of accurate responding during the short ITI compared to the long ITI. Conversely, during the present study, the percentage of accurate responding showed high overlap across all participants and phases with a slight increase in performance during the short ITI for two out of three participants. This difference in outcomes could be a result of a larger difference between

ITIs for some participants and tasks in the Koegel et al. study. Additionally, participants in the Koegel et al. study were noted as avoiding social contact and having little to no functional speech. They mention that a shorter ITI might be particularly important for individuals with a lower mental age, but less important for participants similar to those in the present investigation. It is also possible that the current participants did not respond positively within the group instructional format, regardless of ITI and that these issues might have carried over into the one-to-one phase.

Accurate responding in the present investigation was similar to outcomes observed in Roxburgh and Carbone (2012), wherein the percentage of correct responding overlapped greatly across ITI lengths for both participants. This is consistent with the results of the current study and suggests that shorter ITIs may not have a reliable effect on accurate responding. Cariveau and colleagues (2016) similarly reported a great deal of overlap across relatively shorter ITIs for participants, with clear separation evident only during the 2 s and 20 s comparison. Collectively, these data suggest that different ITI lengths might not be impactful until reaching a substantially longer wait time for children with ASD. However, there are relatively few rigorous evaluations of the full range of ITIs across participants with varied skills. Additional research is needed in this area, particularly within group instruction where ITI might be significantly variable in real world settings.

Limitations

There are several limitations of the present study that should be considered. First, the breadth of problem behavior for this study may have had an impact on the results. Twelve definitions were created based on the participant's problem behaviors during one to one

instruction. Although each of these problem behaviors occurred at least once, the number of observed behaviors may have caused the percentage of problem behavior to increase overall. In addition, one specific definition may have increased the percentages for all participants. This definition is that of looking away from teaching stimuli which is defined as looking away from the teacher, *Language for Learning* (Engelmann & Osborn, 1999) script, or picture cards for 3 or more consecutive seconds. The rationale for a 3 s duration was that instruction could be missed regardless of the ITI. However, a longer measurement of time may be more comparable to what is found in an elementary classroom (e.g., 5 or more consecutive seconds).

Another limitation is the lack of indication of condition change to the participants. The participants were not made aware what ITI was being implemented which could have affected the results of problem behavior. A participant may have engaged in more problem behavior at the beginning of a lesson simply because he was unaware of what condition was being implemented (e.g., more problem behavior during the short ITI because the previous session was long).

Future Research

The results of the present study also offer suggestions for future research. First, participant skill level should be examined in relation to ITI manipulation. Children with relatively similar skill levels (e.g., two word utterances, simple sentences, complex sentences, listener responding, tact, and intraverbal skills) should be grouped together and introduced to varied ITI lengths to determine if skill level has any effect on problem behavior and accurate responding during varied ITI.

In addition, the ITI conditions could be implemented with novel content. In the present study, content was either mastered or taught to independence during pre-teaching. Thus novel content in which the individuals have to learn the material has not been evaluated. Novel content may allow the participants to acquire new knowledge without repeating the same content multiple times, though attention should be given to the novel content so that that the participants do not exhibit problem behavior due the difficulty of the material.

Furthermore, this study only used edible reinforcers in order to limit distractions and non-responding due to tangible items. However, future studies could look to incorporate tangible items during group instruction and ITI manipulation. Some participants may be motivated by tangibles more than edibles. Care should be given in this area to ensure that a time limit is put into place and that if accurate responding is to be recorded, that time for reinforcement does not count against accurate responding.

Implications

This study produces implications for the clinical setting. ITI for individuals with ASD may not be an important factor in reducing problem behavior or increasing skill acquisition when in a group setting with mastered tasks. Current research does not yet provide information on the effects of ITI during group instruction for novel or a mix of novel and mastered tasks. Yet, most group instruction includes a mix of novel and mastered materials. Thus a clinician should not focus solely on the ITI during group instruction but attempt to keep the ITI as short as possible because although it may not reduce problem behavior, it will allow the clinician to provide more instructions within the same time frame. The opportunity for more instructions, could allow the individuals to acquire the skills faster since there are more

trials. In addition, since a mixture of novel and mastered materials have not been evaluated, clinicians should continue to explore the research for when such an evaluation becomes available.

Overall, the results of the current study provide information about the impact of ITI on the percentage of problem behavior and accurate responding. Although previous research suggests that short ITI results in decreased problem behavior, the results of this study suggest that ITI may not always produce decreased problem behavior or accurate responding. More research is needed to examine participant skill level as well as the speed of skill acquisition with ITI manipulation.

APPENDICES

APPENDIX A

Point Card

1	2	3	4	5	6	7	8	9	10

1	2	3	4	5	6	7	8	9	10

1	2	3	4	5	6	7	8	9	10

1	2	3	4	5	6	7	8	9	10

APPENDIX B

Language for Learning Accurate Responding Data Sheet

Lesson 1

Child: _____ Date: _____ Condition: _____ Session #: _____

"+" correct response within 3 seconds "-" incorrect or no response within 3 seconds

Exercise	Trials	Response	Operant		
Exercise 1	1. stand up		LR	Tact	IV
	2. sit down		LR	Tact	IV
	3. stand up		LR	Tact	IV
	4. What are you doing? standing up		LR	Tact	IV
	5. sit down		LR	Tact	IV
	6. What are you doing? Sitting down		LR	Tact	IV
	7. stand up		LR	Tact	IV
	8. What are you doing? standing up		LR	Tact	IV
	9. sit down		LR	Tact	IV
	10. What are you doing? Sitting down		LR	Tact	IV
Exercise 3	11. What's the name of the school you go to?		LR	Tact	IV
	12. What's the name of the school you go to?		LR	Tact	IV
Exercise 4	13. What is this? (tree)		LR	Tact	IV
	14. What is this? (shoe)		LR	Tact	IV
	15. What is this? (dog)		LR	Tact	IV
	16. What is this? (cat)		LR	Tact	IV
	17. What is this? (tree)		LR	Tact	IV
	18. What is this? (shoe)		LR	Tact	IV
	19. What is this? (dog)		LR	Tact	IV
	20. What is this? (cat)		LR	Tact	IV
Exercise 5	21. What is this (boy)		LR	Tact	IV
	22. What is this (girl)		LR	Tact	IV
	23. What is this (cat)		LR	Tact	IV
	24. What is this (dog)		LR	Tact	IV
	25. What is this (boy)		LR	Tact	IV
	26. What is this (girl)		LR	Tact	IV
	27. What is this (cat)		LR	Tact	IV
	28. What is this (dog)		LR	Tact	IV
	29. What is this (girl)		LR	Tact	IV
	30. What is this (boy)		LR	Tact	IV
	31. What is this (girl)		LR	Tact	IV
	32. What is this (boy)		LR	Tact	IV

Percentage of Correct Responses:

APPENDIX C

Mastered Tasks Accurate Responding Data Sheet

Mastered Tasks

Child: _____ Date: _____ Condition: _____ Session #: _____

"+" correct response within 3 seconds "-" incorrect or no response within 3 seconds

Exercise	Trials	Response	Operant
Exercise 1	1. Do this: drum on the table		LR Tact IV IM
	2. Do this: clap hands		LR Tact IV IM
	3. A cat says: meow		LR Tact IV IM
	4. A dog says: woof		LR Tact IV IM
	5. Hip, hip: hooray		LR Tact IV IM
	6. One, two: three		LR Tact IV IM
	7. What is it: zebra		LR Tact IV IM
	8. What is it: lion		LR Tact IV IM
	9. What is it: car		LR Tact IV IM
	10. What is it: flower		LR Tact IV IM
Exercise 2	1. Do this: roll arms		LR Tact IV IM
	2. Do this: arms up		LR Tact IV IM
	3. Do this: blow kiss		LR Tact IV IM
	4. Do this: wave		LR Tact IV IM
	5. Touch your head		LR Tact IV IM
	6. Clpa your hands		LR Tact IV IM
	7. What is it: tree		LR Tact IV IM
	8. What is it: heart		LR Tact IV IM
	9. A cow says: moo		LR Tact IV IM
	10. A horse says: neigh		LR Tact IV IM
Exercise 3	1. What is it: giraffe		LR Tact IV IM
	2. What is it: flower		LR Tact IV IM
	3. What is it: tree		LR Tact IV IM
	4. Hip, hip: hooray		LR Tact IV IM
	5. Stomp your feet		LR Tact IV IM
	6. Touch your nose		LR Tact IV IM
	7. do this: roll arms		LR Tact IV IM
	8. Do this: touch shoulders		LR Tact IV IM
	9. Do this: knock on the table		LR Tact IV IM
	10. Do this: raise the roof		LR Tact IV IM
Exercise 4	1. A cat says: meow		LR Tact IV IM
	2. A lion says: roar		LR Tact IV IM
	3. What is it: fish		LR Tact IV IM
	4. What is it: carrot		LR Tact IV IM
	5. What is it: pig		LR Tact IV IM
	6. What is it: bear		LR Tact IV IM
	7. Do this: blow kiss		LR Tact IV IM
	8. Do this: raise the roof		LR Tact IV IM
	9. Clap your hands		LR Tact IV IM
	10. Stomp your feet		LR Tact IV IM

APPENDIX D

Mastered Tasks Script

Exercise 1

1. Do this: Drum on the table
2. Do this: Clap hands
3. A cat says: meow
4. A dog says: woof
5. Hip, hip: hooray
6. One, two: three
7. What is it? zebra
8. What is it? lion
9. What is it? car
10. What is it? flower

Exercise 2

1. Do this: roll arms
2. Do this: arms up
3. Do this: blow kiss
4. Do this: wave
5. Touch your head
6. Clap your hands
7. What is it? tree
8. What is it? heart
9. A cow says: moo
10. A horse says: neigh

Exercise 3

1. What is it? giraffe
2. What is it? flower
3. What is it? tree
4. Hip, hip: hooray
5. Stomp your feet
6. Touch your nose
7. Do this: roll arms
8. Do this: touch shoulders
9. Do this: knock on the table
10. Do this: raise the roof

Exercise 4

1. A cat says: meow
2. A lion says: roar
3. What is it? fish
4. What is it? Carrot
5. What is it? pig
6. What is it? bear
7. Do this: blow kiss
8. Do this: raise the roof
9. Clap your hands
10. Stomp your feet

Exercise 5

1. A cat says: meow
2. One, two: three
3. Hip, hip: hooray
4. A horse says: neigh
5. What is it? banana
6. What is it? Circle
7. What is it? Square
8. Do this: drum on the table
9. Do this: roll arms
10. Do this: knock on the table

Exercise 6

1. What is it? cow
2. Do this: clap hands
3. Do this: blow a kiss
4. Do this: raise the roof
5. Touch your nose
6. Clap your hands
7. Hip, hip: hooray
8. A lion says: roar
9. A dog says: woof
10. A cat says: meow

APPENDIX E

Definitions of Interfering Behaviors

Interfering Behavior Definitions	
Eloping	Moving body a foot or more away from the chair when not instructed to do so
Crying/Screaming	Sounds above normal conversation levels that last 1 or more seconds
Physical Noncompliance	Laying/sitting on the floor when not instructed to do so; laying/sitting on the table
Self-Injurious Behavior	Intentionally causing harm to oneself (e.g., banging head on objects or biting self)
Physical Aggression Toward Adult/Peer	Intentionally causing harm or attempting to cause harm to an adult or peer (e.g., hitting, kicking, biting)
Vocal Stereotypy	Engaging in inappropriate and/or repetitive vocalizations (e.g., "tree…tree…tree" or "treeeeeeeeeee"). Note repetitive mands are not considered vocal stereotypy
Motor Stereotypy	Engaging in inappropriate and/or repetitive motor movements *that occur in place of responding* (e.g., the child is flapping hands ***and*** does not respond to the instruction
Verbal Noncompliance	Saying "no" when given an instruction
Property Disruption	Disturbing teaching stimuli when not instructed to do so (e.g., moving teaching stimuli or swiping materials from the table)
Standing	Standing up when *not* instructed to do so
Rocking back and forth in chair	Rocking back and forth in the chair so that the front chair legs leave the floor
Looking away from teaching stimuli for 3 or more consecutive seconds	Note for this study, teaching stimuli are as follows: teacher, Language for Learning script, mastered task script, or picture cards. Point cards are not teaching stimuli.

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