MASSED VERSUS DISTRIBUTED PRACTICE AMONG CHILDREN WITH ASD

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ABSTRACT: Teachers can incorporate different modifications of how information is presented to increase the effectiveness of instruction to children in the classroom. Children with autism spectrum disorder (ASD) require more learning opportunities to acquire information and skills. Applied Behavior Analysis (ABA) has been utilized to teach children with ASD through a variety of techniques such as discrete trial teaching and errorless learning. This study posed the question of whether massed or distributed practice would be most beneficial for children with ASD. An adapted alternating treatments design was used to examine skill acquisition and maintenance for receptive identification items across massed and distributed practice among three participants with ASD. The findings from this study illustrated that both practice methods were effective across two participants and the opportunities to respond should be considered when programming for skill acquisition.

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CHAPTER 1

INTRODUCTION

Each state has specific laws for the minimum length of instructional hours or days per year that students are required to attend school. At the minimum, children receive instruction six hours a day. The majority of instruction time is found in the classroom with their teacher. Throughout the day, children receive instruction from the librarian during library time, the gym teacher in gym class, and the lunch staff during lunchtime. Within the set hours at school, children are to receive as much instruction time as possible. Therefore, it is important to provide each student with effective instruction in the most efficient way possible.

Teachers should strive to provide effective instruction to all students during every school day. Haydon, Macsuga-Gage, Simonsen, and Hansen (2012), found that to increase the effectiveness of classroom instruction, it is important to increase appropriate student behavior, while the negative student behaviors are decreased. Reinforcement of the appropriate behaviors can help contribute to the increases of appropriate behavior in the classroom, while decreasing the likelihood for the negative behaviors to occur. One strategy that is important for effective instruction is to increase the opportunities to respond for students (Haydon et al., 2012). When students are given more opportunities to respond to stimuli, they are able to interact with the information more and are able to increase their fluency in that task.

Effective instruction can also be examined through the different components of learning. The components of learning are conceptualized through a learning hierarchy. First, the learner

has to acquire a new skill, then increase in fluency of the skill, generalize the skill to a novel situation, and lastly, to adapt or change their response when a new situation arises (Daly, Lentz, & Boyer, 1996). This hierarchy occurs for each skill the student is learning, or has learned in the past. It may take the student more or less time to go through each component of the learning hierarchy dependent upon the skill being taught. The amount of time each student spends in the different components of learning for a skill can be dependent upon their learning history, difficulty of the skill, amount of instruction provided for the skill, and the amount of practice the student receives for the skill. Oftentimes, more fundamental skills are learned at a faster rate through the learning hierarchy, while more abstract and complex skills may have a slower rate of learning through each component of the hierarchy.

Daly et al. (1996) stated within each component of the learning hierarchy, there are specific strategies that can be used to increase the effectiveness of an intervention. These strategies include: modeling, demonstration, prompting, cueing, drill, reinforcement, and generalization. Each of these strategies can be used within the components of the learning hierarchy to increase student responding to the level of mastery. For example, while in the first component of the hierarchy, acquisition, there are four specific strategies, that can be used all together or independently of one another, to increase the accuracy of responding with a student. These include: modeling, demonstration, prompting, and cueing (Haring, Lovitt, Eaton, & Hansen, 1978). For example, a teacher instructing on vocabulary words would model the appropriate response of a word, or provide a prompt by sounding out the first letter of the word, or cue the vocabulary word by holding up the vocabulary word card, or lastly, demonstrate the vocabulary word by sounding out each letter of the word.

The strategies mentioned above can be used in a variety of settings such as the general education classroom, small group, or even one-on-one. When students struggle to learn the general instruction in the classroom, providing the student an intervention that intensifies the instruction may help the student increase their learning over the material. Fuchs and Fuchs (2015) stated while the strategy of increasing the intensity of instruction is an important area of research, it has yet to be adequately defined and researched. Codding and Lane (2015) examined the literature in the area of treatment intensity and found two common ways to alter interventions are through the frequency and duration of the sessions. Codding and Lane (2015) theorized intervention intensity can be altered by: the amount of learning trials per session, amount of directions for each session, amount of sessions, and lastly, total length of time for the intervention being delivered.

There are other components of effective instruction that are specifically effective in teaching students with autism spectrum disorder (ASD). Applied behavior analysis (ABA) is the application of principles of learning through behavior analysis and using these techniques have been shown to be effective in providing instruction for children with ASD. There are a variety of techniques that include: peer-mediated intervention, reinforcement, differential reinforcement, extinction, prompting, naturalistic teaching, and discrete trial training among many others (Strain, Schwartz, & Barton, 2011). Each of these components has research to show the effectiveness of instruction for children with ASD. When working with students, specifically students with ASD, data must be taken on the programs to ensure appropriate and adequate growth. If the student is not responding as predicted, specific changes to the program should be made to increase the effectiveness as this is an important piece of instruction for each student's education plan in school (Strain, Schwartz, & Barton, 2011).

Effective instruction can incorporate many different instructional modifications that effect how information is practiced, which results in variations in response and time to skill mastery. One instructional modification that has been demonstrated to alter time required to achieve skill mastery is distributed practice. The topic of massed practice or distributed practice in research has been studied for over a century. Distributed practice, also known as spaced practice, occurs when practice opportunities are spread out across numerous sessions. Conversely, massed practice, or concentrated practice, which occurs when practice opportunities are conducted all in the same session (Garrett, 1940).

Research has found distributed practice of skills is more efficient over time than massed practice. Massed practice can be a good strategy to use for learning new information in a short period of time, but recalling it at a later time is not necessary (Rohrer & Taylor, 2007). Research on distributed practice and massed practice, has focused on teaching simpler motor tasks, instead of other applied tasks (Donovan & Radosevich, 1999). One applied task area where there has been research on massed versus distributed practice, is solving math problems. Rohrer and Taylor (2007), conducted a study which examined the massed versus spaced (distributed) practice of math problems within a textbook. Their findings suggest spaced practice, or distributed practice, of math problems within a textbook should be considered by researchers, teachers, and authors as an effective tool to help build student fluency and performance. Examining spaced practice in other areas of applied tasks, or verbal tasks, may help to further the knowledge of areas where spaced practice (distributed practice) is most effective, and massed practice is less effective. There are problems in this line of research, which may limit generalization.

As the research over massed versus distributed practice has mostly found distributed practice to be superior overall, it has not been determined whether it is superior over all tasks that are taught to students. Since research has consistently found results for increased amount of learning in the distributed practice trials over massed practice trials, it is important to continue to study this area of research as further knowledge about skills that benefit from either practice can be determined. The research on distributed practice versus massed practice has focused primarily on the general population, which includes many studies conducted on college-age students and older adults (Haq & Kodak, 2015). There are other areas of the population to study, such as children with disabilities and how massed practice versus distributed practice, for skill acquisition and fluency, can have an effect on learning outcomes.

Children with ASD and massed practice versus distributed practice for learning has not been an area of focus in the research literature. One study examined teaching tacts, textuals, and intraverbal skills to three children with ASD (Haq et al., 2015). This study assessed massed practice versus distributed practice across days; massed practice occurred one day per week, or 80 trials, while distributed practice occurred four days per week, or 20 trials per day. This study found that overall, children with ASD acquired a skill at a faster rate overall in the distributed practice condition. Additionally, the skill acquired in the distributed practice condition was maintained longer post-test.

As children with ASD require more learning opportunities to acquire information and skills, it is important for teachers to implement efficient teaching strategies. To help provide teachers with evidence-based instructional strategies to teach children with ASD, further research needs to be conducted, as research within these areas is limited. Providing children with ASD more opportunities to learn within their environment to promote skill acquisition through

research supported strategies, can further each child's skills and learning. The potential benefit for a study examining massed practice versus distributed practice in children with ASD can impact their learning, the structure of learning opportunities provided to children at treatment centers or schools across the nation, as well as contributing to the limited area of research in this field.

The present study will be examining skill acquisition in children with ASD within the area of receptive identification until the point of mastery for each participant. Mastery has a variety of definitions throughout the research literature. In the current study, mastery is defined as 5/6 (83%) correct responses during test trials across each day. For example, the participant has to have 83% correct responses in the test trials for the item of car to be independent, or without any prompts, during trials across the day. In the research, of the four strategies explained above for skill acquisition, the participants will receive the strategies of modeling, prompting, and cueing, to increase learning during skill acquisition for each participant. Skill acquisition is an important area to study as all children have the capability to learn and to increase their opportunities to respond and grow. The current study has a set number of opportunities to respond to be able to examine the rate of skill acquisition for each participant and how that information for generalization relates to the population overall. The aim of the study is to identify what type of instructional method maximizes learning among children with ASD and which method maintains learning over time.

CHAPTER 2

REVIEW OF LITERATURE

Effective Instruction

Instruction in the classroom can involve various components implemented by the teacher. Some components may be more effective than others and have empirical evidence to support its use in the classroom. As children spend hours a day in the classroom learning different subjects, it is critical to maximize instruction time as well as delivering the instruction effectively for all students. Cooper and Scott (2017) found most instructional practices include direct and explicit instruction, engagement, and feedback. When providing direct instruction to students, it should be delivered clearly and explicitly. Teachers should also provide appropriate modeling of behaviors and expectations across academics and behaviors.

Effective instruction should begin with a foundation; association to prior knowledge, and a clear description of rules the teacher models and demonstrates using numerous questions and activities to help encourage student engagement and interest (Cooper & Scott, 2017). During the instruction time, teachers can assess students' understanding to help identify the skills and tasks they know and do not know (Etzel & LeBlanc, 1979). By testing during teaching time, it can help to guide instruction mid-lesson to provide further instruction for students who may benefit from it. Then, the teacher can guide the students through practice opportunities to achieve success with teacher praise. By providing the students with practice opportunities, it encourages

independent work with realistic problems or samples (Cooper & Scott, 2017). Fuchs and Fuchs (2015) suggested improvements upon the following areas may increase the effectiveness of instruction; addressing problem areas, broadening instructional content, transferring learning, optimizing instructional intensity, and strengthening language comprehension as well as executive functioning in conjunction with academic skills instruction. By addressing at least one of these areas during instruction, it has the potential to increase students' knowledge of the content taught, as instruction may be more effective.

The effectiveness of instruction can also be examined through the lens of the learning hierarchy. The steps of the learning hierarchy across a skill involve skill acquisition, building fluency, generalization in a different environment, and adaption with a new situation (Daly et al., 1996). For each skill a student has been taught or will be taught, can be evaluated with the learning hierarchy. Students will progress through the components of the learning hierarchy at different rates, contingent upon the skill area as well as the student's environment, such as their learning history, instruction time provided for a skill, and practice time provided for the skill. It has been shown that earlier, less complex skills should have faster learning rates, while abstract and complex skills are expected to have slower rates of learning across all components of the hierarchy.

To provide effective instruction for a student in the skill acquisition phase of the learning hierarchy, a teacher should implement modeling, demonstration, prompting, and cueing for optimum learning, but this may not be feasible (Haring et al., 1978). Moving ahead to the second component of the hierarchy, fluency, which is when the student is able to execute the skill at a higher rate with little to no errors. While in the fluency stage, the student should be receiving strategies for reinforcement and drill from the teacher. It is important to increase

fluency until mastery by providing strategies to practice the skill. The third component is generalization; the student is able to perform the new skill in multiple settings that are appropriate for the skill. For example, a student who reached mastery for addition in the generalization phase is expected to be able to perform addition in the grocery store, at home, and even in the car. The opportunities for generalization of skills must be taught to an individual if it is not observed they are capable of doing so independently (Daly et al., 1996). Lastly, adaption is the final component of the learning hierarchy. The student must have the ability to modify their responses with the mastered skill when a novel task is introduced into their environment (Daly et al., 1996). This can be taught to the student by introducing a wide range of novel or new problems or situations for when they can apply the newly mastered skill to increase their ability for adaption (Haring et al., 1978).

When teaching students appropriate behaviors through effective instruction, Rosenshine (1983) hypothesized six different functions to promote learning. These functions include: reviewing and checking the previous day's work and re-teaching skills if needed, presenting new content or skills, initial student practice and checking for understanding, feedback and corrections and re-teaching if needed, independent student practice, and lastly, weekly and monthly reviews. Each of the six functions can be broken down even further. The daily review of a student's work can help to determine their understanding of the skill and if they have a few mistakes, re-teaching of an area or a few areas may be needed. The second function is presenting new content or skills which can include: providing an overview, progressing in small steps if needed, providing detailed instructions, and phasing in the new skills while the old skills are building up mastery levels. The third function of initial student practice includes: high occurrences of questions and practice for the student, providing prompts when needed during the

initial learning phase, giving all students the opportunity to respond and receive feedback, checking for understanding, and continuing to practice the skills through to mastery. The fourth function of feedback and corrections is to provide students feedback when they are correct, and incorrect student responses demonstrate to the teacher that students may need corrections and/or re-teaching of the skill. The second to last function is independent practice and it includes providing practice opportunities for students, like seatwork, to help students become automatic with their responses. Rosenshine (1983), stated automatic responses, or mastery level, was 95% and above for correct responses.

During instruction time in the classroom, teachers provide opportunities to respond (OTR), which is a stimulus provided during instruction, such as a prompt, that warrants a student response through gestural or verbal behaviors (Haydon et al., 2012). Students should have a consistent wait time of three seconds before responding to questions as well as limiting the time between each question and instruction. In the classroom, there are three different categories for OTR that include: teacher-led independent responding, teacher-led choral responding, and peers leading instruction across the class. The traditional opportunity provided to students for responding by the teacher is at the individual level. When teacher-led independent responding is used in the classroom, it can lead to increased amounts of passive students until it is their turn to respond. During this type of OTR, students wait to be called on and some students may not know the answer when they are called on. This category limits the OTR to students that can answer. The researchers suggest teachers combine individual responding with choral responding to increase the OTR.

The second category of OTR is teacher-led choral responding. During choral responding, students are expected to respond in unison and the teacher can indicate choral whether student

responses are nonverbal or verbal (Haydon et al., 2012). Teachers can determine whether students understood a question by the choral responses the teacher receives. If one student or a small group of students provide an incorrect response, the teacher does not have to single out the student(s) by providing corrections to the entire class. Teachers can also use response cards for nonverbal responding from all students. Choral responding can provide the teacher with knowledge for what students do or do not understand for the material being taught.

The third category of OTR is peer led instruction, which occurs across the entire class and involves peers teaching other students, most often in pairs (Haydon et al., 2012). Each student is assigned a role, either tutor or student, and is given directions to follow that include engaging in a specific activity for the day. This category requires pre-teaching of appropriate behaviors during peer led instruction as well as appropriate matching of instruction and level of difficulty for students (Haydon et al., 2012). Researchers studied the effects of peer-assisted instruction and compared it to teacher-directed instruction in first grade reading. The results determined that both groups increased their reading abilities, with the teacher-directed instruction having a larger effect on curriculum-based measurement (CBM) for reading (Mathes, Torgesen, Clancy-Menchetti, Santi, & Grek, 2003). Even though the study showed peer-led instruction did not have as large of an effect on CBM for reading, the peer-assisted group did increase in abilities, which shows the potential for peer-led instruction a few times a week in addition to the regular reading instruction time.

Teachers can also increase student-learning rates in their classrooms by refining their quality of OTRs, in addition to increasing the amount of OTRs during instructional periods (Haydon et al., 2012). As teachers find other OTRs to use in the classroom, it is important to focus on evidence-based strategies. Teachers should consider making data-based decisions with

increasing their quality and quantity of OTRs for students in the classroom through self-monitoring or consultation with another professional. When teachers have fast-paced instruction in the classroom, it can decrease inappropriate behaviors, increase appropriate responding, and provide more OTRs for all students.

A critical component of effective instruction in the classroom is appropriate student engagement. Student engagement can be fostered in a number of ways through interest to the material being taught, relate to prior knowledge, guide instruction to promote greater levels of success, and express interest for the material (Cooper & Scott, 2017). When delivering instruction to students in the classroom, feedback is essential to promote positive student engagement and learning. The delivery of feedback from teacher to student can be verbal and gestural and can be provided for academic and social behaviors. Research on instructional feedback has shown a low rate of adoption among teachers despite its supportive research background.

When students receive positive feedback, there are improved outcomes for academics and problem behaviors are minimized. When students receive negative feedback from teachers it can impact the student-teacher relationship as well as indicate the instruction may not be effective over time (Cooper & Scott, 2017). Higher rates of positive feedback denote effective instruction, as compared to high rates of negative feedback. Research has shown higher rates of student success when the rate of positive to negative feedback is in the range of 3:1 to 6:1.

Intensity of Instruction

Instruction can be adjusted in a variety of ways to help students learn the material to mastery level. A different way to approaching alterations with the delivery of instruction, as well as interventions, can be through the examination of frequency and duration of sessions

(Codding & Lane, 2015). Some students may need shorter (or longer) instructional sessions with higher frequency of occurrence within the day or week, as well as longer intervention time across weeks (Fuchs & Fuchs, 2015). This is also noted in the research literature as treatment dose, or the amount of something across hours, day, week, or even month. Treatment dosages are often noted in the medical research in relation to medications as there is limited research examining treatment dosages for academic interventions. From the few research studies that have examined treatment dose, the theory states changes can occur by: the amount of learning trials per session, amount of directions each session, the overall amount of sessions, as well as the overall length of time the intervention is delivered (Codding & Lane, 2015).

Interventions can be altered through various means to help improve the effectiveness of the current intervention. A teacher or interventionist can change ineffective interventions to become more effective by adjusting instruction, measurement, and the intensity of the intervention (Daly, Martens, Barnett, Witt & Olson, 2007). The determination of whether an intervention requires alterations should be explained and defined beforehand, as well as examining it on an individual basis for each student. When altering the level of instruction for an intervention, it is important to match it to the student's skill level (Daly et al., 2007). An intervention can be adjusted through measurement when the current measure is not sensitive to the current intervention and response level (Daly et al., 2007). The effectiveness of an intervention, or instruction, can also be examined on a small group or individual basis as well (Daly et al., 2007; Fuchs & Fuchs, 2015). Very few studies have examined group size for effectiveness of instruction, but it has been hypothesized that the ideal size is three to four students per instructor.

Applied Behavior Analysis

Applied Behavior Analysis (ABA) utilizes principles of behavior to provide behavioral therapy or specific instruction to an individual to teach new skills and improve upon their abilities. Children with ASD are often taught communication skills, in addition to other skill deficits, through discrete trial teaching (DTT), which is often in a one-on-one setting (Flores & Ganz, 2014; Kates-McElrath & Axelrod, 2006). DTT is a procedure within ABA type interventions of skills broken down into smaller steps, measured by trials, and taught to students until mastery level is met (Kodak, Cariveau, LeBlanc, Mahon, & Carroll, 2017). In the literature, it has also been termed discrete trial instruction (DTI) and they are frequently used interchangeably.

Instruction for DTT is often provided in a less naturalistic setting at a table, with some materials, and few distractions to promote high levels of engagement (Flores & Ganz, 2014; Kates-McElrath & Axelrod, 2006). The structure of a program, or specific skill, begins with simple tasks that become more complex as the skill increases (Kates-McElrath & Axelrod, 2006). Instruction is provided through quick trials where the instructor provides a simple instruction, the student responds correctly, and reinforcement follows. Prompting can be provided to help the student learn the correct target response. DTT involves different prompt-fading strategies, like time delay or most to least prompting, to progressively transfer stimulus control from the prompt to the proper discriminative stimulus (S^D), which can be an instruction or picture, in conjunction with preventing prompt dependency (Severtson & Carr, 2007). Prompting can also occur for situations like transition times between activities inside or outside of the classroom. Visual cues, or visual schedules, during instructional times may help to prompt some students to learn the daily schedule of activities (Kates-McElrath & Axelrod, 2006).

In the typical model of DTT, instruction for receptive identification and expressive labeling, also known as tacting, of items place higher emphasis on acquisition when compared to teaching students to mand, or requesting highly preferred items (Kates-McElrath & Axelrod, 2006). Mastery level is a component utilized to determine the criteria for when an item or set of items have been learned adequately and is established before learning trials begin. Mastery levels vary from person to person and may impact the amount of opportunities teachers provide specific instruction to students (Kodak et al., 2017). Generalization of items for individuals with autism can be a challenge. Generalization of a skill is the ability of an individual to apply the skill in new settings, across instructional materials, and different teachers (Kates-McElrath & Axelrod, 2006). Children with ASD struggle with applying the skill they learned in a new setting and thus, may only be limited to applying the skill in the environment they learned it in.

Reinforcers are a third component of DTT that pair the learning of an item with a positive object, item, or activity an individual enjoys playing with, consuming, or engaging in. Common reinforcers for students include a token system, choice boards, tangible or edible items, and even social praise or attention. When providing reinforcement, the schedule is initially continuous to build skill acquisition and is faded to either fixed or variable ratios when appropriate (Kates-McElrath & Axelrod, 2006). While there are benefits to using DTT, such as quick acquisition, there are drawbacks as well. The drawbacks include: as delivery is one-on-one with an instructor, it can be difficult to provide in a general education classroom, the cost of a trained applied behavior analyst most often is unreachable for a school or district to pay for, a trained analyst may not be available in all areas, especially rural or lower socioeconomic areas, students with ASD do not often generalize what they learn in the DTT environment and thus it does not often carry over to their every day environment (Flores & Ganz, 2014).

Very little research has examined teachers implementing ABA type interventions in the classroom with distractions, demands of other students' needs, and the range of students served in their specific environment (Kodak et al., 2017). Researchers conducted a survey with classroom teachers about receptive identification tasks, the teaching strategies they implement, as well as determining how a skill is mastered. Result from the survey showed receptive identification trials, as well as trial-based instruction, delivered to students with ASD are services provided through special education in the classroom. Survey respondents also rated increased use of evidence-based instruction in their classroom than non-evidence based instruction. The results additionally indicated receptive identification tasks through trial-based instruction are often used across students with ASD in the schools. The researchers highlighted that modifying trial-based instruction for students with ASD is an important component of effective instruction.

Errorless Learning

Errorless learning is an ABA based procedure that involves specific components to help a student decrease the amount of incorrect responses to increase mastery over the materials (Mueller, Palkovic, & Maynard, 2007). Errorless learning refers to the decreased opportunity of selecting incorrect responses and thus a decrease in negative outcomes of selecting incorrect responses. The procedure does not involve the complete removal for the opportunity of making errors; it is just a reduction in the chance to make errors. Some students, like children with ASD, may have increased learning through errorless-learning procedures. Procedures for errorless learning are often utilized when teaching children novel tasks that require choosing one response. A novel task may include a child choosing between colors, pictures, objects, etc. when given more than one stimuli to choose from.

Children with autism are often taught language through one-on-one instruction through ABA-based interventions. Language based instruction can be provided for expressive, receptive, and verbal language abilities. Receptive language can be behaviorally defined as specifying the antecedents and consequences in the environment where responses are likely to occur (Pelios & Sucharzewski, 2004). It is essential to specify the antecedent variables, the response, and the consequence to teach skills, in addition to a conceptual framework of talking and thinking about the intervention (Pelios & Sucharzewski, 2004). Providing students with prompts in errorless learning is another component to help decrease errors and increase appropriate responding. Prompting in errorless learning is often determined before instruction trials and is structured from the highest level of prompting to the lowest level (Severtson & Carr, 2007). Another prompting level used frequently is most to least prompting; it starts off with the most invasive prompt of full physical and hierarchically decreases over time to a point or gesture prompt (Severtson & Carr, 2007).

Errorless learning also includes the gradual increase of difficulty for the task which can be taught through six techniques: stimulus shaping, stimulus fading, delayed prompting, response prevention, superimposition with stimulus fading as well as shaping (Mueller et al., 2007). The procedures used most often for teaching through errorless-learning is fading and stimulus shaping (Etzel & LeBlanc, 1979). Fading occurs through slow and measured changes of a stimulus along a specific dimension to a terminal end (Etzel & LeBlanc, 1979). For example, fading a letter until it is no longer visible on the page but the student has learned through fading what the letter has to look like. The goal of fading is for a student to respond easily to the first response, or easy form of discrimination, to then learn to respond correctly to the last response, or the difficult form of discrimination (Etzel & LeBlanc, 1979).

The other most common procedure for errorless learning is stimulus shaping. This involves altering the topography of a stimulus (Etzel & LeBlanc, 1979). Therefore, the initial stimulus will not resemble the final stimulus for any dimension due to the differences in topography. The changes to the stimuli should be taught to the student to ensure they are learning the differences in appearance to help discriminate the stimuli. Fading and shaping each have their advantages and disadvantages. When using fading or shaping during errorless learning, fading is straightforward and can be simple to implement for teachers when the appropriate situation arises for using fading. When using shaping for errorless learning, it can take longer to implement, when compared to fading, and involves more manipulations of the target stimuli.

Massed Practice and Distributed Practice

The research area of distributed practice compared to massed practice has been studied for over 100 years. Due to the many years of research in this area, there have been a number of definitions in the literature for massed and distributed (or spaced) practice, also known collectively as the practice effect. Distributed practice in experiments have defined practice in one session or distributed across two sessions, as separated by a set amount of time, which is labeled the inter-session interval (Donovan & Radosevich, 1999; Rohrer & Taylor, 2006). Massed practice can be defined as practicing a task continuously in one session (Donovan & Radosevich, 1999).

From the time of the 1950s to the 1970s, research on distributed practice was at the highest and has declined since. In more recent years, research has examined theoretical and practical areas of application for distributed practice (Donovan & Radosevich, 1999). Findings from research studies comparing massed and distributed practice have only occurred in the

environments of educational and classroom settings, which may limit the findings (Donovan & Radosevich, 1999). There is a divide throughout the research on massed practice and distributed practice as an instructional system, for strong empirical support, aimed at which approach is most efficient with students (Haq & Kodak, 2015). As previous research demonstrated distributed practice to be superior for recall of information, the results may not have a direct link to younger children or even in the educational environment (Haq & Kodak, 2015). In educational settings across different research studies, massed and distributed practice can be conceptualized similarly (Haq & Kodak, 2015). The inconsistencies in the research for procedures surrounding massed and spaced practice can be accounted for by the conceptualization and definitions for both methods (Haq & Kodak, 2015).

Studying the acquisition and retention of verbal skills and non-motor tasks through distributed practice has not been adequately studied to determine its effectiveness (Donovan & Radosevich, 1999). It has been hypothesized in the research literature that distributed practice for verbal tasks will continue to have higher performance when compared to massed practice. Other researchers hypothesize the opposite and state distributed practice could impede the speed of acquisition for verbal tasks. With that said, at the time of the article, there was no research article to support or disprove these hypotheses.

Research has not concluded whether there is an ideal period of time between tasks for distributed practice (Donovan & Radosevich, 1999). Further research into this may help to determine the amount of time that increases the effectiveness of instruction taught to individuals. The magnitude of the practice effect was determined by the task practiced over trials, the length of the inter-trial interval (ITI) across time that ranged from minutes to a day or more, as well as the interaction of both factors (Donovan & Radosevich, 1999). The ITI can be described as a

short interval of time between cues for trials (Kates-McElrath & Axelrod, 2006). Donovan and Radosevich (1999) conducted a meta-analytic review and results showed support for the practice effect on simple tasks for spaced practice (Donovan & Radosevich, 1999). The analyses found the length of the ITI to be related to the type of task being taught. For example, with the more difficult tasks, the meta-analytic review showed longer ITIs to be beneficial overall for learning across studies (Donovan & Radosevich, 1999). This result is demonstrated by a study Codding et al. (2016) conducted for math fact fluency through distributed practice. As the complex tasks of math fact fluency increased, the positive effect of longer ITIs between trials resulted in higher outcomes for distributed practice and supports the literature in this area.

Other researchers have investigated massed versus distributed practice in other content areas like math, reading, and spelling. Fishman, Keller, and Atkinson (1968) conducted a study with massed versus distributed practice on a computer program for spelling words. The results favored massed practice during trials, whereas post-test findings indicated distributed practice words were maintained higher across time than massed practice words (Fishman et al., 1968). The researchers concluded massed practice might be beneficial for short-term gain, while distributed practice includes more repetitions that may help to maintain the information across longer periods of time (Fishman et al., 1968). Other research in the area of math has examined the amount of practice problems in textbooks. Rohrer and Taylor (2006) measured the distribution of math practice problems across several assignments that resulted in higher retention compared to massed practice problems in one assignment. The results from this research suggest mathematical textbooks can easily integrate distributed practice problems across chapters to increase student performance and retention of the instruction (Rohrer & Taylor, 2006).

Klug, Davis, and Glover (1990) conducted three experiments that examined the intervention of repeated readings through massed and distributed practice to determine recall of a passage and recall of a paraphrased essay compared to a verbatim essay among college and high school students. The researchers found recall of a passage was higher in the distributed repeated reading sessions when compared to the massed repeated reading sessions, even as a comparison to reading the passage once. The repeated readings massed sessions had increased rates of recall of a passage in contrast to sessions when the passage was read once. When participants reread a paraphrased essay in the massed practice, there were higher rates of recall in comparison to rereading the verbatim essay in the massed practice. However, distributed practice of rereading a paraphrased essay in contrast to the distributed practice of rereading a verbatim essay, revealed no difference in the amount of recall.

Distributed practice research does have its limitations. Limitations found across research studies as conducted by the meta-analytic review, established participant motivation to complete the task can interfere with their performance across both massed and distributed practice. As mentioned above, the ITI may be short or long in duration, and it is not known what the impact of the activity individuals were completing during that time has on the practice effect. Lastly, the generalization of skills to a new environment, materials, and/or instructors may also have an influence on how effective the practice effect is (Donovan & Radosevich, 1999; Kates-McElrath & Axelrod, 2006).

Specific Instruction

There is limited research into the practice effect that has equalized the amount of stimuli across each type of instruction before starting acquisition as well as examining the number of items or stimuli for each type of instruction (Haq & Kodak, 2015). Few studies examining the

practice effect have included a maintenance component to test the acquisition of stimuli across the type of instruction, after a study has ended. Haq and Kodak (2015) addressed these limited areas of knowledge in the research literature by conducting a research study evaluating massed practice and distributed practice on the acquisition of sight words in the English language and tacts in Spanish among two typically developing children, ages four and ten. The results denoted distributed practice was the most effective approach for acquisition of a skill. Haq and Kodak (2015) noted more errors occurred in the massed practice trials, which inadvertently increased the trials required to reach mastery level.

Maintenance data was collected for four weeks post-training sessions, with participants having more correct responses on the distributed practice stimuli when compared to the massed practice stimuli (Haq & Kodak, 2015). The results with school-age children indicate that small assignments presented in the distributed format maintain rates of responding even four weeks post-test. Future directions for research could examine children with developmental disabilities, as they oftentimes need more opportunities to practice for skill acquisition. Additional research should assess the length of time between teaching trials during skill acquisition. A third area of future research could examine if the effects are upheld across students at different levels of functioning whether it be education or intellect.

Autism Spectrum Disorders

Haq et al. (2015) repeated and expanded upon the Haq and Kodak (2015) study by providing instruction through massed practice and distributed practice for tacts, textual, and intraverbal behaviors among three students with autism ranging from four to ten years old. Results from the study displayed distributed practice was more effective than massed practice across all three students. Haq et al. (2015) established the instructional approach of distributed

practice to be more efficient than massed practice across skills and the autism diagnosis did not appear to have an impact upon the instructional approaches. Future research should examine this outcome with the maintenance measure and extend the results by teaching other skills (Haq et al., 2015). The results can be furthered by extending the study to examine the number of days for practice opportunities for optimum learning and responding for students with developmental disabilities (Haq et al., 2015). It was noted by the researchers that they utilized praise and a token economy for correct unprompted responses, while forgoing differential reinforcement. Further research could examine differential reinforcement for massed practice to compare its effectiveness with distributed practice (Haq et al., 2015).

Research Design

An adapted alternating treatments design (AATD) was utilized as the research design for the Haq and Kodak (2015) study, in addition to the replication study by Haq et al. (2015). When using the adapted alternating treatments design, a researcher is able to examine data at the individual level, as well as compare two or more instructional approaches (Sindelar, Rosenburg, & Wilson, 1985). The AATD is exclusive in that each intervention is linked with a specific set of items that are all a part of the same response class (Sindelar et al., 1985). One set of instructional items are taught one way, while the second instruction is provided on a separate set of items, but they are all members of the same response class (Sindelar et al., 1985). Baseline measures are collected across all items at one time. The experimental condition is examining the different levels of acquisition across instructional types. The difference of acquisition for one set can be established when one set has higher acquisition of items comparatively to the second set. The difference in acquisition should also be noted across participant, setting, or behaviors (Sindelar et al., 1985).

Other areas to consider when using the AATD is counterbalancing, item sets, and confounding variables. It is important to counterbalance time, teachers, and/or settings when variables are different (Sindelar et al., 1985). The items in the instructional sets should also be equivalent to each other for equal levels of difficulty. Providing instruction on items the participant does not know at baseline can alter the efficiency of AATD. Any set of items discernible and easily dividable is adequate to use for a study with the AATD. One limitation of AATD is the potential of a carryover effect between the two instructional approaches. Carryover effects can be minimized by utilizing a third set of items, with equal difficulty, in which no instruction is provided. When examining and comparing the performance of responding to all three item sets, if the non-instructional set produces few gains, then the learning effects are strengthened and more likely to be due to the implementation of the instructional approaches. Confounding variables with this design can include: independent variables, previous learning history, and typical development over time.

The Current Study

In 2015, Haq and Kodak as well as Haq et al. conducted two studies examining the instructional material taught to young typically developing children and children diagnosed with ASD through massed practice and distributed practice approaches. The current study intends to extend the limited research on instructional material being taught to young children diagnosed with or displaying symptomology of ASD to determine the rate of skill acquisition. Specifically, the study will provide instruction on a receptive identification task across all participants. The research has not assessed acquisition of receptive identification items across massed and distributed practice for children with ASD. The current study intends to advance the research on the length of maintenance across skill acquisition. Furthermore, the study will examine

maintenance of receptive identification items across massed and distributed practice at two weeks, four weeks, and eight weeks post-instruction. Specifically, student data will be evaluated, using single case design methodology, to implement the instruction, until the instruction is effective in producing mastery levels over the materials.

Research Questions:

1. Will the rates of acquisition across items for receptive identification be higher with the distributed practice method than the rates of acquisition across different items for receptive identification with the massed practice method?
2. Which procedure over time maintains rates of learning?

CHAPTER 3

METHODS

Participants and Setting

Participants included three children from an early intervention center located in the Midwest of the United States. Two participants had diagnoses of Autism Spectrum Disorder, while the third participant presented with symptomology of ASD. Participant ages ranged under three years of age (mean = two years eight months), all were male, and all participants received early intervention services at the center. Table 1 provides demographic information of individual students in the study.

Table 1. Individual Demographic Information

Name	Gender	Age
1	Male	2
2	Male	2
3	Male	2

The early intervention center provides services for children and families in the community through screenings for autism spectrum disorder, teaching the children at risk for autism or those children with a diagnosis of autism at their center, and they deliver in-home support to parents or guardians of children with autism. University institutional review board

approval and written parent consent was obtained prior to the implementation of this study. The written parent consent form included a brief explanation of the study, appropriate contact information, and clearly stated that they could withdraw consent at any time without penalty.

The participants had previous exposure with distributed practice via instruction utilizing DTT. The early intervention center distributed learning trials for each program across each of the four work sessions, thus this is minimal exposure to distributed practice across the participant's programs. Each of the participant's had previous exposure to receptive identification tasks that ranged from a few weeks to months of exposure, which was dependent upon the items being taught.

Instructional assistants are employees at the early intervention center that worked one-on-one with each participant during instructional time. Each instructional assistant received extensive training for discrete trial training. The training consisted of observations of another staff member implementing instructions for a child, practicing data collection with the staff member in vivo (in the moment), then the new staff member slowly implemented instructions for the child while receiving guidance and feedback from the staff member until the instructional assistant was trained on each instructional program. Every few weeks, a staff member would conduct observations of the new staff member to ensure they were following the procedures and implementation correctly with feedback to help improve upon certain areas. All of the instructional assistants collecting data for the duration of the study had been employed at the early intervention center for at least one month.

Each session was in the classroom setting with one to three other children who also received early intervention from their instructional assistants. The layout of the classroom

included generic tables, chairs, and toys. There were other related materials such as: various reinforcers, intervention related tangibles, edibles, and other instructional materials.

Materials

The Peabody Picture Vocabulary Test Fourth edition (PPVT-4) is a standardized measure of vocabulary levels for language development and was utilized as both a pre- and post-intervention test for the current study. The PPVT-4 is an achievement measure that tests a participant's comprehension of spoken word and measures their complete acquisition of vocabulary (Dunn & Dunn, 2007). The test did not require spoken language by the participant and it did not require any reading or writing skills as the participant pointed to their answer.

The PPVT-4 manual reported the internal consistency reliability through split-half reliabilities as .94 or .95 across all age and grade ranges (Dunn & Dunn, 2007). The alternate-form reliability measure for Form A and Form B were high, between .87 and .93. When examining the test-rest reliability of the PPVT-4, the average test-retest correlation ranged from .92 to .96. The standard error of measurement for the PPVT-4 with both Form A and Form B was near 3.6 for all ages and 3.7 for all grades (Dunn & Dunn, 2007).

The study used procedural fidelity forms (Appendix C), daily data sheets (Appendix D and E), maintenance data sheets (Appendix F), a stimuli master list, and stimulus cards. The data sheets were altered forms in which the instructional assistants are already familiar with, to ease the use of data collection. The stimuli master list was developed from the MacArthur-Bates Communicative Development Inventory Words and Sentences (CDIs). The MacArthur-Bates CDIs are intended as parent report instruments for children learning English, Spanish, or any of the numerous other languages it has been translated into (Fenson et al., 2006). The MacArthur-Bates CDIs can be used for the age ranges of children from 8-37 months of age and it is

acceptable to use for children with developmental delays. The English short form guided the word selection for the stimuli master list for the categories included in the study. The short form words and sentences versions include 100-word vocabulary checklist for the ages of children from 16-30 months (Fenson et al., 2006).

Procedures

The instructional assistant had all materials, reinforcers, and data sheets needed for each session at their work area before sitting down with the participant every day. The instructional assistant began the first work session with the first three receptive identification picture cards for the massed practice condition. Each of the three items was rotated randomly within the session to be taught across 12 trials for a total of 36 trials per day, with each stimulus picture card being presented 12 times a day. The specific three stimulus picture cards were used each day until a stimulus item was mastered, at which point the mastered item was removed from the daily practice and a new picture card was introduced. Each instructional assistant was told to only work on those three items for 36 total trials. After all of the trials were conducted, the instructional assistants intermixed the participant's other programs, which were included with their specific treatment goals, but was not included within the focus of this study. The massed practice condition was conducted across two non-consecutive days per week.

The distributed practice condition was conducted across two non-consecutive days per week. The instructional assistant began the second work session of the day with the distributed practice condition. The instructional assistant followed the same procedures as the massed practice trials with the following exceptions: three different stimulus cards were practiced across 12 trials per work session and were spaced throughout the remainder of the work sessions. Each of the three items was randomly rotated for each work session for a total of 36 trials for the entire

day. The same procedure for mastery was followed as detailed above. Once the instructional assistant reached 12 trials in the second work session, they were instructed to work on the participant's daily programs, which were not included in the scope of this study. When the third and fourth work sessions began, the instructional assistant conducted the rest of the 12 trials per session.

Each participant was given the instruction provided and the instructional assistant waited for up to three seconds for their response. If the participant responded correctly within three seconds, the instructional assistant provided a highly preferred reinforcer to the participant. If the participant did not respond, a prompt was used for that trial and an error correction procedure was implemented. Prompting was delivered on a least to most hierarchy level. The type of prompt was specific to each participant's needs for instruction and learning. For example, participants responded to the prompt of a finger tap on the correct item and light touch on the participants' elbow to guide to the correct item.

The same error correction procedure was employed across all participants. After the participant was given three seconds to respond and did not respond or gave an incorrect response, the instructional assistant provided the appropriate prompt with the explanation, "I am sorry [name], you didn't get it. This is pizza." While the instructional assistant pointed to the correct picture card. If the participant continued to sit in their seat and did not respond, the instructional assistant provided a verbal prompt to point to the correct item. The instructional assistant continued to point to the correct picture card and then provided a physical prompt for the participant to point to the correct picture card. Once the participant responded correctly to the prompt, the instructional assistant provided praise for the correct answer. This entire error correction counted as one trial and was notated on the data sheet. The participant was given the

prompt for correction and then a second time to provide errorless teaching, or teaching to ensure a correct response is elicited from the participant.

The instructional assistant provided the least to most prompting level to each participant for the first set of three items, or the practice trials. The next set of three items was labeled as the test trials. These test trials were utilized to determine the participant's independent responding to all three items, therefore the instructional assistant did not provide any prompts. When the participant responded with a correct response to an item, the next presentation of the same item was not prompted. If the participant responded with an incorrect response on the test trial for an item, the instructional assistant provided a prompt on the next presentation of the same item. This cycle of prompting on the next presentation of the same item when the participant was incorrect during the test trial continued until the participant reached mastery criteria for each item. Across each day, the participant was exposed for the opportunity to respond to six different test trials for all three items. Once independent levels of responding were reached for an item, it was considered mastered after five out of six or 83% mastered during the test trials for each day. When mastery criteria was met for an item, the item was pulled out of the daily practice and a new item was introduced into the daily practice. This procedure was the same across distributed and massed practice.

Research Design

This study was conducted using an adapted alternating treatment design (AATD) to evaluate the rate of skill acquisition across participants and items for a receptive identification task across four weeks. The adapted alternating treatment design was utilized in this study, as two different types of practice, distributed and massed, were used across the skill of receptive identification between different sets of items. The adapted alternating treatment design allowed

for evaluation of two comparable, yet functionally independent categories (Sindelar et al., 1985). The independent variables were both massed practice and distributed practice. The experimental manipulation occurred through the acquisition of one set of items that were taught through one specific method, while the acquisition of a second set of items were taught through a second method. These differences could be confirmed when acquisition of one item set were to increase at a faster rate than the acquisition of the second set of items and this effect should be consistent across participants, locations, or behaviors.

Response Measurement

The dependent variable was the correct independent responses to the target stimuli. It was defined as correct independent responses the participant emitted to each target stimulus prior to the presentation of a prompt (Haq et al., 2015). A participant's response was not counted as independent if it was preceded by the presentation of a prompt. For a participant's response to be counted as independent, it had to be within three seconds of the presentation of the instruction without a prompt. The accuracy measure was calculated by the correct independent responses to the target stimuli in the test trials divided by the total number of test trials for each day and multiplied by 100, for the percentage of the session.

Interobserver Agreement

Interobserver agreement (IOA) was calculated by the number of agreements in a session divided by the number of agreements and disagreements, which was then multiplied by 100. Six researchers observed the procedural integrity and engagement observation measures. All researchers were trained on the procedural integrity and engagement observation measures until they reached 90% agreement and above with the main researcher. Thirty five percent of all trials in the study were observed via video recordings.

Procedural Fidelity

A data sheet was created to examine the following areas during all teaching trials: organization of materials, presentation of instruction, prompting procedure, response, consequence, and data collection. Each of these areas had further procedures detailed and the instructional assistant was observed and evaluated for whether they adhered to the procedures for the study. Interobserver agreement was conducted for 35% of all trials with a total IOA at 98% fidelity of implementation. The IOA across all six researchers ranged from 91% - 100%. The fidelity of implementation among the instructional assistants for all intervals observed ranged from 86% - 100%.

Engagement

A data sheet was created to examine the following behaviors during all teaching sessions: out of seat, object play, inattention, vocalization, and engaged. The engagement measure was developed to determine the amount of engagement or inattention of all participants in each condition. This measure utilized momentary time sampling with a ten-second interval. At the end of the ten seconds, the researcher would look up and observe the participant to determine how to code their behavior. These behavior observations were conducted through recorded videos of each participant. Thirty-five percent of all trials were video recorded and behaviors observed. The recorded videos ranged from two minutes up to thirteen minutes in length. All behavior observations were recorded up to the ten-second mark. For example, if the video ended at the forty-eight-second mark, the last observation was for the thirty to forty second interval.

Out of seat behavior was defined as the students' bottom not in their seat or chair. Object play was defined as the student playing with an object, not for its intended use. The student not oriented to or looking in the direction of the table, the instructor, the picture cards, and/or their

reinforcers defined inattention. Engaged was defined as the student oriented to or looking in the direction of the instructor, the table, the picture cards, and/or their reinforcers. Lastly, vocalization was defined as the student inappropriately making noise such as crying and/or whining. Interobserver agreement was conducted for 33% of all trials with a total IOA at 91% for engagement. Specifically, Participant 1 had an overall IOA at 92%, Participant 2 had an overall IOA at 91%, and Participant 3 had IOA at 90%. In further detail, the engagement measure for all intervals observed by participant is as follows: Participant 1 ranged from 84% - 96% IOA, Participant 2 ranged from 84% - 96% IOA, and Participant 3 ranged from 82% - 94% IOA.

Baseline

From the master picture card list each item was tested across two consecutive days before the teaching trials began to ensure each participant did not have prior knowledge of each target. From that list, only the items the participants did not know were included in the study. A control condition was utilized in this study to counterbalance the effects of both the distributed and massed practice conditions. There were 12 items per condition with a total of 36 items total per participant. The items were specific to each participant and were on a numbered list, which was randomized and placed in each condition until the total per condition was met. The instructional assistants were instructed to only present the items in the order of which they appeared on the list for each condition when items were mastered and replaced with non-learned items. Each participant had a different set of items for each condition.

When the study began, each target was presented once a week. Each week all items were randomized in the order they were presented. The participant was given three seconds to respond to the item; if the participant did not respond within the given time, no feedback was

given on whether the participant was incorrect and the item was removed, and replaced with the next item. If the participant responded correctly within three seconds, the participant did not receive any feedback even with a correct response and the next item was presented. Each of the 36 targets was tested before moving on to the teaching sessions of the study for the day.

Distributed Practice

The instructional assistant provided three teaching sessions across the day for each participant. The participant received early intervention services for four days of the week; with this condition scheduled on two days of the week. Each participant received six teaching sessions in one week for distributed practice. Instructional assistants followed procedures, which were identical for both the distributed practice condition and the massed practice condition. The difference between the conditions was the amount of practice per day spread out across time.

Massed Practice

The instructional assistant provided one teaching session per day for each participant. The participant receives early intervention services for four days a week; with this condition scheduled on two days of the week. Each participant received two teaching sessions in one week for massed practice. The instructional assistants followed the same procedures as those in the distributed practice condition; the major difference was the amount of practice per day spaced across time.

Items

The study utilized 12 items per condition for a total of 36 items total per participant, as a control condition was included in the study. Each item was chosen from the stimuli master list at the early intervention center, as well as the MacArthur-Bates CDIs. The items from the baseline were randomly assigned until a total of 12 were met for each condition. Each participant had

individualized items within the categories selected, such as toys and foods. The categories of receptive identification had stimulus equivalence for equal difficulty per condition for each participant as all items were randomly assigned to the conditions. Each trial was presented as a field of three stimuli throughout the entire study for all participants. Each item and trial was also randomized in the study across all conditions.

Maintenance

The teaching sessions lasted for a total duration of four weeks. Instructional assistants collected post-test data, across all three conditions; one day after the instruction was completed. The specific week of the maintenance measure varied by participant due to absences, sickness, and scheduled breaks. The instructional assistants conducted maintenance probes around one week, two week, five week, and ten weeks post-instruction for all three conditions. Maintenance probes were conducted in the same manner as the baseline methods described above. Data was collected during maintenance sessions and given to the researchers for analysis.

Data Analysis

Each participant's daily data was collected, graphed, and analyzed based upon the items correct per condition, in addition to a weekly maintenance graph. The data for each participant was graphed and analyzed using visual analysis to determine the growth of items across condition and time. The results of massed practice versus distributed practice across items were analyzed to determine which instructional approach produced the most growth and maintenance over time. Post-testing data, in addition to post-instruction data, at two, five, and ten weeks, were collected and graphed to determine the amount of maintenance over time for both massed practice and distributed practice.

CHAPTER IV

RESULTS

An adapted alternating treatment design (Sindelar et al., 1985) was used across two different instructional practices, distributed practice and massed practice, and a control condition to evaluate the rate of skill acquisition in young children with autism spectrum disorder. Figure 1, 3, and 5 display all participants' cumulative item mastery across days. These data resulted from participant's performance on items per instructional practice. Specifically, total items learned per condition were used as the dependent variable.

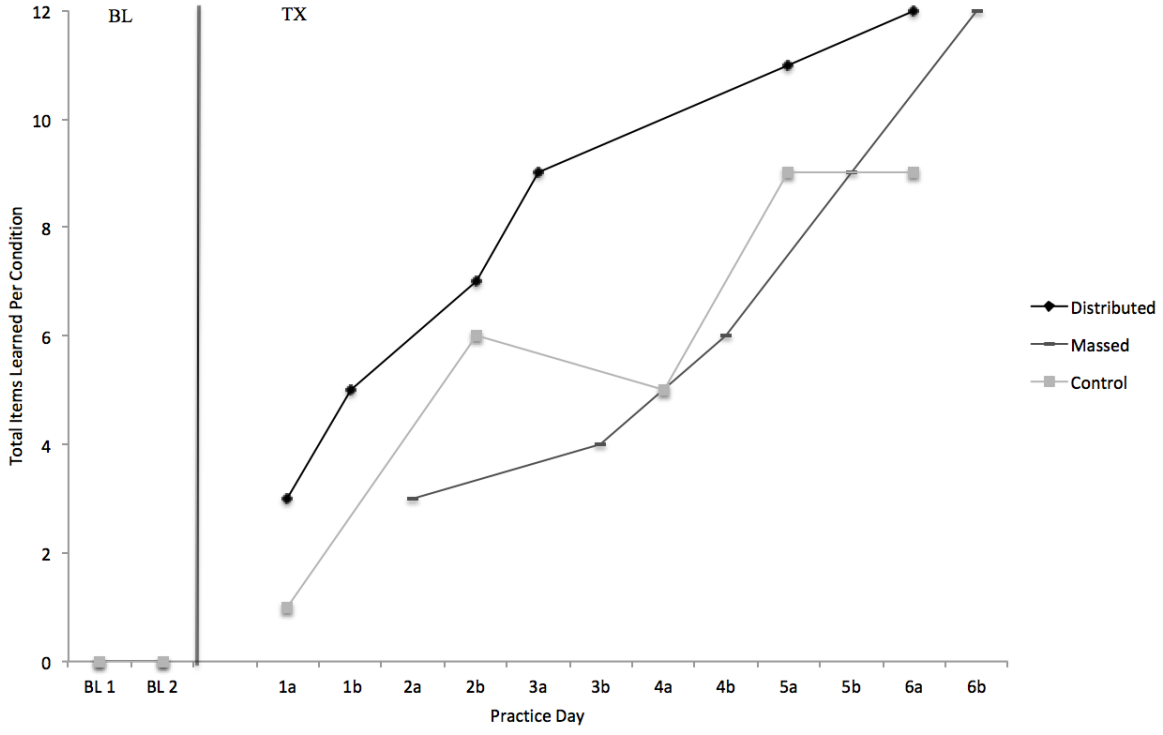
The weekly maintenance measure examined the data across all three conditions collected at one time. Figure 2, 4, and 6 display all participants' weekly maintenance data. These data resulted from participant's performance on items once per week. Specifically, total items correct per condition were used as the dependent variable.

Participant 1

Visual analysis of the daily data indicated mixed results. Baseline data for items across all three conditions is flat with no trend. There are two data points as opposed to three due to the timing of when baseline data was collected and the day of the week. Upon introduction of the treatment phase, starting with the distributed practice condition, Participant 1 shows a moderate level and increasing trend in the distributed condition. Their daily performance throughout the

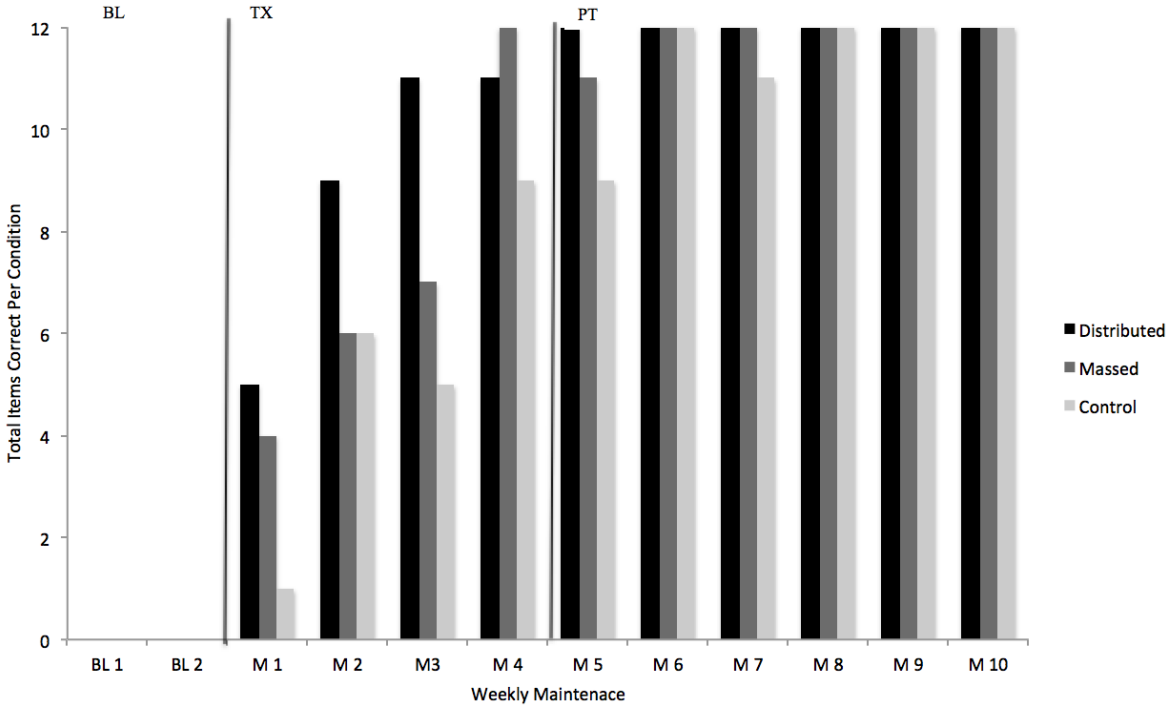
study is consistently at the moderate level and has an increasing trend throughout. In the massed practice condition Participant 1 shows a moderate level and increasing trend. Their daily performance throughout the study is consistently at the moderate level and has an increasing trend throughout. When comparing the distributed practice and massed practice items mastered daily, their performance is almost identical. Participant 1 had five days of massed practice, while distributed practice was at six days. Therefore, their performance is similar across both conditions with no noticeable difference between distributed and massed practice. Lastly, the performance of Participant 1 in the control condition shows a moderate level and increasing trend that decreases and then upticks to zero trend at the end of the data collection period. Participant 1's performance in the control condition is similar to both distributed and massed practice despite not practicing the control items throughout the week.

Figure 1. Participant 1 Cumulative Daily Data



Visual analysis of the maintenance data indicated there was no difference between the three conditions. Baseline data across all three conditions is flat with no trend. In the treatment phase, Participant 1's performance in the distributed condition indicated moderate level across the weeks with an increasing trend. The post-test maintenance was collected at one week, two week, five week, 11 week, and 14 weeks after treatment. In the post-test phase, their performance indicated high level with zero trend. Participant 1's performance in the massed condition during the treatment phase indicated moderate level and an increasing trend. Their post-test performance indicated high level with zero trend. Lastly, Participant 1's performance in the control condition during the treatment phase indicated moderate level with an increasing trend. In the post-test phase their performance indicated a high level with zero trend. Overall, the results of the treatment phase indicate Participant 1 learned the items during the weeks of instruction. The results of the post-test phase indicate the maintenance of Participant 1's performance was consistent across time after the instruction period ended across all three conditions. This implies the items Participant 1 learned in the distributed and massed practice conditions maintained their learning rates across weeks post-instruction.

Figure 2. Participant 1 Maintenance Data

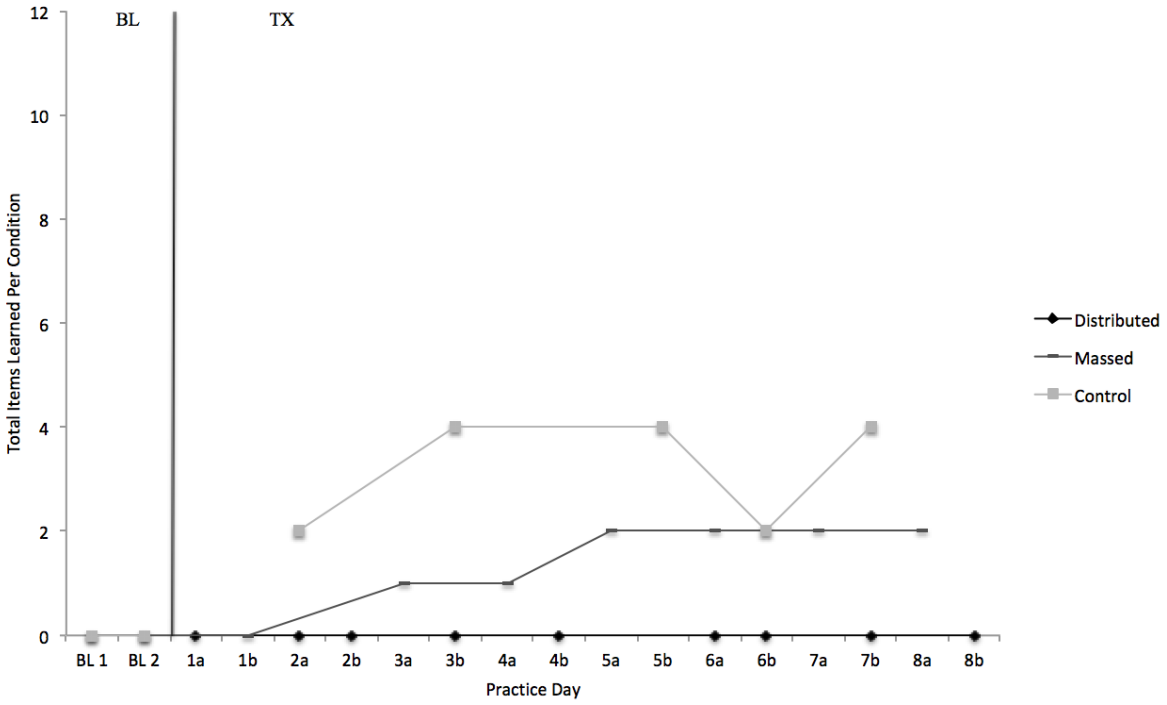


Participant 2

Visual analysis of the daily data indicated there was no difference between the three conditions. Baseline data for items across all three conditions is flat with no trend. There are two data points as opposed to three due to the timing of when baseline data was collected and the day of the week. Upon introduction of the treatment phase, starting with the distributed practice condition, Participant 2 shows no level and zero trend, which continues for the duration of the study. In the massed practice condition Participant 2 shows no to low level and a slight increasing trend. Their daily performance throughout the study fluctuates between no and low level with an increasing and zero trend cycle, with performance flattening out that continues to the end of the study. When comparing the distributed practice and massed practice items mastered daily, their performance varies slightly. Participant 2's performance is slightly

different across both conditions, but the data indicates neither the distributed nor massed practice was effective for this participant. Lastly, the performance of Participant 2 in the control condition shows a moderate level and a fluctuating trend level that increases, flat lines, decreases, and then increases at the end of the data collection period. Participant 2's performance in the control condition is higher in comparison to both distributed and massed practice despite not practicing the control items throughout the week.

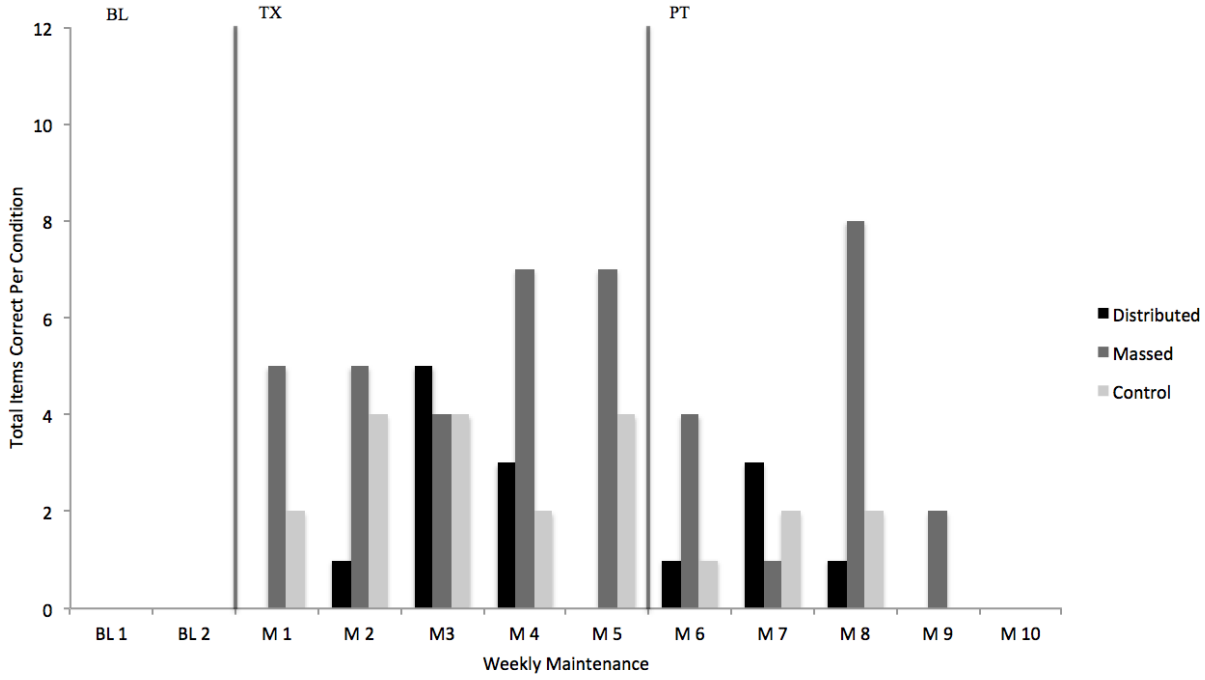
Figure 3. Participant 2 Cumulative Daily Data



Visual analysis of the maintenance data indicated there was no difference between the three conditions. Baseline data across all three conditions is flat with no trend. In the treatment phase, Participant 2's performance in the distributed condition indicated low level across the weeks with an increasing and decreasing trend. The post-test maintenance was collected at one week, two week, five week, seven week, and ten weeks after treatment. In the post-test phase, their performance indicated low level with a decreasing trend. Participant 2's performance in the

massed condition during the treatment phase indicated a low level and an increasing trend. Their post-test performance indicated a low level with zero trend. Lastly, Participant 2's performance in the control condition during the treatment phase indicated moderate level with zero trend. In the post-test phase their performance indicated low level with a decreasing trend. Overall, the results of the treatment phase indicate Participant 2 equally learned some items across all conditions during the weeks of instruction. The results of the post-test phase indicate the maintenance of Participant 2's performance was inconsistent across condition and lower in the post-test phase than the treatment phase. This implies Participant 2 learned few items in the treatment phase and did not maintain their learning rates across the weeks post-instruction.

Figure 4. Participant 2 Maintenance Data

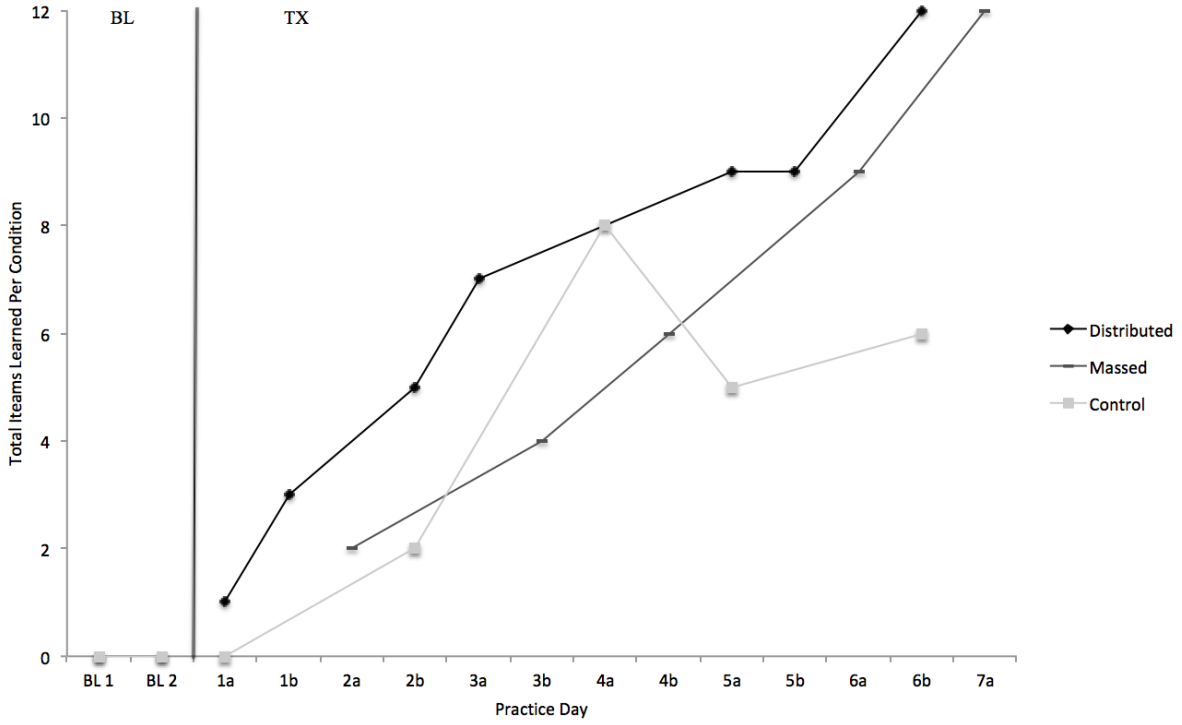


Participant 3

Visual analysis of the daily data indicated mixed results. Baseline data for items across all three conditions is flat with no trend. There are two data points as opposed to three due to the

timing of when baseline data was collected and the day of the week. Upon introduction of the treatment phase, starting with the distributed practice condition, Participant 3 shows a moderate level and increasing trend in the distributed condition. Their daily performance throughout the study is consistently at the moderate level with an increasing trend that becomes zero and then increases again at the end of the data collection period. In the massed practice condition Participant 3 shows a moderate level and increasing trend. Their daily performance throughout the study is consistently at the moderate level and has an increasing trend throughout. When comparing the distributed practice and massed practice items mastered daily, their performance is almost identical. Participant 3 had five days of massed practice, while distributed practice was at seven days. Therefore, their performance is similar across both conditions with no noticeable difference between distributed and massed practice. Lastly, the performance of Participant 3 in the control condition starts at no level and is steadily in the moderate level with an increasing trend that decreases and then has an increasing trend at the end of the data collection period. Participant 3's performance in the control condition is slightly below their performance on both distributed and massed practice despite not practicing the control items throughout the week.

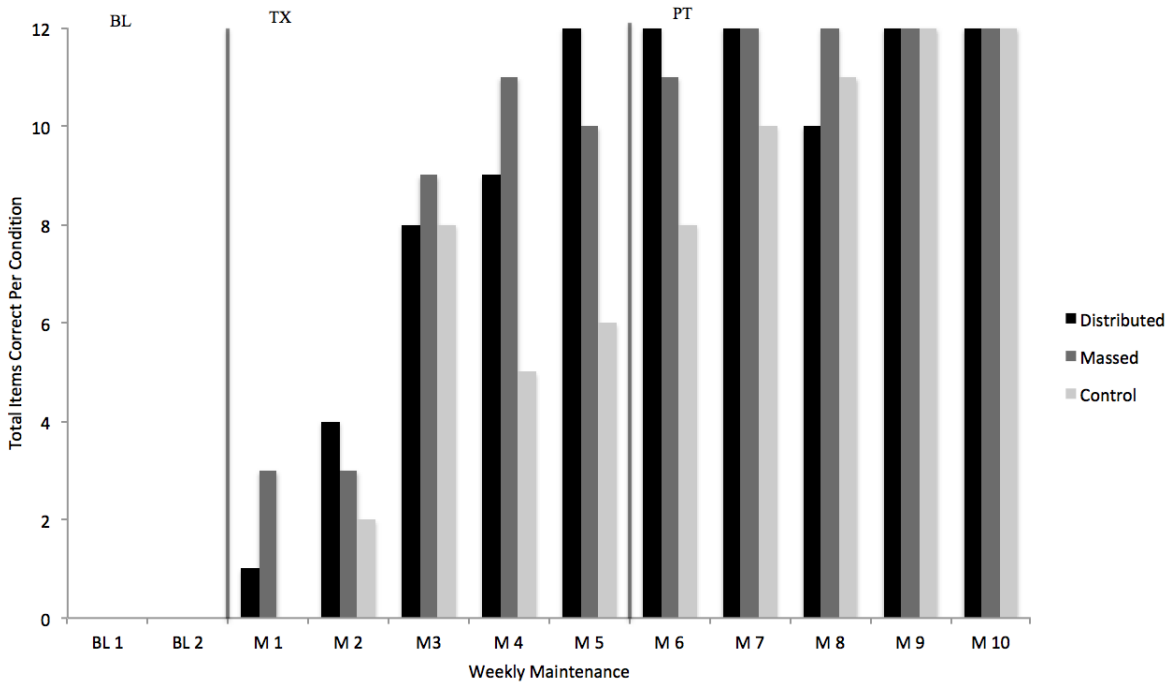
Figure 5. Participant 3 Cumulative Daily Data



Visual analysis of the maintenance data indicated there was no difference between the three conditions. Baseline data across all three conditions is flat with no trend. In the treatment phase, Participant 3's performance in the distributed condition indicated high level across the weeks with an increasing trend. In the post-test phase, their performance indicated high level with zero trend. Participant 3's performance in the massed condition during the treatment phase indicated high level and an increasing trend. The post-test maintenance was collected at one week, two and a half week, five week, six week, and 11 weeks after treatment. Their post-test performance indicated high level with zero trend. Lastly, Participant 3's performance in the control condition during the treatment phase indicated moderate level with an increasing trend. In the post-test phase their performance indicated a high level with an increasing trend. Overall, the results of the treatment phase indicate Participant 3 learned the items during the weeks of instruction. The results of the post-test phase indicate the maintenance of Participant 3's

performance was consistent across time after the instruction period ended across all three conditions. This implies the items Participant 3 learned in the distributed and massed practice conditions maintained their learning rates across weeks post-instruction.

Figure 6. Participant 3 Maintenance Data



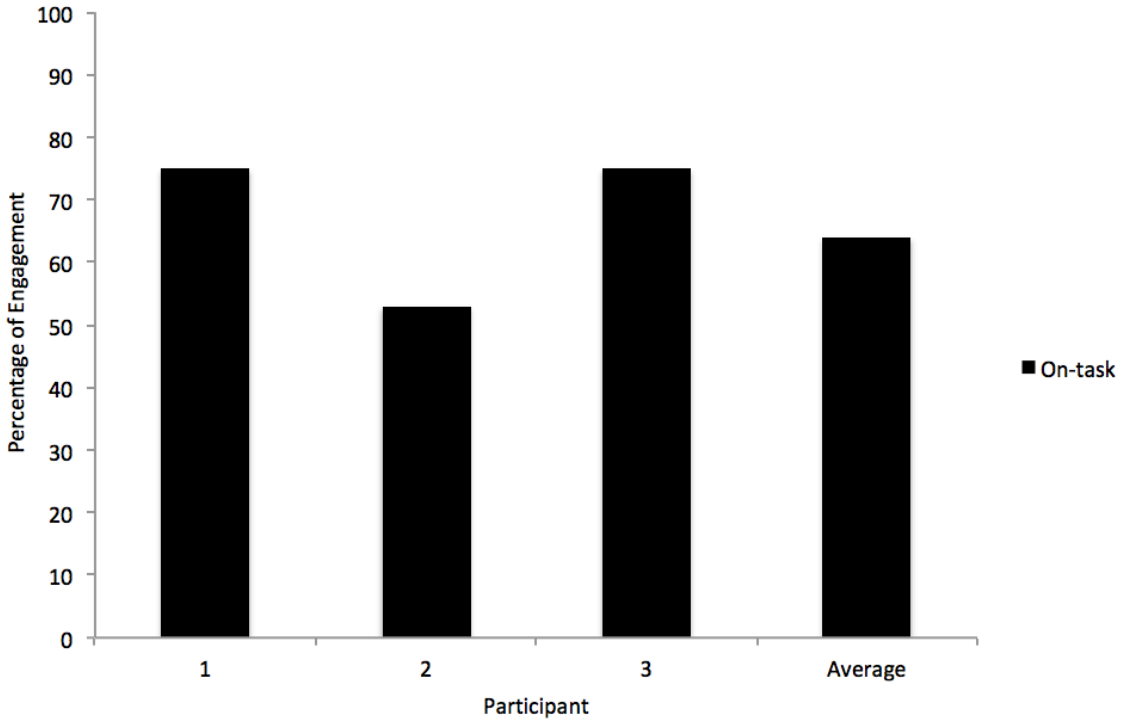
The engagement measure examined participant's behaviors in the distributed and massed practice conditions. These data resulted from participant's behaviors via video recordings observed by researchers coding for engagement and inattention. Figure 7 displays participant's total engagement while Figure 8 displays participant's engagement across condition. Specifically, the overall percentage of engagement was used as the dependent variable.

Engagement

Participant 1's total engagement for the study was at 75% of intervals observed. Participant 1's percentage of engagement ranged from 60% to 91%. Participant 2's total engagement for the study was at 53%. Participant 2's percentage of engagement ranged from

28% to 85%. Participant 3's total engagement for the study was at 75%. Participant 3's percentage of engagement ranged from 50% to 100%. The total average of engagement across all participants fell at 64%. These results for Participant 1 and 3 suggest higher levels of engagement produces higher rates of learning, while Participant 2 had lower rates of engagement and thus lower rates of learning.

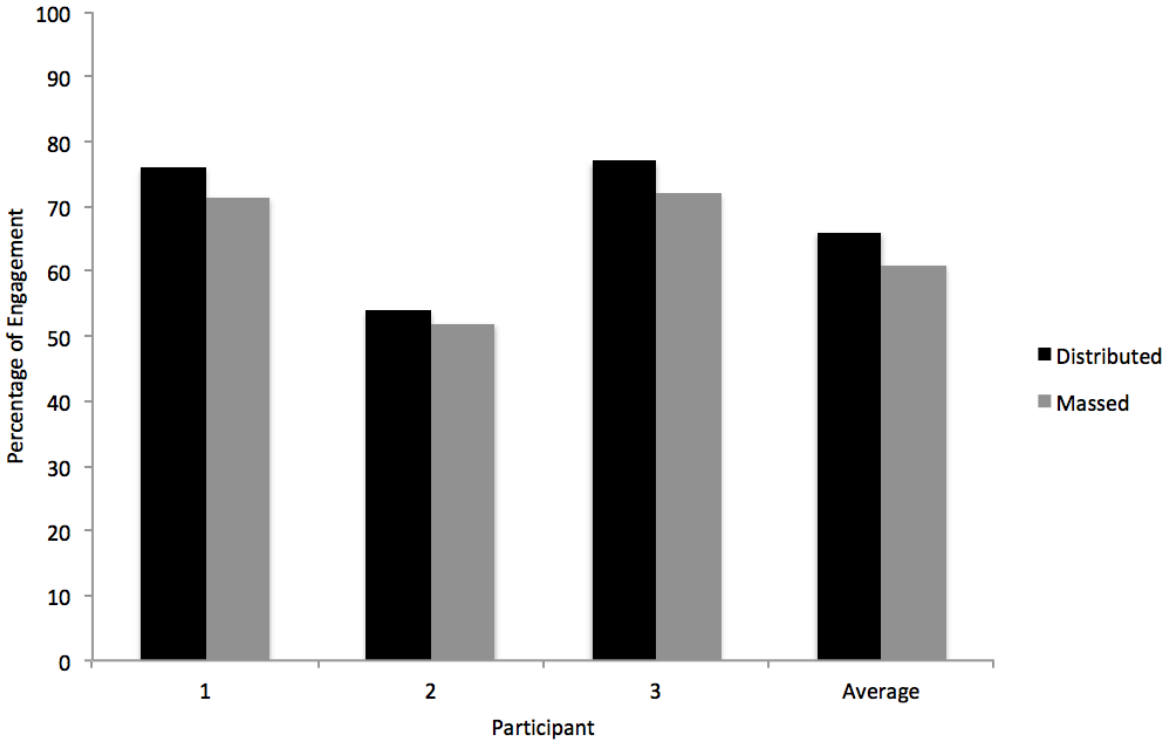
Figure 7. Total Engagement Across Participant



Visual analysis of the total engagement across condition indicated there was little difference between the three conditions. Participant 1's total engagement for the distributed practice condition was at 76%, while the massed practice condition was at 71.5%. Participant 2's total engagement for the distributed practice condition was at 54%, while the massed practice condition was at 52%. Participant 3's total engagement for the distributed practice condition was at 77%, while the massed practice condition was at 72%. When examining the average of engagement across all participants per condition, the distributed practice condition was at 66%,

while the massed practice condition was at 61%. Overall, these results suggest all participants' engagement did not vary across both conditions.

Figure 8. Total Engagement Across Condition and Participant



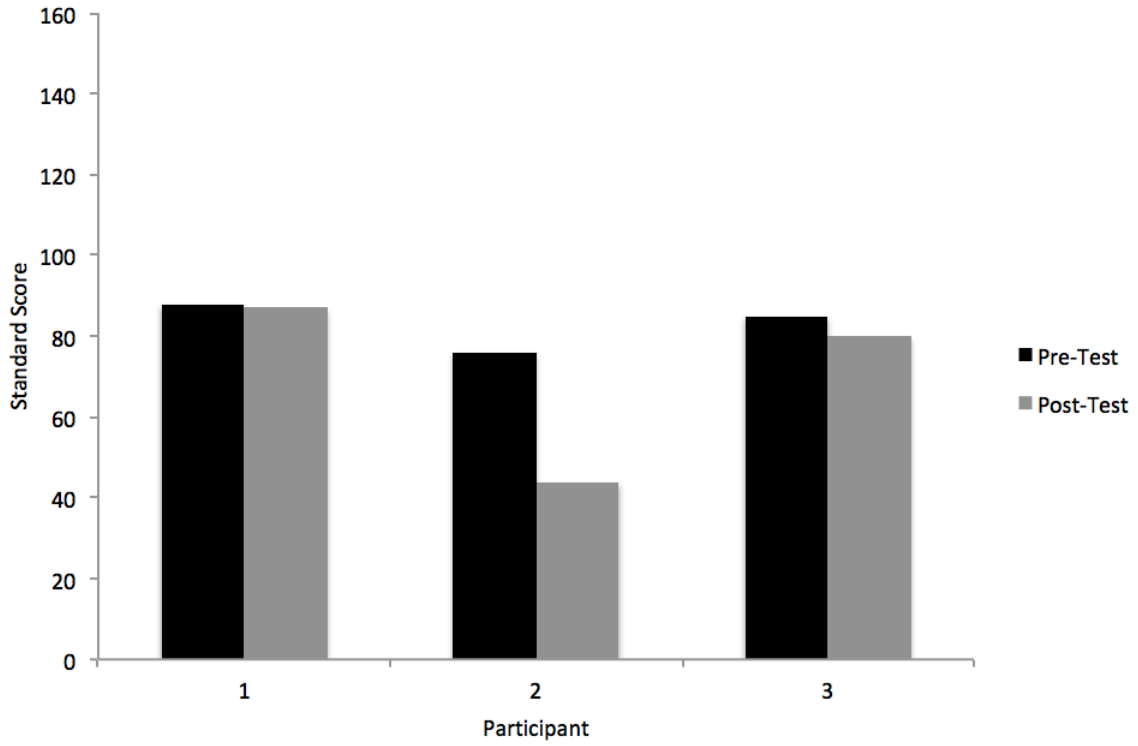
The PPVT-4 was utilized as a pre-test and post-test measure to determine if the participants had growth in their vocabulary skills with a standardized assessment. These data resulted from participant's responses with Form A prior to instruction and Form B post-instruction. Figure 9 displays participant's standard scores on both measures.

Pre/Post Tests PPVT-4

Visual analysis of the pre-test and post-test of the PPVT-4 indicated there was no difference between the three conditions. Participant 1's pre-test standard score was 88, with a post-test standard score of 87. Participant 2's pre-test standard score was 76, with a post-test

standard score of 44. Participant 3's pre-test standard score was 85, with a post-test standard score of 80.

Figure 9. Pre/Post Test PPVT-4 Participant Data



The Social Validity Questionnaire measure was utilized as a post-test measure with 12 questions completed by the instructional assistants. This measure was created to assess the utility, social validity, and perceptions of the instructional assistants for both the distributed practice and massed practice conditions. A Likert scale ranged from one to six, with one being strongly disagree up to six being strongly agree. These data resulted from responses by all instructional assistants after the treatment phase of the study was completed. Figure 10 displays the average of instructional assistants' rating scale responses to all questions.

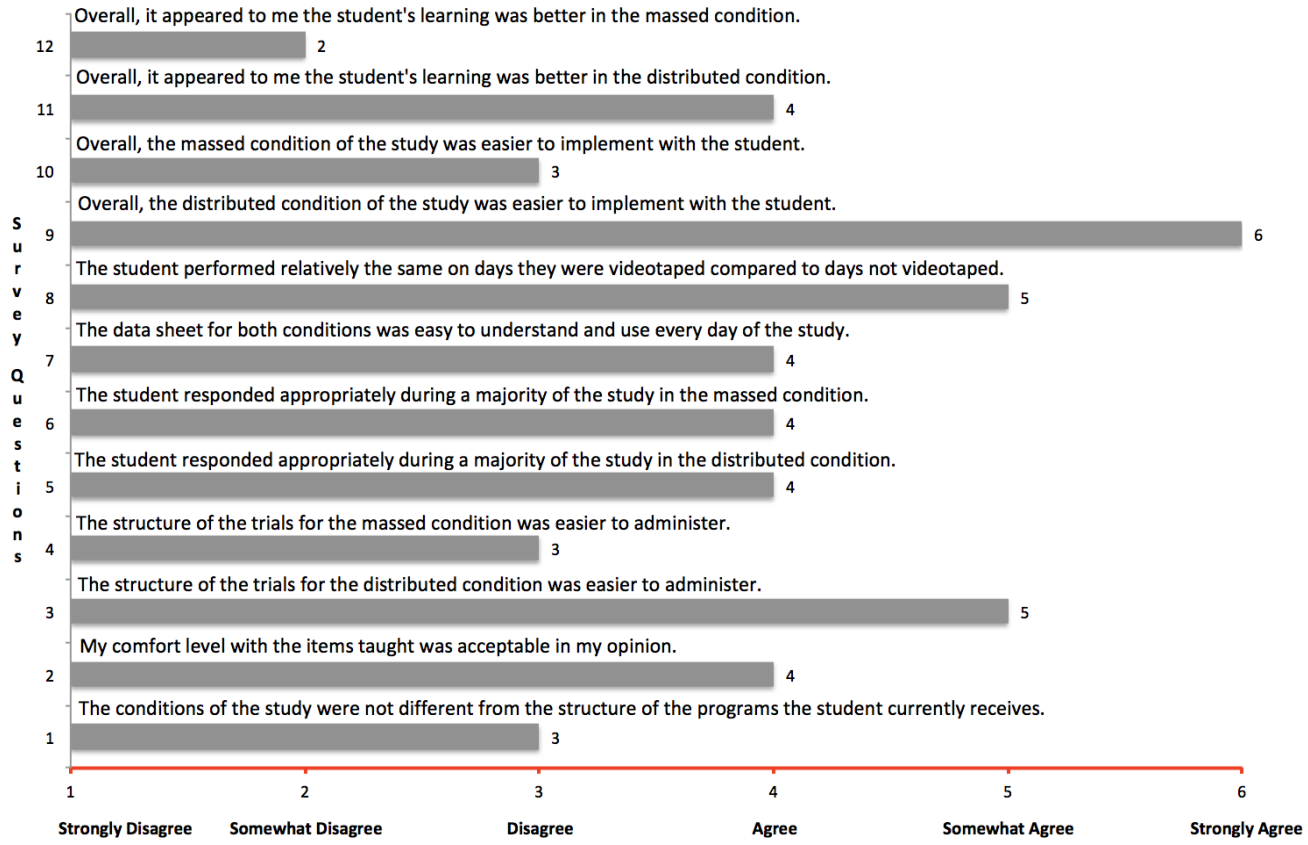
Social Validity Questionnaire

Visual analysis of the average responses across all instructional assistants and questions indicated predictable results. The first question noted is the comfort level of items being taught was rated as agree. The next notable question is the structure of the trials for the distributed condition and massed condition was easy to administer were rated as expected somewhat agree for distributed and disagree for massed. The following question discussed the participant's performance on days they were videotaped versus days they were not and the average rating indicated raters somewhat agreed. When asked whether the distributed and massed conditions were easier to implement with the participants', the raters responded as expected, strongly agree for distributed and disagree for massed. Lastly, the questions about each participant's learning being better in distributed and massed conditions, the raters responded agree for distributed and somewhat disagree for massed.

When investigating the standard deviation of rater's responses, there are a few questions to examine. One question related to how the conditions of the study were not different from the structure of the programs the participant's were receiving at the time of the study was rated as disagree. The standard deviation for this question, 2.36, indicates not all raters were in agreement. The next notable questions related to the student responding appropriately during a majority of the study in both distributed and massed conditions, which were both rated as agree. The standard deviation for these questions, 2.36 for both, indicates not all raters were in agreement. When examining participant's data with these results, it may suggest the instructional assistant whom worked with the participant that did not respond to the treatment, had varying responses than the other raters. The next question of the massed condition being easier to implement with the participant had a standard deviation of 1.7, indicating the ratings for the massed condition was more spread out and not all raters agreed. The last question of the

participant's learning in the distributed condition was better had a standard deviation of 2.16, indicating not all raters agreed upon their participant's learning of items.

Figure 10. Social Validity Questionnaire Average Responses



Summary

Visual analysis of the data indicated that baseline data across each of the participants were stable. The distributed practice condition treatment phase data showed a stable and increasing trend across two participants. The massed practice condition treatment phase data showed a stable and increasing trend across two participants. The other participant's data displayed a stable, slow, and increasing trend in the massed practice condition. Maintenance data collected for the distributed practice, massed practice, and control conditions with all

conditions maintaining high learning rates for two of the three participants for weeks post-instruction. Maintenance data collected for items in the control condition displayed high learning rates despite the participant's only exposure to the items once a week during instruction and once every few weeks post-instruction. Collectively, the data indicates the acquisition of receptive identification items was similar across both the distributed practice and massed practice conditions. The data illustrated distributed practice and massed practice are both effective. The maintenance of learning rates over time shows there is no difference across practice methods. Data did not converge to support the use of distributed practice or massed practice above the other as both conditions resulted in similar rates of learning and maintaining those rates of learning over time post-instruction.

CHAPTER V

DISCUSSION/CONCLUSION

The purpose of this study was to determine if young children with or displaying symptomology of ASD acquire receptive identification items at a higher rate through distributed practice when compared to their acquisition rate of receptive identification items through massed practice. The study sought to answer the following questions: (1) Will the rates of acquisition across items for receptive identification be higher with the distributed practice method than the rates of acquisition across different items for receptive identification with the massed practice method? (2) Which procedure over time maintains rates of learning?

Throughout the history of researching spaced practice, the general conclusion has been that skills learned via distributed practice is more efficient over massed practice. The skills taught have primarily included easy motor tasks; while other applied tasks have not been studied (Donovan & Radosevich, 1999). As extensive as this line of research has been, there has not been enough evidence to suggest that distributed practice is superior for all tasks taught to students and the general population. This research base has utilized the general population for predominately all studies, specifically focusing on older adults and college-age students (Haq & Kodak, 2015). As children with disabilities have not been widely studied in this line of research,

the results have the potential to impact how students acquire skills, gain fluency, and receive instruction.

Students with ASD benefit from instruction provided through ABA techniques that include but are not limited to: reinforcement, discrete trial teaching, prompting, and errorless learning. The area of spaced practice has been limited in studying the area of disabilities and which type of instruction provides optimal learning rates. By utilizing ABA techniques embedded within the structure of massed and distributed practice this area can be further researched. Specifically, young students with ASD are often taught vocabulary, receptive identification, intraverbals, and sorting by feature skills, among many others. As students with ASD often require more trials to achieve mastery of skills when compared to their peers, it is crucial to be efficient with instruction. Currently, little research has been conducted in the area of children with disabilities and the impact of practice method with skill acquisition and maintenance.

Results show evidence that indicate the acquisition of receptive identification items was similar across both massed and distributed practice methods. There did not appear to be a differential effect between learning rates of either massed or distributed practice. It is interesting to note that all participants learned some or all of the receptive identification items in the control condition, despite not being explicitly taught to them. The maintenance of learning rates over time shows there is no difference across practice methods. Furthermore, the maintenance measure indicates either practice method maintains the mastered items even eight weeks after instruction ended.

A strength of this study is that the students were similar in age and received instruction in a classroom with same-aged peers. The students also received the intervention in the same

setting and the setting was familiar to them as they attended the early intervention center prior to the start of the study. Implementation of the intervention was consistent across instructional assistants in the study and they all received comparable training by the center administration staff.

Additionally, with few studies examining skill acquisition of language in students with ASD, these results align with the debate of whether massed practice or distributed practice is more effective. While the results did not indicate a differential effect, it has shown that opportunities to respond to instruction was more important for learning rates when compared to the instructional practice, or the way in which the learning trials were presented. By utilizing the structure the early intervention center had in place and developing data sheets and procedures similar to those already being used, the instructional assistants did not require additional training beyond introduction and a short practice session.

Practical Implications

As children with ASD receive a number of services from a variety of professional fields, it is best practice to strive for the most effective and efficient intervention(s). Children with ASD often have a number of service providers that in the school setting that can include: school psychologists, Board Certified Behavior Analysts (BCBAs), special education teachers, and other related practitioners. While these practitioners work with children often in one-on-one settings, they also may be assisting in small group instruction, and engaging in building level teams to structure the learning environments for all students. All of these practitioners would benefit from the conclusion that scheduling teaching sessions or trials into a school day can be dictated by how it is currently structured or if changes are necessary, to choose what works best

within their workday. Practitioners can also be aware that the way the learning trials were structured was not as important as giving students the opportunity to respond to instruction.

Limitations

A limitation of this study is the level of participant motivation to complete the task could have interfered with their performance across both distributed practice and massed practice conditions.

Another limitation of this study is the percent of on-task behavior across participants was below the expected threshold for acquisition of learning. On average, school-age student's engagement in the classroom is observed at or above 80% for optimal learning. The overall average across participants in this study was 64% and not near the threshold for optimal learning and therefore may have impacted the results.

Furthermore, the vocabulary words utilized across participants may have been too common. The primary researcher cannot irrefutably state the participants' learning rates of items for the duration of the study came from the researcher's instruction in the classroom. For example, the instructional assistants and/or parents/guardians may have taught vocabulary words in the classroom and home setting. Therefore, the study's results were potentially influenced with additional teaching.

Moreover, due to the young age of the participants of this study, they likely hit fatigue at different rates. A variety of age ranges in participants may result in different responses and learning rates.

Future Research

Future studies may further examine different age ranges and/or older school-age students. Specifically, school age students as participants might result in different acquisition, learning

rates, and task engagement. School age students most often have the prerequisite skills of staying seated for long periods of time, sustaining attention for more than a few minutes, and appropriate responding to instruction and tasks. Including different age ranges can help to broaden the results in this line of research. It may also benefit future researchers to increase the number of participants to establish the acquisition and learning rates across participants. A future study with a larger sample size may replicate the results and promote generalization.

While there has been a significant amount of research in the area of massed and distributed practice, there is little research on the acquisition of non-motor tasks and verbal skills. Further studies may provide instruction on different verbal skills aside from receptive identification or can utilize receptive identification with more advanced or specific vocabulary. In addition, increasing the set size of items for the instruction across the practice conditions might be altered in future studies. The set size of items in this study was 12 per condition and increasing this may result in varying outcomes of skill acquisition and learning rates across participants.

Conclusion

In the history of massed and distributed practice research, there is limited research examining skill acquisition in children. While previous studies have examined other areas such as: mathematics, reading, and writing, other verbal skills and non-motor tasks have not been studied in depth. Overall, the research has not concluded whether massed practice or distributed practice is superior to the other. Presently, insufficient research has examined young children with ASD and skill acquisition across verbal tasks with massed and distributed practice. The purpose of this paper is report on a study that compared skill acquisition of receptive identification items across massed and distributed practice in young children with ASD. An

AATD was used to compare the two types of practice across different sets of items and included a control condition to minimize any carryover effects. Furthermore, this study shows there was no notable difference between learning rates of either massed or distributed practice across participants. The focus may need to be on the number of opportunities to respond for students, instead of the way in which instruction is presented. This study provides evidence that either practice method can be effective for students acquiring a skill. For schools or centers to be efficient with instruction, they may benefit from selecting the practice method that fits into their schedule. The findings from this study provide areas for continued research that can benefit children with disabilities and their learning environment.

REFERENCES

Codding, R. S., & Lane, K. L. (2015). A spotlight on treatment intensity: An important and often overlooked component of intervention inquiry. Journal of Behavioral Education, 24, 1–10. doi:10.1007/s10864-014-9210-z.

Codding, R. S., VanDerHeyden, A. M., Martin, R. J., Desai, S., Allard, N., & Perrault, L. (2016). Manipulating treatment dose: Evaluating the frequency of a small group intervention targeting whole number operations. *Learning Disabilities Research and Practice, 31*(4), 208-220. doi:10.1111/ldrp.12120.

Cooper, J. T., & Scott, T. M. (2017). The Keys to managing instruction and behavior: Considering high probability practices. *Teacher Education and Special Education*, *40*(2), 102-113. doi:10.1177/0888406417700825.

Daly, E. J., Lentz, F. E., & Boyer, J. (1996). The Instructional hierarchy: a conceptual model for understanding the effective components of reading interventions. *School Psychology Quarterly*, *11*(4).

Donovan, J. J. & Radosevich, D. J. (1999). A meta-analytic review of the distribution of practice effect: Now you see it, now you don't. Journal of Applied Psychology, 84, 795–805.

Dunn, L. M., & Dunn, D. M. (2007). *Peabody Picture Vocabulary Test, Manual* (Fourth ed.). Minneapolis, MN: Pearson Assessments.

Etzel, B. C., & LeBlanc, J. M. (1979). The simplest treatment alternative: The Law of parsimony applied to choosing appropriate instructional control and errorless-learning procedures

for the difficult-to-teach child. *Journal of Autism and Developmental Disorders*, *9*(4), 361-381.

Fenson, L., Marchman, V. A., Thal, D. J., Dale, P. S., Reznick, J., & Bates, E. (2006). *The MacArthur-Bates Communicative Development Inventories User's Guide and Technical Manual* (Second ed.). Baltimore, MD: Brookes Publishing Co.

Fishman, E. J., Keller, L., & Atkinson, R. C. (1968). Massed versus distributed practice in computerized spelling drills. *Journal of Educational Psychology, 59*(4), 290-296.

Flores, M. M., & Ganz, J. B. (2014). Comparison of direct instruction and discrete trial teaching on the curriculum-based assessment of language performance of students with autism. *Exceptionality, 22,* 191-204. doi:10.1080/09362835.2013.865533.

Fuchs, D., & Fuchs, L. S. (2015). Rethinking service delivery for students with significant learning problems: Developing and implementing intensive instruction. *Remedial and Special Education*, *36*(2), 105-111.

Garrett, H. E. (1940). Variability in learning under massed and spaced practice. *Journal of Experimental Psychology*, *26*(6), 547-567.

Haq, S. S., & Kodak, T. (2015). Evaluating the effects of massed and distributed practice on acquisition and maintenance of tacts and textual behavior with typically developing children. *Journal of Applied Behavior Analysis*, *48*(1), 85-95.

Haq, S. S., Kodak, T., Kurtz-Nelson, E., Porritt, M., Rush, K., & Cariveau, T. (2015). Comparing the effects of massed and distributed practice on skill acquisition for children with autism. *Journal of Applied Behavior Analysis*, *48*(2), 454-459.

Haring, N. G., Lovitt, T. C, Eaton, M. D., & Hansen, C. L. (1978). The fourth R: Research in the classroom. Columbus, OH: Merrill.

Haydon, T., Macsuga-Gage, A. S., Simonsen, B., & Hawkins, R. (2012). Opportunities to respond: A key component of effective instruction. *Beyond Behavior*.

Kates-McElrath, K., & Axelrod, S. (2006). Behavioral intervention for autism: A Distinction between two behavior analytic approaches. *The Behavior Analyst Today, 7*(2), 242-252.

Kodak, T., Cariveau, T., LeBlanc, B. A., Mahon, J. J., & Carroll, R. A. (2017). Selection and implementation of skill acquisition programs by special education teachers and staff for students with autism spectrum disorder. *Behavior Modification, 42*(1), 58-83. doi:10.1177/0145445517692081.

Krug, D., Davis, T. B., & Glover, J. A. (1990). Massed versus distributed repeated reading: A Case of forgetting helping recall? *Journal of Educational Psychology, 82*(2), 366-371.

Mathes, P. G., Torgesen, J. K., Clancy-Menchetti, J., Santi, K., & Grek, M. (2003). A Comparison of teacher-directed versus peer-assisted instruction to struggling first-grade readers. *The Elementary School Journal, 103*(5), 459-479.

Mueller, M. A., Palkovic, C. M., & Maynard, C. S. (2007). Errorless learning: Review and practical application for teaching children with pervasive developmental disorders. *Psychology in the Schools, 44*(7), 691-700. doi:10.1002/pits.20258.

Pelios, L. V., & Sucharzewski, A. (2004). Teaching receptive language to children with autism: A Selective overview. *The Behavior Analyst Today, 4*(4), 378-385.

Rohrer, D., & Taylor, K. (2007). The shuffling of mathematics problems improves learning. Instructional Science, 35, 481–498. Doi:10.1007/s11251-007-9015-8.

Rohrer, D., & Taylor, K. (2006). The Effects of overlearning and distributed practice on the retention of mathematics knowledge. *Applied Cognitive Psychology, 20*, 1209-1224. doi:10.1002/acp.1266.

Rosenshine, B. V. (1983). Teaching functions in instructional programs. Elementary School Journal, 83, 335-352.

Severtson, J. M., & Carr, J. E. (2007). Training novice instructors to implement errorless discrete-trial teaching: A Sequential analysis. *Behavior Analysis in Practice*, *5*(2), 13-23.

Sindelar, P. T., Rosenberg, M. S., & Wilson, R. J. (1985). An Adapted Alternating Treatments Design For Instructional Research. *Education and Treatment of Children*, *8*(1), 67-76.

Strain, P. S., Schwartz, I. S., & Barton, E. E. (2011). Providing interventions for young children with autism spectrum disorders: What we still need to accomplish. *Journal of Early Intervention, 33*(4), 321-332.

APPENDICES

APPENDIX A

Procedural Fidelity Checklist

Procedural Fidelity Checklist ☐ Distributed (A) or ☐ Massed (B)

Date: _____ Set: _____ Evaluator: _____ Student: _____ Time: _____ Overall % _____

Steps

1. Area is clear of any clutter of materials.
2. The student's 3 receptive identification cards are laid in front of student on the table in the randomized order according to the daily data sheet.
3. The instruction is given, "Point to [insert card name]" or "Show me [insert card name]"
4. The instructional assistant waits 0 seconds for prompt delay when appropriate or 3 seconds for the student to point to the card.
5. The instructional assistant follows the prompting procedure appropriately when needed (providing model/gestural prompt after 3 seconds).
6. When the student responds within 3 seconds of the instruction, the instructional assistant provides the appropriate consequence.
7. The instructional assistant waits about 3 seconds before presenting the next trial.
8. The instructional assistant writes down the student's response (incorrect or correct) and whether or not a prompt as well as error correction was implemented, about every 3 trials.

A. Data collected for each trial for reliability with instructional assistant.

Session #	Steps / Trials	1	2	3	4	5	6	7	8	A.	Total
	1	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ - +P E	
	2	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ - +P E	
	3	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ - +P E	
	4	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ - +P E	
	5	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ - +P E	
	6	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ - +P E	
	7	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ - +P E	
	8	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ - +P E	
	9	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ - +P E	
	10	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ - +P E	
	11	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ - +P E	
	12	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ - +P E	
	13	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ - +P E	
	14	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ - +P E	
	15	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ - +P E	
	16	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ - +P E	
	17	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ - +P E	
	18	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ - +P E	
	19	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ - +P E	
	20	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ - +P E	
	21	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ - +P E	
	22	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ - +P E	
	23	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ - +P E	
	24	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ -	+ - +P E	
	Total										

Data Collection

1. Session #___: + - Data collection occurs during teaching time.
2. Session #___: + - Student folder is maintained regularly.

Inter-Observer Agreement

IOA Calculation:
_____ / _____ =
._____ x 100 =
_____%

Evaluator 1:
_____

Evaluator 2:
_____

APPENDIX B

Distributed Practice Daily Data Sheet

Daily Program Data Sheet

Distributed Practice Child: _____ Instructor: _____

Objectives: Teach Set ___ to child during 1st, 2nd, and 3rd session of 1-on-1 days **(Monday & Wednesday)**

Instructional Cue: **'Point to_____', 'Show me_____', 'Find_____', or 'Where is_____'**

Date:
Start Time:
2 + ~~P~~ E___
3 + ~~P~~ E___
1 + ~~P~~ E___
3 + ~~P~~ E___
2 + ~~P~~ E___
1 + ~~P~~ E___
1 + ~~P~~ E___
3 + ~~P~~ E___
2 + ~~P~~ E___
3 + ~~P~~ E___
2 + ~~P~~ E___
1 + ~~P~~ E___
Initial:
End Time:

Date:
Start Time:
1 + ~~P~~ E___
3 + ~~P~~ E___
2 + ~~P~~ E___
2 + ~~P~~ E___
1 + ~~P~~ E___
3 + ~~P~~ E___
2 + ~~P~~ E___
3 + ~~P~~ E___
1 + ~~P~~ E___
1 + ~~P~~ E___
3 + ~~P~~ E___
2 + ~~P~~ E___
Initial:
End Time:

Date:
Start Time:
2 + ~~P~~ E___
1 + ~~P~~ E___
3 + ~~P~~ E___
1 + ~~P~~ E___
3 + ~~P~~ E___
2 + ~~P~~ E___
3 + ~~P~~ E___
2 + ~~P~~ E___
1 + ~~P~~ E___
3 + ~~P~~ E___
1 + ~~P~~ E___
2 + ~~P~~ E___
Initial:
End Time:

Date:
Start Time:
1 + ~~P~~ E___
3 + ~~P~~ E___
2 + ~~P~~ E___
2 + ~~P~~ E___
1 + ~~P~~ E___
3 + ~~P~~ E___
1 + ~~P~~ E___
3 + ~~P~~ E___
2 + ~~P~~ E___
1 + ~~P~~ E___
3 + ~~P~~ E___
2 + ~~P~~ E___
Initial:
End Time:

Date:
Start Time:
1 + ~~P~~ E___
3 + ~~P~~ E___
2 + ~~P~~ E___
3 + ~~P~~ E___
1 + ~~P~~ E___
2 + ~~P~~ E___
2 + ~~P~~ E___
1 + ~~P~~ E___
3 + ~~P~~ E___
1 + ~~P~~ E___
2 + ~~P~~ E___
3 + ~~P~~ E___
Initial:
End Time:

Date:
Start Time:
3 + ~~P~~ E___
1 + ~~P~~ E___
2 + ~~P~~ E___
1 + ~~P~~ E___
3 + ~~P~~ E___
2 + ~~P~~ E___
3 + ~~P~~ E___
2 + ~~P~~ E___
1 + ~~P~~ E___
1 + ~~P~~ E___
3 + ~~P~~ E___
2 + ~~P~~ E___
Initial:
End Time:

Response Key:

+ (correct response): Child provides correct response in 3 secs or less with no prompt.

+P (correct prompt response): child provides correct response with a prompt.

- (incorrect response): child provides incorrect response in 3 secs or less.

Independent Response=IR

Mastery Criteria

5/6 correct responses *(IR)* during test trials for each day/session.

Items in Set: **MONDAY**

1 = _____

IR: Mon (/)= _____%

2 = _____

IR: Mon (/)= _____%

3 = _____

IR: Mon (/)= _____%

Items in Set: **WEDNESDAY**

1 = _____

IR: Wed (/)= _____%

2 = _____

IR: Wed (/)= _____%

3 = _____

IR: Wed (/)= _____%

APPENDIX C

Massed Practice Daily Data Sheet

Daily Program Data Sheet

Massed Practice Child: _____ Instructor: _____

Objectives: Teach Set ___ to child during 1st work session of peer group days **(Tuesday & Thursday)**

Instructional Cue: **'Point to_____', 'Show me_____', 'Find_____', or 'Where is_____'**

Date:	**Start Time:**	
3 + -P__ E__	2 + -P__ E__	1 + -P__ E__
1 + -P__ E__	1 + -P__ E__	3 + -P__ E__
2 + -P__ E__	3 + -P__ E__	2 + -P__ E__
2 + -P__ E__	2 + -P__ E__	1 + -P__ E__
1 + -P__ E__	3 + -P__ E__	2 + -P__ E__
3 + -P__ E__	1 + -P__ E__	3 + -P__ E__
1 + -P__ E__	2 + -P__ E__	3 + -P__ E__
2 + -P__ E__	1 + -P__ E__	2 + -P__ E__
3 + -P__ E__	3 + -P__ E__	1 + -P__ E__
1 + -P__ E__	3 + -P__ E__	2 + -P__ E__
3 + -P__ E__	2 + -P__ E__	1 + -P__ E__
2 + -P__ E__	1 + -P__ E__	3 + -P__ E__
Initial:		**End Time:**

Date:	**Start Time:**	
2 + -P__ E__	3 + -P__ E__	3 + -P__ E__
3 + -P__ E__	1 + -P__ E__	1 + -P__ E__
1 + -P__ E__	2 + -P__ E__	2 + -P__ E__
3 + -P__ E__	2 + -P__ E__	3 + -P__ E__
1 + -P__ E__	3 + -P__ E__	2 + -P__ E__
2 + -P__ E__	1 + -P__ E__	1 + -P__ E__
1 + -P__ E__	3 + -P__ E__	3 + -P__ E__
3 + -P__ E__	2 + -P__ E__	2 + -P__ E__
2 + -P__ E__	1 + -P__ E__	1 + -P__ E__
2 + -P__ E__	1 + -P__ E__	2 + -P__ E__
3 + -P__ E__	2 + -P__ E__	3 + -P__ E__
1 + -P__ E__	3 + -P__ E__	1 + -P__ E__
Initial:		**End Time:**

Response Key:

+ (correct response): Child provides correct response in 3 secs or less with no prompt.

+P (correct prompt response): child provides correct response with a prompt.

- (incorrect response): child provides incorrect response in 3 secs or less.

Independent Response=IR

Mastery Criteria

5/6 correct responses

(IR) during test trials for each day/session.

Items in Set: **TUESDAY**

1 = _____

IR: Tue (✓)= _____%

2 = _____

IR: Tue (✓)= _____%

3 = _____

IR: Tue (✓)= _____%

Items in Set: **THURSDAY**

1 = _____

IR: Thu (✓)= _____%

2 = _____

IR: Thu (✓)= _____%

3 = _____

IR: Thu (✓)= _____%

APPENDIX D

Weekly Maintenance Data Sheet

Weekly Maintenance Data Sheet

Student: _____ Instructor: _____

Objectives: Probe all 36 items with student during 1st session of the work day

Instructional Cue: **'Point to_____', 'Show me_____', "Find _____", or "Where is_____"**

Set: All 36 items across both conditions. Shuffle and probe each item at random. **Only** provide reinforcement for appropriate sitting, pointing, etc.

Category	**Date:**	**Time:**
	Item:	+ -
	Item:	+ -
	Item:	+ -
	Item:	+ -
	Item:	+ -
	Item:	+ -
	Item:	+ -
	Item:	+ -
	Item:	+ -
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	Item:	+ -
	Item:	+ -
	Initial:	

APPENDIX E

Social Validity Questionnaire

Instructional Assistant Questionnaire

Scale of 1-6

1=*strongly disagree*, **2**=*somewhat disagree*, **3**=*disagree*, **4**=*agree*, **5**=*somewhat agree*, **6**=*strongly agree*

	1	2	3	4	5	6
The conditions of the study were not different from the structure of the programs the student currently receives.						
My comfort level with the items taught was acceptable in my opinion.						
The structure of the trials for the distributed condition was easy to administer.						
The structure of the trials for the massed condition was easy to administer.						
The student responded appropriately during a majority of the study in the distributed condition.						
The student responded appropriately during a majority of the study in the massed condition.						
The data sheet for both conditions was easy to understand and use every day of the study.						
The student performed relatively the same on days they were videotaped compared to days not videotaped.						
Overall, the distributed condition of the study was easier to implement with the student.						
Overall, the massed condition of the study was easier to implement with the student.						
Overall, it appeared to me the student's learning was better in the distributed condition.						
Overall, it appeared to me the student's learning was better in the massed condition.						

APPENDIX F

Behavior Observation Form

Observation Form

Student:		Teacher:	Condition:
Date:	Time:	Observer:	

10s	20s	30s	40s	50s	60s
1 OS OP IA VC Engaged	2 OS OP IA VC Engaged	3 OS OP IA VC Engaged	4 OS OP IA VC Engaged	5 OS OP IA VC Engaged	6 OS OP IA VC Engaged
7 OS OP IA VC Engaged	8 OS OP IA VC Engaged	9 OS OP IA VC Engaged	10 OS OP IA VC Engaged	11 OS OP IA VC Engaged	12 OS OP IA VC Engaged
13 OS OP IA VC Engaged	14 OS OP IA VC Engaged	15 OS OP IA VC Engaged	16 OS OP IA VC Engaged	17 OS OP IA VC Engaged	18 OS OP IA VC Engaged
19 OS OP IA VC Engaged	20 OS OP IA VC Engaged	21 OS OP IA VC Engaged	22 OS OP IA VC Engaged	23 OS OP IA VC Engaged	24 OS OP IA VC Engaged
25 OS OP IA VC Engaged	26 OS OP IA VC Engaged	27 OS OP IA VC Engaged	28 OS OP IA VC Engaged	29 OS OP IA VC Engaged	30 OS OP IA VC Engaged
31 OS OP IA VC Engaged	32 OS OP IA VC Engaged	33 OS OP IA VC Engaged	34 OS OP IA VC Engaged	35 OS OP IA VC Engaged	36 OS OP IA VC Engaged
37 OS OP IA VC Engaged	38 OS OP IA VC Engaged	39 OS OP IA VC Engaged	40 OS OP IA VC Engaged	41 OS OP IA VC Engaged	42 OS OP IA VC Engaged
43 OS OP IA VC Engaged	44 OS OP IA VC Engaged	45 OS OP IA VC Engaged	46 OS OP IA VC Engaged	47 OS OP IA VC Engaged	48 OS OP IA VC Engaged
49 OS OP IA VC Engaged	50 OS OP IA VC Engaged	51 OS OP IA VC Engaged	52 OS OP IA VC Engaged	53 OS OP IA VC Engaged	54 OS OP IA VC Engaged
55 OS OP IA VC Engaged	56 OS OP IA VC Engaged	57 OS OP IA VC Engaged	58 OS OP IA VC Engaged	59 OS OP IA VC Engaged	60 OS OP IA VC Engaged

OS: _____/60x100=_____ OP: _____/60x100=_____ IA: _____/60x100=_____
VC: _____/60x100=_____ Engaged: _____/60x100=_____

OS (Out of Seat): momentary: Definition: the students' bottom is not in their seat or chair.
OP (Object Play): momentary: Definition: the student is playing with an object, not for its intended use.
IA (Inattention): momentary: Definition: the student is not oriented to or looking in the direction of the table, the instructor, the picture cards, and/or their reinforcers.
Engaged: momentary: Definition: the student is oriented to or looking in the direction of the instructor, the table, the picture cards, and/or their reinforcers.
VC (Vocalization): momentary: Definition: the student is inappropriately making noise such as crying and/or whining.

Inter-Observer Agreement
IOA Calculation: _____ / _____ x 100 = _____%
Calculating Scored Interval IOA:
# of intervals that there is agreement that the behavior occurred/# of intervals that at least one person indicated the behavior occurred = . _____X 100 = _____%

APPENDIX G

IRB Approval Letter

Oklahoma State University Institutional Review Board

Date:	04/25/2018
Application Number:	ED-18-35
Proposal Title:	Distributed and Massed Practice in Children with Autism
Principal Investigator:	Gary Duhon
Co-Investigator(s):	Lindsey O'Laughlin
Faculty Adviser:	
Project Coordinator:	
Research Assistant(s):	
Processed as:	Expedited

Status Recommended by Reviewer(s): Approved
Approval Date: 04/10/2018
Expiration Date: 04/09/2019

The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

The final versions of any recruitment, consent and assent documents bearing the IRB approval stamp are available for download from IRBManager. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be approved by the IRB. Protocol modifications requiring approval may include changes to the title, PI, adviser, other research personnel, funding status or sponsor, subject population composition or size, recruitment, inclusion/exclusion criteria, research site, research procedures and consent/assent process or forms.
2. Submit a request for continuation if the study extends beyond the approval period. This continuation must receive IRB review and approval before the research can continue.
3. Report any unanticipated and/or adverse events to the IRB Office promptly.
4. Notify the IRB office when your research project is complete or when you are no longer affiliated with Oklahoma State University.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact the IRB Office at 223 Scott Hall (phone: 405-744-3377, irb@okstate.edu).

Sincerely,

Hugh Crethar, Chair Institutional Review Board

VITA

Lindsey Rae O'Laughlin

Candidate for the Degree of

Doctor of Philosophy

Thesis: MASSED VERSUS DISTRIBUTED PRACTICE AMONG CHILDREN WITH ASD

Major Field: Educational Psychology (Option: School Psychology)

Biographical:

Education:

Completed the requirements for the Doctor of Philosophy in School Psychology at Oklahoma State University, Stillwater, Oklahoma in May, 2020.

Completed the requirements for the Master of Science in School Psychometrics at Oklahoma State University, Stillwater, Oklahoma in December, 2016.

Completed the requirements for the Bachelor of Science in Psychology at Central Michigan University, Mount Pleasant, Michigan, in May, 2015.

Experience:

OTISS Support Coach for the Oklahoma Tiered Intervention System of Support grant (June 2018 – Spring 2019)

Completed 1,200+ Practicum Hours in School, Clinical, and Outpatient Settings through Oklahoma State University

Graduate Teaching Assistant at Oklahoma State University in the School of Teaching, Learning, and Educational Sciences in the College of Education. Fall 2016, 2017 and Spring 2017, 2018

Graduate Research Assistant at Oklahoma State University in the School of Applied Heath and Educational Psychology in the College of Education. Fall 2015, 2017 and Spring 2016, 2018

Professional Memberships:

American Psychological Association (2015 – Present)
National Association of School Psychologists (2015 – Present)