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Evaluating the effectiveness of stimulus presentation order in receptive identification skills training

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Evaluating the Effectiveness of Stimulus Presentation Order in Receptive Identification Skills Training

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Abstract

Receptive identification skills are typically taught using match to sample procedures. This can be done through the process of having a learner match an auditory sample and a visual stimulus from an array of multiple comparison stimuli over several trials. Research has evaluated the effectiveness of various stimuli presentation orders when teaching receptive identification skills with differing recommendations across studies. This thesis aimed to compare the effectiveness of sample first and comparison first presentation orders when teaching receptive identification skills using an adapted alternating treatments design. This study was conducted with two non-verbal early childhood learners. The experimenter tested pictures of common objects in the pretest and pre-teaching conditions and then compared the presentation orders. Neither participant reached mastery in the pre-teaching conditions, therefore, the baseline and intervention conditions were not conducted. The experimenter did not have enough data to provide suggestions based on the research questions. Other limitations included the learners' ability to select one target in an array of two and ability to successfully imitate a model prompt.

Keywords: receptive language, sample first, comparison first, sample first, match to sample

Introduction

The first behavioral discussion of language was Skinner's 1957 publication of *Verbal Behavior*. In this book, Skinner analyzes language through the behavior of the speaker stating that the behavior of the listener is only relevant as it explains the behavior of the speaker. Over time, researchers have considered the behavior of both the speaker and the listener. Parrot (1984) stated the behavior of the listener is more than just a consequence to the speaker's behavior, it also involves listening and understanding (in Pelios & Sucharzewski, 2004). One way to demonstrate being the listener is through receptive language which is indicated by a motor, or nonverbal response, to an instruction e.g., pointing or touching a flower in response to someone saying "touch the flower" (Boa et al., 2017; Lovaas & Smith, 2003; Sundberg & Partington, 1998). Pelios and Sucharzewski (2004) explained receptive language (comprehension of language) as a broad term that involves response classes controlled by the antecedents. They then explained expressive language (spoken language) as a communication response typically in the form of a tact or interverbal.

Language skills support development of cognitive processes particularly in regards to shaping attention and short-term memory. When language problems persist in a child, there is often risk of the child also developing behavioral problems or deficits. Tomblin and McSweeny (1997) explained that when a child's language skills increase, they are also increasing their ability to maintain attention and exercise control over their environment, while a child with poor receptive and expressive language skills may have difficulties with social withdrawal, underachievement in academics, impulsive or oppositional behaviors, and deficits in attention.

According to Gremillion and Martel (2014) difficulty developing these skills are often seen in early childhood learners and individuals with ASD therefore, these skills are foundational at this stage. Nearly 7% of kindergartners demonstrate deficits in receptive, expressive, and/or pragmatic language skills. Almost half of the ASD population fail to develop speech and language skills or use them in a functional manner when these skills are developed (Volkmar, 1991). Researchers support the development of these skills through interventions known as receptive identification teaching (Grow & LeBlanc, 2014). Receptive identification teaching is the process of presenting multiple stimuli while teaching an individual to respond correctly to an auditory sample (e.g. “touch this”, “do this”). These skills acquire development of attending, listening, understanding, comprehension, stimulus discrimination, and responding.

Using Match to Sample to Teach Receptive Identification Skills

The receptive identification teaching procedure begins with simple commands such as “touch this”, “come here”, “do this”, “sit down” and so on. These commands gradually progress in complexity as the learner develops skills. According to Pelios and Sucharzewski (2004), progress in complexity includes receptively identifying items across various relations (e.g. spatial, temporal, part/whole, and functional). Match-to-sample (MTS) is one way in which behaviorists approach teaching these skills. Research has shown that MTS training is effective for teaching stimuli relations to children with ASD (Bejnö et al., 2018). MTS is a process in which an individual’s behavior of matching two different stimuli together in relation to one another is reinforced, such as matching an auditory stimulus to a picture or object. This study analyzes MTS when using auditory sample and comparison visual stimuli. The auditory sample stimuli are

words or instructions given to produce a corresponding response. The comparison stimuli are an array of objects or pictures where one corresponds to the sample (the target stimuli) and the others are distractors. When teaching MTS skills, the instructor presents both stimuli and provides prompting as needed. As skills are acquired the learner will be able to produce unprompted correct responses when matching the auditory sample to the corresponding comparison stimuli. Current research has compared stimuli presentation orders when using MTS to teach receptive language skills (e.g., Leon et al. 2021; Cubicciotti et al., 2019; Schneider et al., 2018). Presentation orders are as follow:

Comparison First

When presenting the stimuli, the instructor will present the visual/tangible comparison stimuli before presenting the auditory sample. For example, the instructor will present a pictorial array of a cat, dog, and pig. Following the array presentation, the instructor will present the auditory sample “touch the cat.” The correct response is for the learner to touch the picture of the cat.

Sample First

When presenting the stimuli, the instructor will present the auditory sample before presenting the comparison stimuli. For example, the instructor will present the auditory sample “touch the cat”. Following the auditory sample the instructor will present the pictorial array of a cat, dog, and pig. The correct response is for the learner to touch the picture of the cat.

Statement of The Problem

Receptive language skills are important and necessary for ASD learners and early childhood learners. These skills are often taught using MTS procedures and have proven

effective (e.g., Leon et al. 2021; Gee et al. 2019; Schneider et al., 2018). However, the effectiveness of the presentation order of stimuli has not been fully evaluated, and have yielded varying results across studies. This study reviews six articles that compare the presentation orders. Five of these articles suggest that sample first condition resulted in faster skill acquisition and one study suggested that the presentation order that is most effective is learner-specific. Limitations across some of the studies include lack of generalization of the skills (Petursdottir & Aguilar, 2016), stimulus sets not being counterbalanced because of failure to assess a larger number of targets (Schneider et al., 2018), and failure to train to mastery in each condition (Cubicciotti et al., 2019).

Purpose of the Study

The purpose of this study was to compare the effectiveness of two stimulus presentation orders (sample first and comparison first) when using MTS to teach receptive identification skills to early childhood learners with ASD. This study specifically attempted to answer the following questions:

1. Which stimuli presentation order is most effective when providing MTS instruction to an early childhood aged learner with ASD?
2. How will changing the presentation order of stimuli impact how quickly the learner masters receptive identification targets?

This study will expand on the current research comparing the presentation orders of stimuli in receptive identification teaching. The following chapter consists of a review of the current research that has compared the four presentation orders in various groupings. Chapter III presents a proposed methodology for a research study investigating the

effectiveness of two presentation orders when using MTS to teach receptive identification skills and how quickly the learner(s) masters receptive identification targets.

Literature Review

Receptive language, as explained by Pelios & Sucharzewski (2004), is the way in which a person responds based on an auditory stimulus and is an important skill for individuals with autism spectrum disorder (ASD) and early childhood learners. This chapter will review current research that has analyzed the effectiveness of stimulus presentation orders in receptive identification. The stimuli involved in receptive identification training include the sample stimulus (auditory sample) and the comparison stimulus (visual stimuli). Receptive identification can be taught using matching-to-sample (MTS), where an auditory stimulus is the given sample, and a visual array stimulus is the given comparison. The goal is for the learner to establish auditory-visual conditional discrimination skills (Schneider et al., 2018). Some learners with and without disabilities struggle acquiring these skills, therefore researchers have developed receptive identification skills training to support individuals in acquiring these skills (Bergmann et al., 2018).

Method

The researcher searched for articles using the following procedure. The researcher conducted an electronic search through PsycNET using the James Madison University Libraries databases. The researcher used three separate search engines in this research each consisting of different search terms and criteria. The first search engine used contained the term: “receptive identification.” Criteria included: 2011-2021 publication date, academic journal, and preschool age (2-5 years old). This search engine resulted in 13 articles. The second search engine used contained the terms: “Stimulus presentation” and “receptive identification” or “receptive discrimination.” Criteria included: 2011-2021

publication date, academic journal, and preschool age (2-5 years old). This search engine resulted in four articles, two of which overlapped with the first search engine. The third search engine included the terms: “sample first” and “comparison first.” Criteria included: 2011-2021 publication date, academic journal, and preschool age (2-5 years old). This search engine resulted in four articles one of which overlapped with the first search engine. The researcher then read the articles and eliminated the ones that did not compare different orders of stimuli presentation as a procedure used in providing receptive identification training. This brought the first search to three articles, second search to one article, and third search to two articles. In total there were 18 articles to discern from for this review and six were used.

Review

In this review six articles were used to analyze the effectiveness of different stimulus presentation orders when teaching receptive identification skills. Two articles focused on comparing sample first and comparison first stimulus presentations (Petursdottir & Aguilar, 2016; Leon et al., 20202). Two articles focused on comparing sample first, comparison first, and error correction prompting procedures (Gee et al., 2019; Schneider et al., 2018). One article focused on comparing sample first, comparison first, and sample first with repetition (Bergmann et al., 2021). One article focused on comparing sample first, comparison first, sample first with repetition and simultaneous presentation of stimuli (Cubicciotti et al., 2019).

Replicating stimulus-presentation orders in discrimination training

Bergmann et al. (2021) used this study to compare the effectiveness of using sample first presentation and comparison first presentation orders in teaching auditory-

visual conditional discrimination (AVCD) skills to children with autism spectrum disorder (ASD). This study used an adapted alternating treatments design (AATD) in a synchronous multiple probe across comparisons design in experiment 1 and AATD in experiment 2.

Participants. Bergmann et al. (2021) conducted this study in two experiments. Experiment 1 included four participants with ASD who were receiving in-home applied behavior analytic intervention. All four participants' treatment plans included goals of expanding their AVCD range. In experiment 2 only two of the participants that participated in experiment 1 were used in experiment 2. This is because they did not need modifications for conditions in experiment 1. Then three new participants were included. The review had seven participants in total with ASD between ages 2-15 years old.

Method. Experiment 1 began with a multiple stimulus without replacement (MSWO) preference assessment. During the pretest probes, three visual stimuli were presented in a horizontal line in front of the participant without a blocker. Participants had 5 seconds (s) to respond to the auditory sample with no consequences for incorrect or no responses. Every three trials praise and access to preferred items for 20 s was given. Baseline was identical to the pretest probe with a blocker, used for covering stimuli between presentations. The researchers used constant time delay (CTD) to teach AVCD, using a 0 s delay and a 5 s delay. During intervention every evaluation began with at least one 0 s prompt delay for each condition. First the auditory sample or comparison stimulus was presented and then the experimenter provided the model prompt. With correct responses, the experimenter provided praise and access to the preferred item for 20 s. With error responses, the experimenter repeated the auditory sample stimulus and

represented the prompt. After one session of 89% of correct prompted responses or more, a 5 s constant delay was used for all of the sessions. When the participant responded correctly within 5 s, the participant was given praise and access to preferred items for 20 s. Upon an error response, the experimenter repeated the auditory sample stimulus with the comparison in view and modeled the correct response. The intervention comparison continued until mastery criterion was met or the discontinuation criterion was met. There were two conditions used. For the sample first condition, the experimenter finished saying the auditory sample stimulus before lifting the blocker to expose comparison stimuli. For the comparisons first condition, the experimenter exposed the comparisons by lifting the blocker and then said the auditory sample stimulus.

Experiment 2 was conducted as was experiment 1 within two to five days per week in up to nine sessions each day. All participants repeated the pretest probe trials. The researchers consulted caregivers regarding what items should be used during conditions. Experiment 2 included a third condition. The sample first with repetition condition was similar to the sample first condition except it required the experimenter to repeat the auditory sample stimulus at 2 s and 4 s during the 5 s CTD.

Results. In Experiment 1, both sample first and comparisons first were effective for all four participants. According to Bergmann et al. (2021) comparison first may provide an advantage in that the learner can observe the auditory sample stimulus and the visual stimulus together without an echoic. Experiment 2 resulted in all three conditions demonstrating effectiveness. The sample first condition required more trials and time for participants to reach mastery. This study suggests that the repetition in sample first with repetition did not impact the outcomes, however the presentation of the auditory sample

stimulus within the presence of the visual stimulus deemed comparison first more effective.

Stimulus presentation order in receptive identification tasks: a systematic replication

Schneider et al. (2018) examined the studies that already concluded that sample first has advantages over comparison first studies. The study replicated the procedures used in the Petursdottir and Aguilar (2016) study with an additional error correction trial following every incorrect response. The study used an AATD with a two-tier multiple baseline design across stimulus sets for two participants and a replication across stimulus sets for one participant. The last participant did not do a second evaluation.

Participants. Four typically developing male kindergarten and first graders were used to conduct this study. All four participants were enrolled in an after-school program. Two participants were of Caucasian background and the other two were of Hispanic background, all participants spoke English primarily.

Method. Stimuli were presented in a PowerPoint slideshow on a 13-inch monitor, which controlled the order of stimuli presentation. Each session had 16 trials in the slide presentation. The comparison stimuli were types of birds, American state flowers, or national flags. Each trial consisted of an array of four pictures. During baseline and the instructional intervention, 16 trials were included in four blocks of four trials. Each stimulus was presented in one of the four positions at least once and order of trials were randomized alternating between each condition. In the sample first condition, baseline and instructional trials began with the presentation of a blue square at the top of the computer screen. Participants had 5 s to click on the square, if the participant did not press the square the experimenter said, “click on the square.” When the participant

clicked the square, it disappeared and presented the auditory sample stimulus while the screen was black. The comparison array was presented immediately following the auditory sample stimulus. The comparison first condition began the same way except the blue square was presented in the center of the screen. If a participant selected a picture in the comparison first condition before the auditory sample was given, the experiment restarted the trial and said, “wait and listen before you pick.” Correct responses for each condition resulted in 4 s of the positive feedback slide and incorrect answers resulted in 4 s of a blank screen. No consequences were presented during baseline for correct or incorrect responses.

Results. Comparison first resulted in quicker skill acquisition being evident for two out of seven evaluations. Sample first resulted in quicker skill acquisition for four out of seven sample first evaluations. There were no advantages for one of the evaluations, where the orders compared had the same results. Results suggest that there are advantages in using comparison first for students who have difficulty acquiring target discrimination.

Further examination of the effects of order of stimulus presentation on receptive discrimination

Leon et al. (2021) used this study to evaluate the stimulus order’s role during auditory visual discrimination training for individuals with ASD or speech delays. In order to assess the impact of sample first and comparison first conditions on skill acquisition of AVCD this study used an AATD included in a nonconcurrent multiple baseline across participants and or response sets.

Participants. This study included six participants with ASD or a speech delay. Participants were ages two to six year old boys of different ethnicities. Participants' communication abilities varied across one to four word utterances or a communication device.

Method. Materials used in this study included eight laminated picture cards for experimental evaluation. A Velcro board/mat was used when presenting the cards in an array in front of the participants. A multiple-stimulus-without replacement preference assessment was conducted with all participants. Items selected in the preference assessment by participants were used in the experiment. During baseline both conditions were presented as intended (sample first, comparison first) correct responses had the consequences of a brief statement such as “good”. For incorrect responses or no response following a 5 s delay, the experimenter removed the set and went to the next trial. This study used two conditions. In sample first condition the experimenter gave the auditory sample stimulus first and then 1 s later presented the visual comparison (array of four). The experimenter used a most-to-least prompting hierarchy however, participants were given 5 s to respond before the prompt was given. The sample stimulus was not repeated before the participant was given a prompt. Prompted or independent correct responses resulted in praise and the identified reinforcer. If the two sessions used full physical and gestural prompts after the 5 s delay, then differential reinforcement for independent responses was initiated. Incorrect or no responses resulted in error correction procedures where the trial was re-presented but no reinforcer was provided. Comparison first condition followed the same procedures used in sample first, however, if the participant

selected a comparison visual before the auditory sample stimulus was presented, the participant was instructed to wait.

Results. For five out of six participants, the sample first condition produced more efficient learning compared to the comparison first. However, both were deemed effective. All participants engaged in early responses in comparison first before the presentation of the auditory sample.

Effects of stimulus presentation order during auditory visual conditional discrimination training for children with autism spectrum disorder

Cubicciotti et al. (2019) compared the effects of four stimulus presentation orders for auditory-visual conditional discrimination training for children with ASD. This study used an AATD embedded within a nonconcurrent multiple baseline actress participant design for each condition.

Participants. The study included three male participants with ASD. Zeek was an 8-year, 11-month-old male who received ABA services since he was 20-months-old. Max was a 3-year, 11-month-old male who had been receiving ABA services for 10 months. Adam was a 4-year, 3-month-old male who had been receiving ABA services for 15 months.

Methods. The experiment conducted a paired stimulus preference assessment using ten edibles identified in a parent survey. Prior to each session the experimenter conducted a multiple stimulus without replacement assessment using the top five edibles from the paired stimulus preference assessment. The general procedures used during the experiments are as follows: At least one session of each condition was conducted each day for one to five days a week with five minutes between each session. Sessions were

conducted for each condition in a random order without replacement. A delay of 5 s was used in all conditions and constant time delay (0 s, 5 s) was used during the initial training sessions. When the participant produced a 0 s delay prompted correct response the experimenter delivered verbal praise and an edible. When the learner produced a 0 s delay prompted incorrect response the experimenter removed the materials and went to the next trial. The 0 s prompt delays were conducted until 100% correct responses for two consecutive sessions, and then the experimenter moved to 5 s time delays. During 5 s delay, correct responses resulted in praise and an edible. If a response was incorrect the experimenter re-presented the sample stimulus and modeled the correct response. If the participant gave an incorrect response after a model prompt the experimenter went to the next trial. There were four conditions in this experiment. Sample first provided the sample stimulus first and then revealed the comparison (an array of three). Sample first with re-presentation the sample stimulus was provided before revealing the comparison, once the comparison was revealed the sample stimulus was repeated. In comparison first, the comparison was presented then the experimenter waited 3 s before giving the sample stimulus. In simultaneous presentation the experimenter presented the sample stimulus and the comparison at the same time.

Results. The results suggest that the most efficient condition to use when using auditory visual conditional discrimination training for children with ASD is learner-specific across all three children. The simultaneous procedure was most efficient for Adam, comparison first was most efficient for Zeek and sample first and sample first with representation was most efficient for Max. The results suggest that teachers should

identify and include a student-specific stimulus presentation format rather than one condition across all individuals.

Effects of error-contingent prompts depend on temporal arrangement of stimuli in symbolic matching to sample

Gee et al. (2019) used this study to examine the effects of error-contingent prompts in match to sample (MTS) when using sample first and comparison first presentation order. The study was conducted in two experiments using an experimental design of a brief alternating treatment design.

Participants. The study includes three typically developing male participants ages four to six years old in experiment 1 and three typically developing five year old female participants in experiment 2. Two of the participants were described by their parents as white and non-Hispanic. One participant was described by his parents as Hispanic.

Methods. Each session in Experiment 1 included 32 instructional trials of presentation of an auditory sample stimulus and all four visual stimuli. Trials were random and given within blocks of four trials, one for each sample. At the end of each session the participants were given a prize to take home. In the sample first trial and error condition, a blue square was presented at the top of the screen. The participants had 5 s to press the blue square, if they did not press the square within 5 s the instructor said “click on the square.” When the participant clicked on the square the presentation of the auditory sample was given while the screen remained blank. The comparison sample was presented immediately following the presentation of the auditory sample. A 4 s presentation of an animation was given as a consequence for correct responses and a 4 s

black screen was given following incorrect responses or no responses within 10 s. The comparison first trial and error condition were the same except the blue square was presented at the bottom of the screen and the comparison was presented before the auditory sample. The error correction trials were the same except the error correction prompt was given following the 4 s of the black screen.

Experiment 2 was identical to Experiment 1 except the presentation of the error correction prompt was presented immediately with the presentation of the stimulus presentation.

Results. Comparison first with prompts was more effective than comparison first without prompts in Experiment 1. Sample first without prompts was more effective than sample first with prompts for Experiment 1. Comparison first was most effective for all participants in Experiment 1. Sample first with prompts was more effective than sample first without prompts in Experiment 2. Comparison first without prompts was more effective than comparison first with prompts in Experiment 2. Sample first with prompts was most effective for one participant and comparison first with prompts was most effective for one participant in Experiment 2. Comparison first with prompts was most effective across both experiments.

Order of stimulus presentation influences children's acquisition in receptive identification tasks.

Petursdottir et al. (2016) used this study to compare acquisition in receptive identification skills in two conditions, sample first and comparison first presentation order. This was done to evaluate the conflicting recommendations in current research of which order of stimulus presentation is most effective. The study used an adapted

alternating treatments design combined with a multiple baseline design across stimulus conditions.

Participants. The participants used in this study included three typically developing male kindergarten students. All participants attended an aftercare program in an urban city public elementary school. Two participants were of European and American background, the other participant was of Middle Eastern and Hispanic background.

Methods. Stimuli were presented on a computer screen. In the sample first baseline condition, the sample first, and differential reinforcement trials started with a blue square presented at the top of the computer screen. Participants were instructed or reminded to click on the square if they did not click on the square within 5 s. Once the square was pressed the computer presented the auditory sample stimulus and immediately after presented the comparison, an array of four, on the screen. In the comparison first condition the baseline, comparison first, and differential reinforcement trials started with a blue square presented at the bottom of the computer screen. Participants were instructed and/-or reminded to click on the square if they did not click on the square within 5 s. Once the square was pressed, the computer presented the comparison, an array of 4, after presenting the comparison the auditory sample was presented. In the differential reinforcement trials, correct responses within 4 s produced a computer animation, incorrect answers, or no answers within 10 s produced a black screen for 4 s. During baseline there were no consequences provided.

Results. All participants reached mastery faster in the sample first condition when compared to the comparison first condition. Petursdottir and colleagues concluded that

the presentation order of stimuli during receptive identification training may affect acquisition. The researcher also concluded that the selection of presentation orders should be learner specific.

Discussion of Research Revieweed

The purpose of this review was to evaluate the effectiveness of different stimuli presentation orders during receptive identification training. The researcher asked the questions: a) what is the effect of stimuli presentation order in receptive identification training, b) what stimuli presentation order is most effective when providing receptive identification instruction to early childhood aged children, and c) how does each condition impact various learners?

In answering a and b, this review concluded all conditions are effective in teaching receptive identification skills to early childhood aged students. However, five articles suggest that sample first condition resulted in faster skill acquisition development for most participants. The Cubicciotti et al. (2019) study concluded that the presentation order effect is learner-specific and suggested that teachers take this into consideration when working with students with ASD.

In answering c, this review analyzed studies with various types of learners. Petursdottir et al,. (2016), Gee et al. (2019), and Schneider et al. (2018) included typically developing participants. These articles concluded that mastery was faster in the sample first condition for the participants. The Bergmann et al. (2021) study included participants with ASD. This study demonstrated the effectiveness of both sample first and comparison first for all participants. Results suggested that the learner benefits from observing the comparison stimuli before or while hearing the auditory sample. The Leon

et al. (2020) article analyzed participants with ASD or a speech delay. This study demonstrated that sample first presentation order produced more efficient learning for five out of six participants and comparison first produced incorrect responses before the auditory sample presentation for all participants. The Cubicciotti et al. (2019) article analyzed participants with ASD. The results in this study suggest that the most efficient condition to use when using auditory visual conditional discrimination training for children with ASD is learner specific.

Future Research

Future research should compare the effectiveness of sample first and comparison first presentation orders when using MTS to teach receptive identification skills to early childhood learners with ASD. Future research should also examine how changing the presentation order of stimuli may impact how quickly learners' master's receptive identification targets.

Method

This chapter discusses the method and design used to compare the effectiveness of stimulus presentation orders when using MTS procedures with early childhood learners with ASD. The experimenter gives an overview of the learners and procedures used in this experiment. The experimenter then includes a description of the data sheets, data collection procedures, and data analysis procedures.

Learners

The learners in this study included two early childhood aged children with autism spectrum disorder (ASD). Lily was a four-year 10-month-old female and identified as non-verbal. Lily received home-based Applied Behavior Analysis (ABA) services for two-years and attended preschool. Robert was a five-year one-month old male and identified as non-verbal. Robert received home-based ABA services for seven months. Both learners use a pictorial communication system (PECS) to communicate. Lily is on phase three of PECS using a sentence strip with ten icons on each page in her binder. Robert is on phase one of PECS selecting an icon from a page of seven icons in his binder. Lily makes vocalizations but no recognizable words. Robert emits single words and scripts.

Settings and Materials

All sessions were conducted in the home of the learner at a designated learning space. Learning spaces included an identified hard surface for working (e.g., table, desk). For Lily this was a desk and chair in the living room with mother, grandma, sister, occasionally uncle, and the experimenter all present. For Robert this was the kitchen floor with the experimenter present and mother, brother, and occasionally dad in the kitchen or

the connecting living room. Session materials included data sheets, preferred stimuli to use as reinforcers, video recording device, 4.5x4.5 in. picture cards, and a three panel Velcro board for quick removal and presentation of the comparisons. The Velcro board and all comparison items were on a white background and laminated.

Research Design and Dependent Variables

The experimenter used an adapted alternating treatment design (AATD) to compare skill acquisition of receptive identification when using sample first and comparison first presentation orders (Cooper et al., 2020). The experimenter flipped a coin prior to each phase to determine which condition would be tested first (i.e., heads for comparison first and tails for sample first). The experimenter tested one condition each session alternating each day. During each session data were recorded by the experimenter and consisted of unprompted correct, unprompted incorrect, prompted correct, and prompted incorrect responses. Unprompted correct responses were responses emitted by the learner that were correct. Unprompted incorrect responses included the following: the learner touched the incorrect stimulus, the learner touched more than one stimulus, or no response was given. Prompted correct responses were responses emitted by the learner that were correct and given after the model prompt. Prompted incorrect responses included the following: the learner touched the incorrect stimulus after the model prompt, the learner touched more than one stimulus after the model prompt, or no response was given. During the comparison first teaching, responses given before the presentation of the auditory sample were considered an early response. Data were then recorded on the response after the presentation of the auditory sample.

Procedures

Preference assessment

The experimenter conducted an initial preference assessment to identify each learner's top preferences to use throughout the sessions as reinforcers. The experimenter conducted a multiple stimulus without replacement with Lily and a free operant preference assessment with Robert. Items used in the assessment were based on those used by the experimenter throughout regular ABA sessions. The experimenter used the top two or three preferences identified in the assessment to conduct a paired preference assessment prior each session to identify shifts in preferences.

Preferences used throughout sessions for Lily were marshmallows, cookies, or fruit. Robert received verbal praise and squeezes during trials and access to "Robert's choice" (tablet or spray bottle) at the end of the trials.

Pretest

The experimenter conducted pretest trials to determine the target stimuli that were used for the rest of the study. The experimenter discussed potential targets with the learner's family and the licensed behavior analysts (LBA). A list of ten targets was made based on the learner's current educational goals and learning objectives (five targets for each condition). Each target was tested 2 times. Data were recorded using the data sheet seen in Appendix A. If the learner gave an unprompted correct response the experimenter provided verbal praise, then presented the next trial. If the learner gave an unprompted incorrect response the experimenter removed the materials and presented the next trial.

The experimenter selected pictures of common items that the learners were exposed to daily or weekly. See Appendices H and I for images of the learners' targets. The experimenter assigned four targets to use in each condition based on targets the

learner engaged in less than one unprompted correct response in the pretest trials. If pretest trials resulted in more than four targets with less than one unprompted correct responses, the experimenter selected the targets that were most common and relevant for the learners. The targets selected for each condition are shown in Table 1 and Table 2.

Sample First Condition. The experimenter presented the trial initiation (target was a colored square). The experimenter presented the auditory sample, “touch the red square” and immediately held up the red square following the presentation of the sample. Once the learner engaged in the trial initiation the experimenter began the session. Following the data sheet, the experimenter prepared each array before conducting each trial. The experimenter presented the auditory sample, “touch the [target].” The experimenter immediately presented the comparison stimuli by flipping the Velcro board following the auditory sample presentation. The learner was given 5 s to engage in a response. The experimenter then recorded the learner's response and provided the appropriate consequence. If the learner engaged in more than one unprompted correct response for a pretest target, it was removed from pretest trials.

Comparison First Condition. The experimenter presented the trial initiation. The experimenter held up the blue square and presented the auditory sample “touch the square " 1 s following the presentation of the square. Once the learner engaged in the trial initiation task, the experimenter began the session. Following the data sheet, the experimenter prepared each array before conducting each trial. The experimenter presented the comparison stimuli by flipping the Velcro board. The experimenter presented the auditory sample, “touch the [target]” 1 s following the comparison presentation. The learner was given 5 s to engage in a response. The experimenter then

recorded the learner's response and provided the appropriate consequence. If the learner engaged in more than one unprompted correct response for a pretest target, it was removed from pretest trials.

Table 1
Lily's Targets

Target	Sample First	Comparison First
1	Toothbrush	Cup
2	Fries	Banana
3	Shoes	Desk
4	Spinner	Popper

Table 2
Robert's Targets

Target	Sample First	Comparison First
1	Puffs	Binky
2	Truck	Popper
3	Baby Food	Xylophone
4	Drum	Milk

Pre-teaching

Before conducting the pre-teaching trials, the experimenter conducted a paired stimulus preference assessment with Lily prior to each session using the learners' top preferences identified in the initial assessment. This was done to identify shifts in preferences. Robert received verbal praise and squeezes during trials and access to "Robert's choice" (tablet or spray bottle) at the end of the trials. A 0 s prompt delay was used in each pre-teaching trial and the experimenter used a model prompt. For Robert the model prompt was given by the experimenter touching the correct picture icon with the palm of her hand. For Lily the model prompt was given by Lily's mother touching the correct picture icon with her pointer finger. Each learner needed to demonstrate 80% prompted correct responding for two consecutive sessions to terminate the pre-teaching condition. Data were recorded using Appendix B. Neither Robert nor Lily was able to

meet the mastery criteria for the pre-teaching conditions. The experimenter did not conduct baseline and intervention conditions.

Sample First Condition. The experimenter presented the trial initiation task. The experimenter presented the auditory sample, “touch the red square” and immediately held up the red square following the presentation of the sample. Once the learner engaged in the trial initiation task the experimenter began the session. Following the data sheet, the experimenter prepared each array before conducting each trial. The experimenter presented the auditory sample, “touch the [target].” The experimenter immediately presented the comparison stimuli by flipping the Velcro board following the auditory sample presentation. The experimenter immediately provided the model prompt, and the learner was given 5 s to engage in a response. The experimenter then recorded the learner's response and provided the appropriate consequence. Prompted correct responses resulted in the experimenter giving verbal praise and reinforcement. Prompted incorrect responses resulted in the experimenter removing the materials and presenting the next trial.

Comparison First Condition. The experimenter presented the trial initiation. The experimenter held up the blue square and presented the auditory sample “touch the square " 1 s following the presentation of the square. Once the learner engaged in the trial initiation task the experimenter began the session. Following the data sheet, the experimenter prepared each array before conducting each trial. The experimenter presented the comparison stimuli by flipping the Velcro board. The experimenter presented the auditory sample, “touch the [target]” 1 s following the comparison presentation. The experimenter immediately provided the model prompt, and the learner

was given 5 s to engage in a response. The experimenter then recorded the learner's response and provided the appropriate consequence. Prompted correct responses resulted in the experimenter giving verbal praise and reinforcement. Prompted incorrect responses resulted in the experimenter removing the materials and presenting the next trial.

Pre-teaching with Error Correction. The experimenter added an error correction phase for Lily to focus on imitating the model prompt by only selecting one picture from an array of two pictures. In the presence of a prompted correct response during the pre-teaching trials the experimenter gave Lily verbal praise and reinforcement. In the presence of a prompted incorrect response during the pre-teaching trials the experimenter removed the materials and represented either the auditory sample or the comparison (depending on the specified condition) with a full physical prompt given by Lily's mother. A 0 s prompt delay was used in each pre-teaching with error correction trial. Lily needed to demonstrate 80% prompted correct responding for two consecutive sessions to terminate the pre-teaching with error correction condition.

Interobserver Agreement and Procedural Fidelity

Training

The experimenter recruited a colleague to participate as an observer. The observer was trained following steps from Cooper et. al. (2020). First the observer read the procedures and data collection sheets with the experimenter. The experimenter then practiced recording data with the colleague using practice videos. Once there was 100% agreement across two procedural fidelity and two interobserver practice trials the experimental trials began. Data were recorded using the data sheet seen in Appendix B.

Interobserver Agreement

Interobserver agreement (IOA) was calculated when an independent observer watched the video recording of the teaching sessions. The independent observer and experimenter analyzed the learner's responses for 100% of session (e.g., unprompted correct, prompted correct, unprompted incorrect, and prompted incorrect responses) Agreement was calculated by dividing the total number of skills performed correctly by the total number of opportunities to perform the skill and multiplying the results by 100. Agreement was 98% ((104/106) x 100). Data were recorded using the data sheet seen in Appendix B.

Procedural Fidelity

A second observer observed 75% of sessions that were conducted in pretest and pre-teaching through video recordings to ensure that the experimenter completed the procedures correctly. Data were recorded for pretest and pre-teaching using procedural task lists seen in Appendices D and E. The observer marked each step in the task list as +, -, or NA. A + was marked when the task was correctly implemented. A - was marked when the task was not correctly implemented, and NA was marked when the task was not applicable. Procedural fidelity was calculated by dividing the total number of skills performed correctly by the total number of opportunities to perform the skill and multiplying the results by 100. Procedural fidelity resulted in 100% of skills performed correctly the sessions observed in pretesting and pre-teaching conditions.

Data Analysis

The experimenter used the results collected throughout the experiment to create the visual graphs. Figure 1 and Figure 3 represents the percentage of correct responses across the sample first and comparison first condition for each learner in a line graph.

Figure 2 and Figure 4 represent the total number of responses compared to the total number of correct responses in a bar graph. The data collected in this study were analyzed using visual analysis.

The experimenter evaluated the trend, variability, level, and immediate effect of all phases of the experiment by doing the following. The stability of the level shows if the data is stabilized or instable across teaching sessions. The stability criterion was 80% of the data had to be within 25% of the median. The experimenter calculated the stability envelope by taking the median and then multiplying it by 0.25. Next the experimenter added that number to the median and subtract that number from the median. The two numbers represent the stability envelope. If 80% of the data are in the stability envelope the data are stable.

Results

The experimenter aimed to answer the research questions through four conditions: pretest, pre-teaching, baseline, and intervention. Due to neither Robert nor Lily meeting the mastery criteria for the pre-teaching conditions, only pretest and pre-teaching conditions were completed. The results are summarized below.

Pretest

The experimenter pre-tested 10 targets for both learners with five of the targets assigned to both sample first condition and comparison first condition. Targets were assigned to each condition to avoid similar targets with similar letter sounds being assigned together (i.e., Popper and Puffs). Targets included pictures of common items the learners were familiar with and exposed to daily or weekly (see Appendix' H and I). Each target was tested twice in the pretest phase. Responses were recorded as unprompted incorrect (i.e., selecting the wrong target, selecting both targets, or not selecting a target) or unprompted correct (selecting only the correct target). After pretesting, four of the targets that resulted in less than two unprompted correct responses were selected and assigned to each condition for further use in this study (see Table 1 and Table 2). The experimenter selected targets that were most common and relevant to the learner.

Robert engaged in zero unprompted correct responses for both conditions. During the sample first condition Lily engaged in one unprompted correct response and nine unprompted incorrect responses. During the comparison first condition, Lily engaged in zero unprompted correct response.

Pre-teaching

The experimenter used a 0 sec time delay with a model prompt during each trial in the pre-teaching phase. The experimenter for Robert or Lily's mother for Lily gave the model prompt by touching the correct picture with their hand immediately following the presentation of the auditory sample ("touch the [target]") and the comparison array. The experimenter tested one condition each day. During the sample first condition Robert engaged in one prompted correct responses during both sessions. During the comparison first condition Robert engaged in one prompted correct response during two sessions and four prompted correct responses during one session. During the sample first and comparison first conditions Lily engaged in zero prompted correct responses during both sessions.

Pre-teaching with error correction. The experimenter added a pre-teaching with error correction phase to build the necessary skills Lily needed to continue the research. During the pre-teaching phase Lily selected both stimuli when the model prompt was given. The experimenter added the pre-teaching phase with error correction to help learn to select only one item in a picture array. The error correction procedure consisted of the experimenter using a 0 sec time delay with the model prompt used in the pre-teaching phase during each trial. If Lily engaged in a prompted incorrect response the experimenter represented the stimuli and Lily's mother immediately provided a full physical prompt. The full physical prompt consisted of Lily's mother lifting Lily's right hand to touch the correct image. During the sample first condition, Lily engaged in zero prompted correct responses in the first session with each target being tested three times. During the next sample first condition in the second session, Lily engaged in eight prompted correct responses. During the last sample first session Lily engaged in one

prompted correct response. During the condition first comparison first session, Lily engaged in two prompted correct responses. During the last comparison first session Lily engaged in five prompted correct responses.

Baseline and Intervention

The learners did not reach mastery criteria of 80% of prompted correct responses in the pre-teaching phase. Therefore. they were unable to proceed to the baseline and intervention conditions, Below the experimenter will discuss what the current results suggest.

Figure 1

Lily's Total Number of Correct Responses

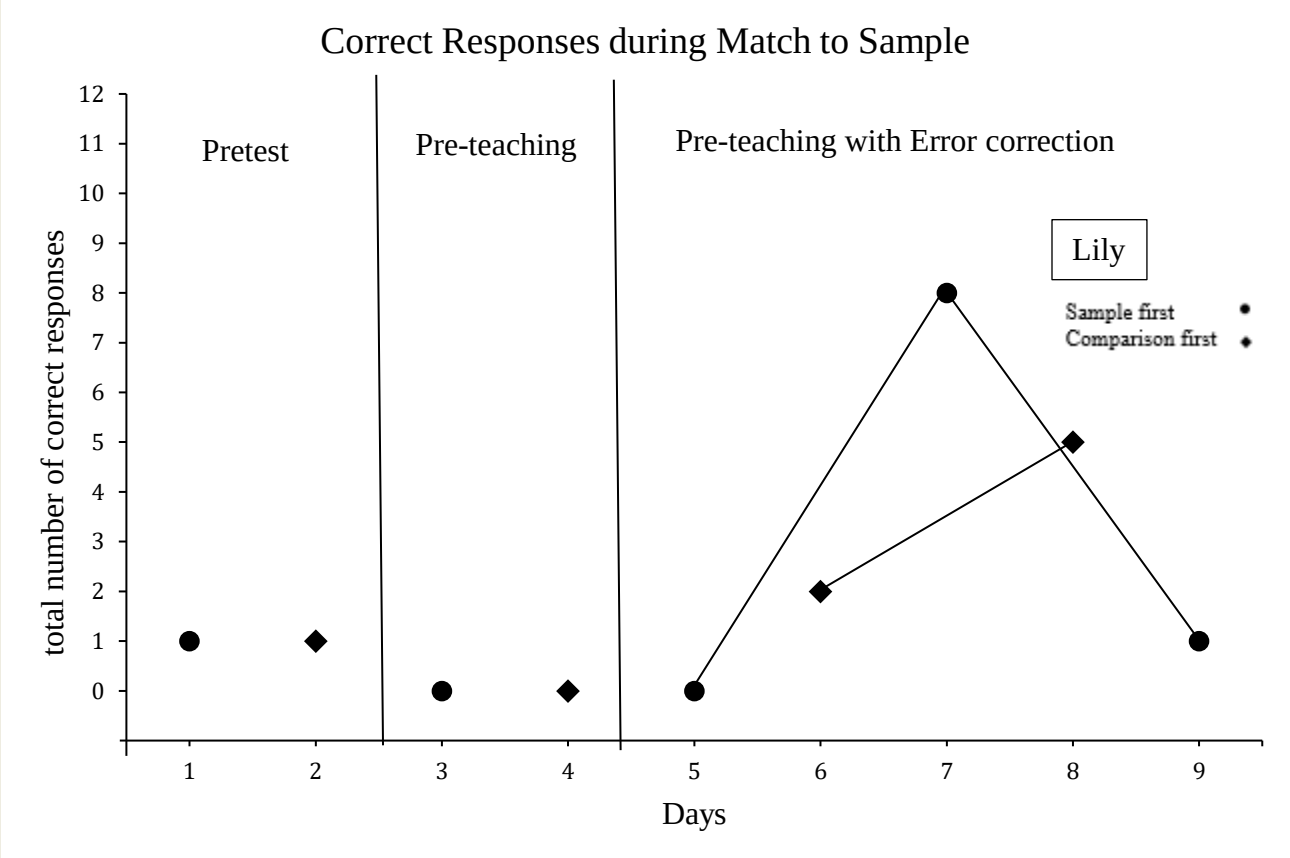
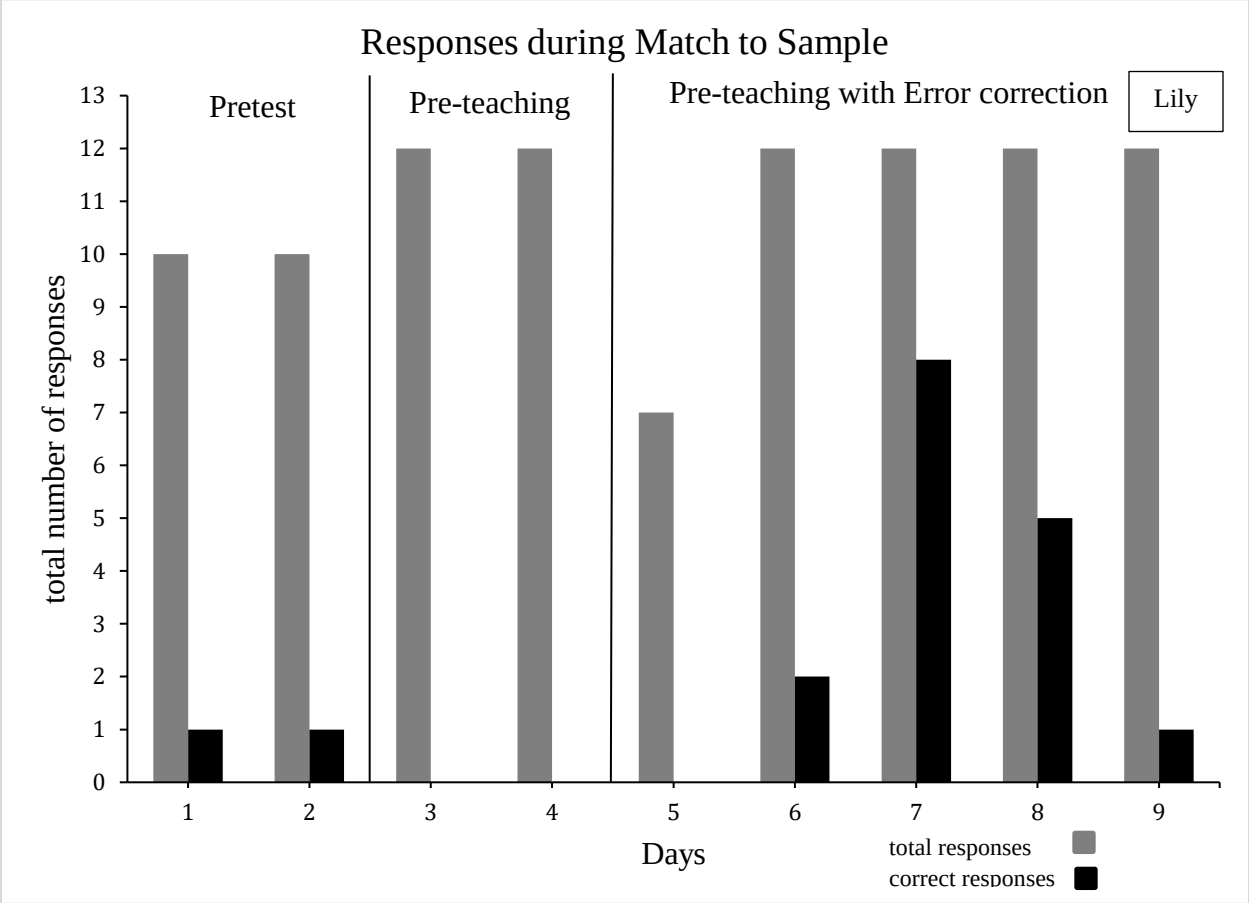


Figure 2

Lily's Total Number of Responses



The results suggest that Lily's data is not stable for either condition. Lily had 40% of her sample first data and 50% of her comparison first data within the stability envelope. Absolute level change suggest that comparison first may be improving skill acquisition at a faster rate. There is not enough data to determine trend.

Figure 3

Robert's Total Number of Correct Responses

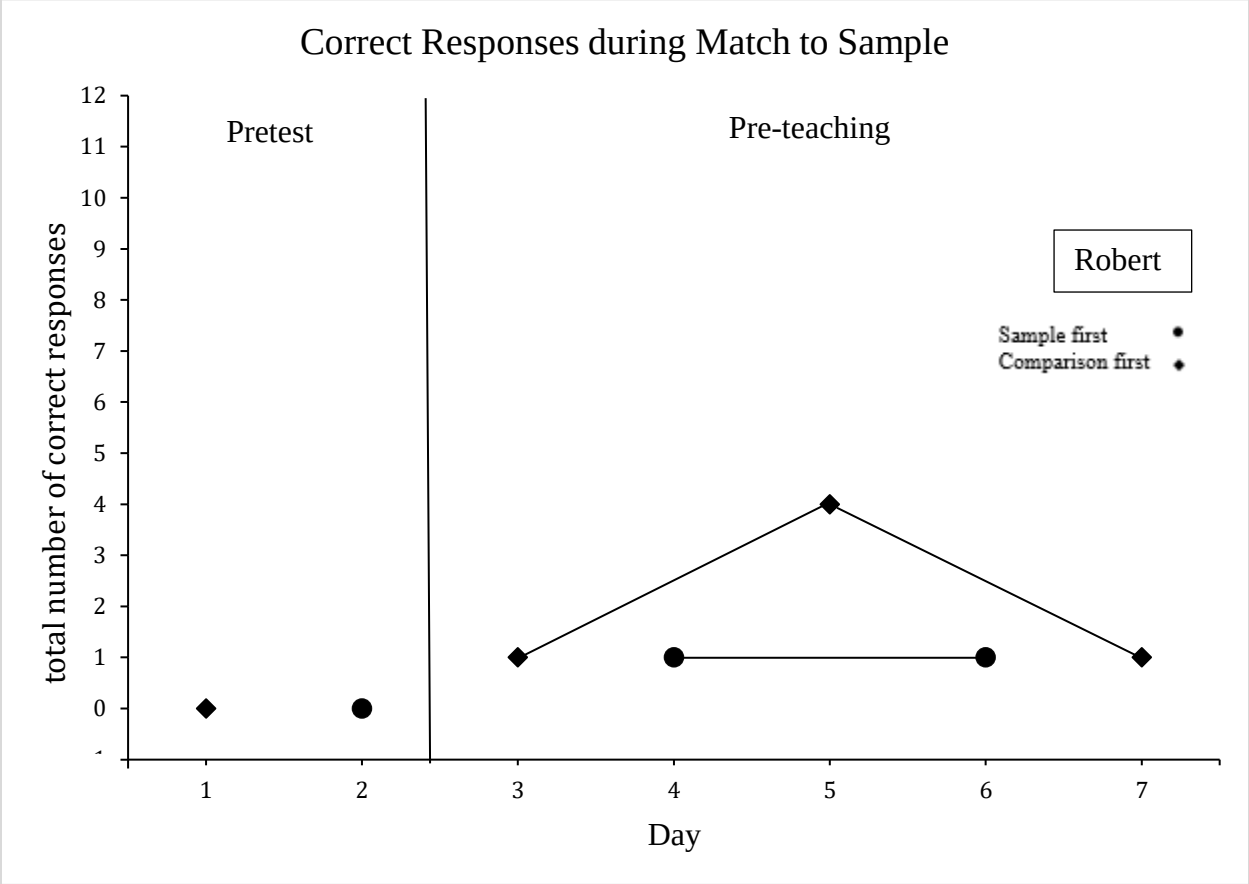
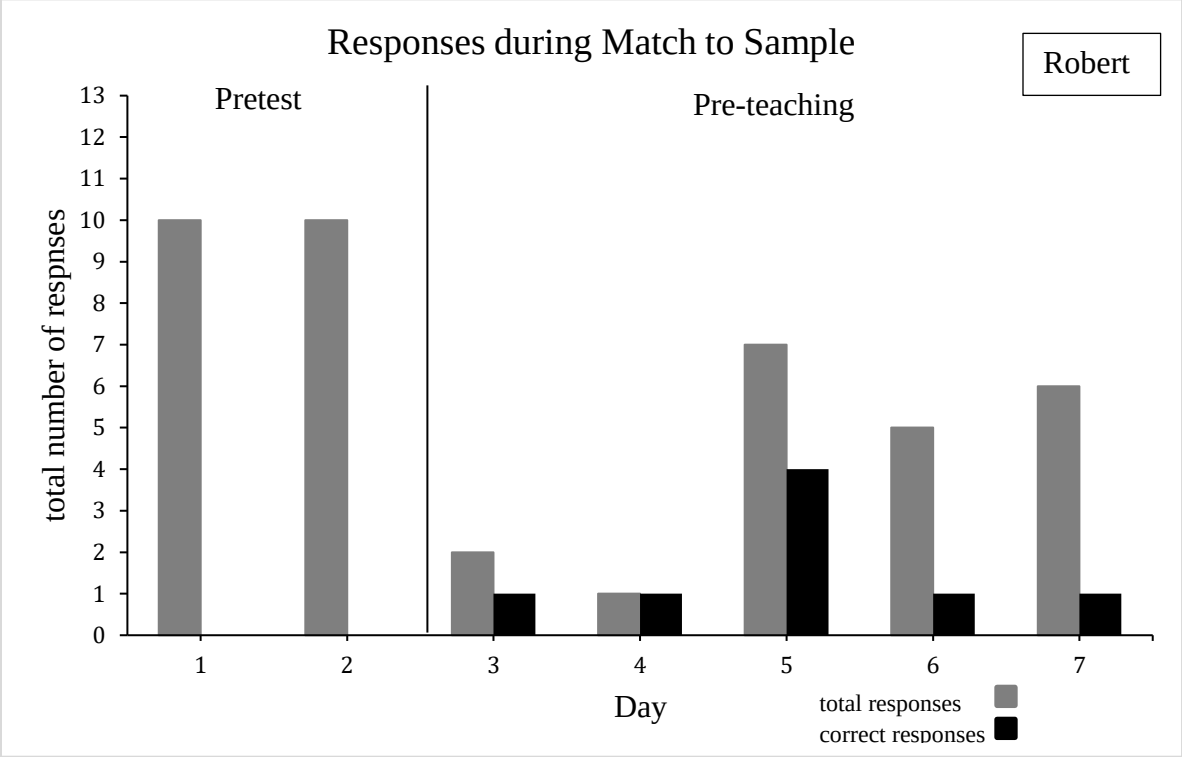


Figure 4

Robert's Total Number of Responses



The results suggest that Robert's data is stable at near zero for the sample first condition. Robert had 100% of his sample first data and 75% of his comparison first data within the stability envelope. There is not enough data to determine level or trend.

Discussion

The purpose of this study was to compare the effectiveness of two stimulus presentation orders (sample first and comparison first) when using match to sample (MTS) to teach receptive identification skills to early childhood learners with ASD. This study attempted to answer two questions; A: which stimuli presentation order is most effective when providing MTS instruction to an early childhood aged learner with ASD and B: how will changing the presentation order of stimuli impact how quickly the learner masters receptive identification targets?

The study included two early childhood aged learners, one female and one male, both with ASD and non-verbal. In order to answer the proposed questions this experimenter first tested the learners' current skill level in the pretest phase by conducting trials with a series of targets determined by the experimenter and LBA. The experimenter then narrowed the targets down to four targets assigned to each condition that would be used throughout the following phases. Once the learner reached mastery criteria of 80% prompted correct responses for two consecutive sessions in pre-teaching the experimenter was to begin the baseline phase until data was stabilized. Neither Robert nor Lily was able to meet the mastery criteria for the pre-teaching conditions. Therefore, baseline and intervention conditions were not conducted. Last, the experimenter was to implement the intervention phase. This phase was designed to compare the conditions when using MTS and time delay procedures with a model prompt to teach receptive identification skills.

Limitations

This study produced four limitations. The first limitation is that the experimenter was not able to complete the study as planned. Neither Robert nor Lily was able to meet the mastery criteria for the pre-teaching conditions. The experimenter did not conduct the baseline or intervention conditions and did not come to conclusions for the research questions.

The next two limitations were the learners' ability to select one target in an array of two and ability to successfully imitate a model prompt. During the pretest and the pre-teaching phase both learners selected both targets when presented with both the auditory sample and comparison array; followed by a model prompt.

The last limitation was the number of learners used in this study. The experimenter was limited to working with two learners, whose results may not reflect the performance of the larger population.

Contributions to Current Research

The experimenter aimed to contribute to research by comparing the effectiveness of sample first and comparison first presentation orders when teaching receptive identification skills to early childhood learners. Learners in this study did not meet mastery criteria in the pre-teaching condition and the experimenter did not conduct the baseline and intervention conditions. The experimenter was unable to answer the research questions with limited results.

Recommendations for Future Research

One way to continue future research would be to use targets that the learners are not exposed to weekly. The experimenter cannot account for skill acquisition acquired outside of session because of extraneous variables when using common items. When

using targets that the learner is infrequently exposed to, the results become more accurate for determining which condition is most effective for the learner. This would increase the accuracy of the results and limit potential bias in responses.

Another way to continue future research would be to expand the number of targets in each trial to decrease the probability of false correct responses. For example, this study used an array of two for each trial, therefore learners have a 50% chance of giving the correct response. If there were three targets the learners would have a 33% chance and 25% chance if there were four targets. A larger array size would decrease the likelihood that the learner will engage in false correct selection and allow for an increase in valid results.

Lastly, future researchers should assess the learners' current imitative repertoires prior to conducting the study. Neither participant could imitate the model prompt, which resulted in both participants selecting two stimuli instead of one. In this study the experimenter proposed to answer questions that the learners did not have the current skill set to participate in.

Recommendations for Practice

This study attempted to determine which stimulus presentation order when was most effective for each individual learner. Current research implies that the stimulus presentation order that an instructor should use should be learner specific (Cubicciotti et al. 2019 and Petursdottir et al. 2016). Therefore, the experimenter cannot recommend sample first or comparison first for outside practice. However, it can be recommended to take into consideration the effect that the different conditions may have on individual learners when teaching receptive identification skills through MTS procedures.

Conclusion

In conclusion, the experimenter attempted to answer two research questions A: which stimuli presentation order is most effective when providing MTS instruction to an early childhood aged learner with ASD and B: how will changing the presentation order of stimuli impact how quickly the learner masters receptive identification targets? The experimenter tested targets of common picture icons for both learners in pretesting and pre-teaching phase. The experimenter did not test the targets in baseline and intervention.

Appendix A

Pretest data sheet

Session ____

Date ____

Coin flip ____

Time duration _____

Targets

Sample first	Comparison first

Unprompted correct = UC
Unprompted incorrect = UI

***number of target presented in each set may change to meet learners needs**

Sample first

Trial	Target	Response
1		
2		
3		
4		
5		
6		

Comparison first

Trial	Target	Response
1		
2		
3		
4		
5		
6		

7		
8		
9		
10		

7		
8		
9		
10		

Appendix B

Data sheet

Session _____

Date _____

Coin flip _____

Time duration _____

Targets

Sample first	Comparison first

Circle response types

Unprompted correct = UC
Unprompted incorrect = UI
Prompted correct = PC
Prompted incorrect = PI

Sample first	**Comparison first**

Trial	Target	Response
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		

Trial	Target	Response
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		

Appendix C

Interobserver agreement data sheet

Session _____

Date _____

Time duration _____

Targets

Sample first	Comparison first

Circle response types

Unprompted correct = UC
Unprompted incorrect = UI
Prompted correct = PC
Prompted incorrect = PI

Sample first

Trial	Target	Response
1		
2		
3		
4		
5		

Comparison first

Trial	Target	Response
1		
2		
3		
4		
5		

6		
7		
8		
9		
10		
11		
12		

6		
7		
8		
9		
10		
11		
12		

Appendix D

Procedural Fidelity: Pretest

Date: _____

Session: _____

Task	Circle one
The experimenter flipped a coin to determine which condition to start session with	**+ - NA**
The experimenter conducted a paired stimulus preference assessment	**+ - NA**
The experimenter presented the trial initiation trial for both conditions	**+ - NA**

Condition: _____

Mark: +, -, or **NA**

Trial	Task			
	Experimenter presented items in the correct order	Experimenter allowed 5 s time delay for the learner to respond	If the learner engaged in a prompted correct response the experimenter gave verbal praise and reinforcement	If the learner engaged in a prompted incorrect response the experimenter removed the materials and presented the next trial.
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				

9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				

Condition: _____

Mark: +, -, or **NA**

Trial	Task			
	Experimenter presented items in the correct order	Experimenter allowed 5 s time delay for the learner to respond	If the learner engaged in a prompted correct response the experimenter gave verbal praise and reinforcement	If the learner engaged in a prompted incorrect response the experimenter removed the materials and presented the next trial.
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

11.				
12.				
13.				
14.				
15.				
16.				

Appendix E

Procedural Fidelity: Pre-teaching

Date: _____

Session: _____

Task	Circle one
The experimenter flipped a coin to determine which condition to start session with	**+ - NA**
The experimenter conducted a paired stimulus preference assessment	**+ - NA**
Each target was presented 3 times during session	**+ - NA**
The experimenter presented the trial initiation trial for both conditions	**+ - NA**

Condition: _____

Mark: +, -, or **NA**

Trial	Task				
	Experimenter presented items in the correct order	Experimenter provided the prompt immediately following the SD	Experimenter allowed 5 s for the learner to respond	If the learner engaged in a prompted correct response the experimenter gave verbal praise and reinforcement	If the learner engaged in a prompted incorrect response the experimenter removed the materials and presented the next trial.
1.					
2.					
3.					
4.					
5.					
6.					
7.					

8.					
9.					
10.					
11.					
12.					

Condition: _____

Mark: +, -, or **NA**

Trial	Task				
	Experimenter presented items in the correct order	Experimenter provided the prompt immediately following the SD	Experimenter allowed 5 s for the learner to respond	If the learner engaged in a prompted correct response the experimenter gave verbal praise and reinforcement	If the learner engaged in a prompted incorrect response the experimenter removed the materials and presented the next trial
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					

11.					
12.					

Appendix F

Procedural Fidelity: Baseline

Date: _____

Session: _____

Task	Circle one
The experimenter flipped a coin to determine which condition to start session with	**+ - NA**
Verbal praise was given for collateral behaviors (e.g., sitting, looking, quiet hands) approximately every other trial to maintain learners engagement.	**+ - NA**
Each target was presented 3 times during the session	**+ - NA**
The experimenter presented the trial initiation trial for both conditions	**+ - NA**

Condition: _____

Mark: +, -, or **NA**

Trial	Task			
	Experimenter presented items in the correct order	Experimenter allowed 5 s for the learner to respond	The experimenter provided a brief verbal statement (e.g., "okay").	The experimenter removed the materials and presented the next trial.
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				

10.				
11.				
12.				

Condition: _____

Mark: **+**, **-**, or **NA**

Trial	Task			
	Experimenter presented items in the correct order	Experimenter allowed 5 s for the learner to respond	The experimenter provided a brief verbal statement (e.g., “okay”).	The experimenter removed the materials and presented the next trial.
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				

Appendix G

Procedural Fidelity: Intervention

Date: _____

Session: _____

Task	Circle one
The experimenter flipped a coin to determine which condition to start session with	**+ - NA**
The experimenter conducted a paired stimulus preference assessment	**+ - NA**
Each target was presented 3 times during the session	**+ - NA**
The experimenter presented the trial initiation trial for both conditions	**+ - NA**

Condition: _____

Mark: **+**, **-**, or **NA**

Trial	Task						
	Experimenter presented	Experimenter allowed 5 s	If the learner engaged in	If the learner	Experimenter allowed 5 s	If the learner engaged in a	If the learner

	items in the correct order	for the learner to respond	an unprompted correct response the experimenter delivered reinforcement and verbal praise	engaged in an unprompted incorrect response the experimenter re-presented the stimuli in the presentation order and provided the prompt	for the learner to respond	prompted correct response the experimenter delivered reinforcement and verbal praise	engaged in a prompted incorrect response the experimenter presented the next trial.
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
9.							
10.							
11.							
12.							

Condition: _____

Mark: +, -, or **NA**

Trial	Task						
	Experimenter presented items in the correct order	Experimenter allowed 5 s for the learner to respond	If the learner engaged in an unprompted correct	If the learner engaged in an unprompted	Experimenter allowed 5 s for the learner to respond	If the learner engaged in a prompted correct response the	If the learner engaged in a prompted incorrect

			response the experimenter delivered reinforcement and verbal praise	incorrect response the experimenter re-presented the stimuli in the presentation order and provided the prompt		experimenter delivered reinforcement and verbal praise	response the experimenter presented the next trial.
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
9.							
10.							
11.							
12.							

Appendix H

Lily's Pretest Targets

Appendix I

Robert's Pretest Targets

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