A Comparison of Methods to Teach Visual-Visual Discriminations and Auditory-Visual Discriminations to Children with Autism

by

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A Thesis submitted to the Faculty of Graduate Studies of

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Abstract

The Assessment of Basic Learning Abilities (ABLA) test is an assessment that assesses 6 basic discriminations. Two of the 6 discriminations (referred to as Levels) were investigated in this study. ABLA Level 4 is a quasi-identity match-to-sample discrimination, and ABLA Level 6 is an auditory-visual discrimination. Study 1 investigated the effectiveness of two methods to teach visual-visual identity discriminations to two children with autism. Study 2 investigated a method to teach a visual quasi-identity match-to-sample task to one child with autism, and study 3 investigated a method to teach auditory-visual discriminations to two children with autism. Once children mastered the training tasks they were then tested to see if their skills generalized to ABLA Level 4 (for Study 1 and Study 2) and ABLA Level 6 (for Study 3). Results of Study 1 indicated that one child was able to learn the matching task in 125 trials, and the other child was not able to learn the matching task. Generalization to ABLA Level 4 did not occur. In Study 2, the child learned the quasi-identity matching task and generalization to ABLA Level 4 did occur. In Study 3, both children learned at least one auditory-visual discrimination task, and generalization to ABLA Level 6 occurred for one child.

A Comparison of Methods to Teach Visual-Visual Discriminations and Auditory-Visual Discriminations to Children with Autism

An intensive early intervention program based on applied behaviour analysis (ABA) is recognized by the Surgeon General of the United States as the treatment of choice for children with autism (Department of Health, 1999). Such a program typically consists of approximately 35 hours of ABA intervention per week for a period of at least two years. The focus is on teaching the children a variety of skills including language, play, and social skills. Research has found that approximately 40% of children receiving ABA will be indistinguishable from their peers once they enter the school system (Conner, 1998; Rogers, 1998; Schreibman, 1997). The children who do not become indistinguishable from their peers may experience limited treatment gains, particularly in the area of language, and may also have a diagnosis of mental retardation (MR). Improved assessment tools are required when selecting a training curricula for these latter children (Howlin, 1998; Schreibman, 2000). The Assessment of Basic Learning Abilities (ABLA) test (Martin, Yu, & Vause 2004) is an assessment tool that has been extremely beneficial and useful when selecting training tasks for individuals with MR. Can the ABLA test aid in the development of the curricula in an intensive ABA training program for children with autism? This research is one of several experiments needed to answer that question.

ABA Treatment for Children with Autism

Lovaas and his colleagues were among several researchers who began investigating the effectiveness of ABA with children with autism approximately 30 to 40 years ago (Lovaas, 1966; Martin, 1975; Martin, England, Kaprowy, Kilgour, & Pilek, 1968; Martin & Pear, 1970; Wolf, Risley, & Mees, 1964), and research in this area continues today. Approximately 20 years ago Lovaas and his colleagues demonstrated that ABA was an effective treatment of choice for

young children with autism (Lovaas, 1981, 1987; McEachin, Smith & Lovaas, 1993). More specifically, after two to three years of intensive training, approximately half of the children were able to enter regular classrooms with no assistance. Further, all of the children were able to acquire and maintain various skills. As a result of research done in this area government agencies in most provinces of Canada have provided funding for ABA programs for children with autism. Despite concerns regarding the experimental design of the Lovaas study (Foxx, 1993; Gresham & MacMillan, 1997; Kazdin, 1993) partial replications (Birnbrauer & Leitch, 1993; Eikeseth, Smith, Jahr, & Eldevik, 2002; Fenske, Zalenski, Krantz, & McClannahan, 1985; Harris & Handleman, 2000; Weiss, 1999) and studies demonstrating the effectiveness of ABA principles applied to target behaviours (Connor, 1998; Ghezzi, Williams, & Carr, 1999; Rogers, 1998), have proven that intensive behavioural intervention is the treatment of choice for children with autism. However, there are children who progress more slowly than others. Preliminary evidence on the ABLA test suggests that it may be a useful assessment and training tool for these children.

Assessment of Basic Learning Abilities (ABLA) test

The ABLA test, developed by Kerr, Meyerson, and Flora (1977) is an assessment that examines the ease or difficulty with which an individual can learn six different types of discriminations, referred to as levels. DeWiele and Martin (1996) provided evidence that each level was a prerequisite for teaching many vocational, academic, and daily tasks to individuals with developmental disabilities (see Table 1 for a summary of each ABLA level).

Prior to the commencement of the assessment of a level the individual is given a demonstration of the correct response, a guided trial, and an opportunity to respond independently. The assessment of that level begins when the individual is able to respond correctly independently. Correct responses are reinforced and incorrect responses are followed

Table 1

A Description of the ABLA Levels and the Types of Discriminations Required

ABLA Level	Type of Discriminations
ABLA Level 1, Imitation A tester puts an object into a container and asks the client to do likewise	A simple imitation
ABLA Level 2, Position Discrimination When a red box and a yellow can are presented in a fixed position, a client is required to consistently place a piece of green foam in the container on the left when the tester says, "Put it in."	A simultaneous visual discrimination with position, colour, shape, and size as relevant cues
ABLA Level 3, Visual Discrimination When a red box and a yellow can are randomly presented in left-right positions, a client is required to consistently place a piece of green foam in the yellow can when the tester says, "Put it in".	A simultaneous visual discrimination with colour, shape, and size as relevant cues
ABLA Level 4, Match-to-Sample Discrimination A client demonstrates level 4 if, when allowed to view a yellow can and a red box in randomly alternating left-right positions, and is presented randomly with a yellow cylinder and a red cube, he/she consistently places a yellow cylinder in the yellow can and red cube in the red box.	A conditional visual-visual identity discrimination with colour, shape, and size as relevant cues
ABLA Level 5, Auditory Discrimination When presented with a yellow can and a red box (in fixed positions), a client is required to consistently place a piece of foam in the appropriate container when the tester randomly says, "red box" (in a high pitched rapid fashion) or "yellow can" in a low pitched drawn-out fashion).	A conditional auditory-visual quasi-identity discrimination, with pitch, pronunciation, and duration as relevant auditory cues, and position, colour, shape, and size as relevant visual cues
ABLA Level 6, Auditory-visual Discrimination The same as Level 5, except that the right-left position of the containers is randomly alternated	A conditional auditory-visual quasi-identity discrimination, with the same auditory cues as Level 5, and with only colour, shape, and size as relevant cues

Note. From "Overview of Research on the Assessment of Basic Learning Abilities Test," by Martin, G. L., & Yu, D. C. T, 2000, Journal on Developmental Disabilities, 7, 14-15. Reprinted with permission.

by an error correction procedure consisting of a demonstration, a guided trial, and an opportunity for an independent response. An individual is said to have passed a level if eight consecutive correct responses are made (excluding correct responses as part of an error correction procedure). An individual is said to have failed a level if eight cumulative errors are made, including errors made during the independent response portion of the error correction procedure.

Past Research on the ABLA Test with Persons with Developmental Disabilities

Research has demonstrated that the ABLA levels are hierarchically ordered by level of difficulty with persons with developmental disabilities (Kerr et al., 1977; Martin, Yu, Quinn, & Paterson, 1983), hearing-impaired persons with multiple handicaps (Wacker, 1981), and typically- developing children (Casey & Kerr, 1977). In addition, research has shown that: (a) it is difficult to teach failed ABLA levels using standard prompting and reinforcement (Conyers, Martin, Yu, & Vause, 2000; Meyerson, 1977; Stubbings & Martin, 1995, 1998; Wacker, Kerr, & Carroll, 1983; Wacker, Steil, & Greenbaum, 1983; Witt & Wacker, 1981; Yu & Martin, 1986); (b) performance on the ABLA is a good predicter of whether a client will pass or fail similar tasks in his/her daily environment (Stubbings & Martin, 1995, 1998; Tharinger, Schallert, & Kerr, 1977; Wacker, Kerr et al.; Wacker, Steil et al.); and (c) the ABLA test is a useful assessment for selecting the types of tasks (and their level of difficulty) that the individual can accomplish in his/her daily lives (Martin et al. 2004).

Research has found (e.g., Kerr et al., 1977) that the auditory-visual discrimination levels of the ABLA test (Levels 5 and 6) are correlated with IQ. For instance 73% of individuals with moderate MR are able to learn Levels 5 and 6, whereby only 35% with severe MR, and no persons with profound MR are able to learn Levels 5 and 6 (Kerr et al; Martin & Yu, 2000; Richards, Williams, & Follette, 2002; Stubbings & Martin, 1995, 1998; Yu, Martin & Williams,

1989). Thus, given these findings the ABLA test can be useful for: (a) teachers and front line staff when they select tasks for individuals with MR; and (b) researchers who will be able to determine their client's ability prior to their participation in various research projects.

Teaching Failed ABLA Levels to Individuals with Developmental Disabilities

Yu and Martin (1986) assessed which of two methods was most effective in teaching a visual discrimination (ABLA Level 3) to 5 individuals with developmental disabilities. In the *Control Training Procedure* there were three components: (a) extra-stimulus prompt fading (a pointing prompt); (b) an indirect response-to-reinforcer relationship (following a correct response the reinforcer was delivered by the experimenter); and (c) an error correction procedure which consisted of a demonstration, a guided trial and an independent response. In the *Experimental Training Procedure*, there were also three components: (a) within-stimulus prompt fading (changing the height of the S-); (b) a discovery-reinforcer contingency following correct responses; and (c) response preclusion following errors (blocking errors followed by a demonstration, a guided trial, and an independent response). Only 2 individuals learned the training task with the control procedure, and 3 individuals learned the training task with the experimental procedure. The researchers also examined whether participants would readily learn a novel Level 3 task after learning the training task. Only the individuals who learned the training task with the experimental procedure demonstrated rapid learning of a new task.

In a similar study by Conyers et al. (2000) 4 adults with developmental disabilities were taught an auditory-visual discrimination (ABLA Level 6). A modified version of the two procedures used by Yu and Martin (1986) were compared. Results indicated that none of the individuals learned the task using the *Control Procedure* and all the individuals learned the task

in under 85 trials using the *Experimental Procedure*. Further, only 2 of the participants were able to readily learn a novel ABLA Level 6 task after learning the training task.

Is the ABLA test Relevant for Children with Autism?

When assessing the ABLA test for children with autism, we need to keep in mind the following consistent findings that have been demonstrated for each of the ABLA levels with persons with developmental disabilities. First, the levels of the ABLA are hierarchically ordered in degree of difficulty. Two studies have assessed whether this finding also occurs with children with autism. Ward and Yu (2000) assessed a group of 20 children with autism spectrum disorder (ASD). These included 7 children with a diagnosis of autism, 3 with a diagnosis of PDD-NOS, and 10 with a diagnosis of developmental delay with autistic-like features. All 20 children conformed to the hierarchical sequence of the ABLA test listed previously. Morris (2002) assessed a sample of 46 children with ASD, 38 of whom had a diagnosis of autism with MR and 8 of whom had a diagnosis of PDD-NOS with MR. All but four participants confirmed the ABLA hierarchy. A second finding was that for persons with developmental disabilities each level has consistent test-retest reliability over approximately 3 months. According to Morris this was confirmed and is consistent across children with autism. Third, for persons with developmental disabilities each ABLA level has good predictive validity for other discriminations at that level. Condillac (2002) assessed the predictive validity of the ABLA test for children with autism. Forty-six children with ASD were administered the ABLA test. An attempt was then made to teach each of the children six everyday predictive tasks, one task at each ABLA Level. Overall, 78% of the predictions were confirmed. Across the six everyday tasks, predictions were confirmed for 72% of the participants for the task at Level 1, 57% of the participants for the task at Level 2, 80% of the participants for the task at Level 3, 85% of the

participants for the task at Level 4, 87% of the participants for the task at Level 5, and 87% of the participants for the task at Level 6. However, this study was limited by having only one predictive task for each ABLA level. Moreover, the Level 1 predictive task, making a stirring motion in an empty cup with a spoon, may have been inconsistent with everyday experiences of the participants (e.g., stirring with a spoon only when there is something to stir), especially given that lack of imaginary play is one of the difficulties in children with autism spectrum disorders (American Psychiatric Association, 2000). Also, the Level 2 task, putting a cup in the upper right quadrant of placement above or beside a plate, appears to be a four-choice discrimination rather than a two-choice discrimination. Given these limitations, additional research is needed to assess the predictive validity of the ABLA test for children with autism.

Finally, for individuals with developmental disabilities, failed ABLA levels are extremely difficult to teach using standard prompting and reinforcement procedures (SPR) (Meyerson, 1977; Stubbings & Martin, 1998; Wacker, Kerr et al., 1983; Wacker, Steil, et al., 1983; Witt & Wacker, 1981; Yu & Martin, 1986). No one has yet assessed if failed ABLA levels are difficult to teach using SPR procedures to children with autism.

A Review of Prompting Methods to Teach Discriminations Skills to Individuals with Developmental Disabilities.

Demchak (1990) reviewed research on four different types of prompt fading procedures used to teach discrimination to adults and children with various disabilities (e.g, autism, mental retardation, learning disabled, pervasive developmental disorder). One method known as extra-stimulus prompt fading is commonly used to teach discrimination skills. There are several different extra-stimulus prompt fading procedures described in the literature. The first is referred to as "least to most prompting", "system of least prompts" or "least intrusive prompts". In this

prompting strategy the teacher gradually increases assistance given to the student on each trial until a correct response occurs. The second procedure is called "most to least prompting." In this procedure the teacher delivers the most intrusive hand-over-hand assistance first and gradually reduces the amount of assistance across trials. The third procedure is known as "graduated guidance". The amount of assistance is adjusted within a trial as needed and subsequent trials typically begin with less guidance than the preceding trial. Lastly, time delay (also referred as prompt delay or delayed cue) procedures are also used (Demchak). Wolery et. al., (1992) reviewed 36 studies that used time delay methods with individuals with various developmental disabilities (e.g., Mental Retardation, Autism, Downs Syndrome). There are two types of time delay procedures described in the literature: a progressive time delay and a constant time delay. A progressive time delay consists of gradually increasing the time between the S^D and the prompt until the learner responds correctly to the S^D before the prompt. The constant time delay consists of delivering a prompt following an S^D after a set amount of time and the time between the delivery of the S^D and the delivery of the prompt remains constant throughout training (Wolery et al.). Researchers comparing the two different time delay methods have found that: (a) both are equally effective (Demchak; Wolery et. al.); (b) these time delay methods are most effective when individuals can wait and are able to imitate (Demchak; Wolery et. al.); (c) they are more effective than some prompting procedures (e.g., system of least prompts, most-to-least prompt systems) (Demchak; Wolery et. al.); and (d) constant time delay is more effective than stimulus fading procedures (Wolery et al.).

Teaching Visual-Visual Matching Discriminations to Individuals with Developmental Disabilities and Autism

A part of this research focused on strategies to teach visual-visual matching discriminations to children with autism who had failed ABLA Level 4. Only two studies thus far, that have attempted to teach visual-visual matching discriminations to children with autism, have reported on the ABLA Level of the participants. In this section, I will review those two studies, and I will also describe other studies that have attempted to teach visual-visual matching discriminations to individuals with developmental disabilities and autism but that did not report on the ABLA level of the participants.

In order to have the most success on teaching matching tasks, it has been suggested that participants must be able to; (a) discriminate among stimuli; (b) scan objects; and (c) select a correct comparison or reject the incorrect comparison (Kelly, Green, & Sidman, 1998). In addition, some researchers suggest that: (a) teaching three stimuli at once prevents perseverative responding (Remington, Light, and Porter, 1981); (b) individuals with verbal comprehension (Remington et al.) or trained vocalization (Smeets & Striefel, 1974) are more successful on match-to-sample training; and c) success rate is controlled by the positive and negative feedback given to the client (Smeets & Striefel).

Recent studies have attempted to teach simple visual matching tasks using different methods. In a study by Perez-Gonzalez and Williams (2002), 2 children with autism and MR were taught a two choice matching task. The stimuli were presented over six steps, including first maintaining the comparisons in a fixed position and teaching one sample at a time, then randomly rotating the position of the comparisons and presentation of the sample. The children learned in 650 and 190 trials respectively. The authors concluded that this procedure was

effective in producing rapid learning. However Martin and Yu (2000) have suggested that rapid learning might be defined as learning that occurs in fewer than 100 trials.

Cummings and Williams (2000) used a simple training procedure to teach 5 children with autism or pervasive developmental disorder in ABA programs three types of matching tasks (3D-3D; 2D-2D; 3D-2D). Two of the children had passed up to and including ABLA Level 4, and 3 of the children had passed up to and including ABLA Level 2. Correct responses were followed by praise and every 4 to 6 correct responses were followed by an edible or an enjoyable activity. For incorrect responses the trainer said "No" and modeled the correct response. For all matching tasks three comparisons were placed on the table, however, the authors failed to mention how many matching targets were taught at one time. The authors concluded that all of the children, regardless of their ABLA level, learned to pass 3D to 3D identity matching. A limitation of this study is that the authors did not report whether the children were retested on the ABLA to see whether the children who were at Level 2 were now at Level 4. Without these results we are unable to relate the ABLA level of a participant to the learning of generalized matching ability. The present research (Study 1) addressed this question. Similarities between the Cummings and Williams study and part of the current research are: (a) the populations, preschool children with autism in an ABA program, and (b) children at various ABLA levels.

Stimulus overselectivity occurs when an individual pays more attention to one component of a stimulus (e.g., shape, size, or colour) than to the stimulus as a whole (Schneider & Salzberg, 1982). Research has indicated that stimulus overselectivity can occur when training match-to-sample tasks to children with autism, which results in the individual's inability to discriminate all the dimensions of a stimulus (Schneider & Salzberg). It has further been found that when attempting to train different dimensions of match-to-sample tasks (e.g., colour and

shape), the individual is more successful when they are first taught to match their non-predisposed dimension followed by the predisposed dimension (Bond, Black, & Raskin, 1973). For instance, if an individual can discriminate colours very well but does not discriminate by size, colour would be their predisposed dimension and size would be their non-predisposed dimension. According to Bond et al., teaching this individual to discriminate items by size first would be more effective than teaching them to discriminate items by colour first.

Researchers have also investigated whether a direct alteration to the stimuli to be discriminated (known as a within-stimulus prompt fading) or an extra component added to the stimuli, such as pointing (known as an extra-stimulus prompt fading) would aid an individual to learn a target skill. Schreibman (1975) examined this question. Six children with autism were taught two visual discriminations. The extra-stimulus prompt fading consisted of gradually fading a pointing prompt to the correct item for the visual discrimination and the within-stimulus prompt fading consisted of gradually fading in the picture of the S-. Once the children learned a task with one method of prompting, they were then taught the task again with the other method of prompting. The researcher found that: (a) increasing the number of unprompted trials did not facilitate learning; (b) within-stimulus prompt fading was effective whereas extra-stimulus prompt fading was not effective and; (c) the children who learned the task first with within-stimulus prompt fading, and were taught the task again using extra-stimulus prompt fading, usually lost the skill. The researcher concluded that within-stimulus prompt fading is successful because it limits the stimuli that the child needs to respond to.

A second study examined the effectiveness of within-stimulus prompt fading (fading the size of the S-) in combination with two other components; error preclusion and a discovery reinforcement contingency (Hazen, Szendrei, & Martin, 1989). Error preclusion prevented the

incorrect container from being lifted. The discovery reinforcer contingency allowed the individual to have immediate access to the reinforcer once the correct response was chosen. Using a non-concurrent multiple baseline across individuals, 2 individuals with developmental disabilities and one child with autism were taught a three dimensional identity match-to-sample task. All 3 individuals learned the task in under 90 trials, and 2 out of the 3 were able to generalize their matching skill to ABLA Level 4. The one individual who was not able to generalize was diagnosed with autism.

In an attempt to teach visual-visual matching skills to one child with autism, Kelly et al. (1998) used a computer program and a delayed prompting technique. Appearing on the computer screen were two comparisons. The child was required to match (using a computer key) the correct sample to the correct comparison. The incorrect comparison would disappear after 0.1 s and this delayed cue was then gradually increased to 15 s. The child was able to learn the two-choice matching task. However, generalization to a larger number of comparisons was problematic. The authors concluded that the generalization may not have occurred as a result of the participant being taught to reject the incorrect stimulus versus accept the correct stimulus because the child was not taught to scan a large number of comparisons. Other researchers (Beasley & Hegarty, 1970) used a computer program to determine whether teaching one, two, and three-choice match-to-sample tasks is more effective when the choices are rotated throughout one sitting, or whether it is more effective to teach one, two, and three choice tasks one at a time. Results indicated that there was no difference between methods after one session. The researchers concluded that more sessions need to be conducted in order to evaluate the effectiveness of using a computer as a means to teach a match-to-sample task.

Teaching and Assessing Generalized Match-to-Sample Ability

The results are unclear as to whether individuals, after learning one task, can generalize their match-to-sample ability to untrained stimuli. For instance, Hazen et al. (1989) found that two individuals were able to generalize their match-to-sample ability to another task while one person was not able to do so. Others (e.g., Kelly et al., 1998) found that individuals who learned matching with computerized items were able to transfer their skill to different computerized items, (e.g., black and white photographs and coloured photographs). However, when the pictures were placed on the table instead of a computer screen, there was a lack of generalized match-to-sample ability. Perez-Gonzalez, and Williams (2002) assessed whether one child in their study was able to learn a novel two-choice matching task after learning a similar 2-choice matching task. They found that the child was able to learn the second task in fewer trials than the first training task.

Generalized match-to-sample ability to a larger number of comparisons (increasing the stimulus field) did not occur when children with autism were taught a 2-choice match-to- sample task. Kelly et al. (1998) stated that the reason for the lack of generalized match-to-sample ability from a 2-choice task to a 3-choice task may be a result of the individual rejecting the incorrect stimulus instead of accepting the correct stimulus. Thus, when more comparisons are presented there is more than one incorrect stimulus, which may cause a problem for the individual. Furthermore, Kelly et al. concluded that individuals may not be able to scan a larger number of comparisons. Therefore, in order to increase the likelihood of generalized match-to-sample ability across a larger comparison field, one may need to teach individuals how to scan.

In order to increase the likelihood of generalized match-to-sample ability, Dube and McIlvane (1992) offered the following suggestions. First, conditional discriminations must be

taught. In other words the same comparisons must serve as the S- on some trials and the S+ on other trials. Secondly, in order to avoid the probability that the individual will respond by exclusion, the stimuli of the training tasks should both be novel and remain the same until mastery. In other words both stimuli must be mastered before a novel stimulus can be introduced.

Teaching Auditory-Visual Discriminations to Individuals with Developmental Disabilities and Autism.

A second part of this research focused on teaching auditory-visual discriminations to children with autism who failed ABLA Level 6. To date few studies have investigated teaching auditory-visual discriminations to children with autism. Research with individuals with various developmental disabilities (e.g., MR, autism) that used the procedures investigated in the present research will be reviewed.

One study previously mentioned (Shreibman, 1975) examined the effectiveness of within-stimulus prompts versus extra-stimulus prompt in teaching visual discriminations. The author also examined the same questions while teaching auditory-visual discriminations. The authors examined the use of the extra-stimulus prompt and the within-stimulus prompt while teaching auditory-visual discriminations to three children with autism. The extra-stimulus prompt consisted of a buzzer and the within-stimulus prompt consisted of emphasizing the important components of the sound. Results with the auditory learners were the same as those with the visual learners; within-stimulus prompts were more effective.

Another study previously mentioned (Perez-Gonzalez & Williams, 2002) examined the effectiveness of a blocking procedure (see page 19 for description of the blocking procedure) in

teaching an auditory-visual discrimination task (match spoken words to objects) to 3 individuals with autism. All individuals were successful in learning the task in 260, 140, and 220 trials.

One study investigated using a prompt delay procedure in conjunction with various schedules of reinforcement to teach auditory-visual letter discriminations under 3 different conditions : (a) continuous reinforcement for correct responses made both before and after the prompt, (b) continuous reinforcement for correct responses made before the prompt, and those made after the prompt were on an FR3 schedule, and (c) continuous reinforcement for correct responses made after the prompt, and those made before the prompt were on an FR3 schedule. Results indicated that all the individuals learned the auditory-visual letter discriminations in fewer than 100 trials regardless of the reinforcement schedule (Touchette and Howard, 1984). The researchers concluded that it was the prompt delay that was the effective component of the procedure, not the reinforcement schedules.

Another study that investigated a prompt delay procedure to teach auditory-visual discriminations to an individual with autism (Glat, Gould, Stoddard, & Sidman, 1994) found that introducing an echoic response (i.e., having the individual repeat the S^D) prior to the participant making a selection response was more effective than the prompt delay alone.

Other researchers have investigated whether delivering specific consequences upon specific responses would increase acquisition (e.g., Estevez, Fuentes, Overmier & Gonzalez, 2003). This procedure, known as a differential-outcomes procedure (also known as differential-outcomes effect), suggests that a discrimination task can be more readily learned when the consequence to the response made to one stimulus is different than the consequence following a response made to the other stimulus in the discrimination. This procedure has been proven to be effective with animals (e.g., Miyashita, Nakajima, & Imada, 2000; Poling, Temple, & Foster,

1996) and humans, including: (a) typically developing children (Maki, Overmier, Delos, & Gutman, 1995; Estevez & Fuentes, 2003), (b) individuals with developmental disabilities (Estevez, Fuentes, Overmier et. al., 2003) and (c) individuals with Prader-Willi Syndrome (Joseph, Overmier, Thompson, 1997).

Statement of the Problem

Two studies were conducted to investigate procedures to teach visual match-to-sample tasks, and one study was conducted to investigate a procedure for teaching auditory-visual discriminations. Study 1 compared two multiple-component procedures for teaching visual-visual identity match-to-sample tasks to children with autism. Study 2 examined a multiple-component procedure for teaching a visual quasi-identity match-to-sample task to a child with autism. Study 3 examined a multiple-component procedure for teaching auditory-visual discriminations to two children with autism

STUDY 1: TEACHING IDENTITY MATCHING TASKS

In this study two procedures were compared to teach visual-visual identity match-to-sample tasks to children with autism who had failed ABLA Level 4. Following the training, the children were retested on ABLA Level 4. Researchers have found that many procedures have been effective in teaching this type of discrimination such as: (a) prompt delay (Kelly et al., 1998; Touchette & Howard, 1984), (b) a blocking procedure (Perez-Gonzalez & Williams, 2002), (c) within-stimulus prompt fading (Shreibman, 1975), and (d) multiple-component procedures consisting of discovery reinforcers, within-stimulus prompt fading, and response preclusion (Conyers et al., 2000; Hazen et al., 1989; Yu & Martin, 1986). Most of the procedures mentioned above were included in one of the two training procedures in this study. The two procedures will be referred to as Multiple-Component Training Package 1 (MCTP1) and Multiple-Component Training Package 2 (MCTP2)

Method

Participants and Setting

The participants were 2 preschool children with autism. None of the children were receiving sedatives or psychotropic medications. The children were diagnosed by an external agency. Logan was 6-years old at the commencement of the study and was recruited from the St. Amant Applied Behaviour Analysis Program for Children with Autism (ABACA). He was involved in an intensive ABA program consisting of 35 hours per week of therapy. Logan had been participating in the ABACA program for 2 years. When assessed for this study he was able to pass ABLA Levels 1 and 2 and failed Levels 3 to 6. According to his ABA consultant Logan had difficulty learning identity match-to-sample tasks, and although he had acquired the ability to match some items he continued to fail ABLA Level 4. Logan was a nonverbal and nonvocal

child, was able to follow only a few instructions (i.e., come here, sit down), and was able to imitate only a few gross motor actions (i.e., clap, wave). Logan's mother had his hearing and vision checked and the test results indicated that he had normal vision and hearing. Logan's ABA sessions took place in his bedroom. Sessions for this study took place in the same location.

Dylan was a 3-year old child at the commencement of the study and was diagnosed with autism spectrum disorder. He was recruited from Children's Special Services in Winnipeg, Manitoba. His parents reported that Dylan's hearing was assessed and the results indicated that his hearing was normal. His vision had never been tested. Dylan never participated in an ABA program and did not demonstrate appropriate forms of communication (e.g., sign language, picture communication, pointing, vocalizing), did not look when his name was called, was unable to perform simple gross motor imitation actions (e.g., clap, wave), and was unable to follow simple instructions (e.g., come here, sit down, stand up). Initially, Dylan frequently cried when highly preferred items were withheld or taken away from him. Given that Dylan had never been exposed to discrimination training, learning the two different response topographies (i.e., putting a sample in a box versus lifting an item) needed to occur prior to teaching the match-to-sample tasks. Attempts had never been made to teach Dylan match-to-sample tasks. Dylan attended a daycare all day; therefore sessions took place in a small room within the daycare. Dylan was able to pass ABLA Levels 1 to 3 and unable to pass ABLA Level 4 and 6.

During the sessions, the children were seated at a child-size table, the experimenter was seated in front of the child and the observer was seated in the same room in a location where she could see both the experimenter and the child.

Apparatus

Training materials. The training materials were objects not used in the ABA training program. The training tasks for Logan were pompoms, paintbrushes, stars, batteries, measuring spoons, fishing floats, rolled up socks, and white glue bottles. The training materials for Dylan were, pompoms, paintbrushes, stars, and batteries. The items were 4 different sizes ranging from very small to large. Figure 1 shows a typical match-to-sample task.

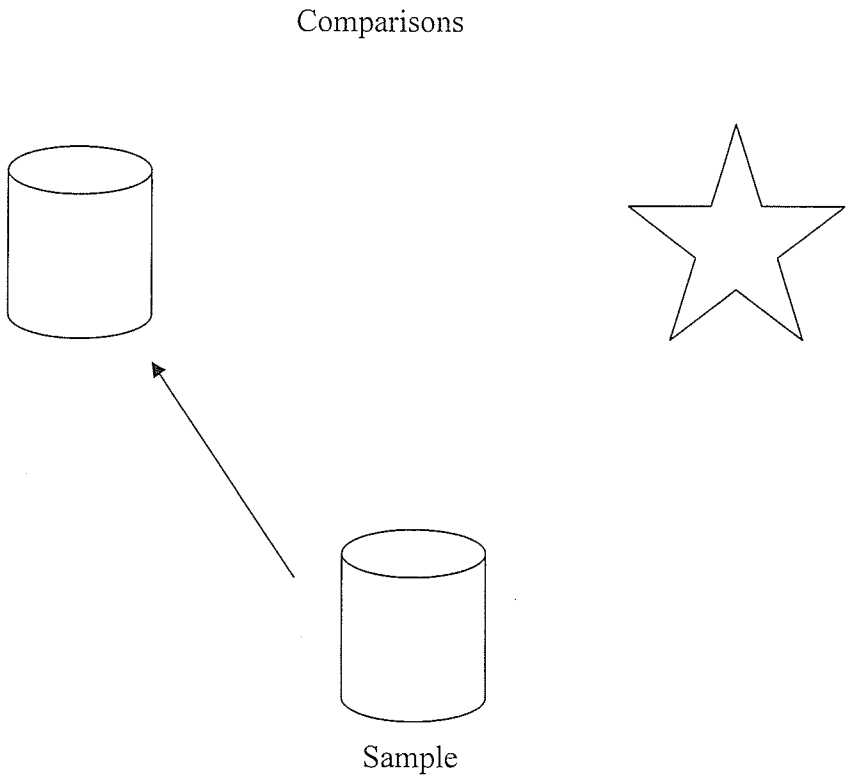
ABLA levels 1, 2, 3, and 6. A yellow can, red box with black diagonal stripes, and a piece of irregularly shaped white foam were used to administer the ABLA Levels 1, 2, 3, and 6.

ABLA level 4. The same can and box used to assess Levels 1, 2, 3, and 6 were used along with a small red cube with black diagonal stripes and small yellow cylinder. The ABLA data sheets are found in Appendix A, and the Procedural Integrity/Reliability data sheets are found in Appendix B.

Research Design

An alternating-treatments design was used to compare the two procedures. Logan and Dylan were taught two matching tasks simultaneously. One task was taught using MCTP1 and the other using MCTP2, both are described later in detail. In order for the children to discriminate between procedures the comparisons for the MCTP1 were placed on a blue board (for Logan) and blue boxes (for Dylan), and the comparisons for the MCTP2 were placed on a red board (for Logan) and red boxes (for Dylan). Once a child learned one of the tasks he was tested on ABLA Level 4. Logan started with MCTP2 and received 20 teaching trials in this condition (in one session), then 20 teaching trials in MCTP1 (in another session), and the treatments alternated in subsequent sessions. Dylan received his training in reverse order (20

A. A typical Match to sample task



B. Example of fading steps for the incorrect comparison.

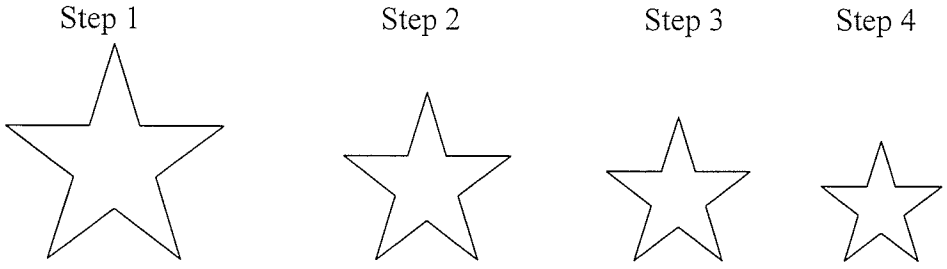


Figure 1. A typical match-to-sample task, and an example of fading steps for incorrect comparisons (S -)

trials of MCTP1, then 20 trials of MCTP2), with the treatments alternating in subsequent sessions. One procedure was taught per session. Sessions were interspersed by a minimum of a 30 minute break.

Phases of the Study

Pre-assessments. Prior to training, the children were assessed on the ABLA Levels 1 through 6, both failed ABLA Levels 4 and 6. After this the children were tested to see whether they could pass the first set of training tasks (the first set consisted of two two-choice tasks, one task taught in each condition). The children were also tested on a three-choice task using objects that were not used in training. The same testing procedure and pass/fail criteria were used as in the ABLA test. Both children failed the training tasks and the three-choice tasks. A sample of a pre-assessment data sheet for one of the tasks is shown in Appendix C. The pre-assessment and post-assessment task Procedural Integrity/Reliability data sheets were the same as the ABLA Level 4 data sheet.

Pre-training: Dylan did not have a previous history of responding by placing an item inside of another to access a reinforcer (response required for MCTP 1) or by lifting an item to access a reinforcer underneath (response required for MCTP 2). Pre-training sessions were conducted to teach these procedures. Pre-training for the MCTP1 consisted of placing two boxes on the table. Dylan was given a clear empty plastic container and he was required to place the container in one of the boxes. When Dylan placed the container in one of the boxes he was reinforced with an edible or a toy. In the pre-training MCTP2 there were two steps. In the first step, two boxes were placed on the table and a reinforcer was placed in one of the boxes; Dylan was required to take the reinforcer out of the box. In the second step the experimenter placed a reinforcer in one of the boxes while Dylan was watching, and then covered the box with a card.

On the card there was a clear empty plastic container. Dylan was required to the lift the card and retrieve the reinforcer underneath. If Dylan did not respond a full prompt (e.g., hand over hand) or partial prompt (e.g., pointing, light guidance) was delivered. Mastery for each pre-training step was 5 consecutive correct responses over two sessions. During the MCPT2 discrimination training (described later), if Dylan was unresponsive for 10 seconds he was returned to the MCTP2 pre-training phase and was required to get 5 consecutive correct responses on the second pre-training step before returning to the MCTP2 discrimination training. It was found that Dylan returned to the MCTP2 pre-training after one MCTP2 training trial, and remained on the second pre-training step for several sessions. Therefore the second pre-training step was administered using the MCTP2 task materials. After 5 consecutive correct responses, the MCTP2 training resumed. Once this was done Dylan never returned to the pre-training.

Training. Two multiple component training packages described later, were compared to teach visual-visual identity matching tasks.

Post-assessments. Once a child mastered a training task, or at the end of the study if a child had not mastered a task, ABLA Level 4 was re-administered. If a child was unable to pass ABLA Level 4, administration of lower levels of the ABLA continued until a passed level was found. Each child was also assessed on the 3-choice novel task. Appendix D has the data sheet used for the 3-choice novel task.

Follow-up. A six week follow-up was administered with Logan for the training task that he passed. Follow-up was administered in the same manner as training, however no prompts were provided.

General Procedure for Assessment and Training

Sessions began with the child engaging in a preferred activity (e.g., watching a movie, playing with toys). After two to five minutes the child was asked to come to the table and the training began. The S^D delivered for each trial was "Where does it go, match?". After the completion of 10 trials the child was given a break lasting two to five minutes. During the break the child had access to preferred items (e.g., doing a puzzle, listening to music). After the break the child returned to the table and 10 more trials were completed. After the completion of the 20 trials the child was given access to a preferred item (e.g., jumping on a bed, listening to music, toys). If on the last trial before the break or the last trial before the end of the session the child made an error, the experimenter asked the child to perform two to five mastered skills (e.g., imitation, receptive instruction). This was done to ensure that the child ended on a success and was reinforced for correct responding.

Details of Multiple Component Training Package 1 (MCTP1)

An overview of MCTP1 and MCTP2 is shown in Table 2. The MCTP1 procedure consisted of (a) preference assessment, (b) prompt delay, and (c) error correction.

Preference assessment. A preference assessment was conducted at the start of every session to determine which reinforcer would be used. The preference assessment for Logan consisted of showing him two edibles and he was required to pick one. Upon his selection he was shown the edibles again, however they were in the opposite left-right position. The edible that he chose both times was the one that was chosen as the reinforcer for that session. If he selected each edible once, a third trial was presented, and the edible chosen on 2 of the 3 trials was used as the reinforcer. Some of the edibles that served as reinforcers for Logan were cucumbers,

Table 2

A Comparison of the MCTP1 and MCTP2 Procedures to Teach Identity Match-to-Sample tasks in Study 1.

Components	Multiple Component Training Package 1 (MCTP1)	Multiple Component Training Package 2 (MCTP2)
Preference assessments	Child was given a choice of one of two items.	Child was given a choice of one of two items.
Prompts	Prompts delivered according to a prompt delay. Extra-stimulus prompts were used (e.g., pointing, hand over hand)	Within-stimulus prompt fading was used. The size of the S- was gradually increased over 4 successive sessions
Response topography	Child placed the sample on the correct comparison.	Child was required to lift the correct comparison.
Error correction	The error correction consisted of re-presenting the SD, prompting the response, representing the SD, and allowing the child to respond independently.	No error correction was used.
Delivery of reinforcer	Experimenter handed the reinforcer to the child.	A discovery reinforcer was used. When the child lifted the correct comparison the reinforcer was found underneath.

oranges, red/green peppers, broccoli, raw potato, chips, Fruit to Go, crackers, and cherry tomatoes. Initially, the same preference assessment was done with Dylan. However due to reinforcer satiation a second preference assessment was done after the break. Because reinforcer satiation still appeared to occur during several sessions, his preference assessment then became choosing three items out of six items presented. The items chosen were used as the reinforcers, which were alternated across trials. After the break this preference assessment was redone. Initially edibles (i.e., apple, pear, toast) were selected as reinforcers, however given food restrictions, edibles that were made available to this study were given to Dylan throughout the day, and Dylan eventually stopped consuming them. Therefore, small toys (e.g., squishy toys, musical toys, and basic cause and effect toys) were used as reinforcers instead of edibles.

Prompt delay. During sessions, similar to the ABLA procedure, two items (comparisons) were placed on the table. The child was given an item (sample), that he was required to match to the comparison that was identical to the sample given. A response was considered correct if the child placed the sample on top or in front of the correct comparison (for Logan) or inside the correct box (for Dylan). A response was considered incorrect if the child placed the sample on top or in front of the incorrect comparison (for Logan) or inside the incorrect box (for Dylan). The trial was repeated if the child placed the sample between the two comparisons. The position of the comparisons and the sample given were randomly rotated across trials.

The MCTP1 procedure was based on the prompting and reinforcement strategies most commonly used by the tutors and senior tutors in the ABACA program. Currently a prompt delay procedure is implemented in four steps where prompts occur after 0 s, 2 s, 4 s, and then not at all. A prompt hierarchy determines the types of prompts delivered, where the intrusiveness of the prompt is dependent on the graduated guidance procedure. In the ABACA program, the criterion

to advance a step or move back a step depends upon the child and the program. In this research the child moved up a step if he made 4/5 or 5/5 prompted and/or correct responses. The child remained on a step if he made 2/5 or 3/5 prompted and/or correct responses. The child moved down a step if he made 1/5 prompted and/or correct responses. If the child responded correctly he was given an edible or favourite toy and praise. If the child responded correctly after an error-correction procedure, only praise was given.

Error correction. The error-correction procedure involved a 2 s time-out, re-presenting the S^D, a prompt for the correct response, and an opportunity for the child to respond independently. The data sheet used for the MCTP1 is shown in Appendix E. The Procedural Integrity/Reliability data sheet is shown in Appendix F

Details of Multiple Component Training Package 2 (MCTP2).

This condition consisted of three components: (a) a preference assessment, (b) within-stimulus prompt fading, and (c) a discovery-reinforcer component (see overview in Table 2).

Preference assessment. At the beginning of every session a preference assessment was conducted. The preference assessment was conducted in the same manner as in the MCTP1 procedure.

Within-stimulus prompt fading. The size of the S- went from being very small to large, over 4 steps (see figure 1 on page 30). In order for the child to move from one step to the next he needed to make 5 consecutive correct responses. If the child made an error he returned to the previous step. The advancing and regression criterion were changed for Dylan on session 25 since he was fluctuating between Steps 3 and 4. His advancing criterion then became 3 consecutive correct responses on Step 3, and his regression criterion became 3 cumulative errors on Step 4. This was done to allow Dylan to be exposed to more trials on Step 4 than on Step 3.

Further, as of session 25 Steps 1 and 2 were eliminated to allow Dylan to remain on the more challenging steps, therefore giving him more training on these steps.

Discovery reinforcer. For Logan, the comparisons (items on the table) were placed on a wooden board. There was a hole under the correct comparison. In the hole was a reinforcer. He was required to lift the correct item to reveal the reinforcer. For Dylan the comparisons were placed on two boxes. The reinforcer was hidden in one of the boxes. He was required to lift the comparison to reveal the reinforcer in the box. Appendix G shows the data sheet used for the MCTP2 procedure, and Appendix H shows the MCTP2 Procedural Integrity/Reliability data sheet.

Mastery criterion for MCTP1 and MCTP2.

Mastery for the training tasks was eight consecutive correct responses (not including those in the error correction procedure) over two consecutive sessions. However on the second session, mastery needed to occur in the first eight trials.

Reliability

Inter-Observer Reliability (IOR).

The observer and experimenter recorded whether the child responded correctly or incorrectly on each trial. An agreement occurred if both the experimenter and observer recorded that the participant either responded correctly, or if they recorded that the participant responded incorrectly. A disagreement occurred if either the experimenter or observer recorded that the participant responded correctly or incorrectly, and the other person recorded the opposite. The IOR score was calculated by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100% (Martin & Pear, 2007).

For Logan no IOR scores were taken for the pre-assessments due to technical difficulties (i.e., video camera did not work). IORs were taken for 57% of the MCTP1 sessions, 43% of the MCTP2 sessions, and 100% of the post-assessments. They all averaged 100%.

For Dylan IORs were taken for 88% of pre-assessments, 100% for the MCTP1 pre-training sessions, 27% for the MCTP2 pre-training sessions, 60% for MCTP1 training sessions, 59% for MCTP2 training sessions, and 100% of the post-assessments. IOR scores were 100% for pre-assessments, MCTP1 pre-training sessions MCTP2 training and post-assessments, and averaged 95% for MCTP2 pre-training sessions.

Procedural Integrity (PI).

The same observer conducting the IOR simultaneously conducted the Procedural Integrity (PI) assessment. The observer checked off on a list the steps that were followed by the experimenter. An agreement was scored if the observer recorded that the experimenter followed a step. A disagreement was scored if the observer recorded that the experimenter did not follow the procedure correctly. The PI score was calculated the same way as the IOR score.

The PI scores for the pre-assessments were not taken for Logan due to technical problems (i.e., video camera did not work). The PI scores were taken for 43% of the MCTP1 sessions, 43% of the MCTP2 sessions, and 100% of the post-assessments, and they each averaged 99%.

The PI for Dylan was taken for 88% for pre-assessments, 100% for MCTP1 pre-training sessions, 45% for MCTP2 pre-training sessions, 57% for MCTP1 training sessions, 59% for MCTP2 training sessions, and 100% for post-assessments. The PI scores averaged 95% for MCTP2 training sessions and 100% for the rest.

Procedural Reliability (PR).

An agreement was scored if both recorders recorded that the experimenter followed the procedure correctly. A disagreement was scored if the observers did not agree on whether the experimenter followed the procedure correctly. The PR scores were calculated in the same way as the IOR score.

The PR for Logan's pre-assessments were not taken due to technical problems (i.e., video camera did not work). The PR score was taken for 43% of the MCTP1 and MCTP2 sessions, and 100% for the post-assessments, and they each averaged 100%

The PR for Dylan was taken for 88% of pre-assessments, 100% for MCTP 1 pre-training sessions, 45% for MCTP2 pre-training sessions, 57% for MCTP1 training sessions, 59% for MCTP2 training sessions, and 100% for post-assessments. Scores averaged 99% for the pre-assessments, 95% for MCTP2 training sessions, and 100% for the rest.

Results

Logan learned one of the training tasks using the MCTP1 procedure in 128 trials and was unable to learn the training task using the MCTP2 procedure within 128 trials (see Figure 2). After mastering the training task Logan was unable to pass ABLA Level 4, but was able to pass the 4 sets of novel 2-choice tasks without direct teaching (i.e., in the assessment period). Logan also passed the novel 3-choice task (assessed during the pre-assessments) and a 3-choice task that combined 3 items from the tasks mastered in training or assessments.

A six week follow-up indicated that Logan was able to pass the training task (i.e., star and battery).

As described previously, Dylan required pre-training sessions in both conditions PIior to the commencement of the training procedures. A total of 11 sessions and 183 trials for the MCTP2

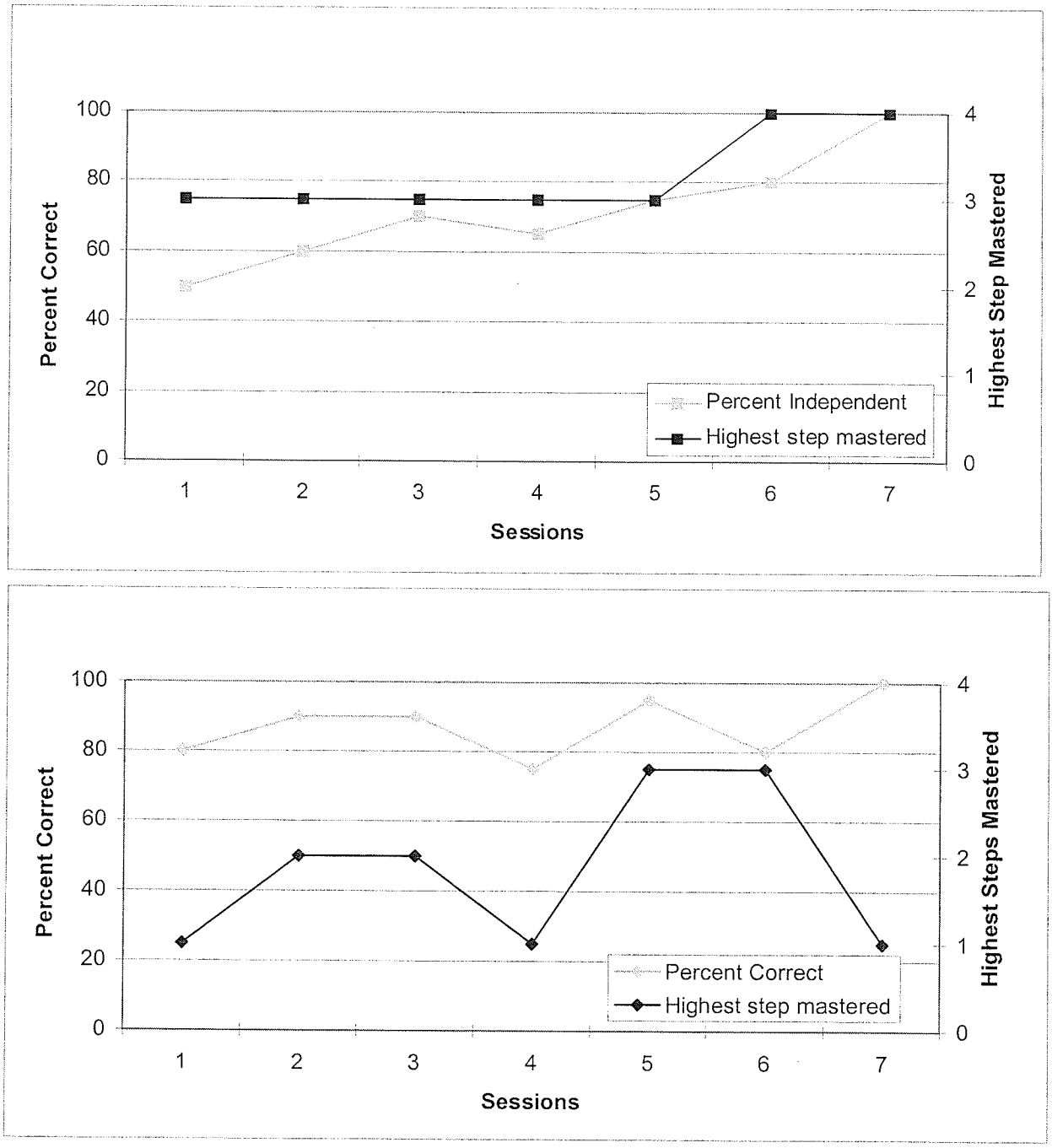


Figure 2. Logan's performance with both procedures. The top graph indicates Logan's performance on the MCTP1 procedure (star versus battery), and the bottom graph indicates Logan's performance on the MCTP2 (pompom versus paintbrush). Logan was successful in learning the match-to-sample task with the MCTP 1 procedure.

pre-training were completed, and 2 sessions and 13 trials were completed for the MCTP1 pre-training. Dylan's MCTP2 sessions typically consisted of 1 or 2 trials of the training task and the rest of the session was spent on the pre-training. Given that returning to pre-training was not effective, 5 trials were done where he observed the experimenter hide the reinforcer under the correct comparison, where the comparisons were the training stimuli. He was able to correctly find the reinforcer for all 5 trials. Training for the MCTP2 began after this and Dylan was no longer required to return to the pre-training. A total of 35 sessions and 700 trials were completed for the MCTP1 and 32 sessions and 624 trials were completed for the MCTP2 (see Figure 3). More trials were completed for the MCTP1 because training in this procedure continued while Dylan was on the pre-training for the MCTP2. Dylan was unable to learn the training tasks. Post-assessment results indicated that he was able to pass ABLA Level 3 and failed ABLA Level 4. He also failed the novel 3-choice task.

Discussion

Neither procedure was effective in teaching Dylan match-to-sample skills. There are several possible reasons for this failure. First, Dylan did not participate in an ABA program, therefore did not have any history of discrimination training, and had difficulty responding appropriately, scanning, and looking. Second, his parents often cancelled several sessions which increased the delay between sessions. Third, observations indicated that Dylan was reinforced for inappropriate behaviours (e.g., crying) by adults and these behaviours were displayed during the first several sessions and may have interfered with learning. Fourth, parents and daycare staff frequently reported that Dylan was ill (e.g., ear infection, flu, cold) and did not sleep well at night, often waking up in the early morning (e.g., 1:00 am) and not falling asleep until several hours later (e.g., 6:00 am), this resulted in the parents' decision to occasionally give Dylan

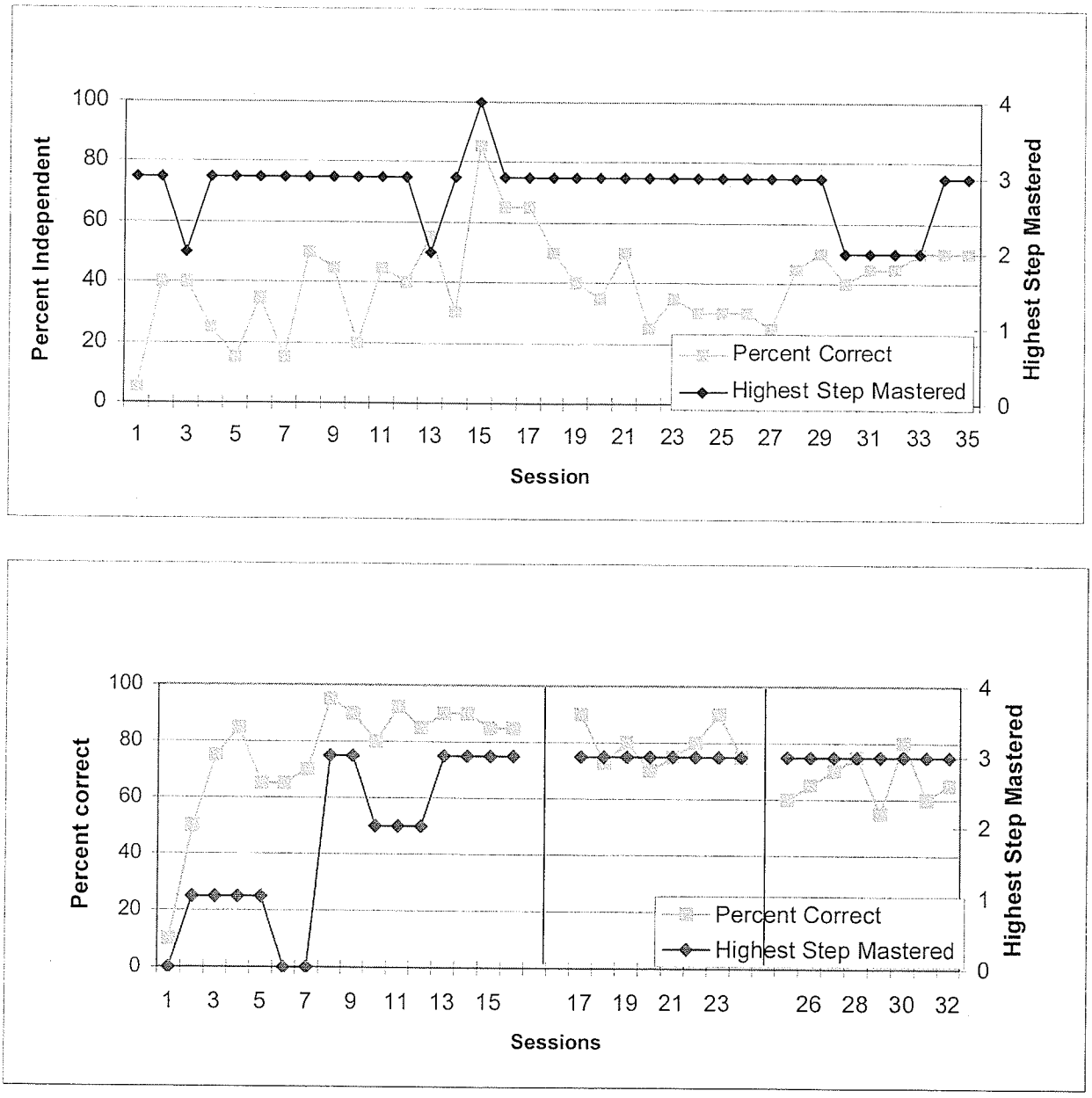


Figure 3. Dylan's performance on both procedures. The top graph indicates his performance on the MCTP1 procedure (pompom and paintbrush) and the bottom graph indicates his performance on the MCTP2 procedure (star versus battery). On session 17, the regression criteria for Step 4 change from 1 error to 3 cumulative errors. On session 25, the advancing criterion on Step 3 changed from 5 consecutive correct responses to 3 consecutive correct responses. Steps 1 and 2 were no longer administered after session 25.

melatonin. Fifth, Dylan had unlimited access to some items used as preferred items outside of the training sessions which may have limited their reinforcing value during training sessions.

The match-to-sample MCTP1 procedure was successful in teaching Logan a match-to-sample task. Possible reasons for its success over the MCTP2 procedure were: (a) Logan had a previous reinforcement history of matching by placing a sample on top of the comparison and no reinforcement history for matching by looking at the sample and lifting the correct comparison; and (b) Logan's ABA program used the prompt delay and error correction procedure to teach several discrimination skills (e.g., visual, auditory, imitation), thus Logan was familiar with this method of teaching. Further Logan was able to pass the novel 3-choice task (assessed in the pre-assessments), and was able to pass a 3-choice task that combined 3 objects from passed training task and tasks that were mastered in the assessment phase. It should be noted that during the pre-assessments Logan approached the mastery criterion for the novel 3-choice task (i.e., 7 consecutive correct responses) prior to reaching the failing criterion. This result suggests that for Logan the ability to show generalized match-to-sample ability to a larger comparison field did occur. However given that Logan approached the passing criteria during pre-assessments the results should be interpreted with caution.

Logan had learned to match 3 dimensional identical items, and when assessed was able to pass 4 novel identity matching 2-choice tasks, however was unable to pass ABLA Level 4. ABLA Level 4 is a quasi-identity match-to-sample task. It is possible that, Logan needed to learn quasi-identity matching tasks in order for his match-to-sample ability to generalize to ABLA Level 4. This is what was attempted in Study 2.

STUDY 2: TEACHING A QUASI-IDENTITY MATCHING TASK

In this study attempts were made to teach a quasi-identity matching task to Logan, who was able to perform several identity matching tasks but was unable to pass ABLA Level 4, a quasi-identity matching task. Kelly et al. (1998) suggested that in order for an individual to learn match-to-sample discriminations he/she must be able to (a) scan objects, (b) discriminate among stimuli, and (c) select the correct comparison or reject the incorrect comparison. A procedure to promote scanning was introduced prior to discrimination training, and was also incorporated into a multiple component training package to teach a quasi-identity matching task.

Method

Participants and Setting

The participant was Logan who participated in Study 1. Logan was 6-years old. The setting remained the same as in Study 1.

Apparatus

Training task. The training materials were objects not used in his ABA program. Training tasks for Logan were: stars, batteries, measuring spoons, and fishing floats that ranged in 4 sizes from very small to large. Figure 4, shows a typical quasi-identity match-to-sample task.

ABLA level 4. The materials were as described for Study 1.

Phases of the Study

Pre-assessment. Given that Logan was just assessed on the ABLA in Study 1, he was not re-assessed for Study 2. Logan was assessed on several quasi-identity match-to-sample tasks (i.e., matching a small sample to a large comparison, with items identical with the exception of size). The assessment procedure and pass-fail criteria were those of the ABLA test described

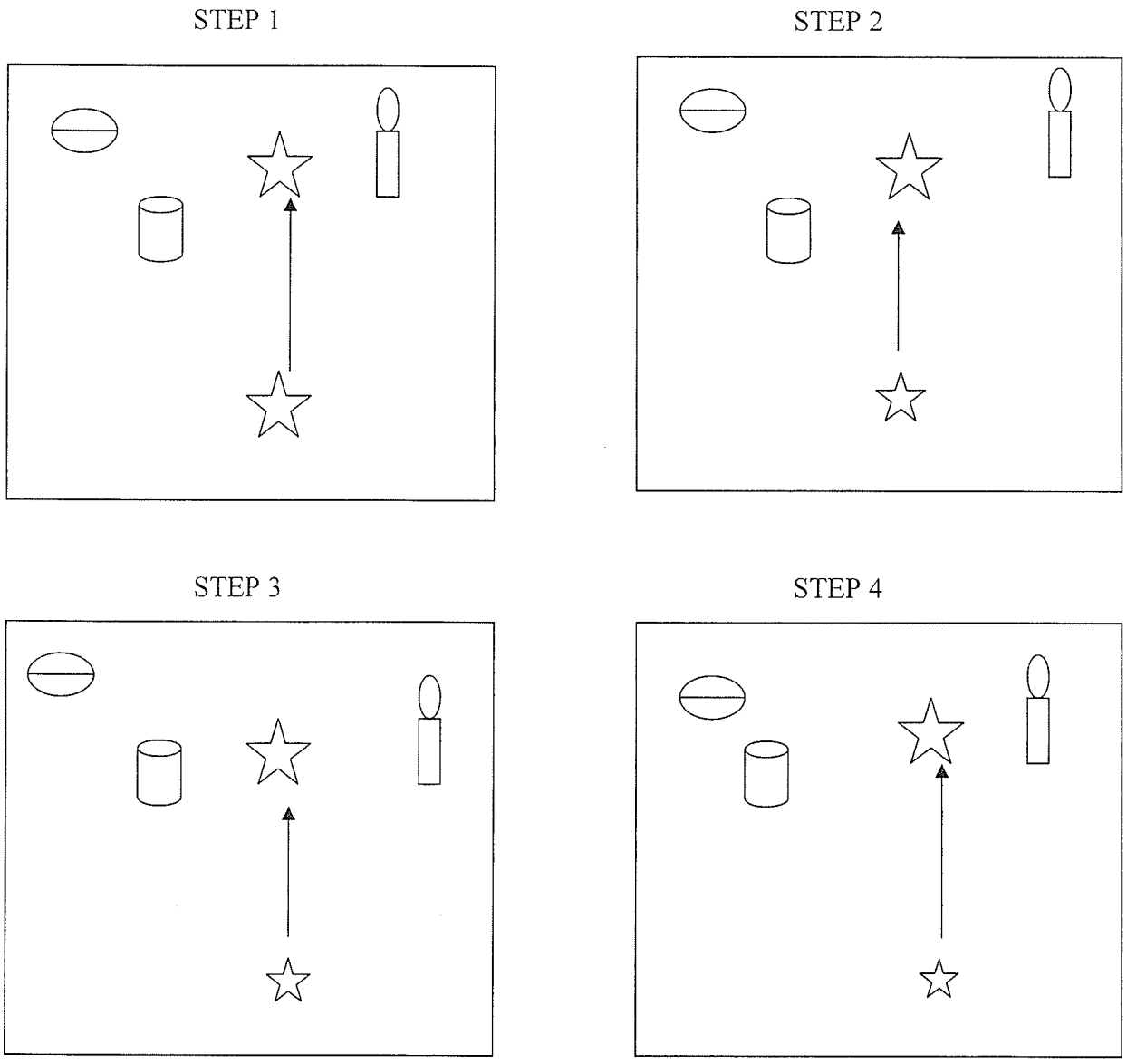


Figure 4. A typical training task (with star as sample) and fading steps.

earlier. Logan was able to pass all the tasks assessed with the exception of the star versus battery task. Therefore this task along with one of the other tasks that he had passed (i.e., measuring spoon versus float) were chosen as the training stimuli.

Procedure to promote scanning prior to training. One of the difficulties observed with Logan in Study 1 was that he did not frequently scan the items on the table. This preliminary procedure was implemented to increase the likelihood that Logan would scan all the comparisons on the table prior to making his response. This procedure began by presenting Logan with several identity-matching tasks (i.e., fishing floats, stars, batteries, and measuring spoons) that he had mastered in Study 1. In the first step two comparisons were placed on the table, one of the comparisons was very small and the other was very large. Logan was given a sample, which he was required to match (i.e., place on top) to the large comparison. Gradually the number of incorrect comparisons increased over 3 steps for a total of three incorrect comparisons and one correct comparison on the table. Increasing the number of incorrect comparisons required him to scan more comparisons prior to making his response. In order to increase the likelihood that Logan would look at all the comparisons prior to making his response, the comparisons were placed in various locations on the table. This made the placement of the comparisons unpredictable and prevented Logan from displaying a position preference (e.g., always matching to the comparison on the left). Once mastery was reached for one sample across all the steps, the next sample was introduced. Once mastery was reached for all the steps with all four samples, quasi-identity match-to-sample training began. Criterion to advance a step was 5 consecutive correct responses. Upon making errors Logan remained on the same step. Table 3 describes the steps used in the procedure to promote scanning.

Table 3

Steps to the Procedure to Promote Scanning Described in Study 2

Step	Sample	Correct comparison	Incorrect comparisons	Number of Incorrect Comparisons
1	Battery big	Big	Small	1
2	Battery big	Big	Small	2
3	Battery big	Big	Small	3
4	Star Big	Big	Small	1
5	Star Big	Big	Small	2
6	Star Big	Big	Small	3
7	Float big	Big	Small	1
8	Float big	Big	Small	2
9	Float big	Big	Small	3
10	Spoon Big	Big	Small	1
11	Spoon Big	Big	Small	2
12	Spoon Big	Big	Small	3
13	Alternate big star, big battery, big float, big spoon	Big	Small	3

Training. The training procedure consisted of a multiple component training package that is described later.

Post-assessments. To assess whether generalization to the ABLA test had occurred, upon mastery of the training task, ABLA Level 4 was re-administered.

Follow-up. To assess whether Logan had retained the match-to-sample ability he was re-assessed on the training task and ABLA Level 4 at 1 week and 3 weeks after the date that the training task was passed. The follow-up procedure was the same as the training procedure.

Training procedure

The training procedure consisted of three components: (a) a preference assessment, (b) within-stimulus prompt fading, and (c) a procedure to promote scanning. The training procedure data sheet is shown in Appendix I. The Procedural Integrity/Reliability data sheet is shown in Appendix J. Details of the training procedure are as follows.

Preference assessment. At the beginning of the session the preference assessment was conducted in the same manner as in Study 1.

Within-stimulus prompt fading. The sample size went from being very large to very small over 4 successive steps. Table 4 describes the steps used in this procedure. From sessions 1 to 32, 10 consecutive correct responses were required to advance to the next step. When one error was made Logan regressed to the previous step. It was observed that Logan would frequently get the first responses correct and begin to make errors towards the end of the 10 trials. It was hypothesized that the task was possibly too easy, thus decreasing his performance. From sessions 32 to 35 the advancing criterion was changed from 10 to 5 consecutive correct responses. Upon reaching this criterion on any step Logan moved to the final step (i.e., Step 4). If Logan made an error on Step 4 he was then moved back to the step that was the next highest step from the last

Table 4

Steps to the Quasi-Identity Match-to-Sample Task Described in Study 2

Step	Sample	Correct comparison	Incorrect comparisons	Number of Incorrect Comparisons
Step 1	Alternate big star, big battery, big float, big spoon	Big	Big	3
Step 2	Alternate big star, big battery, big float, big spoon Sample now medium size	Big	Big	3
Step 3	Alternate big star, big battery, big float, big spoon Sample now small size	Big	Big	3
Step 4	Alternate big star, big battery, big float, big spoon Sample now very small size	Big	Big	3

step mastered. For example, if Logan received 5 consecutive correct responses on Step 2, he would then move to Step 4, upon making an error on Step 4 he would then regress to Step 3.

Procedure to promote scanning during training. The location and position of the comparisons varied across trials where the pattern made by the comparisons was random, and no longer consisted of always a left-to-right sequence on every trial.

Mastery Criterion for Training Task

Mastery for the training task was eight consecutive correct responses (not including those in the error correction procedure) over two consecutive sessions. However on the second session, mastery needed to occur in the first eight trials.

Reliability

Inter-Observer Reliability (IOR)

IOR scores were taken for 100% of the pre-assessments, 53% of the training sessions, 100% of the post assessments, and 100% of the follow-ups. The IOR was calculated as described in Study 1. IORs averaged 98% for pre-assessments and 100% for the rest.

Procedural Integrity (PI)

The same observer conducting the IOR simultaneously conducted the Procedural Integrity (PI) assessment. The observer and experimenter checked off on a list the steps that were followed by the experimenter. An agreement was scored if the observer recorded that the experimenter followed a step. A disagreement was scored if the observer recorded that the experimenter did not follow the procedure correctly. The PI score was calculated the same way as the IOR score. Procedural Integrity was taken for 100% of pre-assessments, 53% of the training sessions, 100% of post-assessments, and 100% of follow-ups, and they all averaged 100%.

Procedural Reliability (PR)

An agreement was scored if both recorders recorded that the experimenter followed the procedure correctly. A disagreement was scored if the observers did not agree on whether the experimenter followed the procedure correctly. The PR was taken for 100% of pre-assessments, 53% of the training sessions, 100% of post assessments, and 100% of follow-ups, and averaged 94% for training sessions and 100% for the rest. The PR score was calculated the same way as the IOR score.

Results

Procedure to Promote Scanning

Logan quickly mastered all the steps. Learning occurred within 100 trials (see Figure 5).

Training Task

A total of 35 sessions and 850 trials were done. Logan was successful in learning the quasi-identity match-to-sample task. Once the advancing and regression criteria changed, Logan was able to reach the mastery criterion within 4 sessions (see Figure 6).

Post- Assessments

After Logan mastered the training task, he was then assessed on ABLA Level 4. Logan passed ABLA Level 4.

Follow-Up

Logan passed the training task at the 1-week follow-up and failed the training task at the 3-week follow-up. Logan passed ABLA Level 4 at the 1-week and the 3-week follow-up.

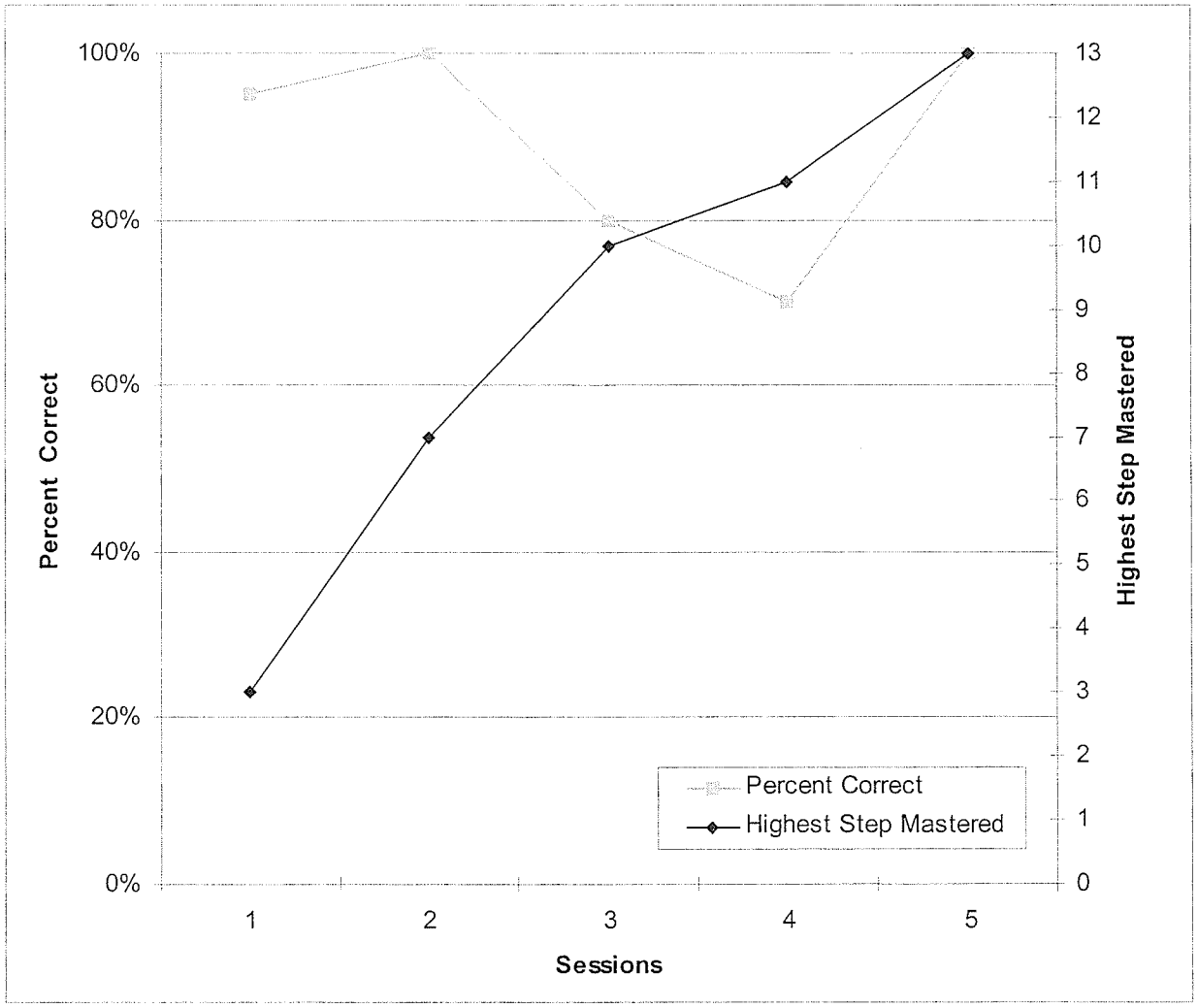


Figure 5. Logan's results on the procedure to promote scanning. Logan was able to quickly master each step.

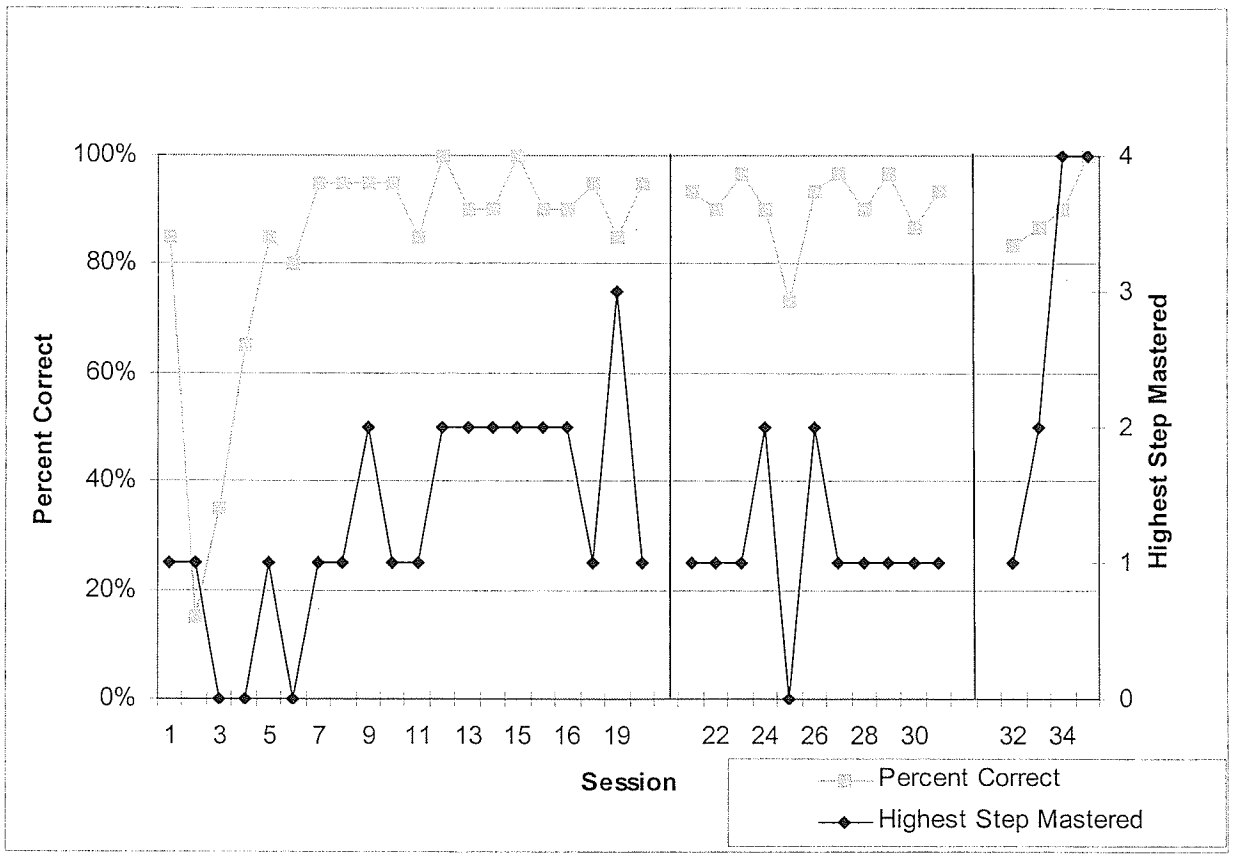


Figure 6. Logan's performance on the quasi-identity match-to-sample task described in Study 2. Sessions 1 to 20 consisted of 20 trials per session, Sessions 21 to 31 consisted of 30 trials per session, and Sessions 32 to 35 consisted of the new advancing and regression criteria. Once the regression criteria changed, Logan mastered the task within 4 sessions.

Discussion

Incorporating a procedure to promote scanning prior to responding in addition to using a within-stimulus prompt was effective in teaching a quasi-identity match-to-sample task. In addition, Logan's match-to-sample ability generalized to ABLA Level 4. Results also suggest that the change in the advancing and regression criteria strongly contributed to Logan learning the training task.

STUDY 3: TEACHING AUDITORY-VISUAL DISCRIMINATIONS

Research has found that some procedures consisting of a discovery reinforcer, within-stimulus prompt fading, and response preclusion are effective in teaching auditory-visual discriminations to individuals with developmental disabilities (Conyers et al., 2000). Other procedures such as prompt delay (e.g., Glat et al., 1994; Touchette & Howard, 1984) and differential outcomes (e.g., Estevez & Fuentes, 2003; Maki et al., 1995) have also been found to be effective. The current study investigated a prompt delay procedure in combination with an error correction procedure and differential outcomes using natural consequences to teach auditory-visual discriminations to two children with autism.

Method

Participants and Setting

The participants were 2 preschool children with autism, neither of whom were receiving sedatives or psychotropic medications. The children were diagnosed by an external agency. Logan who participated in Study 1 and 2 also participated in Study 3. Logan was now 7 years old. His sessions were conducted in a different location of the house for each task. This was primarily done due to the location and size of some of the stimuli.

Eric was 7-years old at the commencement of the study and was diagnosed with autism spectrum disorder. Eric was recruited from the St. Amant Centre Applied Behaviour Analysis Program for Children with Autism (ABACA). He was involved in an intensive ABA program consisting of 35 hours per week of therapy. Eric had been participating in the ABA program for 2 years. He did not have any vocal language, however he was observed using some communication skills (i.e., pointing, bringing you to something, nodding head yes and shaking head no). Eric's systems of communication consisted of a modified version of American Sign

Language, a talking device (i.e., CHAT PC) and a picture communication system. Eric's ABA consultant reported that Eric had strong visual discrimination skills however all attempts made to teach him auditory-visual discrimination skills had failed. Eric was readily able to imitate several gross motor tasks (e.g., arms out, hands on head, clap, wave), and was able to follow simple instructions (e.g., come here, sit down, give, clap, wave). Parents reported that Eric's hearing was normal and Eric wore glasses during the day to correct a visual impairment.

During session, a child was seated in a chair. Across from a child were either two chairs (for Logan) or two tables (for Eric). Each comparison was on one of the chairs/tables. The experimenter sat beside the child and the observer sat in a location of the room where she was able to see both the child and the experimenter. Given that Logan began to display a position preference (i.e., always selecting the item located on the side where the experimenter was sitting), the experimenter changed positions every 10 trials. This eliminated the position preference for the first task however, the position preference returned for the last task, therefore the experimenter sat in front of the child and the observer sat behind the child while teaching the last task.

Apparatus

Auditory-visual training tasks. Training materials for Eric were: a Buzz Lighter toy (from the Toy Story movie), a Tigger stuffed toy (from Winnie the Pooh), a Bob the Tomato stuffed toy (from the Veggie Tales movie), a Shrek stuffed toy (from the Shrek movie), a Larry the Cucumber toy (from the Veggie Tales movie), a Blues Clues toy (from the Blues Clues cartoon), a balloon, and A Bug's Life video case holder and movie. Training materials for Logan were: an indoor swing, cherry tomatoes, a juice box, chips, an orange, and an indoor one-person trampoline. All edible items were placed in a clear cylindrical container.

ABLA levels 3, 4, and 6. The materials were as described for Study 1.

Phases of the Study

Pre-assessments. Logan was assessed on ABLA Levels 4 and 6. Eric was assessed on all the ABLA Levels. It should be noted that for Logan ABLA Level 4 was administered in November 2005 and this training procedure did not begin until March 2006. For Eric ABLA Levels 1 through 4 were administered in August 2005 and this training procedure did not begin until March 2006. Both children were assessed on the training tasks using the ABLA procedure and the pass/fail criteria prior to training. If the child passed the training task, they were assessed on another task until they failed a task.

Training. The training procedure is described later.

Post-assessments. Once a child mastered a training task, ABLA Level 6 was administered. If the child failed ABLA Level 6, a new training task was introduced. If upon termination of the study the child did not master the task currently being taught, ABLA Level 6 was administered. If the child failed ABLA Level 6, administration of lower levels of the ABLA test continued until a passed Level was found.

Follow-up. Follow-up was administered in the same manner as the training task however no prompts were administered and if the child did not respond within 4 seconds, the trial was considered an error. A 1-week, 2-week, and 5-week follow-up were administered after the date that the child mastered the task. Follow-ups were administered for ABLA Level 6 and the mastered training tasks. However given that Eric's parents withdrew him from the study, only a 1-week and 4 ½-week follow-up were done for ABLA Level 6 after the mastery of the last training task.

Training Procedures

General procedure for assessment and training

Sessions began with the child engaging in a preferred activity (e.g., watching a movie, playing with toys). After two to five minutes the child was asked to come to the table and the training began. After the completion of 10 trials the child was given a break lasting two to five minutes. During the break the child had access to preferred items (e.g., toys, watching a movie, swinging on a swing). After the break the child returned to the table and 10 more trials were completed. After the completion of the 10 trials the child was given access to a preferred item (e.g., computer, swing, movie, book). If on the last trial before the break or the last trial before the end of the session the child made an error, the experimenter asked the child to perform two to five mastered skills (e.g., imitation, receptive instruction). This was done to ensure that the child ended on a success and was reinforced for correct responding. The training data sheet is shown in Appendix K. Appendix L shows the Procedural Integrity/Reliability data sheet.

Auditory-visual discrimination training

The auditory-visual discrimination procedure consisted of: (a) differential outcomes, (b) prompt delay, and (c) error correction.

Differential outcomes .Both children had demonstrated the ability to go to some named preferred items to do an activity (e.g., when told "Let's go swing" the child would go to the swing). To capitalize on this skill, preferred items were chosen and placed at a distance from the child. The child sat on a chair, and two chairs or tables were placed across from the child. A comparison was placed on each chair/table. The S^D given to the child was the name of an item (e.g., "balloon"), upon the delivery of the S^D the child was required to point to the named item. A response was considered correct if the child pointed to the correct comparison. A response was

considered incorrect if the child pointed to the incorrect comparison. The left–right position of the comparisons and the S^Ds were randomly rotated across trials. Table 5 shows the differential outcomes tasks for each child.

Prompt delay. The auditory-visual discrimination procedure was based on the prompting and reinforcement strategies most commonly used by the tutors and senior tutors in the ABACA program along with a differential-outcomes procedure. Currently in the ABACA program a prompt delay procedure is implemented in four steps where prompts occur after 0 s, 2 s, 4 s, then not at all. Prompts are delivered according to the graduated guidance prompt system. In the ABACA program, the criterion to advance a step or move back a step depends upon the child and the program. In this study the child moved up a step if he made 4/5 or 5/5 prompted and/or correct responses. The child remained on a step if he made 3/5 prompted and/or correct responses. The child moved down a step if he made 1/5 or 2/5 prompted and/or correct responses. If the child responded correctly he was given access to the item which he pointed to and was praised. If the child responded correctly after an error-correction procedure, only praise was given.

Error correction. The error-correction procedure involved a 2 s time-out, re-presenting the S^D, a prompt for the correct response, and an opportunity for the child to respond independently.

Mastery Criterion for Training Tasks.

Mastery for the training tasks was eight consecutive correct responses (not including those in the error correction procedure) over two consecutive sessions. However on the second session, mastery needed to occur in the first eight trials.

Table 5

Differential outcomes tasks for each child

LOGAN	ERIC
Tomato versus Swing	Buzz versus Tigger
Music versus Potato	Bob versus Shrek
Juice versus Chips	Larry versus Blue
Trampoline versus Orange	Balloon versus Bug's Life

Reliability

Inter-Observer Reliability (IOR).

The IOR was calculated as described for Study 1. For Logan, IORs were taken for 100% of pre-assessments, 62% for tomato versus swing sessions, 62% for chips versus juice sessions, 51% for trampoline versus orange sessions, 100% for follow-up, and 83% for post-assessments. IOR scores averaged 98% for trampoline versus orange and 100% for the rest.

For Eric, an observer sat in the room for 78% of pre-assessments, 100% of Bob versus Shrek sessions, 42% of Larry versus Blue sessions, 60% of balloon versus Bug's Life sessions, and 100% of the post-assessment and follow-up sessions, and they each averaged 100%.

Procedural Integrity (PI).

The same observer conducting the IOR simultaneously conducted the Procedural Integrity (PI) assessment. The observer checked off on a list the steps that were to be followed by the experimenter. An agreement was scored if the observer recorded that the experimenter followed a step. A disagreement was scored if the observer recorded that the experimenter did not follow the procedure correctly. The PI score was calculated the same way as the IOR score.

For Logan, PI was taken for 100% of pre-assessments, 54% for tomato versus swing sessions, 62% for chips versus juice sessions, 51% for trampoline versus orange sessions, 100% for follow-up and 88% for post-assessments, and they each averaged 100%.

For Eric, PI was taken for 78% of pre-assessments, 100% of the Bob versus Shrek sessions, 37% of the Larry versus Blue sessions, 60% of the balloon versus Bug's Life sessions, and 99% of the post-assessment and follow-up sessions, and they each averaged 100%.

Procedural Reliability (PR).

An agreement was scored if both recorders recorded that the experimenter followed the procedure correctly. A disagreement was scored if the experimenter and observer did not agree on whether the experimenter followed the procedure correctly.

For Logan the PR was taken for 89% of pre-assessments, 54% of tomato versus swing sessions, 62% for chips versus juice sessions, 51% of trampoline versus orange sessions, and 100% for the follow-up and post-assessment sessions. The PR averaged 99% for tomato versus swing, and 99% for trampoline versus orange, and 100% for the rest.

For Eric, the PR was taken for 78% of pre-assessments, 100% of the Bob versus Shrek sessions, 37% of the Larry versus Blue sessions, 60% of the balloon versus Bug Life sessions, and 100% of the post-assessment and follow-up sessions. The pre-assessments averaged 99% and the rest averaged 100%.

Results

Logan learned one auditory-visual discrimination task with the training procedure and learned one task in the assessment phase. Logan was unable to learn two other discrimination tasks. Figure 7 shows Logan's performance across sessions on each task. Table 6 summarizes the number of trials and sessions completed for each task as well as the follow-up results. On post-assessments Logan failed ABLA Levels 4 and 6 and passed ABLA Level 3. It should be noted that Logan approached mastery of ABLA Level 4 (i.e., 6 consecutive correct responses), and he engaged in several challenging behaviours (e.g., swiping materials from the table, displaying a stimulus preference, responding prior to scanning or looking) that may have affected his performance. A 1-week, 2-week, and 5-week follow-up were administered for the task swing versus tomato. Logan failed the 1-week and 5-week follow-up and passed the 2-week follow-up.

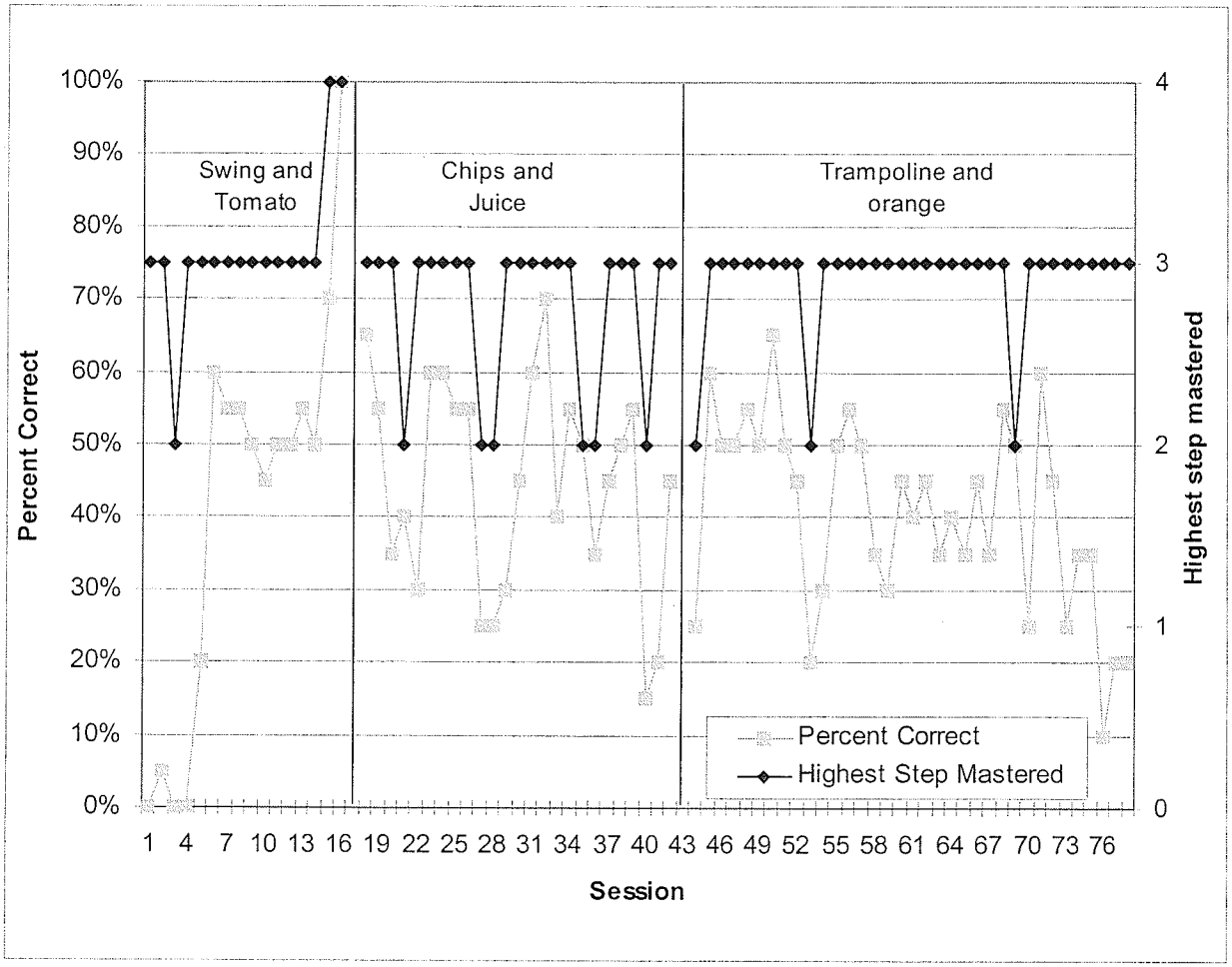


Figure 7. Logan's performance on the auditory-visual discrimination training described in study 3. Logan was able to learn the task swing versus tomato, and was unable to learn the other two tasks.

Table 6

Summary of the auditory-visual result and follow-up results for Logan for each task in Study 3

	Training			Follow-Up		
Task	Number of sessions	Number of trials	Results	1 week	2 weeks	5 weeks
Swing and Tomato	16	308	Child passed task and failed ABLA Level 6	Fail	Pass	Fail
Music and Potato	None	None	Baseline mastery			
Chips and Juice	25	500	Training stopped- tested ABLA Level 6, failed			
Trampoline and Orange	35	700	Task never mastered. Post assessments were done and he was able to pass ABLA Level 3 and failed Levels 4 and 6			

Eric learned 3 auditory-visual discrimination tasks in 22 (Bob versus Shrek), 295 (Larry versus Blue), and 138 (Balloon versus Bug's Life) trials (see Figure 8). He was able to learn one task (Buzz and Tigger) during the assessment period. Table 7 summarizes the number of trials and sessions completed for each task and follow-up results. It should be noted that although several trials were done prior to mastery on the last two tasks, Eric would frequently get 8 consecutive correct responses in a session, however would often make one or more errors in the second session. Further, although his parents identified the first two sets of stimuli as preferred items, observations indicated that they were less preferred than his parents had thought. For instance, when Eric was given a toy, he would often hold it, and then place it back on the table. Using highly preferred items was not possible because they were being used in one of Eric's ABA programs. At follow-up, Eric passed the Bob versus Shrek task at 2-weeks and 5-weeks, and failed the task at the 1-week follow-up. For the Larry versus Blue task Eric passed the task at 1-week and 3-weeks (a 3-week follow-up needed to be done instead of 2-weeks because the experimenter was out-of-town), and failed the task at the 5-week follow-up. For the Balloon versus Bug's Life task, Eric passed the 2-week follow-up but failed the 1-week (did make 7 consecutive correct responses), and 5-week follow-ups. For the post-assessments Eric passed ABLA Level 6, and passed at the 1-week and 4½ -week follow-up.

Discussion

The differential-outcomes procedure in combination with an error correction and prompt delay procedure was effective in teaching auditory-visual discriminations to both children. Eric learned 3 auditory-visual discrimination tasks using this procedure. His ABA team had reported that several attempts had been made to teach him auditory-visual discriminations but they had all failed. The above procedure was the most effective procedure to date that had been tried with

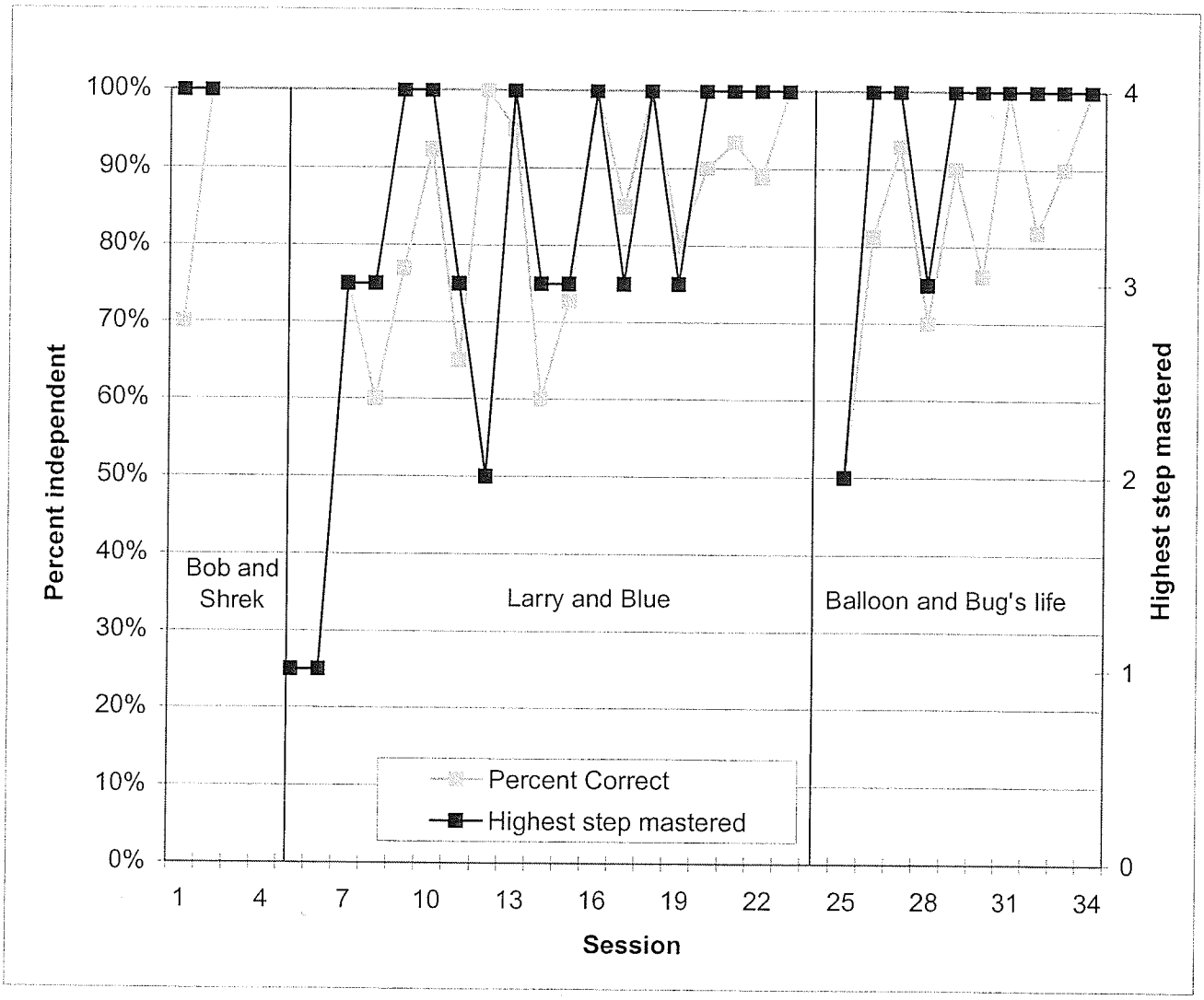


Figure 8. Eric's performance on the auditory-visual discrimination training. Eric was able to learn all the three training tasks. Note that some sessions have more or less than 20 trials

Table 7

Summary of the training s and follow-up results for Eric for each task in Study 3

	Training			Follow-Up		
Task	Number of sessions	Number of trials	Results	1 week	2 weeks	5 weeks
Buzz and Tigger	None	None	Baseline mastery			
Bob and Shrek Differential-outcomes Procedure	2 sessions	22 trials	Child passed task and failed ABLA Level 6	Failed * lots of problem behaviour during this session	Pass	Pass
Larry and Blue (Clues)	19 sessions	295 trials	Child passed task and failed ABLA Level 6	Pass	Pass (3 week follow-up done)	Fail lots of problem behaviours and not looking
Balloon and Bug's Life	10	138	Child passed task and passed ABLA Level 6	Fail (did get 7 consecutive correct responses)	Pass	Fail
ABLA Level 6				Pass	Not done	Pass (4 ½ weeks)

him. Further after learning 3 discrimination tasks involving reinforcers, he was able to generalize and pass ABLA Level 6. Logan on the other hand learned one auditory-visual discrimination using reinforcing items. The task "swing versus tomato" had very different outcomes (i.e., eating versus a physical activity), it is for this reason that when the task "juice versus chip" was unsuccessful, training on this task was terminated and the task "trampoline and orange" was introduced. Despite several trials Logan was unable to learn the last task.

Possible reasons why the training procedure was more effective with Eric than with Logan may be a result of participant characteristics. For instance: (a) Eric's visual discriminations were more advanced than Logan's (e.g., Eric could match 2-dimensional items, sort, do various puzzles and had mastered these skills within his first year of his ABA program yet Logan was currently learning only some of these skills); (b) Eric was able to follow more instructions than Logan; and (c) Eric was able to communicate using pictures, a talking device, American Sign Language, gestures, shaking his head "no" or nodding his head "yes", whereas Logan was just beginning to learn to communicate with miniature objects and pointing.

No other study reviewed has used natural consequences (i.e., the task materials) as the reinforcer when using the differential outcomes procedure (for a review see Goeters & Blakely, 1992). Both children in this study had very different characteristics and skills and both children were able to learn at least one auditory-visual discrimination using this procedure. Future research should examine the use of the training procedure with children with common as well as different characteristics to determine whether some prerequisite skills may aid in the acquisition of auditory-visual discriminations using this procedure. Future research should also investigate using natural consequences as the reinforcer when teaching other types of discriminations (e.g., visual). It would also be important to determine whether consequences with very different

functions (e.g., eat versus doing a physical activity) produces faster acquisition rates than consequences that have similar functions (e.g., eat versus drink)

SUMMARY

Several studies have demonstrated that various procedures are effective in teaching visual and auditory-visual discriminations. For instance, some procedures have found that a prompt delay (e.g., Kelly et al., 1998; Touchette & Howard, 1984) method is effective, whereas others have found that a differential-outcomes procedure is effective (e.g., Estevez et al., 2003; Maki et al., 1995). Other procedures have also been used and been found to be effective. For instance some researchers (e.g, Conyers et al., 2000; Hazen et al., 1986; Yu & Martin, 1986) found that a training package composed of several components, is more effective than reinforcement and standard prompting procedures. Within-stimulus prompt fading has also been shown to be more effective than extra-stimulus prompt fading (Schreibman, 1975).

In study 1, two procedures were compared to teach visual-visual identity match-to-sample tasks. One participant, Logan learned the task in just over 100 trials using a prompt delay and an error correction method (referred to in this study as MCTP1), and did not learn the task using a package consisting of within-stimulus prompt fading and a discovery reinforcer (referred to in this study as MCTP2). Although rapid learning took place with the MCTP1 procedure it was noted that Logan had received 2 years of an intensive ABA program which primarily uses this procedure as the method of teaching. Further, the response topographies required in each procedure differed (i.e., placing a sample on top of an item versus lifting up a comparison). Logan had a strong reinforcement history of placing the sample on the comparison when matching and no reinforcement history of lifting up a comparison in a matching task. Upon mastery of the training using MCTP1, Logan was also able to pass all the next tasks in Baseline but was unable to pass ABLA Level 4. The second child in this study, Dylan, despite many trials with both procedures, was unable to learn either procedure. Dylan was not in an intensive ABA

program and had no reinforcement history of performing this task or responding in the ways required. Many variables may have affected Dylan's performance, for instance access to reinforcers outside of the study, several cancellations which prevented consistency and repetition which is important in learning, and changes in his sleeping schedule. No study to date has compared the two procedures used in this study. Future research should continue to compare the procedures with children who have no history of learning using either procedure to avoid confounding the results.

In the second study, one child, Logan, was taught a quasi-identity match-to-sample task. This was attempted because Logan was able to perform several identity match-to-sample tasks but was unable to pass ABLA Level 4, a quasi-identity match-to-sample task. Observations indicated that Logan frequently would not scan or look at the comparisons prior to making a response. Researchers (Kelly et.al., 1998) suggest that scanning is an important pre-requisite in learning any type of discrimination. A procedure to promote scanning was implemented which consisted of having the comparisons in various locations on the table and gradually increasing the number and size of incorrect comparisons. Components of this procedure were then incorporated into the training procedure. The mastery criterion (10 consecutive correct responses) was instituted as this would ensure that each sample was shown at least twice, and Logan would be required to demonstrate mastery on each sample prior to being able to move to the next step. It was found that he spent most of the sessions on easier steps. Upon changing the mastery criterion, Logan was able to learn the training task within 4 sessions. Further Logan was able to generalize his match-to-sample ability to ABLA Level 4. Future research should examine the use of this criterion in combination or in comparison to using the procedure to promote

scanning. Further this procedure should also be used to teach other types of discriminations (e.g., auditory, identity matching).

The third study investigated a differential-outcomes procedure in combination with a prompt delay and error correction procedure to teach auditory-visual discriminations. The procedure was extremely effective for one child, Eric, and had some success with the other child, Logan. Eric was able to quickly learn auditory-visual discriminations, and after learning 3 discrimination tasks, he was able to then generalize his match-to-sample ability to pass ABLA Level 6. Logan was able to learn one auditory-visual discrimination task and was unable to pass ABLA Level 4 or 6 during post-assessments. It was noted earlier that Logan was displaying several behaviours that may have influenced his performance during post-assessments (e.g., swiping task materials, throwing tasks materials, bolting from the table, not scanning or looking). Also as previously noted Logan approached the passing criteria for ABLA Level 4, making 6 consecutive correct responses. No other study reviewed investigated using natural consequences in the differential-outcomes procedure. Future research should continue to investigate the use of this type of procedural components for teaching auditory-visual discriminations as well as other discriminations (e.g., visual).

In summary, the present study investigated several different procedures, to teach visual-visual identity matching, visual-visual quasi-identity matching, and auditory-visual discriminations to children with autism. Some procedures were effective for some children and not effective for other children. The most effective procedure was differential-outcomes, prompt delay and error correction for teaching auditory-visual discriminations.

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Appendix A

Data Sheet for ABLA Level 1

Student_____ Tester _____ Observer_____ Date _____

Instructions: If response is correct, circle trial number. If response is incorrect, place X on trial number. Continue to place Xs for incorrect responses on the lines below until the student corrects the error. Upon correction, place a check mark on the next line below, and then move on to the next trial.

Level 1 (Imitation) **Ask, "Where does it go?"**

Passing criterion includes 8 correct trials in a row as follows:

- 4 trials with foam + box
- 4 trials with foam + can

1	2	3	4	5	6	7	8	9	10	11	12	13	14
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—

15	16	17	18	19	20	21	22	23	24	25	26	27	28
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—

29	30	31	32	33	34	35	36	37	38	39	40
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—

8 right in a row (counting circled numbers, <u>not</u> counting checks during error correction)
That's a PASS. Go to the next level.

8 wrong altogether (counting X's on numbers <u>and</u> X's on lines)
FAIL!!! STOP THE WHOLE TEST.

Data Sheet for ABLA Level 2

Student_____ Tester _____ Observer_____ Date _____

Instructions: If response is correct, circle trial number. If response is incorrect, place X on trial number. Continue to place Xs for incorrect responses on the lines below until the student corrects the error. Upon correction, place a check mark on the next line below, and then move on to the next trial.

Level 2 (Position) Can and Box remain stable.
Ask, "Where does it go?"
Correct container is yellow can.

1	2	3	4	5	6	7	8	9	10	11	12	13	14
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—

15	16	17	18	19	20	21	22	23	24	25	26	27	28
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—

29	30	31	32	33	34	35	36	37	38	39	40
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—

8 right in a row (counting circled numbers, not counting checks during error correction)
That's a PASS. Go to the next level.

8 wrong altogether (counting X's on numbers and X's on lines)
FAIL!!! STOP THE WHOLE TEST.

Data Sheet for ABLA Level 3

Student_____ Tester _____ Observer_____ Date _____

Instructions: If response is correct, circle trial number. If response is incorrect, place X on trial number. Continue to place Xs for incorrect responses on the lines below until the student corrects the error. Upon correction, place a check mark on the next line below, and then move on to the next trial.

Level 3 (Visual) 'L' and 'R' indicate correct placement of can

Ask, "Where does it go?"
Correct response is **foam in can**

L	R	L	L	R	L	R	R	R	L	L	R	L	R
1	2	3	4	5	6	7	8	9	10	11	12	13	14
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—

L	L	R	L	R	R	L	R	R	R	L	R	L	L
15	16	17	18	19	20	21	22	23	24	25	26	27	28
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—

L	R	R	L	R	L	L	R	L	R	R	L
29	30	31	32	33	34	35	36	37	38	39	40
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—

8 right in a row (counting circled numbers, not counting checks during error correction)
That's a PASS. Go to the next level.

8 wrong altogether (counting X's on numbers and X's on lines)
FAIL!!! STOP THE WHOLE TEST.

Data Sheet for ABLA Level 4

Student_____ Tester _____ Observer_____ Date _____

Instructions: If response is correct, circle trial number. If response is incorrect, place X on trial number. Continue to place Xs for incorrect responses on the lines below until the student corrects the error. Upon correction, place a check mark on the next line below, and then move on to the next trial.

Level 4 (Match-to-Sample)

'L' and 'R' indicate correct placement of can
'b' indicates to present little red box.
'c' indicates to present small cylinder.
Ask, "Where does it go?"

R	L	R	L	R	R	L	L	R	R	L	L	R	R
c	c	b	b	c	b	c	b	b	c	b	c	c	b
1	2	3	4	5	6	7	8	9	10	11	12	13	14
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
L	L	R	L	R	L	R	R	L	L	R	L	R	L
c	b	b	b	c	c	b	c	b	c	c	b	b	c
15	16	17	18	19	20	21	22	23	24	25	26	27	28
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
L	R	L	R	L	L	R	R	R	L	R	L		
b	c	c	b	b	c	c	b	c	b	b	c		
29	30	31	32	33	34	35	36	37	38	39	40		
—	—	—	—	—	—	—	—	—	—	—	—		
—	—	—	—	—	—	—	—	—	—	—	—		
—	—	—	—	—	—	—	—	—	—	—	—		
—	—	—	—	—	—	—	—	—	—	—	—		
—	—	—	—	—	—	—	—	—	—	—	—		
—	—	—	—	—	—	—	—	—	—	—	—		
—	—	—	—	—	—	—	—	—	—	—	—		

8 right in a row (counting circled numbers, not counting checks during error correction)
That's a PASS. Go to the next level.

8 wrong altogether (counting X's on numbers and X's on lines)
FAIL!!! STOP THE WHOLE TEST.

Data Sheet for ABLA Level 6

Student_____ Tester _____ Observer_____ Date _____

Instructions: If response is correct, circle trial number. If response is incorrect, place X on trial number. Continue to place Xs for incorrect responses on the lines below until the student corrects the error. Upon correction, place a check mark on the next line below, and then move on to the next trial.

Level 6 (Auditory-Visual) 'L' and 'R' indicate correct placement of can
Say, "Red Box" (RB) or "Yellow Can" (YC)

R YC 1	R RB 2	L YC 3	L RB 4	L YC 5	R YC 6	R RB 7	L RB 8	R YC 9	L YC 10	R RB 11	R YC 12	L RB 13	R RB 14
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—

L YC 15	R RB 16	L RB 17	L YC 18	L RB 19	R YC 20	L YC 21	R RB 22	L RB 23	R RB 24	R YC 25	L YC 26	L RB 27	R YC 28
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—

R RB 29	L YC 30	R YC 31	L RB 32	L YC 33	R RB 34	L RB 35	R YC 36	L YC 37	R YC 38	L RB 39	R RB 40		
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—

8 right in a row (counting circled numbers, not counting checks during error correction)
That's a PASS. Go to the next level.
8 wrong altogether (counting X's on numbers and X's on lines)
FAIL!!! STOP THE WHOLE TESTS.

Appendix B

ABLA Level 1 - Procedural Integrity/Reliability

Date _____ Participant _____

Tester _____ Observer _____

If completed correctly place a √ If completed incorrectly place an **X**

	Demo	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial
Set up														
Demonstration														
Guided trial														
Demonstration														
Independent response														
Praise														
Demonstrate														
"Where does it go?"														
Independent response														
Praise and provide reinforcer														
Errors														
Demonstration														
Guided trial														
Demonstration														
Independent response														
Praise														
Reinforcer not given														

	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial
Demonstrate														
"Where does it go?"														
Independent response														
Praise and provide reinforcer														
Errors														
Demonstration														
Guided trial														
Demonstration														
Independent response														
Praise														
Reinforcer not given														

ABLA Level 2 - Procedural Integrity/Reliability

Date _____ Participant _____

Tester _____ _____ Observer _____

If completed correctly place a √ If completed incorrectly place an **X**

	Demo	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial
Set up													
Demonstration													
Guided trial													
Independent response													

Set up													
"Where does it go?"													
Independent response													
Praise and provide reinforcer													

Errors

Demonstration													
Guided trial													
Independent response													
Praise													
Reinforcer not given													

	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial
Set up													
"Where does it go?"													
Independent response													
Praise and provide reinforcer													

Errors

Demonstration													
Guided trial													
Independent response													
Praise													
Reinforcer not given													

ABLA Level 3 Procedural Integrity/Reliability

Date _____ Participant _____

Tester _____ Observer _____

If completed correctly place a √ If completed incorrectly place an **X**

	Demo	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial
Set up														
Demonstration														
Guided trial														
Independent response														
Praise														

Set up														
Task items in correct position														
"Where does it go?"														
Independent response														
Praise and provide reinforcer														

Errors

Demonstration														
Guided trial														
Independent response														
Praise														
Reinforcer not given														

	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial
Set up														
Task items in correct position														
"Where does it go?"														
Independent response														
Praise and provide reinforcer														

Errors

Demonstration														
Guided trial														
Independent response														
Praise														
Reinforcer not given														

ABLA Level 4 Procedural Integrity/Reliability

Date _____ Participant _____

Tester _____ Observer _____

If completed correctly place a V If completed incorrectly place an **X**

	Demo	Demo	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial
Set up												
Present sample item												
Demonstration												
Guided trial												
Independent response												
Praise												
Set up												
Present sample item												
Task items in correct position												
"Where does it go?"												
Independent response												
Praise and provide reinforcer												
Errors												
Demonstration												
Guided trial												
Independent response												
Praise												
Reinforcer not given												

	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial
Set up												
Present sample item												
Task items in correct position												
"Where does it go?"												
Independent response												
Praise and provide reinforcer												
Errors												
Demonstration												
Guided trial												
Independent response												
Praise												
Reinforcer not given												

ABLA Level 6 - Procedural Integrity/Reliability

Date _____ Participant _____

Tester _____ Observer _____

If completed correctly place a √ If completed incorrectly place an **X**

	Demo	Demo	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial
Set up															
Demonstration															
Guided trial															
Independent response															
Praise															

Set up															
Containers in correct position															
Correct Verbal Prompt															
Independent response															
Praise and provide reinforcer															

Errors

Demonstration															
Guided trial															
Independent response															
Praise															
Reinforcer not given															

	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial	Trial
Set up															
Containers in correct position															
Correct Verbal Prompt															
Independent response															
Praise and provide reinforcer															

Errors

Demonstration															
Guided trial															
Independent response															
Praise															
Reinforcer not given															

Appendix C

Data Sheets for two-choice pre-assessment TASK 2

Subject _____ **Tester** _____ **Observer** _____ **Date**____

Instructions : If response is correct, circle trial number. If response is incorrect, place X on trial number. Continue to place Xs for incorrect responses on the lines below until the student corrects the error. Upon correction, place a checkmark on the next line below, and then move on to the next trial.

Task 2 star and battery

'L' and 'R' indicate correct placement of the star
'b' indicates to present battery.
's indicates to present star.
Ask, "Where does it go? Match"

R	L	R	L	R	R	L	L	R	R	L	L	R	R
s	s	b	b	s	b	s	b	b	s	b	s	s	b
1	2	3	4	5	6	7	8	9	10	11	12	13	14
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–

L	L	R	L	R	L	R	R	L	L	R	L	R	L
b	s	b	b	s	s	b	s	b	s	s	b	b	s
15	16	17	18	19	20	21	22	23	24	25	26	27	28
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–

L	R	L	R	L	L	R	R	R	L	R	L
s	b	s	b	b	s	s	b	s	b	b	s
29	30	31	32	33	34	35	36	37	38	39	40
–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–

8 right in a row (continue numbers, not counting checks during error correction)
That's a PASS. Go to next level.

8 wrong altogether (counting X's on numbers and X's on lines)
FAIL!!! STOP THE WHOLE TEST.

Appendix D

Data Sheets for three-choice pre-assessment Novel 3 choice

Subject _____ **Tester** _____ **Observer** _____ **Date**____

Instructions : If response is correct, circle trial number. If response is incorrect, place X on trial number. Continue to place Xs for incorrect responses on the lines below until the student corrects the error. Upon correction, place a checkmark on the next line below, and then move on to the next trial.

Novel 3 choice bottle, mitten, apple

'b' indicates the bottle
'm' indicates the mitten .
'a indicates the apple.
The bolded letter indicates the sample for that trial.
Ask, "Where does it go? Match"

BMA	BAM	ABM	AMB	MAB	MBA	BAM	BMA	ABM	AMB	MAB	BAM	MAB	BMA
1	2	3	4	5	6	7	8	9	10	11	12	13	14
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–

ABM	AMB	MBA	MBA	BMA	BAM	ABM	AMB	MAB	MBA	BAM	BMA	ABM	AMB
15	16	17	18	19	20	21	22	23	24	25	26	27	28
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–

MAB	BAM	MAB	BMA
29	30	31	32
–	–	–	–
–	–	–	–
–	–	–	–
–	–	–	–
–	–	–	–

8 right in a row (continue numbers, not counting checks during error correction)
That's a PASS. Go to next level.

8 wrong altogether (counting X's on numbers and X's on lines)
FAIL!!! STOP THE WHOLE TEST.

Appendix E

DATA SHEETS FOR MULTIPLE COMPONENT TRAINING PACKAGE 1 – STUDY 1

Participant _____ Location _____
Date _____ Reinforcer _____
Experimenter _____ Observer _____
Stimulus A _____ **Stimulus B** _____

5/5 move up
4/5 move up
3/5 stay
2/5 stay
1/5 move down

TRIAL	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
STIMULUS	A	A	B	A	B	B	A	B	B	A	B	B	A	B	A	A	B	A	A	B
POSITION	L	R	R	L	L	R	L	L	R	R	L	R	R	L	L	R	L	L	R	R
STEP																				
RESPONSE																				

I = INDEPEDENT FP = FULL PROMPT PP = PARTIAL PROMPT E=ERROR

Participant _____ Location _____
Date _____ Reinforcer _____
Experimenter _____ Observer _____
Stimulus A _____ **Stimulus B** _____

5/5 move up
4/5 move up
3/5 stay
2/5 stay
1/5 move down

TRIAL	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
STIMULUS	A	A	B	A	B	B	A	B	B	A	B	B	A	B	A	A	B	A	A	B
POSITION	L	R	R	L	L	R	L	L	R	R	L	R	R	L	L	R	L	L	R	R
STEP																				
RESPONSE																				

I = INDEPEDENT FP = FULL PROMPT PP = PARTIAL PROMPT E=ERROR

Appendix F

PI/PR SHEETS FOR MULTIPLE COMPONENT TRAINING PACKAGE 1 – STUDY 1

Participant _____ Date _____
Location _____ Experimenter _____
Observer _____ Reinforcers _____
Task _____

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Presented correct **blue** board/box																				
Comparison are in the correct left-right position																				
Correct Sample is given																				
S^D: "Where does it go, Match"																				
Prompt given according to prompt delay step																				
IF CORRECT																				
Praise and edible reinforcer is delivered																				
Go to next trial																				
IF INCORRECT																				
Attempt to Block response																				
Say "Where does it go, Match"																				
Prompt the response																				
Say "Where does it go Match"																				
If correct praise go to next trial																				
If incorrect – **go to next trial do not give rf or praise**																				

Appendix G

DATA SHEETS FOR MULTIPLE COMPONENT TRAINING PACKAGE 2 – STUDY 1

Participant ____________ Location ________________________
Date _________________ Reinforcer ______________________
Experimenter ____________________ Observer ________________________
Stimulus A ______________________ **Stimulus B** ______________________

TRIAL	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
STIMULUS	A	A	B	A	B	B	A	B	B	A	B	B	A	B	A	A	B	A	A	B
POSITION	L	R	R	L	L	R	L	L	R	R	L	R	R	L	L	R	L	L	R	R
STEP																				

CIRCLE TRIAL IF CORRECT; MARK X ON TRIAL IF INCORRECT

Participant ____________ Location ________________________
Date _________________ Reinforcer ______________________
Experimenter ____________________ Observer ________________________
Stimulus A ______________________ **Stimulus B** ______________________

TRIAL	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
STIMULUS	A	A	B	A	B	B	A	B	B	A	B	B	A	B	A	A	B	A	A	B
POSITION	L	R	R	L	L	R	L	L	R	R	L	R	R	L	L	R	L	L	R	R
STEP																				

CIRCLE TRIAL IF CORRECT; MARK X ON TRIAL IF INCORRECT

Participant ____________ Location ________________________
Date _________________ Reinforcer ______________________
Experimenter ____________________ Observer ________________________
Stimulus A ______________________ **Stimulus B** ______________________

TRIAL	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
STIMULUS	A	A	B	A	B	B	A	B	B	A	B	B	A	B	A	A	B	A	A	B
POSITION	L	R	R	L	L	R	L	L	R	R	L	R	R	L	L	R	L	L	R	R
STEP																				

CIRCLE TRIAL IF CORRECT; MARK X ON TRIAL IF INCORRECT

Participant ____________ Location ________________________
Date _________________ Reinforcer ______________________
Experimenter ____________________ Observer ________________________
Stimulus A ______________________ Stimulus B ______________________

TRIAL	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
STIMULUS	A	A	B	A	B	B	A	B	B	A	B	B	A	B	A	A	B	A	A	B
POSITION	L	R	R	L	L	R	L	L	R	R	L	R	R	L	L	R	L	L	R	R
STEP																				

CIRCLE TRIAL IF CORRECT; MARK X ON TRIAL IF INCORRECT

Appendix H

PI/PR DATA SHEETS FOR MULTIPLE COMPONENT TRAINING PACKAGE 2 – STUDY 1

Participant _____ Date _____
Location _____ Experimenter _____
Observer _____ Reinforcers _____
Task _____

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Presented correct **red** board/box																				
Comparison are in the correct left-right position																				
Correct Sample is shown																				
S^D: Where does it go, Match																				
Edible placed under the correct object																				
Correct size of S – is used																				

IF CORRECT																				
Praise																				
Go to next trial																				

IF INCORRECT																				
Go to next trial																				

Appendix I

TO MOVE UP A STEP = 10 CONCSCUTIVE CORRECT

DATA SHEETS FOR PROCEDURE TO PROMOTE SCANNING PRIOR TO TRAINING – STUDY 2

Participant _____ Location _____
Date _____ Reinforcer _____
Experimenter _____ Observer _____

Step 1 = all comp big
Step 2 = Sample #2
Step 3 = Sample # 3
Step 4 = Sample # 4

TRIAL	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
STIMULUS	ST	F	SP	F	B	B	ST	SP	ST	F	ST	F	SP	B	ST	SP	SP	B	B	F
STEP																				

CIRCLE TRIAL IF CORRECT; MARK X ON TRIAL IF INCORRECT

-Participant _____ Location _____
Date _____ Reinforcer _____
Experimenter _____ Observer _____

Step 1 = all comp big
Step 2 = Sample #2
Step 3 = Sample # 3
Step 4 = Sample # 4

TRIAL	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
STIMULUS	ST	F	SP	F	B	B	ST	SP	ST	F	ST	F	SP	B	ST	SP	SP	B	B	F
STEP																				

CIRCLE TRIAL IF CORRECT; MARK X ON TRIAL IF INCORRECT

Participant _____ Location _____
Date _____ Reinforcer _____
Experimenter _____ Observer _____

Step 1 = all comp big
Step 2 = Sample #2
Step 3 = Sample # 3
Step 4 = Sample # 4

TRIAL	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
STIMULUS	ST	F	SP	F	B	B	ST	SP	ST	F	ST	F	SP	B	ST	SP	SP	B	B	F
STEP																				

-CIRCLE TRIAL IF CORRECT; MARK X ON TRIAL IF INCORRECT

Participant _____ Location _____
Date _____ Reinforcer _____
Experimenter _____ Observer _____

Step 1 = all comp big
Step 2 = Sample #2
Step 3 = Sample # 3
Step 4 = Sample # 4

TRIAL	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
STIMULUS	ST	F	SP	F	B	B	ST	SP	ST	F	ST	F	SP	B	ST	SP	SP	B	B	F
STEP																				

CIRCLE TRIAL IF CORRECT; MARK X ON TRIAL IF INCORRECT

ST = STAR F = FLOAT SP = SPOON B=BATTERY

TO MOVE UP A STEP = 10 CONCSCUTIVE CORRECT

DATA SHEETS FOR TRAINING PROCEDURE (STUDY 2)

Step 1 = all comp big
Step 2 = Sample #2
Step 3 = Sample # 3
Step 4 = Sample # 4

Participant _____ Location _____
Date _____ Reinforcer _____
Experimenter _____ Observer _____

TRIAL	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
STIMULUS	ST	F	SP	F	B	B	ST	SP	ST	F	ST	F	SP	B	ST	SP	SP	B	B	F
STEP																				
TRIAL	21	22	23	24	25	26	27	28	29	30										
STIMULUS	ST	F	SP	F	B	B	ST	SP	ST	F										
STEP																				

CIRCLE TRIAL IF CORRECT; MARK X ON TRIAL IF INCORRECT

Step 1 = all comp big
Step 2 = Sample #2
Step 3 = Sample # 3
Step 4 = Sample # 4

Participant _____ Location _____
Date _____ Reinforcer _____
Experimenter _____ Observer _____

TRIAL	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
STIMULUS	ST	F	SP	F	B	B	ST	SP	ST	F	ST	F	SP	B	ST	SP	SP	B	B	F
STEP																				
TRIAL	21	22	23	24	25	26	27	28	29	30										
STIMULUS	ST	F	SP	F	B	B	ST	SP	ST	F										
STEP																				

CIRCLE TRIAL IF CORRECT; MARK X ON TRIAL IF INCORRECT

Step 1 = all comp big
Step 2 = Sample #2
Step 3 = Sample # 3
Step 4 = Sample # 4

Participant _____ Location _____
Date _____ Reinforcer _____
Experimenter _____ Observer _____

TRIAL	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
STIMULUS	ST	F	SP	F	B	B	ST	SP	ST	F	ST	F	SP	B	ST	SP	SP	B	B	F
STEP																				
TRIAL	21	22	23	24	25	26	27	28	29	30										
STIMULUS	ST	F	SP	F	B	B	ST	SP	ST	F										
STEP																				

ST = Star ; F = Float; B = Battery; S = Spoon

Appendix J

PI/PR DATA SHEETS FOR PROCEDURE TO SCAN AND LOOK PRIO TO TRAINING – STUDY 2

Participant _____ Date _____
Location _____ Experimenter _____
Observer _____ Reinforcers _____
Task _____

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Correct number of comparisons																				
Comparison in random order																				
Correct sample used (and size)																				
S^D "Where does it go Match"																				
Correct size of S – is used																				
IF CORRECT																				
Praise and give edible																				
Go to next trial																				
IF INCORRECT																				
Go to next trial																				

PI/PR DATA SHEETS STUDY 2 TRAINING

Participant _____ Date _____
Location _____ Experimenter _____
Observer _____ Reinforcers _____
Task _____

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Correct number of comparisons																				
Comparison in random order																				
Correct sample used (and size)																				
S^D "Where does it go Match"																				
IF CORRECT																				
Praise and give edible																				
Go to next trial																				
IF INCORRECT																				
Go to next trial																				

	21	22	23	24	25	26	27	28	29	30
Correct number of comparisons										
Comparison in random order										
Correct sample used (and size)										
S^D "Where does it go Match"										
IF CORRECT										
Praise and give edible										
Go to next trial										
IF INCORRECT										
Go to next trial										

Appendix K

DATA SHEETS FOR STUDY 3

Participant _____ Location _____
Date _____
Experimenter _____ Observer _____
Stimulus A _____ **Stimulus B** _____

5/5 move up
4/5 move up
3/5 stay
2/5 move down
1/5 move down

TRIAL	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
STIMULUS	A	A	B	A	B	B	A	B	B	A	B	B	A	B	A	A	B	A	A	B
POSITION	L	R	R	L	L	R	L	L	R	R	L	R	R	L	L	R	L	L	R	R
STEP																				
RESPONSE																				

I = INDEPEDENT FP = FULL PROMPT PP = PARTIAL PROMPT E=ERROR

Participant _____ Location _____
Date _____
Experimenter _____ Observer _____
Stimulus A _____ **Stimulus B** _____

5/5 move up
4/5 move up
3/5 stay
2/5 move down
1/5 move down

TRIAL	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
STIMULUS	A	A	B	A	B	B	A	B	B	A	B	B	A	B	A	A	B	A	A	B
POSITION	R	L	L	R	R	L	R	R	L	L	R	L	L	R	R	L	R	R	L	L
STEP																				
RESPONSE																				

I = INDEPEDENT FP = FULL PROMPT PP = PARTIAL PROMPT E=ERROR

Participant _____ Location _____
Date _____
Experimenter _____ Observer _____
Stimulus A _____ **Stimulus B** _____

5/5 move up
4/5 move up
3/5 stay
2/5 move down
1/5 move down

TRIAL	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
STIMULUS	B	A	B	B	A	A	A	B	A	B	A	B	A	A	B	B	B	A	B	A
POSITION	R	L	L	R	R	L	R	R	L	L	R	L	L	R	R	L	R	R	L	L
STEP																				
RESPONSE																				

I = INDEPEDENT FP = FULL PROMPT PP = PARTIAL PROMPT E=ERROR

Participant _____ Location _____
Date _____
Experimenter _____ Observer _____
Stimulus A _____ **Stimulus B** _____

5/5 move up
4/5 move up
3/5 stay
2/5 move down
1/5 move down

TRIAL	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
STIMULUS	B	A	B	B	A	A	A	B	A	B	A	B	A	A	B	B	B	A	B	A
POSITION	L	R	R	L	L	R	L	L	R	R	L	R	R	L	L	R	L	L	R	R
STEP																				
RESPONSE																				

I = INDEPEDENT FP = FULL PROMPT PP = PARTIAL PROMPT E=ERROR

Appendix L

PI/PR SHEETS FOR STUDY 3

Participant _____ Date _____
Location _____ Experimenter _____
Observer _____ Reinforcers _____
Task _____

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Comparison are in the correct left-right position																				
S^D: (name of item)																				
Prompt given according to prompt delay																				
IF CORRECT																				
Praise access to selected item																				
Go to next trial																				
IF INCORRECT																				
Attempt to Block response																				
SD: "name the item"																				
Prompt the response																				
S^D"(name item)"																				
If correct praise go to next trial																				
If incorrect – **go to next trial do not give rf or praise**																				