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A Comparison of Methods for Teaching Auditory-Visual Conditional Discriminations to Children with Autism Spectrum Disorders

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A COMPARISON OF METHODS FOR TEACHING AUDITORY-VISUAL CONDITIONAL DISCRIMINATIONS TO CHILDREN WITH AUTISM SPECTRUM DISORDERS

by

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A COMPARISON OF METHODS FOR TEACHING AUDITORY-VISUAL CONDITIONAL DISCRIMINATIONS TO CHILDREN WITH AUTISM SPECTRUM DISORDERS

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Early and intensive behavioral intervention (EIBI) is an approach to treating the behavioral deficits and excesses observed in children with autism spectrum disorders. The magnitude of improvement in the overall functioning of children receiving EIBI has stimulated additional research and widespread clinical dissemination through the publication of EIBI curricular manuals. Many EIBI manuals recommend teaching conditional discriminations using the *simple/conditional method.* Initially, component simple discriminations are taught in isolation and in the presence of a distracter stimulus. Finally, conditional discriminations, which include stimuli previously taught as simple discriminations, are presented to the learner. Although the *simple/conditional method* is often recommended in EIBI curricular manuals, issues of faulty stimulus control and overselectivity may arise as a result of the *simple/conditional method.* As a result, there has been a call for the use of alternative teaching procedures such as the *conditional only method* which involves conditional discrimination training from the onset of intervention. No studies to date have compared *simple/conditional* and *conditional only methods* for teaching conditional discriminations in applied settings.

Therefore, the purpose of the current study was to compare the *simple/conditional* and *conditional only methods* for teaching auditory-visual conditional discriminations to children with autism spectrum disorders. Three children between the ages of 4 and 7 participated in the study. An adapted alternating treatments design was used to compare the two teaching procedures. The results indicated that the *conditional only method* was a more reliable teaching method. In addition, problematic error patterns emerged during training using the *simple/conditional method.* The results are discussed in terms of the implications for current teaching practices in EIBI programs.

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INTRODUCTION

Autism spectrum disorders (ASDs) are pervasive developmental disorders (PDDs) that include autism, Asperger Syndrome, and PDD not otherwise specified (American Psychiatric Association, 2000). The ASDs have similar core features: impairments in reciprocal social interactions and communication skills and stereotypic behavior, activities, or interests. Although not necessary for a diagnosis, individuals with ASDs may also display disruptive, noncompliant, aggressive, or self-injurious behavior. Although there are common characteristics among the ASDs, the behavioral profiles of individuals with ASDs vary widely. For example, an individual with autism may fail to acquire vocal communication skills and display cognitive impairments; whereas, individuals with Asperger Syndrome may have typical communication skills and cognitive abilities but lack the social skills that are expected of their same-aged peers.

Impact of Behavioral Deficits and Excesses

The behavioral deficits and excesses observed in individuals with ASDs can impact the number and quality of opportunities to interact with the environment. Weak communication repertoires may preclude high-quality interactions with others and ultimately reduce opportunities to learn new social and academic skills. Deficits in social skills may interfere with individuals initiating and maintaining meaningful relationships with members of their community. The stimulation of stereotypic behavior may compete with attending and differentially responding to important stimuli in the environment. Noncompliant, aggressive, or self-injurious behavior may lead to restrictive placements in school and living settings which may result in fewer opportunities to learn new skills and develop reciprocal relationships. Overall, these excesses in inappropriate behavior and deficits in adaptive behavior can interfere with or reduce meaningful learning opportunities and social interactions.

Intensive Behavioral Intervention

Early and intensive behavioral intervention (EIBI) is a behavioral approach to educational programming for individuals with ASDs. Intensive behavior intervention involves consistent, comprehensive programming for several years to improve the overall functioning individuals with ASDs (Smith, 1999). The environment is arranged to foster numerous learning opportunities with carefully programmed teaching methods and reinforcement procedures. Multiple areas of functioning are targeted in a developmental sequence to improve several broad behavioral repertoires. Educational targets for EIBI programming often include pre-academic and academic skills, language, social skills, self-help skills, independent play skills, among others.

The University of California Los Angeles (UCLA) Young Autism Project evaluated the short- and long-term outcomes of EIBI programming on the overall functioning for young children with autism (Lovaas, 1987; McEachin, Smith, & Lovaas, 1993). Children were assigned to one of three conditions: 1-on-1 behavioral intervention for 40 hours per week, one-on-one behavioral intervention for 10 or fewer hours per week, or community care (interventions that were available in their local communities). Large improvements in cognitive functioning as determined by intellectual assessment were observed for children assigned to the 40 hour-per-week behavioral intervention condition compared to children assigned to other intervention conditions. Approximately 47% of children in the intensive condition obtained scores on intellectual assessments similar to that of their same-aged, typically developing peers. Another 42% of participants scored within the mild mental retardation range of intellectual functioning. More than 90% of the children receiving EIBI displayed improvements in their overall intellectual functioning. In the two other experimental conditions (i.e., low intensity behavioral intervention, community care), children displayed modest to no improvement in intellectual functioning.

Several outcome studies have demonstrated that children receiving EIBI experience greater gains in intellectual functioning and adaptive behavior compared to children receiving other interventions (see Eikeseth, 2009 for a review). For example, a study by Eikeseth and colleagues (2002, 2007) compared EIBI programming to eclectic treatments for young children with autism. Children in both conditions received approximately 28 hours of services for one year and the number of hours of service gradually reduced over the next two years. A follow-up was conducted three years following the start of intervention. Results indicated that children receiving EIBI services gained an average of 25 points on standard intellectual assessments while students receiving eclectic treatments gained an average of seven points. These results are consistent with other follow-up studies indicated that EIBI programming results in better outcomes than other approaches (e.g., Colorado Health Sciences Program).

The promising results of EIBI in the early studies conducted by Lovaas and his colleagues have led to dissemination and research in the area of EIBI. Evidence of the wide dissemination of EIBI can be observed in the numerous program manuals that are commercially available (e.g., Leaf & McEachin, 1999; Lovaas, 2003; Maurice, Green, & Luce, 1996; Sundberg & Partington, 1998). Although there are several general approaches to EIBI, they share similar features and goals. First, EIBI programs utilize the basic principles of operant conditioning (e.g., reinforcement, extinction, stimulus control) to increase desirable behavior and reduce problem behavior. Second, most EIBI programs focus on teaching small, observable units of behavior with the goal of broadening repertoires across a range of domains (e.g., communication, social, and academic skills). For example, if a conversation repertoire is targeted, it would be broken down and taught in smaller units (e.g., starting a conversation, appropriate body language and facial expressions, responding appropriately during conversation, ending a conversation). Finally, EIBI places a heavy emphasis on teaching individuals to differentially respond and attend to important stimuli in the environment (i.e., discrimination training).

Discriminations

Discrimination training is considered a critical component of EIBI and is used as a primary instruction technique in areas such as matching, sorting, reading, language, and social skills (Smith, 2001). Discrimination training involves differential reinforcement of behavior in the presence of a specific stimulus while withholding reinforcers for the same behavior in the presence of different stimuli. Two broad classes of discrimination skills exist: simple and conditional discriminations (Green, 2001).

Simple Discriminations

A simple discrimination involves a 3-term contingency. First, some type of discriminative stimulus is presented. During simple discrimination training in EIBI programming, discriminative stimuli are often presented in a visual (e.g., picture of an object) or auditory (e.g., a vocal instruction) format. Next, the learner emits or is prompted to emit an appropriate response. Finally, differential consequences are delivered for incorrect and correct responses. That is, in the presence of the discriminative stimulus, a particular response is reinforced and in its absence is not. For example, an early simple discrimination target involves teaching a child to sit in a chair when presented with an instruction to sit down. The discriminative stimulus is presented (e.g., the therapists says, "Sit down"), the child sits in the chair or is prompted to sit, and a putative reinforcer is delivered (e.g., enthusiastic praise and a toy).

Simple discrimination skills are required to complete a number of classroom activities (e.g., lining up for lunch, going to a gender-specific bathroom). As such, simple discrimination training is often needed to establish and maintain appropriate responses during various school-related activities. Simple discrimination skills are integrated into EIBI curricular programming, particularly at the onset of intervention to teach prerequisite behaviors to table work (e.g., coming to the teaching table, looking at the therapist). One common practice within EIBI programming is to train several simple discrimination skills prior to targeting discrimination skills with more complex arrangements of antecedent stimuli (Green, 2001).

Conditional Discriminations

A conditional discrimination involves four components: a sample stimulus, the presentation of an array of comparison stimuli, a response, and a consequence (Saunders & Spradlin, 1989/1990). First, a learning trial is initiated by presenting a sample stimulus. Within the context of EIBI, sample stimuli often consist of visual (e.g., pictures of items) or auditory (e.g., vocal instructions) stimuli. Second, the learner is presented with an array (usually between two and three) of comparison stimuli (e.g., pictures of an apple, banana, and orange). Comparison stimuli are typically presented visually; however, comparisons may be presented in an auditory format (e.g., matching identical sounds). Comparison stimuli are usually presented simultaneously with the sample stimulus. Third, the learner engages in a response (e.g., pointing or touching one of the pictures) or is prompted to respond. Fourth, differential consequences for correct and incorrect responses are provided. Correct responses are typically followed by the delivery of a putative reinforcer (e.g., enthusiastic praise and a small edible item).

Accurate responses during conditional discrimination tasks require several prerequisite repertoires (McIlvane, Dube, Kledaras, Iennaco, & Stoddard, 1990). First, learners must observe and differentially respond to comparison stimuli. Next, learners must attend and differentially respond to the various samples that are presented across teaching trials. In a visual-visual conditional discrimination (i.e., an identity matching task), sample stimuli involve the presentation of an identical or similar visual stimulus to the S+ in the comparison array. In an auditory-visual conditional discrimination (e.g., a receptive labeling task), sample stimuli involve the presentation of an auditory instruction (e.g., "Point to banana") that does not share physical characteristics with the S+. Last, learners must attend to the sample stimulus and subsequently observe and respond to the comparison stimuli (i.e., a successive discrimination). A number of different teaching procedures have been developed; yet, research indicates that children and adults with and without developmental disabilities display difficulties in acquiring conditional discrimination skills despite exposure to several validated teaching procedures (e.g., McIlvane et al.).

Discrimination training is a critical component of many pre-academic and academic skills during early intervention programming (Smith, 2001). The documented difficulties in teaching conditional discriminations have led to a growing area of research that is focused on the development and identification of reliable and efficient teaching procedures for discrimination training. In a recent Internet survey, supervisors of EIBI programs were asked to provide information about the types procedures used to teach discrimination skills (Love, Carr, Almason, & Pettursdottir, 2009). Based on the results of the study, Love and colleagues identified two main approaches to teaching conditional discrimination tasks: the *simple/conditional* and *conditional only methods.* The sampled service providers implemented the *simple/conditional method* most often (approximately 37%) while slightly fewer service providers utilized the *conditional only method* (approximately 32%) as the standard approach to discrimination training across the children in the early intervention clinic. Other providers (i.e., about 31%) implemented either the *simple/conditional* or *conditional only method* depending on the specific repertoire of the child, although the decision rules for choosing a particular method were not evaluated in the survey.

Discrimination Training

The *simple/conditional method* involves component simple discrimination training in a massed-trial format and introduces increasingly difficult discriminations over time (Lovaas, 2003). As mentioned previously, approximately 37% of early intervention programs sampled in the Love et al. (2009) study reported using the *simple/conditional method* as the primary approach to teaching conditional discriminations. The overwhelming majority of the published EIBI curricular manuals recommend the *simple/conditional method* as opposed to other methods for teaching conditional discriminations (e.g., Leaf & McEachin, 1999; Lovaas, 2003; Maurice et al., 1996; Sundberg & Partington, 1998).

A graphical depiction of how the *simple/conditional method* can be applied to teaching a 3-array conditional discrimination is shown in Figure 1.

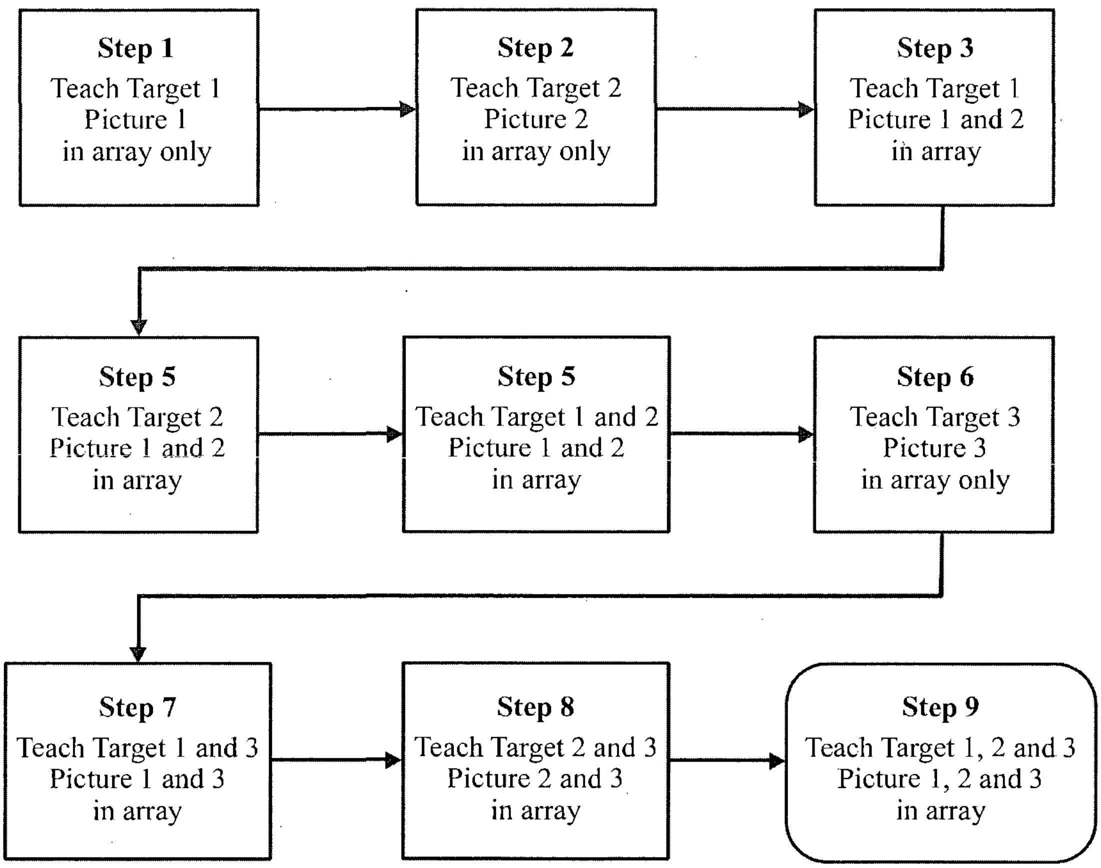


Figure 1. Depiction of the acquisition steps in the *simple/conditional method.*

Steps 1, 2, and 6 consist of teaching the three component simple discriminations in isolation in a massed-trial format. The three component simple discriminations comprise the stimuli included in the final conditional discrimination performance. During simple discrimination training in isolation, one picture or object is placed in front of the learner, an auditory discriminative stimulus is presented (e.g., "Point to ____"), and correct responses are differentially reinforced. Following Steps 1 and 2, Step 3 is introduced in which the stimulus that functioned as the S+ in Step 1 is taught in a massed-trial format in the presence of a nontarget, distracter stimulus (i.e., the stimulus that functioned as the S+ in Step 2). Step 4 involves a reversal of the discrimination taught in Step 3. That is, the S+ in Step 3 functions as the S- and the S- in Step 3 functions as the S+ in Step 4. Steps 5, 7, 8, and 9 involve teaching either a 2- or 3-array conditional discrimination. That is, each stimulus presented as a comparison functions as both an S- and S+ across teaching trials.

The rationale supporting the use of the *simple/conditional method* is straightforward: break down the conditional discrimination task into multiple, easier steps, teach the prerequisite repertoires that are needed to complete the final performance, and gradually increase the task difficulty as the learner acquires the discriminations. Breaking down the conditional discrimination task into smaller components may increase the efficiency with conditional discriminations are acquired. Some previous research supports of the use of the *simple/conditional method* or procedures like it (e.g., the blocked-trial procedure) to teach conditional discriminations (Dube, Iennaco, & McIlvane, 1993; Gutierrez et al., 2009; McIlvane et al., 1990; Saunders & Spradlin, 1989). Breaking down conditional discrimination tasks into smaller components appears to have gained popularity in early intervention clinics from both research support and dissemination in EIBI manuals.

In her discussion of stimulus control technology, Green (2001) noted that a history of the *simple/conditional method* may promote faulty stimulus control during the final stages (e.g., Steps 5, 7, 8, and 9) of discrimination learning, particularly for auditory-visual conditional discriminations. The simple discriminations that are taught in isolation during Steps 1, 2, and 6 do not require differential responding to the array of comparison stimuli or auditory stimuli. Thus, these steps do not explicitly teach any of the prerequisite repertoires for responding accurately during conditional discrimination training (McIlvane et al., 1990). During simple discrimination training in isolation, incidental learning may occur such that the learner observes the auditory discriminative and the correct visual stimulus and relates those stimuli with each other; however, that skill is not directly taught or required. Rather, the individual can respond to the only visual stimulus present, usually a card or object, following the presentation of an auditory discriminative stimulus and still receive the programmed reinforcer. It is possible that a learner could respond correctly during Steps 1, 2, and 6 without observing the specific auditory discriminative stimulus or visual S+ by simply repeating the same response that was reinforced in the preceding trial.

The discrimination task in Steps 3 and 4 is made more difficult by requiring differential responding to the comparison stimuli in order to respond accurately. One potential problem with a learning history that involves Steps 1 through 4 is that the learners may establish a reinforcement history with repeatedly responding to the same visual comparison stimulus without being required to attend to the auditory discriminative stimulus. Thus, the visual stimulus present during previous reinforcer deliveries may come to influence responses rather than the sample stimulus and corresponding visual stimulus, producing faulty stimulus control.

There is some evidence that faulty sources of stimulation may exert control over responses as a function of exposure to the *simple/conditional method.* Lovaas (2003) described several common error patterns that arise during receptive objective identification programs, which teach conditional auditory-visual discriminations. Two types of error patterns, termed "win-stay" responses, may result from a history of the early steps of the *simple/conditional method.* Molar win-stay responses might occur when transitioning from simple discrimination training of a particular stimulus with distracters to either simple discrimination training with a different stimulus or conditional discrimination training (e.g., transitioning from Step 3 to Step 4). Molar win-stay responses are characterized by a disproportionately high percentage of responses to the particular visual stimulus that served as the S+ in the preceding acquisition step. Molar win-stay responses likely result from (a) an immediate reinforcement history involving a particular visual stimulus and (b) the availability of that stimulus as a response option during the subsequent teaching step.

Another type of error, molecular win-stay responses, may also develop as a result of the *simple/conditional method.* Because the auditory discriminative stimulus remains unvaried in Steps 1 through 4 during the *simple/conditional method,* the learner may ignore the auditory sample stimuli in subsequent conditional discrimination training because prior presentations of auditory stimuli were superfluous to the reinforcement contingency. As a result, the visual stimulus present during either response prompting or reinforcer delivery in the preceding trial may come to influence selection responses.

Other error patterns may occur during the *simple/conditional method* due to the arrangement of the comparison stimuli during training. More specifically, the majority of steps in the *simple/conditional method* include an array of two comparison stimuli, which may result in several error patterns (e.g., position bias). In addition, the schedule of reinforcement (i.e., variable-ratio [VR] 2) associated with many types of error patterns during a 2-array discrimination procedure may support the maintenance of those error patterns over time because the schedule is relatively dense (Kangas & Branch, 2008; MacKay, 1991).

The *conditional only method* is an alternative training procedure suggested by Green (2001). Component simple discriminations are not targeted prior to conditional discrimination training. Rather, all target stimuli, usually three, are presented during conditional discrimination training. That is, all three stimuli function as both the correct and incorrect stimulus across training trials. The specific conditional stimulus is quasi-randomly rotated such that all three stimuli are targeted within the same session. The rationale behind this procedure is to start out with a preparation that requires the prerequisite behavior required to respond correctly during conditional discrimination training (i.e., attending and differential responding to the auditory conditional stimulus and scanning the array of comparison stimuli). Individuals may be more likely to engage in consistent error patterns (e.g., position biases, win-stay responses) during the *simple/conditional method* because the schedule of reinforcement for a particular error pattern is leaner in the *conditional only method* compared to the *simple/conditional method* (i.e., VR3 versus VR2). If the schedule of reinforcement does not support the maintenance of a particular error pattern, engrained faulty stimulus control might be less likely. Acquisition may occur more rapidly despite the level of difficulty involved in a 3-array conditional discrimination if error patterns are less likely and the appropriate antecedent stimuli (i.e., auditory sample stimulus and corresponding visual stimulus) come to exert stimulus control over responses.

Several studies in the basic literature indicate that training component simple discriminations may enhance the subsequent acquisition of conditional discriminations, particularly for learners who have struggled with acquiring conditional discriminations in the past (Dube, Iennaco, & McIlvane, 1993; McIlvane et al., 1990; Saunders & Spradlin, 1989). Although there is support in the literature for the practice of breaking down conditional discriminations into smaller, component steps (e.g., blocked-trial method), the *simple/conditional method* described by EIBI manuals varies from the previously successful training procedures in the basic literature in several ways.

First, the *simple/conditional method* involves both simple discrimination training in isolation (Steps 1, 2, and 6) and in the presence of distracter stimulus (Steps 3 and 4) whereas simple discrimination training in previous basic studies (e.g., Dube et al., McIlvane et al.) was always conducted in the presence of a distracter stimulus. Given that training component simple discriminations in isolation does not systematically teach any of the prerequisite behaviors to learn conditional discriminations, extended training in isolation may be questionable. Second, the function of the various comparison stimuli were rapidly changed within the teaching session during the blocked-trial method while changes to the function of the stimuli occur more gradually in the *simple/conditional method* (i.e., across acquisition steps). Third, the distracter stimuli utilized in several of the basic studies varied within and across sessions. That is, no specific stimulus was associated with the S- during simple discrimination training with distracters. In comparison, the blocked-trial method and the *simple/conditional method* utilizes the same group of two to three stimuli throughout training. Furthermore, simple discrimination training in the presence of distracter stimuli in a massed-trial format may overly train attention to visual comparison stimuli and interfere with responses coming under control of both the auditory sample stimulus and corresponding comparison stimulus in later conditional discrimination training. Thus, there is a loose conceptual link between the *simple/conditional method* used in applied settings and procedures employed in basic studies of stimulus control during discrimination training. However, it is unknown how the specific changes to the approach employed in basic studies impact conditional discrimination acquisition in applied settings.

Gutierrez and colleagues (2009) conducted one of few studies evaluating the impact of different types of simple discrimination training on subsequent conditional discrimination training in applied settings. Three children with a previous diagnosis of an ASD participated in the study. Several unknown targets were selected for each participant. Half of the unknown targets were first exposed to simple discrimination in isolation. Next, the previously mastered simple discriminations in isolation were trained in the presence of a distracter stimulus. The other half of the unknown targets was trained in a simple discrimination format in the presence of distracter stimuli from the onset of training. It should be noted that the distracter stimuli never functioned as the S+ during subsequent conditional discrimination training. Following both training methods, previously taught component simple discriminations were targeted in a conditional discrimination format. That is, each of the stimuli in the 2-array conditional discrimination functioned as both the S+ and S- across teaching trials. The authors noted that fewer sessions were required to meet a mastery criterion when target stimuli were taught in the presence of distracter stimuli (i.e., without isolation training).

Gutierrez et al. (2009) noted that the increased number of sessions required to meet the mastery criterion in the *simple/conditional method* was likely a result of the additional teaching steps inherent in the procedure rather than the procedure itself hindering learning in some way. The results of the study conducted by Gutierrez and colleagues may provide some preliminary evidence that Steps 1, 2, and 6 of the *simple/conditional method* may not build necessary prerequisite behaviors for learning conditional discriminations nor enhance future learning. As mentioned previously, the *conditional only method* is a widely used procedure for teaching conditional discriminations in early intervention programs (Love et al., 2009). Compared to the *simple/conditional method,* the *conditional only method* may promote appropriate stimulus control during conditional discrimination training and decrease the likelihood of error patterns that interfere with acquisition. To date, no published studies have compared the effectiveness and efficiency of the *simple/conditional* and *conditional only methods* for teaching conditional discriminations to children with ASDs. Therefore, the purpose of the current study was to compare the efficiency of the *simple/conditional* and *conditional only* for teaching auditory-visual conditional discriminations to children with ASDs.

CHAPTER II

METHOD

Participants and Setting

Three children with a previous diagnosis of an ASD participated in the study. Participants were recruited from schools serving children with ASDs and regional EIBI service providers. Parental permission and child assent were obtained prior to the study. The recruitment and experimental procedures were approved by Western Michigan University's Human Subjects Institutional Review Board (see Appendix A).

Erin was 7 years of age and had been previously diagnosed with pervasive developmental disorder-not otherwise specified. Erin spoke in full sentences and could independently complete most daily living skills expected of her same-aged peers. Erin attended a first-grade general education classroom for most of her school day and received additional out-of-classroom instruction for approximately two hours in reading and math skills. Erin also received approximately 5 to 10 hours of EIBI each week. Erin had a history of difficulties with acquiring auditory-visual conditional discriminations. Erin had previous exposure to both of the teaching methods that were evaluated in the study. Sessions were conducted in an unused room in of Erin's home. The room was located in the finished basement and contained a work table, two to three chairs, a couch, and a computer desk.

Shane was 4 years of age at the time of the study and had been previously diagnosed with autism. Shane communicated using gestures (e.g., leading people to preferred items, pointing) and several spoken words (e.g., pretzels, juice, water). Shane needed assistance to complete several daily living activities that were expected of his typically developing same-aged peers. Shane attended a preschool for children with developmental disabilities for half of his school day and received an additional 15 hours of EIBI each week in his home. Shane had a brief history (i.e., six months) with the *simple/conditional method* in his preschool program prior to the study. Sessions were conducted in the a finished room in the basement that contained a table, two to three chairs, and several play activities (e.g., indoor swing, sand table).

Devin was 4 years of age and had been previously diagnosed with autism and disruptive behavior disorder not otherwise specified. Devin communicated using 3- to 4-word utterances. He attended an early intervention program for approximately 20 hours per week. Devin had a brief history (i.e., three months) with the blocked-trial procedure and the *conditional only method* at his early intervention clinic prior to the study. Sessions were conducted in a small, treatment room at Devin's early intervention clinic. The room was equipped with a small table, two to three chairs, and a small bookcase.

Inclusion in the study required that participants (a) exhibit little or no severe problem behavior, (b) tolerate physical contact, (c) display a matching repertoire, and (d) need additional training in auditory-visual conditional discriminations (e.g., receptive labeling of objects). Participants were considered tolerant of physical contact if light physical contact (e.g., a pat on the back) from an experimenter did not result in indicators of stress such as physical resistance or crying.

Assessment of Basic Learning Abilities

The Kerr Meyerson Assessment of Basic Learning Abilities (ABLA; Martin, & Yu, 2000) was conducted prior to teaching sessions to ensure that each participant displayed a matching repertoire as required by the inclusion criteria. The procedures used in the current study were based on those described by DeWiele and Martin, 1998. The ABLA is designed to assess a variety of discrimination skills such as position, visual-visual, and auditory-visual discriminations. Level 1 assessed the participant's ability to imitate experimenter-delivered model prompts. The experimenter placed a red box in front of the child and then placed a small piece of white foam into the container. The experimenter then removed the foam from the box and delivered an instruction for the child to complete the same response ("Put in").

Level 2 assessed the participant's simple visual discrimination skills based on position, color, shape, and size. The experimenter placed a yellow can on the left and a red box on the right in front of the participant and the position of those containers remained constant. The experimenter provided an initial model prompt to put the piece of foam in the yellow can on the left and delivered instructions to do the same (i.e., "Put in").

Level 3 was similar to Level 2 with except that the position of the containers was semi-randomly rotated between the left and right positions across trials. The experimenter provided an initial model of putting a piece of foam into the yellow can, regardless of the position of the can. Level 3 assessed the participant's ability to complete simple visual discriminations by color, shape, and size by rotating the position of the yellow can and measuring correct responses to the yellow can.

During Level 4, a visual-visual conditional discrimination task (i.e., a matching task) was presented to the participant. The experimenter placed a yellow can and a red box in semi-random, left-right positions and modeled putting the small yellow cylinder in the yellow can and putting a small red block into the red box. Then, the experimenter presented the participant with either the yellow cylinder or red block and gave the instruction, "Put in". The presentation of the yellow cylinder and red block was semi-randomly rotated. Level 4 assessed the participant's ability to complete conditional visual-visual discriminations by color, shape, and size (i.e., matching similar items) by semi-randomly rotating the position of the yellow can and red box and the presentation either the yellow cylinder or red block. Level 5 was included in earlier versions of the ABLA; however, this level was since been excluded from the ABLA and, thus, and was not included in the current assessment.

Level 6 involved an auditory-visual conditional discrimination task (i.e., spoken word to object discrimination). The procedures were similar to Level 4 with a few exceptions. First, the experimenter modeled putting the small yellow cylinder in the yellow can after the auditory instruction, "Yellow" and putting a red block in the red box following the auditory instruction, "Red". In addition, the yellow cylinder and red block were both concurrently available. The experimenter semi-randomly presented the instructions "Yellow" and "Red". Level 6 assessed the participant's ability to complete conditional auditory-visual discriminations based on color, shape, and size. This was accomplished by semi-randomly rotating the positions of the yellow can and red block and auditory sample stimuli.

For the purposes of this study, participants were included if they could complete the skills that were required during Levels 4 or 6. The results of the ABLA indicated that all participants had a matching repertoire and could complete the tasks included in all ABLA levels.

Reinforcer Identification

Prior to the beginning of the study, the Reinforcer Assessment for Individuals with Disabilities (RAISD; Fisher, Piazza, Bowman, & Amari, 1996) was distributed to the parents of each participant. The RAISD contains questions about a variety of potential reinforcers including social consequences (e.g., praise, tickles), foods, and activities. A list of 9 to 12 items (e.g., preferred food and toys) was generated from the RAISD and those items were subsequently evaluated in a paired-stimulus preference assessment.

The paired-stimulus preference assessment is a selection-based assessment commonly used to identify a hierarchy of preferred items (Fisher et al., 1992). During the assessment, the experimenter presented two stimuli in front of the participant and delivered the instruction, "Pick one". The experimenter provided brief access (i.e., 30 s) to the selected food or activity and removed the unselected stimulus at which point another stimulus pair was presented. The experimenter presented pairs of stimuli until each stimulus was presented with every other stimulus. The goal of the paired-stimulus preference assessment was to identify several highly preferred items that would be subsequently evaluated in a brief preference assessment prior to each teaching session.

A brief multiple-stimulus (without replacement) preference assessment (MSWO; DeLeon & Iwata, 1996) was conducted prior to each session with the top four or five items identified from the paired-stimulus preference assessment (see Table 1). The purpose of the brief MSWO was to control for potential fluctuations in the participants' preference across sessions by providing opportunities to choose reinforcers prior to each teaching session. The activities or foods evaluated in the MSWO were placed in front of each of the participant and the experimenter instructed the participant to "Pick one". The experimenter delivered the selected item or activity and the participant was allowed to consume the food or interact with the activity for 30 s. The selected item was then removed from the array and the remaining stimuli were rearranged and re-presented to the participant. This process was repeated until all of the activities or foods were selected. The food or activity that was selected first was used as the putative reinforcer in the subsequent teaching session.

Table 1

Top stimuli selected during the paired-stimulus preference assessment and subsequently included in the multiple-stimulus preference assessment

Participant	Food	Activity
Erin	________	Board game, cat figurine set, Legos®, manicure set, Playdoh®
Shane	Brownie, cranberries, cookies, Nerds®, pretzels	________
Devin	Cookies, fruit snacks, jelly beans, rice crispy treats	________

Response Definitions

A paper-and-pencil method was used to score a number of participant responses during each trial of a 9-trial "session". An *independent correct response* was scored if the participant pointed to the correct visual stimulus within 5 s of the presentation of the sample stimulus without errors (e.g., touching two visual stimuli simultaneously) or experimenter-delivered prompts. A *prompted correct response* was scored if the participant pointed to the correct visual stimulus following a experimenter-delivered prompt. The specific prompt that occasioned behavior during each trial was noted on the data collection sheet. *No response* was scored if the participant failed to point to a stimulus within 5 s following the presentation of the auditory sample stimulus. The position of the first response (prompted or unprompted) during each trial was noted on the data sheet.

The primary dependent variable was the *number of sessions* required to meet the mastery criterion for the 3-array conditional discrimination in each experimental condition. To meet the mastery criteria in Steps 1 through 8 of the *simple/conditional method*, the participants were required emit independent correct responses for eight of the nine trials in the session. The participants were also required to accurately respond during the first presentation of each stimulus. If this criterion was not added, it would have been possible for a participant to master a step if he or she responded incorrectly during the first trial and repeated the prompted responses for the remaining eight trials. The mastery criterion for Step 9 of the *simple/conditional method* and the *conditional only method* was three consecutive sessions with 100% independent, correct responses. The overall number of sessions to meet the mastery criterion for each training set in each evaluation across participants was compared in a bar graph.

Training Sets

All three stimuli in each training set were associated with 33% or less accuracy during baseline probes. The exemplars included in the training sets were selected based on the participants' goals in either their individualized education plan or early intervention program. Receptive labeling tasks were identified and selected depending on whether an individual had the preexisting repertoire necessary to complete the task. For example, receptive identification of specific food and toy items is required before categories of items (e.g., food and toys) can be taught. Therefore, an evaluation including receptive identification of items would be conducted before receptive identification of categories of items.

A total of 18 stimuli were selected for Erin and Shane and 12 stimuli were selected for Devin. For each evaluation, three tasks were assigned to both the *simple/conditional* and *conditional only methods*. That is, a total of six stimuli were taught during each comparative evaluation. Overall, three within-participant evaluations were conducted for Erin and Shane and two evaluations were conducted for Devin. The specific exemplars that were taught in the study are displayed in Table 2.

Table 2

Exemplars taught using the *conditional only* and *simple/conditional methods* during each evaluation for all participants

Participant/ Evaluation		*Conditional Only*	*Simple/Conditional*
Erin			
	One	Aardvark, Gazelle, Hedgehog	Bison, Lemur, Warthog
	Two	Crane, Elk, Squid	Newt, Sloth, Yak
	Three	Asia, Australia, S. America	Africa, Antarctica, Europe
Shane			
	One	F, J, M (letter name)	B, S, T (letter name)
	Two	Africa, Antarctica, Europe	Asia, Australia, S. America
	Three	D, K, L (sounds)	G, H, R (sounds)
Devin			
	One	Bathing, Coloring, Dancing	Catching, Giving, Sitting
	Two	C, G, O (letter name)	M, V, W (letter name)

The experimenter attempted to equate the training sets by selecting similar types of tasks for the evaluation. In addition, the stimuli in the training sets were grouped such that the auditory sample stimuli contained the same number of syllables and were as distinct as possible. One exception to this occurred in Devin's second evaluation. Highly similar visual stimuli were targeted within the training set as Devin had a history of incorrect responses with these particular stimuli.

Materials

Stimuli (e.g., pictures of objects) were printed on 8.5 in (21.59 cm) x 11 in (27.94 cm) sheets and placed in clear page protectors to create a trial sheet. For Erin and Shane, trial sheets were placed in a 3-ring binder and presented to the learner in a horizontal fashion. Due to Devin's disruptive behavior with the stimulus binder (e.g., pulling out pages, ripping or crinkling pages), single trials sheets were presented horizontally. A darkly colored sheet was placed on top of each trial sheet to (a) prevent the participant from viewing the visual comparison stimuli prior to the delivery of the auditory sample stimulus and (b) provide an opportunity for the child to complete a differential observing response which is described in more detail later.

One to three stimuli were printed on a trial sheet depending on the experimental condition and acquisition step. The *simple/conditional method* binder contained trial sheets with one to three printed stimuli depending on the acquisition step. The *conditional only method* condition binder always contained trial sheets with three printed stimuli. Regardless of the experimental condition, the trial sheets were pre-printed and arranged in the order in which they were presented during the session.

Baseline Probes

The experimenter conducted baseline probes of potential target stimuli for the subsequent evaluations. During baseline, the participant was presented with an array of three pictures and then instructed to complete a differential observing response. The purpose of the differential observing response was to require the participant to attend to the visual comparison stimuli on the trial sheet prior to the delivery of the auditory sample stimulus. For Erin and Shane, darkly colored sheets were placed between each trial sheet in a 3-ring binder. Erin and Shane were instructed to turn the sheet over to expose the trial sheet. A least-to-most prompting procedure was used to facilitate independent, differential observing responses over time. If Shane or Erin did not attend to the comparison stimuli after turning over the sheet, the experimenter placed their own finger directly over the stimulus in the left position. The experimenter moved their finger in a left-to-right fashion over the area directly above the printed visual stimuli and instructed the participant to "Look".

Devin's observing response was slightly altered by removing the requirement to turn the pages due to the disruptive behavior that occurred with the binder of stimuli. Rather than presenting the sheets in a binder, stimuli were presented as single sheets for each trial. A darkly colored sheet was placed over the trial sheet and Devin was instructed to point to the sheet and a least-to-most prompting procedure was used to promote independent differential observing responses. The experimenter removed the colored sheet immediately after the observing response. Additional procedures such as tapping near the stimuli or holding the trial sheet at eye level and pointing to the stimuli were occasionally needed to evoke observing responses for all of the participants. Each participant was required to attend to each comparison stimulus for at least 1 s prior to the delivery of the auditory stimulus.

Following the observing response, the experimenter presented the appropriate auditory stimulus (e.g., "Point to lemur") and provided a 5 s opportunity to respond. Regardless of whether the response was correct or incorrect, the experimenter removed the stimuli and did not provide consequences for correct or incorrect responses. Stimuli were selected if accuracy was 33% or less during a 3-array conditional discrimination format. If the participant responded to a given stimulus with greater than 33% accuracy, the stimulus was removed from consideration for the evaluations.

General Teaching Procedures

A trial was initiated by instructing the participant to complete the same differential observing response that was previously described. Next, the experimenter presented the appropriate auditory stimulus and waited 5 s for the participant to respond. If the participant made an error or did not respond within 5 s, a least-to-most prompt hierarchy was initiated (Horner & Keilitz, 1975). The hierarchy of prompts included two levels of model prompts and a physical prompt. The less intrusive model prompt involved the experimenter pointing within 3 in (7.62 cm) from the top of the correct visual stimulus. The more intrusive model prompt involved the experimenter pointing within 1 in (2.54 cm) from the top of the correct stimulus. The experimenter provided opportunities to respond following the initial presentation of the auditory stimulus and delivered increasing assistance if an error occurred or 5 s elapsed without a response. All prompts in the hierarchy were simultaneously presented with the appropriate auditory sample stimulus. Enthusiastic praise and access to a small piece of food (Shane and Devin) or one sticker (Erin) was provided for independent, correct responses during teaching trials. When Erin accumulated 20 stickers, she was given a choice between selecting an activity and playing for 5 *min* or saving the activity time and adding it to a future break. Erin chose to select an activity and play immediately after the 20 stickers were accumulated for the majority of opportunities to play. Erin's token reinforcement system was identical to the reinforcement program used in her EIBI program.

Simple/Conditional Method

The *simple/conditional method* was based on procedures described by Lovaas (2003). For the purposes of this study, the procedures outlined by Lovaas

(2003) were modified by removing the position prompt fading that is recommended for each teaching step. Rather than using position prompts, least-to-most and most-to-least prompting procedures were used as stimulus control transfer procedures during the study. The general teaching procedure involved a series of nine steps (see Figure 1 for a visual depiction of the teaching steps).

During Step 1, the first component simple discrimination was taught in isolation. For example, the experimenter placed a picture of a dog in front of the participant and instructed him to, "Point to dog". Step 2 was identical to Step 1 except training was conducted with second stimulus (e.g., a picture of a cat). Step 3 entailed simple discrimination training with the stimulus targeted in Step 1 in the presence of a distracter stimulus. For example, the experimenter placed a picture of a dog and cat in front of the participant and instructed the participant to point to the dog. Step 4 was similar to Step 3 except that the participant was instructed to point to the stimulus targeted in Step 2. For example, the experimenter placed a picture of a dog and cat in an array and provided instructions to respond to the cat.

The first conditional discrimination was targeted in Step 5. Both of the previously introduced stimuli functioned as the S+ and S- across trials. For example, the experimenter placed a picture of a dog and cat in front of the participant and semi-randomly rotated between providing instructions to respond to the dog and cat. Step 6 involved simple discrimination training in isolation for the third and final stimulus. For example, the experimenter placed a picture of a fish in front of the learner and provided the instruction, "Point to fish". Step 7 was identical to Step 5 except that a 2-array conditional discrimination was targeted for the first and third stimulus introduced. For example, pictures of a dog and fish were presented to the participant and the experimenter rotated between instructions to point to the dog and fish. Step 8 was similar to Step 7 except that 2-array conditional discrimination training was conducted with the second and third stimulus that was introduced. Step 9 consisted of a 3-array conditional discrimination of all three stimuli that were previously introduced. For example, pictures of a cat, dog, and fish were presented in an array and the experimenter semi-randomly rotated between providing instructions to respond to the cat, dog, and fish across the teaching trials.

If a simple discrimination in isolation (i.e., Steps 1, 2, and 6) was targeted for a trial, the placement of the stimulus was semi-randomly rotated between the left, middle, and right positions on the trial sheet. If a simple discrimination with a distracter (i.e., Steps 3 and 4) or a 2-array conditional discrimination (i.e., Steps 5, 7, and 8) was targeted, the stimuli were placed on the trial sheet such that the correct stimulus was semi-randomly rotated between the left and right positions on the trial sheet. For 3-array conditional discrimination, the correct stimulus was semi-randomly rotated between the left, middle, and right positions.

Conditional Only Method

The procedures were identical to Step 9 of the *simple/conditional method.* That is, a 3-array conditional discrimination was targeted from the onset of training. The correct visual comparison stimulus was semi-randomly rotated between the left, middle, and right positions. The experimenter quasi-randomly rotated between providing instructions to point to each stimulus in the training set. The *conditional only method* in this study varied from the procedure recommended by Green (2001) in that a least-to-most prompting procedure rather than an errorless procedure was used as the prompt fading method.

Additional Procedures

In some cases, the *simple/conditional* and the *conditional only methods* were insufficient in teaching the training sets. In those situations, additional procedures were implemented and the selection of the specific additional procedure was based on within-session patterns of responses during training. A more detailed description of the rationale for the additional procedures is provided in the description of the error analyses.

Repeated Auditory Stimulus Presentations + Additional Observing Response + Error Correction (RAS + EC)

Based on patterns of errors in the *simple/conditional method* during Evaluations 2 and 3 for Erin, the experimenter hypothesized that the auditory sample stimuli had not gained sufficient stimulus control over selection responses when presented with visual comparison stimuli. Instead, Erin's responses were influenced by the specific visual stimulus correlated with reinforcement in either the previous phase or trial. Given Erin's pattern of responding, an intervention package was designed to increase the likelihood that Erin would attend to the auditory sample stimulus and differentially respond to the visual comparison stimuli correlated with the specific sample stimulus. Previous research indicates that error correction may result in more rapid acquisition of discrimination skills (Rodgers & Iwata, 1991; Smith, Mruzek, Wheat, & Hughes, 2006). Error correction was added to the teaching procedures to increase the likelihood that Erin responded to the correct stimulus and to establish a history of reinforcement for responses to the correct stimulus.

Following the initial delivery of the sample stimulus, Erin was instructed to emit a vocal observing response (i.e., repeat the auditory sample stimulus) to ensure that she attended to the auditory sample stimulus. Immediately after the vocal observing response, the experimenter presented the comparison stimuli and re-presented the sample stimulus. Due to the transience of auditory sample stimuli, the experimenter also delivered additional presentations of the auditory stimulus every 2 s following Erin's observing response. The purpose of repeating the auditory sample stimulus was to increase the salience of the auditory stimulus (Green, 2001). In addition, if an error occurred during the trial, Erin was prompted to emit the correct response and the trial was re-initiated. This process continued until Erin emitted one independent, correct response. Independent, correct responses during error correction resulted in the delivery of a putative reinforcer (i.e., a sticker).

Most-to-Least Prompting

During Evaluations 2 and 3 for Shane, the prompting procedure was changed from least-to-most prompting to most-to-least prompting or two reasons. First, low levels of accuracy led to an overall reduction in the number of reinforcers earned during the session. During sessions in which a large proportion of responses were not reinforced with food items, Shane engaged in mild to moderate problem behavior including elopement from the work context, self-biting, and aggressive behavior. A previous functional analysis from Shane's early intervention program indicated that problem behavior was maintained by access to food and toys (i.e., positive reinforcement in the form of tangibles). A most-to-least prompting procedure was employed to increase accuracy of responses, thereby increasing access to food in an attempt to reduce problem behavior. Second, a higher proportion of responses were allocated to particular positions during teaching which may have interfered with the acquisition of the conditional discrimination. Overall, most-to-least prompting was implemented to increase access to reinforcers for correct responses to reduce problem behavior and to build a history of responding to all of the comparison positions in an attempt to reduce the side bias.

The most-to-least prompting procedure was identical to the previously mentioned procedure with the exception of the order of prompts. The initial teaching session during most-to-least prompting involved hand-over-hand guidance to point to the S+ following each auditory sample stimulus. All physically guided responses were reinforced. Physical prompts were used to reduce or eliminate errors and establish a reinforcement history with correct responses. A least-to-most probe was conducted after the first session with physical guidance to determine if the prompt level could be faded. During least-to-most probes, independent, correct responses were differentially reinforced. The least intrusive prompt that occasioned the highest proportion of correct responses during the least-to-most probe was subsequently used as the most intrusive prompt during two subsequent most-to-least teaching sessions. If a less intrusive prompt was identified in the least-to-most probe, responses that followed more intrusive prompts were no longer reinforced in subsequent most-to-least prompting sessions. For example, if the participant completed a most-to-least prompting session with hand-over-hand guidance, a least-to-most session was conducted. If a model prompt was effective in evoking correct responses during the least-to-most probe, physically guided responses were no longer reinforced during subsequent sessions using most-to-least prompting. The prompt level that evoked correct responding for the majority of the sessions was used as the most intrusive prompt during two additional most-to-least prompting sessions. Another least-to-most probe was conducted to determine if the intrusiveness of the prompts could be faded. The process was repeated until prompts were faded and the mastery criterion was met.

Additional Observing Response

During Evaluation 2, Shane required extensive (i.e., approximately three per trial) prompts to attend to the visual comparison stimuli following the standard differential observing response. Previous research has evaluated the use of differential observing responses to promote attendance to sample stimuli during discrimination training (e.g., Dube & McIlvane, 1999; Walpole, Roscoe, & Dube, 2007). Thus, an additional observing response was added prior to the delivery of the auditory sample stimulus and comparison stimuli to increase attendance to the comparison stimuli. The experimenter presented a darkly colored sheet on top of a trial sheet at Shane's eye level in a vertical format. The experimenter instructed Shane to pull the darkly colored sheet from the trial sheet to expose the visual stimuli. A least-to-most prompting procedure was used to facilitate independent, accurate observing responses over time.

Maintenance

Baseline probes were conducted three weeks following mastery of each training set. The purpose of the baseline probes was to assess the maintenance of the 3-array conditional discrimination over time. A maintenance probe was not conducted for the stimuli in the *simple/conditional method* for Shane's third evaluation due to the failure in meeting the mastery criterion.

Experimental Design

An adapted alternating treatments design (Sindelar, Rosenberg, & Wilson, 1985) was used to compare discrimination learning during the *simple/conditional* and *conditional only methods*. Between two and three within-participant evaluations were conducted for each participant. The primary dependent variable was the number of teaching sessions required to *teach* the 3-array conditional discrimination for the *simple/conditional* and *conditional only methods.* The secondary dependent variable was the percentage of independent responses during teaching sessions using the *simple/conditional* and *conditional only methods.*

Interobserver Agreement

Data were collected on several learner responses by a second, independent observer. Measures included whether responses were independent or prompted and the location of the first response during each trial. If a response was prompted, the data collectors noted the specific prompt that evoked a correct response. An agreement was defined if both observers coded (a) either a correct, prompted, or non-response for a particular trial and (b) the same location of the first response in each trial and (c) the same visual stimulus for the first response. A disagreement was coded during trials in which observers scored any of the participant's responses differently from each other. Point-by-point agreement was calculated by dividing the number of agreements in a session by the number of agreements and disagreements (i.e., nine) and multiplying by 100. Across all evaluations for each participant, agreement on all learner responses met or exceeded acceptable limits. Table 3 depicts the percentage of sessions with interobserver agreement measures and the corresponding mean agreement with a range of agreement scores across experimental conditions.

Treatment Integrity

An independent observer recorded the experiment's implementation of the following: (a) each type of prompt, (b) the order in which prompts should have

Table 3

Percentage of sessions in which interobserver agreement was assessed, mean agreement scores, and the range of agreement scores for each participant across evaluations and condition types

	Simple/Conditional Method		Conditional Only Method		Modified Procedure I				Modified Procedure II			
					Simple/Conditional		Conditional Only		Simple/Conditional		Conditional Only	
Participant	Percentage (%) of trials assessed	Mean agreement % (range)	% of trials assessed	Mean agreement % (range)	% of trials assessed	Mean agreement % (range)	% of trials assessed	Mean agreement % (range)	% of trials assessed	Mean agreement % (range)	% of trials assessed	Mean agreement % (range)
Erin												
One	63	99 (78-100)	63	98 (78-100)	—	—	—	—	—	—	—	—
Two	51	98 (89-100)	52	100.0	65	100.0	—	—	—	—	—	—
Three	37	98 (67-100)	39	97.9 (67-100)	67	99 (78-100)	—	—	—	—	—	—
Shane												
One	85	99 (89-100)	77	100	—	—	—	—	—	—	—	—
Two	69	98 (89-100)	64	98 (89-100)	38	96 (89-100)	33	100	33	97 (78-100)	40	100
Three	44	99 (89-100)	35	96 (89-100)	42	98 (89-100)	—	—	—	—	—	—
Devin												
One	39	98 (78-100)	35	98 (89-100)	—	—	—	—	—	—	—	—
Two	32	97 (78-100)	33	99 (89-100)	—	—	—	—	—	—	—	—

occurred, (c) the response interval following prompts, (d) consequences for correct and incorrect responses, and (e) the differential observing response. Additional treatment integrity measures were gathered for Erin during Evaluations 2 and 3 and included the proper implementation of (a) instructing the participant to complete a vocal differential observing response (i.e., repeating the name of the stimulus prior to pointing to the visual stimulus), (b) additional deliveries of the auditory sample stimulus, and (c) the error correction procedure. Additional treatment integrity measures were coded for Shane and included the correct implementation of (a) an additional differential observing response (Evaluation 2) and (a) a most-to-least prompting procedure (Evaluations 2 and 3).

A trial was scored as correct if all treatment integrity measures were implemented as specified by the research protocol. A trial was scored as incorrectly implemented if any of the treatment integrity measures were scored as incorrect by either observer. The percentage of correctly implemented trials was calculated by dividing the number of correctly implemented trials by the total number of trials (i.e., nine) and multiplying by 100. Treatment integrity measures met or exceeded acceptable limits. Table 4 depicts the percentage of sessions with measures of treatment integrity and the corresponding mean and range of integrity scores across the experimental conditions.

Interobserver Agreement on Treatment Integrity Measures

A second, independent observer collected data on all treatment integrity measures for each participant. An agreement was defined as both observers scoring a given trial as correctly or incorrectly implemented. A disagreement was scored in a

Table 4

Percentage of sessions in which treatment integrity was assessed, mean treatment integrity scores, and the range of treatment integrity scores for each participant across evaluations and condition types

	Simple/Conditional Method		Conditional Only Method		Modified Procedure I				Modified Procedure II			
					Simple/Conditional		Conditional Only		Simple/Conditional		Conditional Only	
Participant	Percentage (%) of trials assessed	Mean treatment integrity % (range)	% of trials assessed	Mean treatment integrity % (range)	% of trials assessed	Mean treatment integrity % (range)	% of trials assessed	Mean treatment integrity % (range)	% of trials assessed	Mean treatment integrity % (range)	% of trials assessed	Mean treatment integrity % (range)
Erin												
One	63	99 (89-100)	63	100	—	—	—	—	—	—	—	—
Two	51	98 (89-100)	52	98 (78-100)	65	97 (89-100)	—	—	—	—	—	—
Three	37	99 (89-100)	39	100	67	100	—	—	—	—	—	—
Shane												
One	85	100	77	100	—	—	—	—	—	—	—	—
Two	69	98 (89-100)	64	98 (78-100)	38	100	33	100	33	96 (89-100)	40	97 (89-100)
Three	44	98 (89-100)	35	96 (89-100)	42	96 (78-100)	—	—	—	—	—	—
Devin												
One	39	99 (89-100)	35	96 (78-100)	—	—	—	—	—	—	—	—
Two	32	97 [illegible]	33	98 [illegible]	—	—	—	—	—	—	—	—

given trial if the observers scored any of the treatment integrity measures differently from each other. Point-by-point agreement was calculated by dividing the number of agreements in a session by the number of agreements plus disagreements and multiplying by 100. Interobserver agreement met or exceeded acceptable limits. Table 5 depicts the percentage of sessions with interobserver agreement on measures of treatment integrity and the corresponding mean and range of agreement scores across the experimental conditions.

Error Analyses

Several error analyses were conducted during phases in which the teaching procedure was insufficient in teaching the target discrimination. The experimenter reviewed the data sheets and retrieved information regarding a number of participant responses. Data were gathered on the placement of the comparison stimuli from the learner's perspective, the location of the learners' responses, and the specific visual stimulus that the learner responded to following the initial presentation of the auditory sample stimulus.

An analysis of the proportion of molar win-stay responses was conducted if an additional intervention was required for Steps 3, 4, 5, or 7 of the *simple/conditional method.* A molar win-stay analysis could be conducted for these steps because one particular visual stimulus was targeted in a massed-trial format in the previous teaching step. Therefore, responses to the previously massed-trialed stimulus could be measured during Steps 3, 4, 5, and 7. A molar win-stay response was scored if the learner responded to the visual comparison stimulus that functioned as the S+ in the preceding step.

Table 5

Percentage of sessions in which interobserver agreement on treatment integrity was assessed, mean agreement scores, and the range of agreement scores on treatment integrity for each participant across evaluations and condition types

	Simple/Conditional Method		Conditional Only Method		Modified Procedure I				Modified Procedure I I			
					Simple/Conditional		Conditional Only		Simple/Conditional		Conditional Only	
Participant	Percentage (%) of trials assessed	Mean agreement % (range)	% of trials assessed	Mean agreement % (range)	% of trials assessed	Mean agreement % (range)	% of trials assessed	Mean agreement % (range)	% of trials assessed	Mean agreement % (range)	% of trials assessed	Mean agreement % (range)
Erin												
One	35	100	40	100	—	—	—	—	—	—	—	—
Two	34	98 (89-100)	41	99 (89-100)	29	100	—	—	—	—	—	—
Three	37	99 (89-100)	39	99 (78-100)	67	100	—	—	—	—	—	—
Shane												
One	46	100	39	98 (89-100)	—	—	—	—	—	—	—	—
Two	49	98 (79-100)	41	99 (89-100)	38	95 (89-100)	33	100	33	100	40	100
Three	36	99 (89-100)	35	100	42	98 (89-100)	—	—	—	—	—	—
Devin												
One	39	99 (89-100)	35	96 (78-100)	—	—	—	—	—	—	—	—
Two	32	98 (89-100)	33.0	100.0	—	—	—	—	—	—	—	—

The percentage of molar win-stay responses was calculated by dividing the number of molar win-stay responses by the total number of teaching trials and multiplying by 100. An evaluation of molar win-stay response was not possible for the *conditional only method* because stimuli are not presented in a massed-trial format during this teaching procedure.

A molecular win-stay response was scored if the learner responded to the visual comparison stimulus that functioned as the S+ in the preceding trial. The percentage of molecular win-stay responses was calculated by dividing the number of molecular win-stay responses by eight and multiplying by 100. The denominator was eight rather than nine (i.e., the total number of trials) because each session included eight opportunities to respond to the S+ in the previous trial. An analysis of molecular win-stay responses was possible during sessions that involved 2- or 3-array conditional discriminations.

A position bias analysis was conducted if a high proportion of responses were allocated to a particular position regardless of the auditory sample stimulus. The percentage of responses to the left and right side was calculated for steps that contained an array of two comparison stimuli. The percentage of responses to the left, middle, and right side was calculated for sessions with an array of three comparison stimuli. The percentage of responses to a particular position was calculated by dividing the number of responses to the position and dividing by the number of trials (i.e., nine) and multiplying by 100. The horizontal line on the position bias analysis indicates the desired percentage of responses that should be allocated to each position (e.g., 33% for 3-stimulus arrays).

CHAPTER III

RESULTS

Erin

Figures 2, 3, and 4 depict the results for Erin. Figure 2 depicts the percentage of independent responses for each evaluation. In Evaluation 1 (top panel), both 3-array conditional discriminations were mastered after the same number of teaching sessions for the *simple/conditional* and *conditional only methods.* During the 3-week follow-up, both sets of stimuli maintained at 89% under baseline contingencies. Additional error analyses were not conducted for Erin's first evaluation given the effectiveness of both teaching methods.

The middle panel of Figure 2 depicts the results of Evaluation 2. Approximately the same number of teaching sessions was required to meet the mastery criterion during the *conditional only method* compared to Evaluation 1. Erin mastered Steps 1 through 4 of the *simple/conditional method* with relatively few errors. Step 5 was implemented for 45 sessions and the level of independent responses failed to increase above chance level (i.e., 50%). The procedures in Step 5 were continued for an additional 10 sessions following mastery of the 3-array conditional discrimination in the *conditional only method.*

Based on Erin's pattern of responding during Step 5, error analyses were conducted to help determine how to alter the teaching method. Figure 3 displays the error analyses for Erin's second evaluation. The top panel shows the percentage of molar win-stay responses during Step 5. Given that the S+ in Step 4 was targeted in

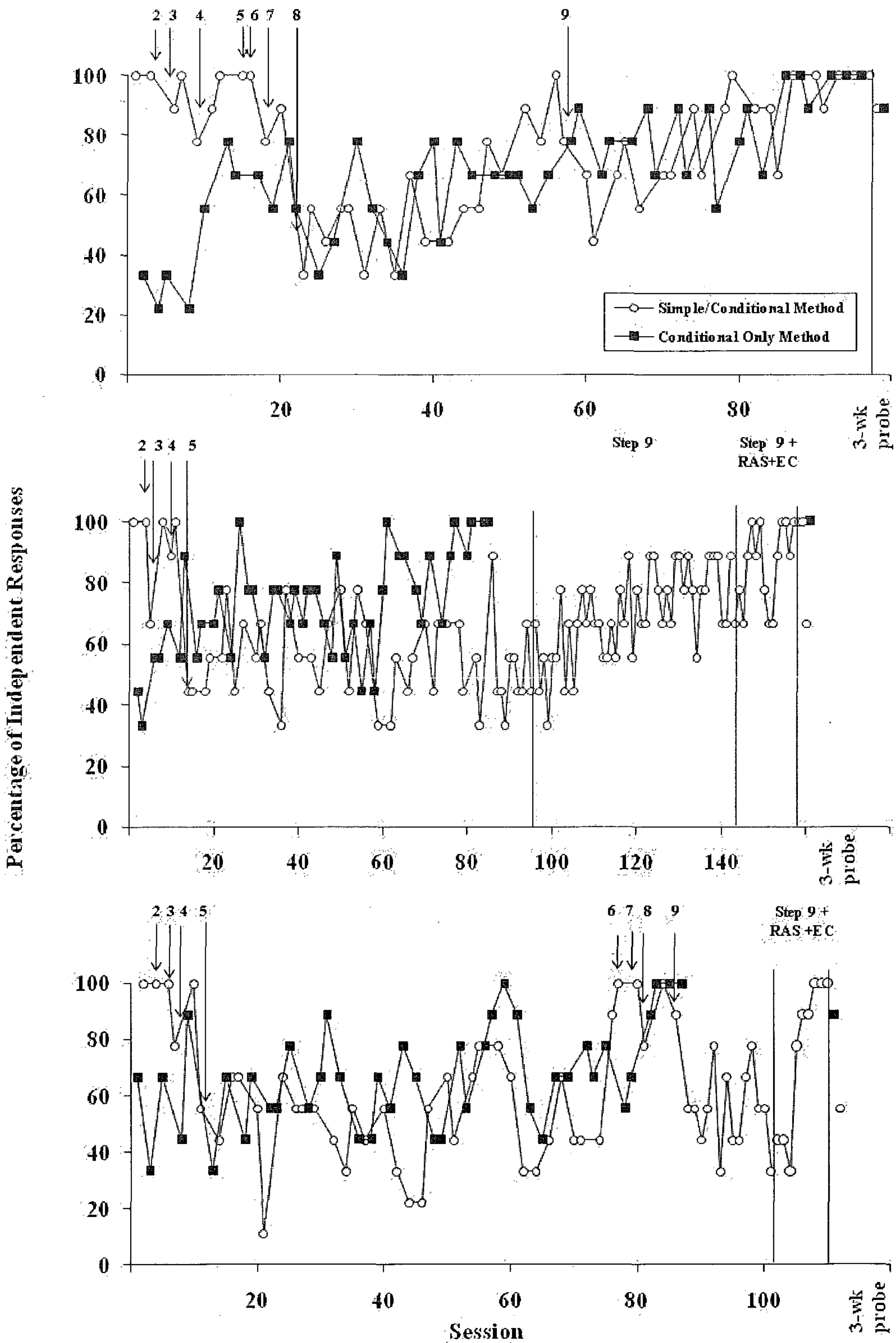


Figure 2. Percentage of independent responses during each evaluation for Erin.

approximately half the trials during Step 5, one would expect that responding to that stimulus would occur during 50% of sessions. Erin engaged in a higher percentage of molar win-stay responses during the initial teaching sessions of Step 5 compared to the final teaching sessions of Step 5. These data suggest that molar win-stay responses may have decreased due to extinction and that a history of a massed-trial format of the particular visual stimulus in Step 4 may have produced a maladaptive pattern of responding when the conditional discrimination task was introduced. The bottom panel of Figure 2 displays the percentage of molecular win-stay responses during Step 5. A moderate and variable increase in molecular win-stay responses were observed during Step 5. When two stimuli are semi-randomly rotated between in a 2-array conditional discrimination, molecular win-stay responses are likely to contact reinforcers for a moderate proportion of trials (i.e., VR-2 schedule of reinforcement). However, in a 3-array conditional discrimination in which three stimuli are semi-randomly rotated, molecular win-stay responses are less likely to contact such a dense reinforcement schedule. Therefore, thinning the schedule of reinforcement for molecular win-stay responses by implementing a 3-array conditional discrimination appeared to be a reasonable attempt to decrease the molecular win-stay responses.

Given that Evaluations 1 and 2 demonstrated the *conditional only method* as an effective acquisition procedure, Step 9 (i.e., *conditional only method*) was introduced immediately after Step 5. That is, the third, untrained stimulus was added into the array and all three stimuli were presented in a conditional discrimination format. Molecular win-stay responses decreased when Step 9 was introduced (Figure 3, bottom panel) and an increase in independent responses was observed. Although Step 9 resulted in an increase in independent, correct responses and reduced problematic error patterns, the procedure alone was not effective in meeting the

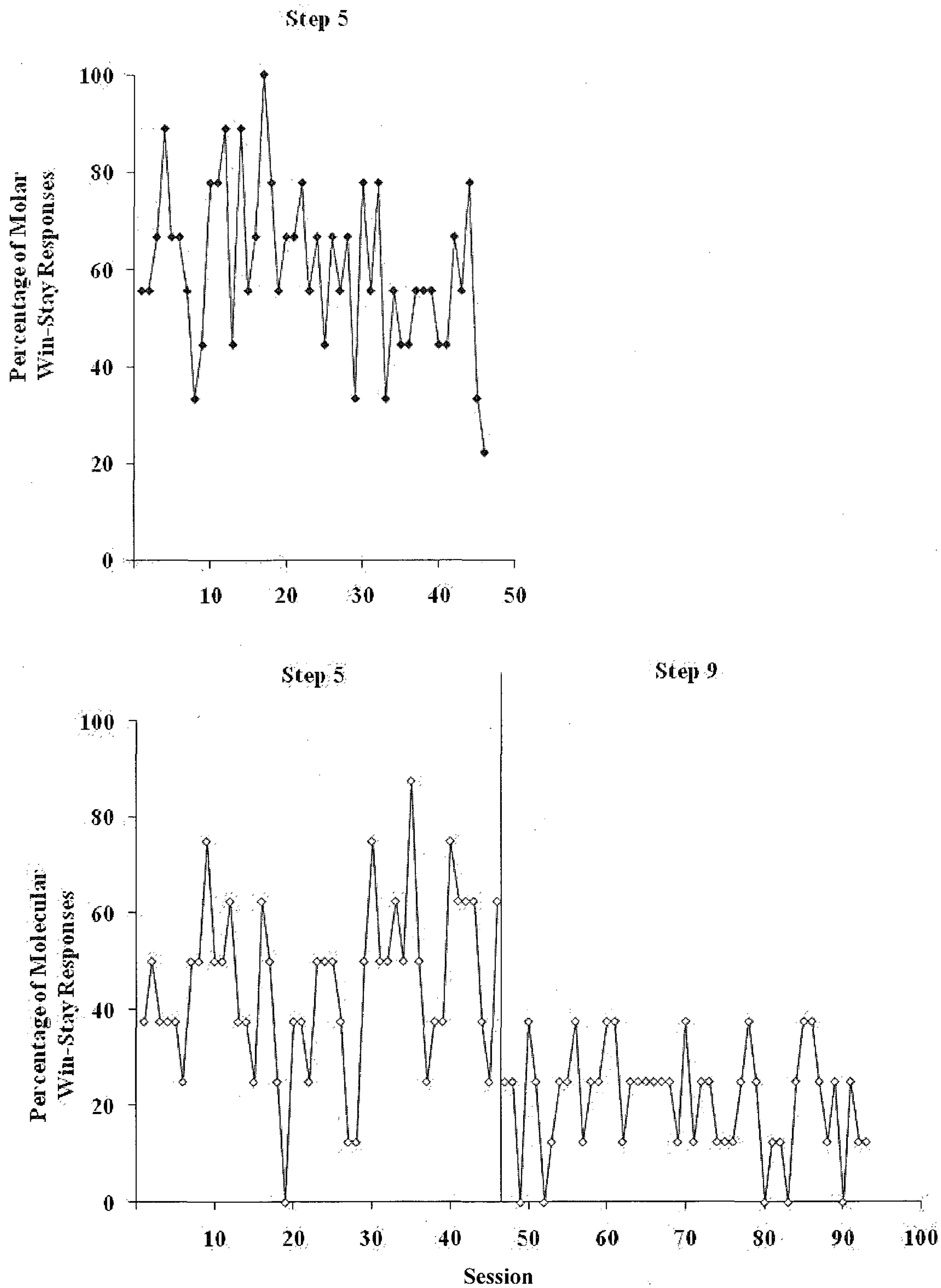
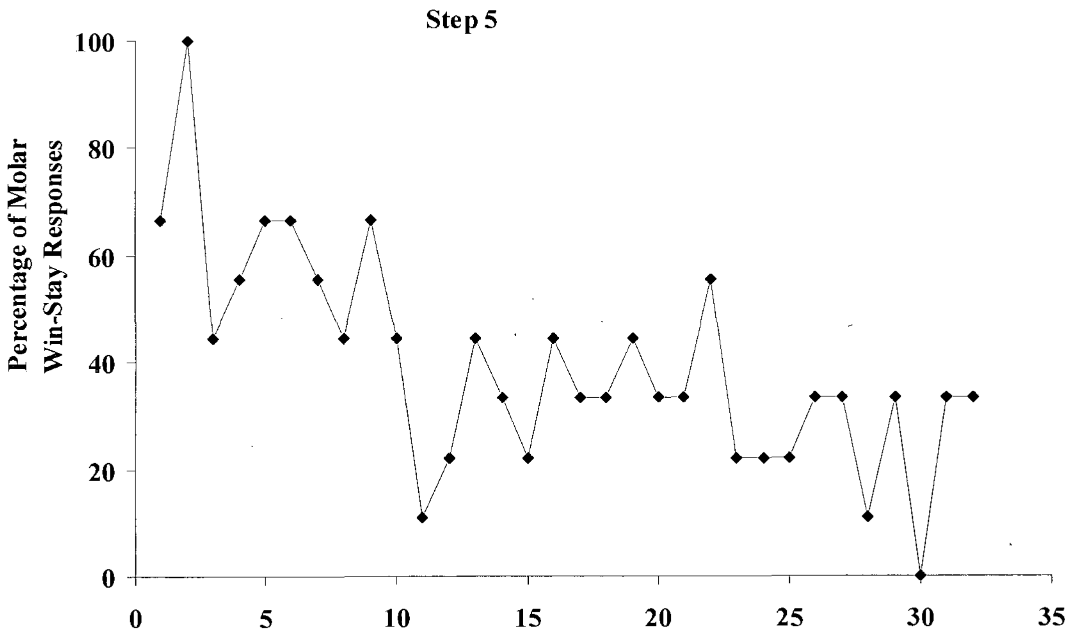


Figure 3. Error analyses during Evaluation 2 for Erin.

mastery criterion. Several additional procedures (i.e., RAS + EC) were added to increase the saliency of the auditory sample stimulus and the likelihood that Erin would attend and differentially respond to the auditory sample stimulus. Following the introduction of the RAS and EC components, Erin mastered the training set. At the 3-week follow-up, the *conditional only method* training set maintained at 100% while the *simple/conditional method* training set maintained at 67%. Follow-up sessions were conducted under baseline conditions (i.e., no response prompts, no consequences for responding) which does not contain the RAS and EC components. The bottom panel of Figure 2 depicts the results of Erin's third evaluation.

Approximately the same number of teaching sessions was required to meet the mastery criterion for the *conditional only method* in Evaluation 3 compared to Evaluations 1 and 2. Erin quickly progressed through Steps 1 through 4 of the *simple/conditional method.* Although Erin completed Step 5 following a lengthy number of teaching sessions, an error analysis was conducted to evaluate potential error patterns that may have interfered with more rapid acquisition.

Figure 4 displays the error analyses for Erin's third evaluation. The top panel depicts the percentage of molar win-stay responses during Step 5. Erin engaged in a higher percentage of molar win-stay responses during the initial sessions compared to the final sessions of Step 5. These data are similar to the molar win-stay response pattern that occurred in Step 5 of Evaluation 2. A similar interaction between error types occurred in Evaluations 2 and 3 when an increase in molecular win-stay responses occurred as molar win-stay responses decreased during Step 5. Although Erin displayed difficulties during Step 5, Erin eventually met the mastery criteria for Step 5 and progressed to Step 9.



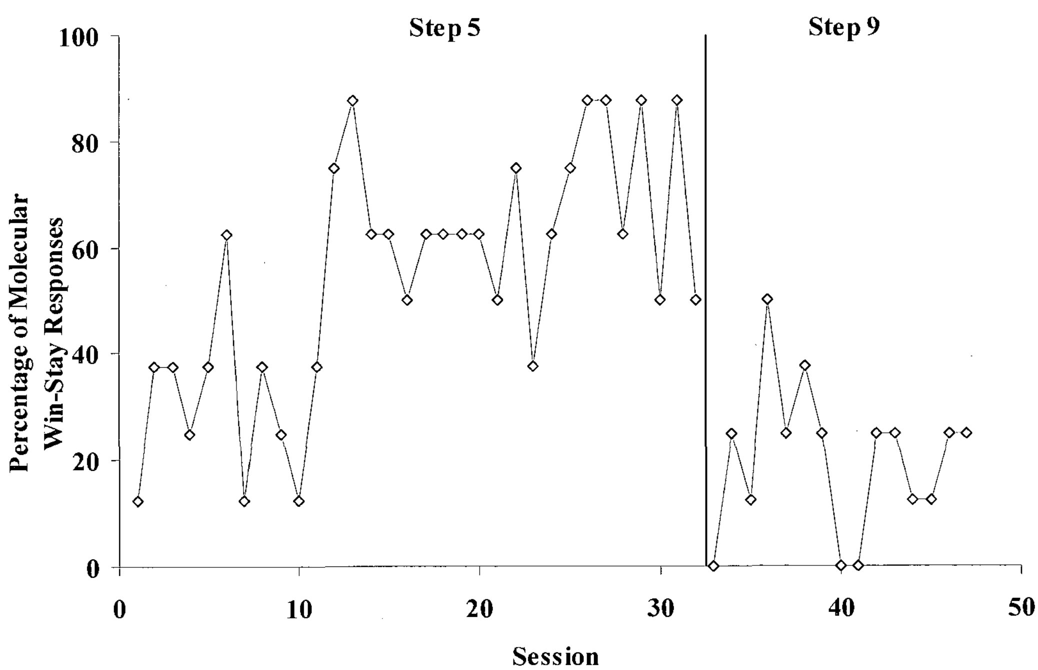


Figure 4. Error analyses during Evaluation 3 for Erin.

The RAS and EC components were implemented during Step 9 after meeting the failure criterion (i.e., at least 10 sessions with no increases in independent responses after the mastery criterion was met in the other condition). Following the introduction of the RAS and EC components, Erin mastered the training set. At the 3-week follow-up, the training sets maintained at 89% and 56% for the *conditional only* and *simple/conditional methods,* respectively.

Shane

The top panel of Figure 5 depicts the percentage of independent responses for Evaluation 1 for Shane. The same number of sessions of the *simple/conditional* and *conditional only methods* was required to meet the mastery criteria for the training sets. During the 3-week follow-up, the training sets maintained at 89% and 78% for the *simple/conditional* and *conditional only methods*, respectively.

The middle panel of Figure 5 depicts the percentage of independent responses during Shane's second evaluation. Shane met the mastery criteria for Steps 1 through 8 with relatively few errors. However, Shane displayed difficulties in learning the 3-array conditional discriminations in Step 9 of the *simple/conditional* and the *conditional only methods.* During teaching sessions in both experimental conditions, Shane engaged in moderate levels of problem behavior including aggression, self-injurious behavior, and disruptive behavior. A prior functional analysis indicated that Shane's problem behavior was maintained by access to positive reinforcement in the form of tangibles (i.e., edibles). It was hypothesized that Shane's problem behavior during Step 9 of the *simple-conditional method* and the *conditional only method* was more likely when edible items were withheld after incorrect responses (i.e., brief periods of tangible extinction for incorrect responses).

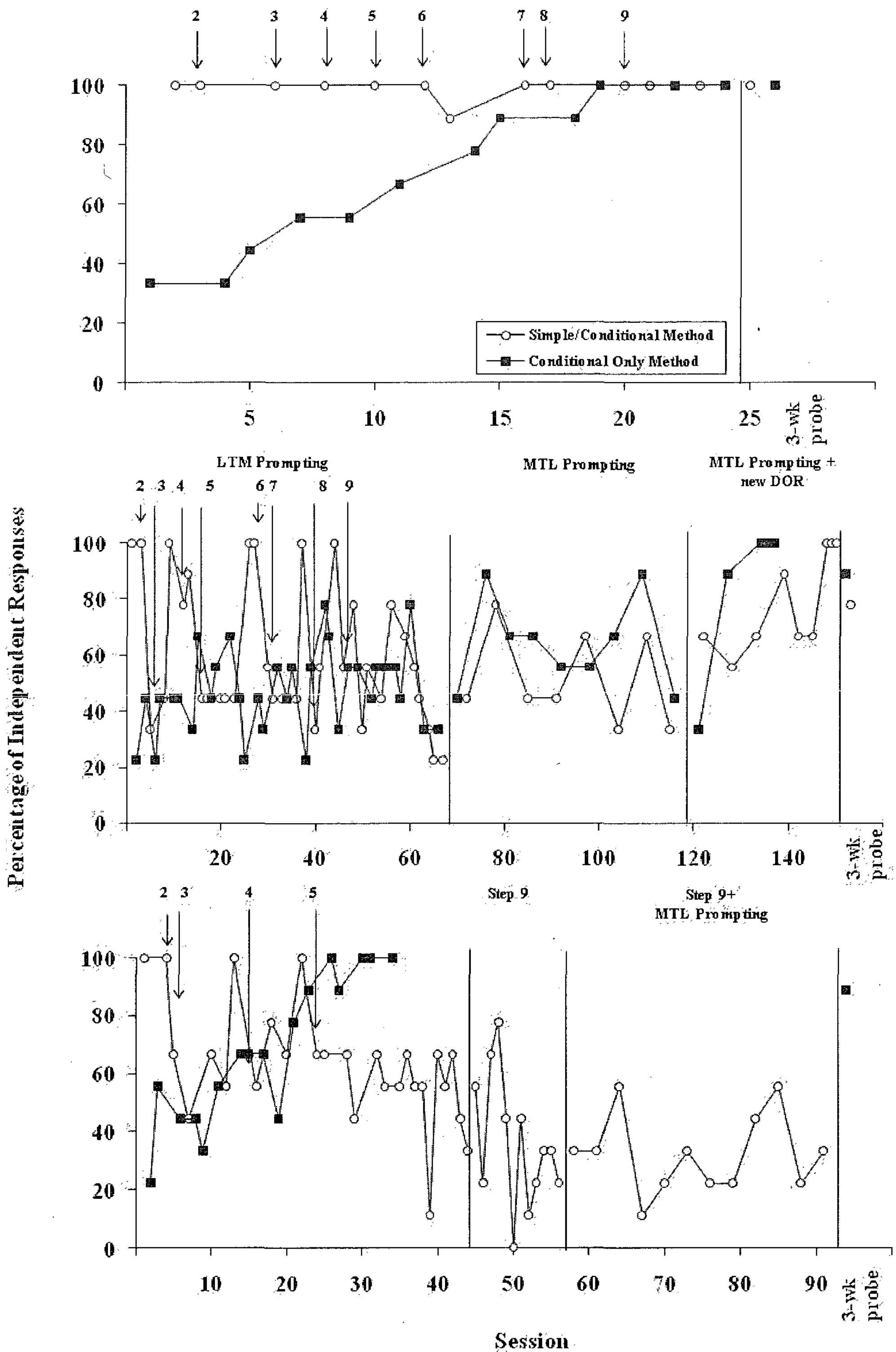


Figure 5. Percentage of independent responses during each evaluation for Shane.

The top panel of Figure 6 displays the percentage of responses allocated to the right position during Step 9 of the *simple/conditional method* and the *conditional only methods*. The horizontal line in the position bias graph indicates the appropriate level of responses (i.e., 33%) to each position. During the *conditional only method,* Shane responded to the stimulus located in the right position for the majority of trials in a session, although the severity of the bias was variable. The right position bias was less variable during Step 9 and on an increasing trend at the end of the phase. Following the implementation of the most-to-least prompting procedure, Shane's responses to the right position stabilized somewhat, although Shane's responses were allocated to the right position more often compared to the other positions.

A most-to-least prompting procedure was introduced to limit the opportunities to engage in errors, increase the number of reinforcers earned during sessions, and facilitate the acquisition of the training sets. Based on anecdotal observations, little to no problem behavior occurred after most-to-least prompting procedure was implemented. In addition, general compliance increased with coming to the work table, remaining at the table in a chair, and attending to the instructional materials. The bottom panel of Figure 6 displays the percentage of molecular win-stay responses during Step 9 of the *simple/conditional method* and the *conditional only method.* Shane engaged in variable and moderate levels of molecular win-stay responses during the *conditional only method.* Molecular win-stay responses were on an upward trend during Step 9 of the *simple/conditional method.* Following the introduction of most-to-least prompting, molecular win-stay responses reduced to low levels in the *conditional only method* and increased and stabilized at high levels in Step 9.

An alternative observing response was used to increase attendance to the comparison stimuli to reduce the extensive prompts required to evoke observing

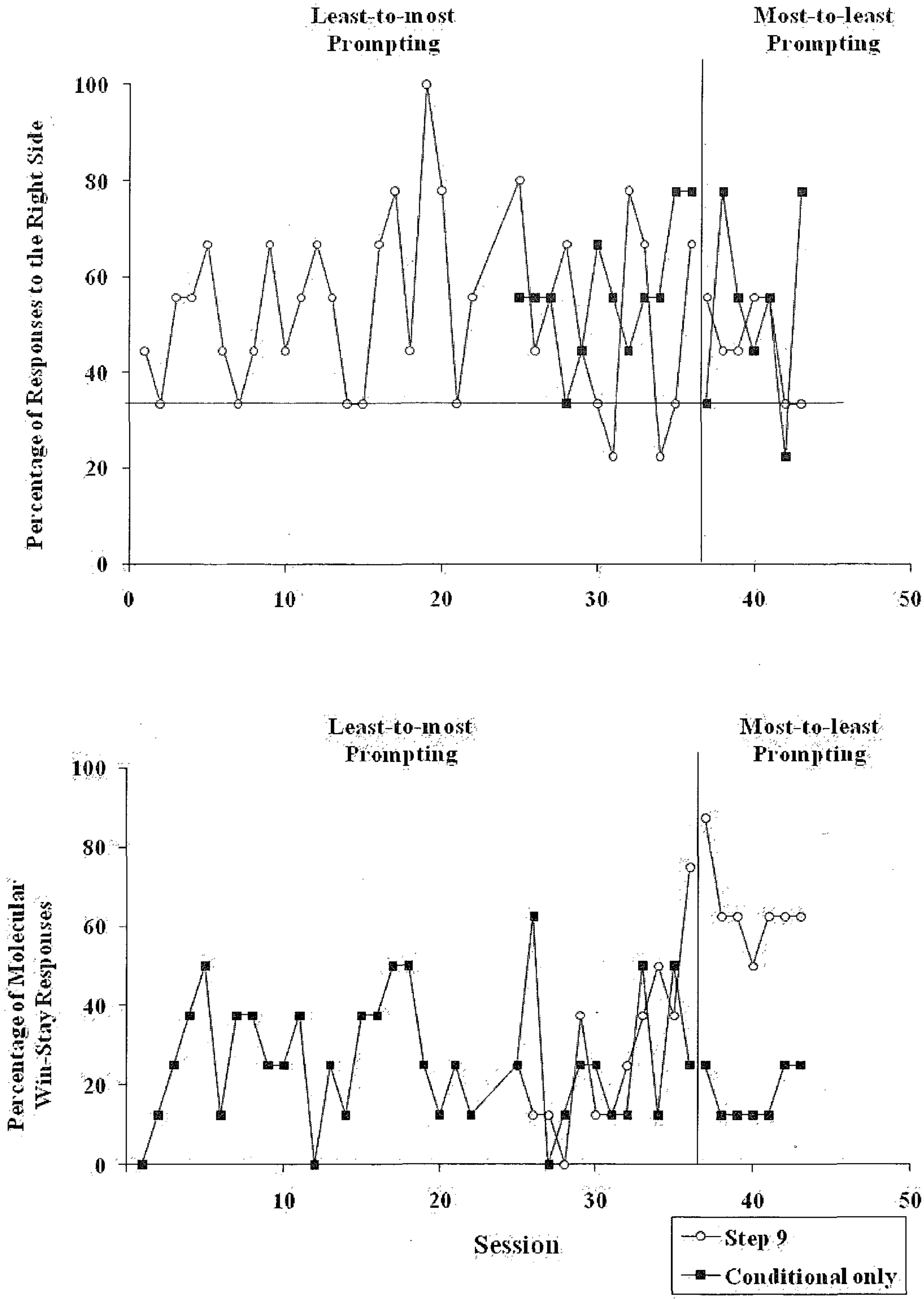


Figure 6. Error analyses during Evaluation 2 for Shane.

responses and decrease molecular win-stay responses during Step 9 of the *simple/conditional method.* Following the introduction of the alternative observing response, Shane mastered the training set in the *conditional only method* in slightly fewer sessions than the training set taught using the *simple/conditional method.* During the 3-week follow-up, the training sets maintained at 89% and 78% for the *conditional only* and *simple/conditional methods*, respectively.

The bottom panel of Figure 5 depicts the percentage of independent responses during the third evaluation for Shane. Shane met the mastery criteria for Steps 1 through 4 of the *simple/conditional method.* Step 5 was continued for 10 additional sessions after the mastery criteria were met for the training set taught using the *conditional only method.* Levels of independent responses did not increase above chance levels (i.e., 50%). Given that the *conditional only method* was an effective acquisition procedure in the first and third evaluations, Step 9 (i.e., *conditional only method*) was introduced using a least-to-most prompting procedure. That is, the third, untrained stimulus was added into the array and all three stimuli were presented in a conditional discrimination format. An additional 12 sessions of Step 9 were conducted with a least-to-most prompting procedure before a most-to-least prompting procedure was introduced. Similar to Evaluation 2, Shane engaged in problem behavior when few of his responses contacted reinforcers.

Figure 7 displays the error analyses for Shane's third evaluation. The top panel of Figure 7 displays the position bias analysis for steps requiring additional intervention components. During Step 5, Shane displayed a position bias to the comparison stimulus on the left. Following the introduction of Step 9, Shane's responses were primarily allocated between the left and middle positions. After most-to-least prompting was introduced, Shane's bias shifted to the middle position.

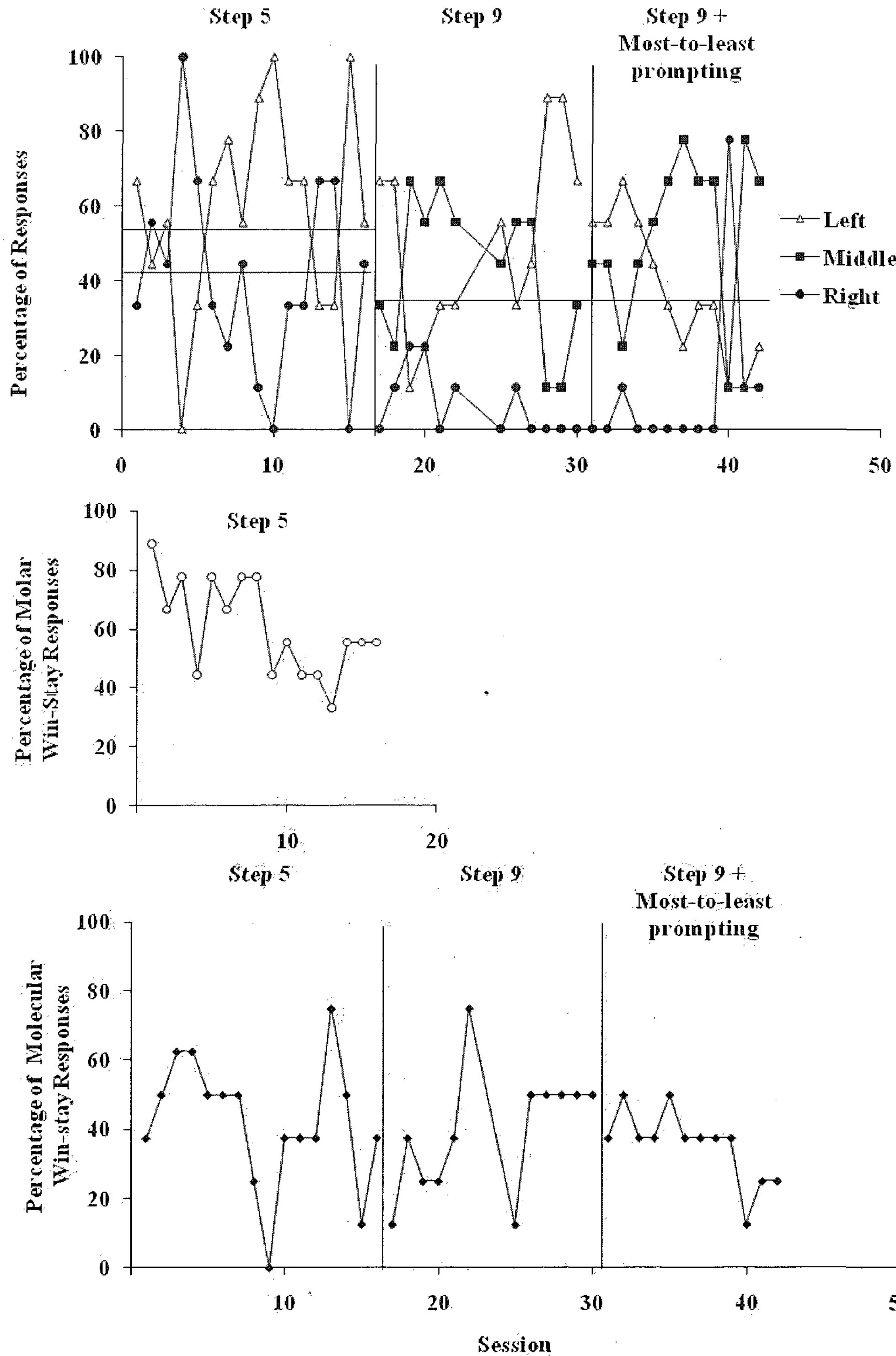


Figure 7. Error analyses during Evaluation 3 for Shane.

The middle panel of Figure 7 displays molar win-stay responses during Step 5. Molar win-stay responses were high during the initial sessions of Step 5 and reduced over time suggesting that a history of massed-trial sessions of the Step 4 S+ may have temporarily increased responses to the prior S+ despite a change in the discrimination task. The bottom panel of Figure 7 displays the percentage of molecular win-stay responses during Step 5 and Step 9 with and without most-to-least prompting. Molecular win-stay responses occurred at moderate and variable levels during Step 5. Following the introduction of Step 9, molecular win-stay responses occurred at moderate levels and stabilized toward the end of the phase. Molecular win-stay responses decreased slightly after most-to-least prompting was implemented. The training set taught using the *conditional only method* maintained at 89% during the 3-week follow-up probe. A follow-up probe was not conducted for the training set taught under the *simple/conditional method* given that the mastery criterion was not met.

Devin

Figure 8 displays the percentage of independent responses during Evaluations 1 and 2 for Devin. During the first evaluation, Devin met the mastery criteria for the training set taught using the *simple/conditional method* in slightly fewer sessions than the training set taught using the *conditional only method.* During the 3-week follow-up session, Devin responded accurately during 100% of the trials for both teaching methods. For the second evaluation, the mastery criteria were met in the *conditional only method* a few sessions prior to mastery in the *simple/conditional method.* Both training sets were maintained at 100% at the follow-up assessment. Overall, both procedures were effective without the use of additional procedures.

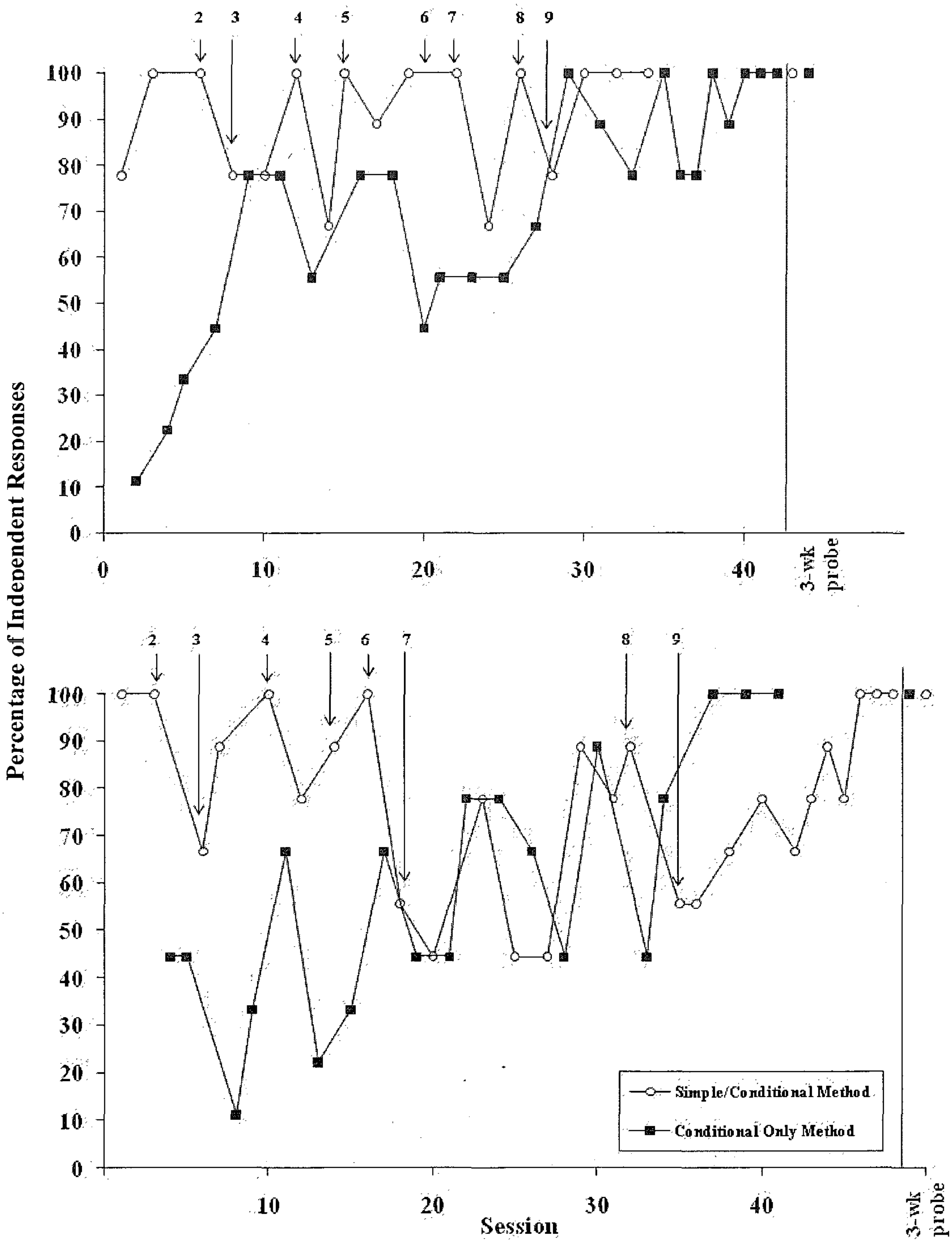


Figure 8. Percentage of independent responses during each evaluation for Devin.

It is difficult to determine from these data if one procedure was generally more efficient than the other, given the mixed results in the number of sessions required to meet the mastery criterion across the evaluations.

Figure 9 depicts of the number of sessions required to meet the mastery criterion for each evaluation across participants. Training sets taught using the *simple/conditional method* required more sessions to meet the mastery criterion for six of the eight evaluations. However, small differences in the number of sessions (i.e., three) necessary to meet the mastery criterion were observed during Erin's first evaluation. The *simple/conditional method* was associated with a fewer number of sessions to mastery for Devin's second evaluation. Overall, the data indicate that the *conditional only method* was a more efficient procedure for teaching conditional discriminations.

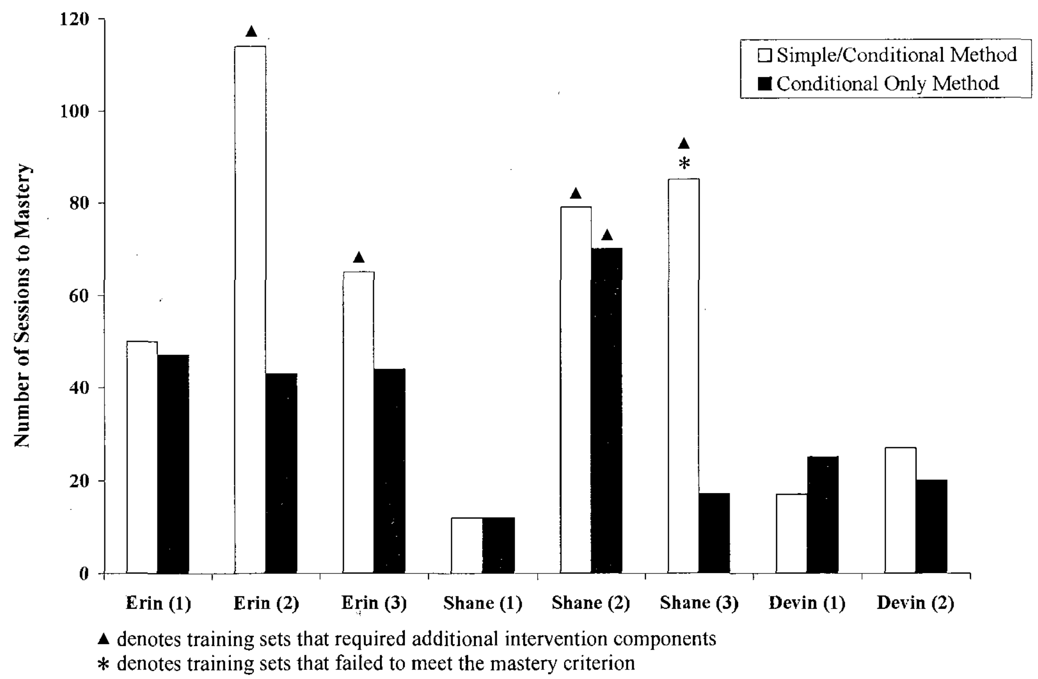


Figure 9. The total number of sessions required to meet the mastery criterion for each teaching method during each evaluation across participants.

CHAPTER IV

DISCUSSION

The purpose of the study was to evaluate two commonly implemented approaches to conduct conditional discrimination training in EIBI programs. The teaching approaches were evaluated by comparing the overall number of sessions required to meet the mastery criterion for the training sets in the evaluation. Additional error analyses were conducted for training sets that required an additional intervention component in an attempt to identify potential sources of faulty stimulus control that may have interfered with discrimination learning. The *conditional only method* alone was effective for seven of the eight evaluations across the participants while the *simple/conditional method* alone was effective for four of the eight evaluations. That is, half of the training sets taught using the *simple/conditional method* required at least one additional intervention to meet the mastery criterion. Overall, the *conditional only method* with least-to-most prompting was generally a more reliable procedure for teaching a 3-array conditional discrimination for Erin and Shane. For Devin, both procedures were effective without the use of additional intervention components. Better maintenance of skills occurred during the 3-week follow-up probes for the *conditional only method* compared to the *simple/conditional method.* In evaluations in which additional procedures were needed to address an error pattern, maintenance was relatively low (e.g., Erin's second and third evaluations).

The combined results of Erin's evaluations suggest that a history of the *simple/conditional method* may foster faulty stimulus control during discrimination training. More specifically, a high proportion of Erin's responses were directed to visual stimuli that functioned as the S+ in either the previous phase (i.e., molar win-stay responses) or in the preceding trial (i.e.., molecular win-stay responses). The *conditional only method* consistently produced acquisition of the 3-array conditional discrimination. Moreover, a similar number of sessions were required to meet the mastery criteria across the evaluations for the *conditional only method.* Overall, the *conditional only method* was more reliably associated with acquisition while the *simple/conditional method* required additional procedures and was associated with detectable error patterns.

The results for Shane suggest that the *conditional only method* may have been a more effective teaching procedure for conditional discrimination training. The *simple/conditional method* was associated with error patterns such as position biases and molecular win-stay responses that interfered with learning the target conditional discriminations. Molar win-stay responses typically occurred during Step 5, although that type of error typically reduced over time while molecular win-stay responses typically increased over time. Based on anecdotal observations, problem behavior occurred in both the *simple/conditional* and *conditional only methods*, particularly during sessions in which Shane engaged in low levels of independent responses and earned few reinforcers. The results of Evaluation 3 may suggest that, after a history of a less-than-ideal teaching procedure, acquisition may not occur despite the introduction of best-practices teaching procedures.

The overall results for Devin indicate that both procedures were effective without the introduction of additional procedures. The results were mixed in terms of the number of sessions to meet the mastery criterion in each teaching method. Regardless of the teaching procedure, the training sets maintained at 100% for both evaluations.

Additional treatment procedures (e.g., error correction) were required for the *simple/conditional method* during four evaluations. In the current study, error patterns were detected and analyzed throughout training which may have aided in the selection of an appropriate intervention during the *simple/conditional method.* Following a change in procedures based on the specific error pattern, mastery occurred in three of the four training sets. A great deal of expertise on stimulus control and discrimination learning is required to accurately detect and measure a wide range of potential error patterns (e.g., win-stay responses, side biases) during acquisition. It is possible that clinicians may not have the resources or training required to effectively problem solve when issues of faulty stimulus control arise. This may provide a rationale for the use of the *conditional only method* in applied settings given that error patterns were less likely than in the *simple/conditional method.*

The initial prompt fading strategy (i.e., a least-to-most prompting procedure) used in the current investigation warrants further discussion. First, the prompting procedure used in the current investigation differs from the prompts recommended for the *simple/conditional method* in the Lovaas (2003) EIBI manual. Lovaas suggested a prompt fading package that included position prompts and graduated guidance (i.e., a type of errorless learning procedure); whereas a least-to-most prompting procedure was used in the current study. It is possible that an errorless learning procedure might have prevented the establishment of the error patterns that were observed during Erin and Shane's evaluations.

A least-to-most prompting procedure was selected for the study for two main reasons. First, if an errorless procedure was utilized, a measure of independent responses would be required to evaluate changes in stimulus control and learning over time. It may be possible to intersperse least-to-most probes of the final performance throughout training. However, difficulties arise when the 3-array conditional discrimination is probed in the *simple/conditional method.* For example, if the learner has experience with two of the three stimuli in the array, the learner may respond correctly during the least-to-most probes by responding to the novel comparison stimuli following the presentation of a novel auditory sample stimulus. Thus, a least-to-most prompting procedure was selected over other methods because a measure of independent responses was possible across the evaluation. Second, a least-to-most prompting procedure involves a standard set of procedures that remain unvaried across learning which may result in better treatment integrity in natural settings compared to an errorless learning procedure. In contrast, errorless procedures require rapid decision-making with respect to fading prompts and, if done incorrectly, can result in prompt dependence. Although errorless learning procedures are the most common prompt strategy in EIBI programs represented in the Love et al. (2009) survey study, it is possible that other service providers (e.g., special education programs) with less access to resources and training on errorless procedures may utilize procedures such as a least-to-most prompting procedure to teach conditional discriminations. Thus, based on the aforementioned considerations, a least-to-most prompting procedure was selected as the initial prompt fading procedure.

Basic studies of stimulus control during discrimination training might help interpret the results of the current investigation. Previous research indicates that children with ASDs are likely to engage in overselective responding to particular aspects, often one, of a multiple-component antecedent stimulus. Lovaas, Schreibman, Koegel, and Rehm (1971) taught children with ASDs to press a bar in the presence of a multi-component antecedent stimulus. Next, each component of the complex stimulus was presented in isolation to evaluate the extent to which each component influenced discriminated responses. The results of the study indicated that children with autism tended to respond to one of three stimuli (either the visual or auditory portions, but not both) while typically developing children typically responded to all three of the components. The results suggest that children with autism may attend and respond to certain aspects of relevant stimuli.

The early steps of the *simple/conditional method* may foster overselective responding to the visual component of the antecedent stimulus (Green, 2001). Molar win-stay responses in the current study may have occurred as a result of the massed-trial format in Steps 1 through 4. That is, a history of repeatedly responding to the same visual stimulus within an acquisition step without the requirement of differentially attending to auditory stimuli may have hindered subsequent conditional stimulus control from developing. This procedural aspect of the *simple/conditional method* may promote overselective responding to the visual stimulus. Molar win-stay responses are problematic in Step 5 because attending and differential responding of the auditory sample stimuli and the comparison array are required to respond accurately, but have not yet been taught in Steps 1 through 4.

The 2-array discrimination procedure in many of the steps of the *simple/conditional method* may have increased the likelihood of the acquisition and maintenance of molecular win-stay responses. Given that only two stimuli were presented as comparisons during conditional discrimination training in Steps 5, 7, and 8, the likelihood of accessing reinforcers for molecular win-stay responses was approximately a VR-2 schedule of reinforcement which could have maintained win-stay responses. Erin's data during Evaluations 2 and 3 suggest that overselective responses to the visual stimulus correlated with previous deliveries of reinforcers or response prompting may have resulted from exposure to the *simple/conditional* *method.* This error pattern interfered with the acquisition of conditional discriminations during the *simple/conditional method* only, which suggests that the arrangement of the *simple/conditional method* may differentially promote overselective responding compared to the *conditional only method.*

Additional procedures during Erin's second and third evaluations were added to increase the likelihood that Erin would attend and differentially respond to the auditory sample stimuli during conditional discrimination training. The RAS and EC components may have been effective because they promoted attention to the relevant antecedent stimuli. Another possibility is that the extra work requirement during the error correction procedure might have functioned to punish molecular win-stay responses over time. Although the percentage of molecular win-stay responses was somewhat low after the introduction of Step 9 in both Evaluations 2 and 3, the percentage of errors that resulted from molecular win-stay responses was high. That is, when Erin engaged in an error, it likely resulted from a molecular win-stay response.

Molar and molecular win-stay responses may not occur as often in a 3-array conditional discrimination because those responses rarely contact reinforcers. Given that the target stimulus is rotated between three stimuli, there are very few instances (i.e., 1 or 2 out of 9 trials) in which the same stimulus is targeted across two adjacent trials. Thus, the schedule of reinforcement for molecular win-stay responses during the *conditional only method* is quite lean compared to that of the *simple/conditional method.*

The results of a study conducted by Koegel, Schreibman, Britten, and Laitinen (1979) suggest that thinning the schedule of reinforcement for overselective responses may reduce errors over time. The results of Erin's evaluation are consistent with those obtained in the Koegel et al. study because molecular win-stay responses were lower during 3-array conditional discrimination compared to Step 5 of the *simple/conditional method* (i.e., a 2-array conditional discrimination). In addition, 3-array conditional discrimination training was associated with somewhat lower levels of position biases during Evaluations 2 and 3 for Shane. One rationale for using large arrays of comparison stimuli (at least three) is that stable error patterns (e.g., win-stay responses, side biases) are less likely to be established and maintained due to the relatively lean reinforcement schedule associated with any particular type of error pattern.

The results of the present study in conjunction with those obtained by Gutierrez and colleagues (2009) indicate that simple discrimination training in isolation may not be needed as part of the *simple/conditional method.* In the current study, participants typically completed Steps 1, 2, and 6 with few, if any, errors. Given that simple discrimination training in isolation does not develop any of the prerequisite behaviors required during conditional discrimination training, it might be possible to remove Steps 1, 2, and 6 from the procedure. The results of the study conducted by Gutierrez and colleagues suggest that simple discrimination training in isolation does not result in increases in the efficiency of learning conditional discriminations. Future research might consider comparing variations of the *simple/conditional method* to take advantage of any benefits that may result from training component simple discriminations while attempting to avoid faulty stimulus control that might result from particular aspects of the procedure such as training in isolation.

The errors associated with the *simple/conditional method* call into question the practice of breaking down conditional discriminations into smaller components.

While there is support in the basic literature for the practice of training component simple discriminations prior to conditional discrimination training (e.g., Dube, Iennaco, & McIlvane, 1993; Dube, & Serna, 1998; McIlvane et al., 1990; Saunders & Spradlin, 1989/1990), the *simple/conditional method* described by EIBI manuals varies from the previously successful training procedures in the basic literature in several ways. First, the *simple/conditional method* involves simple discrimination training in isolation (Steps 1, 2, and 6) and in the presence of a nontarget, distracter stimuli (Steps 3 and 4) whereas simple discrimination training in previous basic studies only involved simple discrimination training in the presence of a distracter stimulus.

Second, changes to the function of the various comparison stimuli were rapidly changed within the teaching session in basic studies while changes to the function of the stimuli are changed more gradually in the *simple/conditional method* across teaching steps. Given that training component simple discriminations systematically teaches one of several prerequisite behaviors to learn conditional discriminations (i.e., attending to comparison stimuli), training in isolation may be questionable given that none of the prerequisite behaviors are systematically targeted. Furthermore, extended periods of simple discrimination training in the presence of distracter stimuli may overly train attention to the visual comparison and interfere with responses coming under control of both the auditory sample stimulus and corresponding comparison stimulus in later conditional discrimination training. While there is a procedural link between the *simple/conditional method* used in applied settings and the procedures employed in basic studies of stimulus control during discrimination training, it is relatively unknown how the drifts in methodology impact conditional discrimination acquisition in applied settings. However, the present data call into question this practice.

Additional applied research in the area of stimulus control and conditional discrimination training is needed to advance teaching technologies for children with ASDs. Future research might consider evaluating the *simple/conditional* and *conditional only methods* using an errorless learning procedure. Although the current investigation employed a least-to-most prompting procedure for the purposes of assessing independent responses during acquisition, a most-to-least prompting procedure could be used in future studies if least-to-most probes were interspersed throughout training. Given that many EIBI programs use errorless learning strategies as the primary teaching strategy (Love et al., 2009), this evaluation may be useful in evaluating current practices in EIBI.

Future research might also attempt to replicate this study with visual-visual conditional discriminations (i.e., matching programs). The participants included in the current study had a history of auditory-visual conditional discrimination training. Moreover, participants had prior experience with one or both of the teaching methods. In EIBI programming, it is common to target visual matching skills prior to more difficult discriminations such as auditory-visual conditional discriminations. Visual matching skills are presumably less difficult because the sample stimulus resembles or is identical to the corresponding comparison stimulus. Future research may include visual matching skills to determine if similar problems with faulty stimulus control arise as a result of the *simple/conditional method.*

One interesting point is that both Erin and Shane had a prior history with the *simple/conditional method* which may have impacted the results of the study. Both Erin and Shane displayed several error patterns that interfered with the acquisition of the training sets in the *simple/conditional method.* Future research might conduct additional evaluations with participants who have little if any history with conditional discrimination training to compare the procedures in the absence of a learning history with one particular teaching method.

The current study investigated a commonly used but understudied behavior acquisition procedure in EIBI programs. Many of the EIBI manuals recommend the *simple/conditional method* and EIBI supervisors report the use of the teaching method. However, the current study suggests that the *simple/conditional method* may be associated with error patterns and slower acquisition than the *conditional only method*. Future research in the area of EIBI should focus on comparative evaluations of procedures that are commonly utilized in applied settings. While there are promising outcomes for children who receive EIBI, there is considerable room for refining current procedures and developing new techniques for skill acquisition to improve the outcomes for children with ASDs.

Appendix

HSIRB Approval Letter

WESTERN MICHIGAN UNIVERSITY
Human Subjects Institutional Review Board

Date: October 20, 2008

To: Wayne Fuqua, Principal Investigator
Laura Grow, Student Investigator for dissertation

From: Amy Naugle, Ph.D., Chair

Re: HSIRB Project Number: 08-08-07

This letter will serve as confirmation that your research project entitled "A Comparison of Methods to Teach Skills to Individuals with Developmental Disabilities" has been **approved** under the **full** category of review by the Human Subjects Institutional Review Board. The conditions and duration of this approval are specified in the Policies of Western Michigan University. You may now begin to implement the research as described in the application.

Please note that you may **only** conduct this research exactly in the form it was approved. You must seek specific board approval for any changes in this project. You must also seek reapproval if the project extends beyond the termination date noted below. In addition if there are any unanticipated adverse reactions or unanticipated events associated with the conduct of this research, you should immediately suspend the project and contact the Chair of the HSIRB for consultation.

The Board wishes you success in the pursuit of your research goals.

Approval Termination: October 15, 2009

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