A COMPARISON OF PROCEDURES TO ESTABLISH EMERGENT INTRAVERBALS IN CHILDREN WITH AUTISM SPECTRUM DISORDERS

by

Mary Vallinger

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Youngstown State University

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A Comparison of Procedures to Establish Emergent Intraverbals in Children with Autism Spectrum Disorders

Mary Vallinger

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Mary Vallinger, Student
Date

Approvals:

________________________________________________________________________
Rocio Rosales, Ph.D., Thesis Advisor
Date

________________________________________________________________________
Stephen Flora, Ph.D., Committee Member
Date

________________________________________________________________________
Leah Gongola, Ph.D., Committee Member
Date

________________________________________________________________________
Bryan DePoy, Ph.D., Interim Associate Provost for Research and Dean, School of Graduate Studies and Research
Date
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Mary K. Vallinger

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ABSTRACT

The current study examined two methods to facilitate the emergence of untaught intraverbal responses to questions involving the function of items for participants with a diagnosis of autism. Listener behavior training (LT) involved reinforcing a selection based response when the experimenter showed the participant an array of pictures and stated the function of the item. The stimulus pairing observation procedure (SPOP) involved presenting a picture of an item in isolation as the experimenter vocally stated its function. Participants were not required to engage in an overt vocal response. Results indicate both procedures were effective at producing some untaught intraverbal responses. Results will be discussed in terms of prerequisite skills that may be necessary for the effectiveness of each procedure, and the requirement of overt or echoic responses to facilitate the emergence of this verbal operant.

Keywords: intraverbal, derived relations, listener training, stimulus pairing observation procedure, autism spectrum disorders
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A Comparison of Procedures to Establish Emergent Intraverbals in Children with Autism Spectrum Disorders

Autism spectrum disorders (ASDs) are a group of developmental disabilities that can cause significant social, communication, and behavioral challenges (Centers for Disease Control, 2012). According to the CDC’s Autism and Developmental Disabilities Monitoring (ADDM) Network, it is currently estimated that 1 in 88 children have been identified with ASD. With the growing number of children diagnosed with autism, evidence based interventions that target the disorder’s core deficits, especially communication, have become essential to researchers and practitioners working with this population. Language and communication are essential skills for learning; therefore, teaching communication skills should be a large part of any training program for children with autism (Sundberg & Michael, 2001).

The behavioral approach to training language using the principles of positive reinforcement has been an effective method to teach these skills (Sundberg & Michael, 2001). In order to assess a child's current language abilities and to help determine language and communication goals, language and learning assessments have been developed such as the Assessment of Basic Learning and Language (ABLLS; Partington & Sundberg, 1998) and the Verbal Behavior Milestones Assessment and Placement Program (VB-MAPP; Sundberg, 2008). These assessments are designed to reflect developmental milestones that typically developing children reach according to their chronological age. Most practitioners use the ABLLS and VB-MAPP in order to assess a child's current level of functioning, and to demonstrate progress made following training.
The assessments are based on Skinner's verbal behavior approach to language (Skinner, 1957).

**Elementary Verbal Operants**

In 1957 B. F. Skinner published *Verbal Behavior* in which he described language from a behavioral perspective and defined seven elementary verbal operants. In his book, he defined verbal behavior as behavior that is socially mediated, rather than mediated by the physical environment (Skinner, 1957, pg 2). Consequently, in order for verbal behavior to occur, there must be a speaker and a listener. Skinner described seven elementary verbal operants that are necessary to acquire higher order language skills to include: mands, tacts, intraverbals, echoics, transcriptive, copying a text, and textual responses.

The *mand* is a verbal operant controlled by an establishing operation (EO), or motivating variable, and maintained by reinforcement specific to that mand (Skinner, 1957, pg. 35). For example, if a child is hungry and says "chip" this serves as a mand or request for a chip that is socially mediated by an adult giving the child access to chips. The mand is reinforced by the specific stimulus (in this example, chips) and is often the first verbal operant taught due to the fact that it is controlled by an EO and maintained by a desired stimulus rather than social praise or acknowledgement. For children with autism, EOs for basic needs is usually more motivating than social praise (Sundberg & Michael, 2001).

The next verbal operant Skinner described was the *tact*. The tact is controlled by a nonverbal stimulus and is maintained by nonspecific reinforcement (Skinner, 1957, pg. 82). For example, if a child is shown a picture of a dog and says "dog" the child has
labeled or tacted "dog." This verbal operant is maintained by nonspecific reinforcement (i.e., social praise from a caregiver "You’re right, that is a dog!"). The *intraverbal* is controlled by a verbal stimulus without point-to-point correspondence or formal similarity, and is maintained by nonspecific reinforcement (Skinner, 1957, pg. 71). The intraverbal can be described as answering questions, filling in words to a song or nursery rhyme, or commenting. For example, a child hears "Ready, set..." and responds "go", or "One, two…” and responds "three." This can also be answering the question "How old are you?" with the child’s response being "six." The main feature of the intraverbal is that the controlling variable is a verbal stimulus, but that stimulus does not in any way resemble the response required. The intraverbal is maintained by social reinforcement.

The *echoic* is controlled by an antecedent stimulus with point-to-point correspondence and formal similarity to the response, and is maintained by nonspecific reinforcement (Skinner, 1957, pg. 55). For example, the echoic could be repeating a word or phrase after hearing it, followed by social praise by another individual in the environment. For example, if a teacher says "cat" and the child repeats "cat" the response has formal similarity to the antecedent stimulus and is maintained by social reinforcement (i.e., teacher says, "Nice job saying cat"). Children often learn language by repeating what others around them say; this is an example of Skinner's verbal operant, the echoic.

*Copying a text* is similar to the echoic in that it is controlled by a verbal stimulus with point-to-point correspondence and formal similarity to the response and is maintained by nonspecific reinforcement (Skinner, 1957, pg. 70). The difference between copying a text and echoic is the form of the response. The echoic is a verbal response to a verbal antecedent, while copying a text is a written response to a verbal antecedent. For
example, a teacher says "write car" and the child writes "c-a-r" which is maintained by nonspecific social reinforcement (i.e., the teacher says, "I like how you wrote car").

The final two verbal operants, the *textual* and *transcriptive*, are both controlled by a verbal stimulus with point-to-point correspondence, but without formal similarity and are maintained by nonspecific reinforcement (Skinner, 1957, pg. 65 & 69). The difference between the transcriptive and textual is that transcriptive could also be referred to as taking dictation or note taking, and the textual could be described as reading a written stimulus. The main feature of these two verbal operants is that there is no formal similarity between the antecedent stimulus and the response. An example of the transcriptive would be hearing a teacher talk and copying down notes. The words of the teacher and the written notes of the student do not have formal similarity. An example of the textual would be reading a book. The written words and the spoken words have point-to-point correspondence, but are not formally similar.

The current study will focus on the *intraverbal* which is an essential skill to learn, as it “facilitates other verbal and nonverbal behavior; it prepares a speaker to behave rapidly and accurately with respect to further stimulation and, at a more advanced level, and plays an important role in continuing a conversation" (Sundberg & Michael, 2001, pg 713). This verbal operant is often difficult for children with autism to acquire due to social and communication deficits inherent in this population. Delayed or absent intraverbal repertoires are common, even when children with autism have an extensive verbal repertoire comprised of mands and tacts (Sundberg & Michael, 2001).
Establishing an Intraverbal Repertoire

Several different procedures have been examined in the literature on intraverbal training and have been shown to be effective to teach intraverbal responses to children with autism. The procedures include: transfer of stimulus control (Ingvarsson & Hollobaugh, 2011; Miguel, Petursdottir, & Carr, 2005; Partington & Bailey, 1993; Vendora, Meunier, & Mackay, 2009), match-to-sample training or listener training (Miguel, et al., 2005; Petursdottir, Carr, Lechago, and Almason, 2009; Petursdottir, Olafsdottir, & Aradottir, 2008), and multiple exemplar instruction (MEI; Fiorile & Greer, 2007; Greer, Yuan, & Gautreaux, 2005; Nuzzolo-Gomez & Greer, 2004). The following sections will specify components of each of the above mentioned intraverbal training procedures.

**Transfer of Stimulus Control.** The transfer of stimulus control procedure is designed to transfer a response from one antecedent condition to another. For example, when teaching intraverbal responses, the verbal antecedent stimulus (the question itself) should control the response. Visual or echoic antecedent conditions are often used as prompts for the correct response. For example, if a child can tact “dog” upon presentation of a picture of a dog or upon seeing a dog in the park, and we want to teach the child to answer the question "what animal barks?" a transfer of stimulus control from the picture to the verbal antecedent (the question) may be implemented. We can pair the question "what animal barks?" with the picture of the dog to evoke the response “dog." Eventually the picture can be faded until the verbal stimulus "what animal barks?" evokes the response "dog."
Partington and Bailey (1993) used a transfer of stimulus control procedure to bring intraverbal responses under verbal antecedent control rather than visual antecedent control. The transfer of stimulus control procedure was conducted by first presenting a verbal antecedent stimulus (i.e. "what are some toys?"). If a child emitted a correct response, they were given verbal prompts ("what else?") to list additional exemplars from that category. If the child emitted an incorrect response, or no response, they were given additional prompts through the use of pictures (all children were able to tact these pictures). The transfer of stimulus control procedure resulted in considerable increases in intraverbal responses. This study was important because through the use of verbal prompts, participants were able to become more independent in their natural environment. That is, teachers and caregivers are more likely to give verbal prompts to children due to the fact that pictures or visual prompts are not always available. Children often receive verbal prompts from others in their environment for example, verbal instructions.

Miguel and colleagues (2005) used procedures very similar to Partington and Bailey (1993) to accomplish transfer of stimulus control. After receptive discrimination training and tact training did not result in large increases in intraverbal responses, a transfer of stimulus control procedure was implemented in which participants were given the verbal discriminative stimulus "what are some (category)?" (e.g., musical instruments). If the participant did not emit a response or emitted an incorrect response within 10 seconds, the experimenters showed the participant a picture of the training stimuli, which the participant was taught to tact. If the participant did not respond to the picture (tact prompt), they were then given an echoic prompt. Results demonstrated that
the transfer of stimulus control procedure (direct intraverbal training) resulted in substantial increases in novel intraverbal responses demonstrating that speaker and listener repertoires may be functionally independent and these responses may need to be taught individually.

Finkel and Williams (2001), Vendora et al. (2009), and Ingvarsson and Hollobaugh (2011) compared different prompting procedures to transfer stimulus control and train intraverbal responses to children with autism. Finkel and Williams (2001) and Vendora and colleagues (2009) both found that textual prompts seemed to be more effective than echoic prompts for training intraverbal responses for children that were able to read. One issue with echoic prompts is that children may become prompt dependent due to the fact that these prompts are more difficult to fade during the training process (Vendora et al., 2009). Therefore, both of these studies illustrate that if possible, using textual prompts may be more efficient for teaching intraverbals. Ingvarsson and Hollobaugh (2011) compared visual (pictures) and echoic prompts and found that visual prompts were more efficient for teaching intraverbal responses. However, eventually both prompting procedures were effective. This study was important because visual prompts can be used with children regardless of their reading abilities as long as they can tact the picture. All three studies illustrated that textual (written word) or visual (picture) prompts are more efficient in teaching intraverbal responses than echoic prompts.

**Listener Training.** Listener training has also been used to teach intraverbals to children with autism. Listener training has also been referred to as match-to sample training (MTS), conditional discrimination training, and receptive discrimination training. All of these terms have been used in the literature to refer to similar procedures that only
require the participant to respond as a listener. Listener training involves selection based responding in which a child is given an array of stimuli and is then required to select one or multiple stimuli following presentation of a verbal instruction. For example, to teach a child to identify household items, an array of pictures (e.g., boat, chair, and horse) may be placed in front of the child, followed by the instruction "point to chair." The child would then be required to select the picture of the chair or point to the chair. Often following listener training, experimenters may probe to see if other verbal operants (i.e., speaker behavior) emerge. For example, after being taught to select "chair", experimenters probe the tact response to see if the child responds "chair" when shown a picture of a chair and asked "what is it?"

Results on the emergence of untaught speaker behavior following listener behavior training are currently mixed (Miguel et al., 2005; Petursdottir et al., 2009; Petursdottir et al., 2008). For example, Miguel and colleagues (2005) examined the effects of receptive discrimination training on the acquisition of intraverbals. Receptive discrimination training involved an auditory-visual MTS procedure in which the participants were required to select a visual stimulus (picture) following the experimenter’s presentation of the name of an object or the name of a category to which the object belonged. For example, for the category musical instruments, the experimenters would show the participants an array of three pictures from various categories and say "point to the bell" or "point to the musical instrument." Participants were taught to select both the object by name and by category. In this study, receptive discrimination training did not produce any additional intraverbal responses.
Similarly, Petursdottir et al. (2009) examined listener behavior training to increase categorization intraverbals for five typically developing children. Listener behavior training involved a MTS procedure in which the child was shown the sample stimulus and then presented with three comparison stimuli. Participants were given a verbal instruction "Which one is (category name)?" Children received praise and tokens for correct responses, and incorrect responses were prompted by the experimenter pointing to the correct stimulus and saying "It's this one." If incorrect, the child was required to point to the correct stimulus. Following listener training, participants were able to emit few if any untaught intraverbal responses. Researchers concluded that in this case, listener behavior training did not result in any gains of untaught categorization skills.

In contrast, Petursdottir and colleagues (2008) investigated the influence of tact training and listener behavior training on the emergence of untaught bidirectional intraverbals (Icelandic to Spanish and Spanish to Icelandic). Participants were typically developing five year old children whose native language was Icelandic. Listener behavior training included providing the participant with an array of three visual stimuli and the instruction "point to the one that is called (x) in Spanish." The participant was required to point to the target stimulus. Intraverbal probes included two different questions to assess the bidirectional intraverbal relation: "What does (Spanish name) mean in Icelandic?" and "What is (Icelandic name) in Spanish?" Results of this study indicated that listener behavior training was variable for the emergence of intraverbal relations across participants. Participants often were able to emit one relation (i.e., Icelandic to Spanish) but not the other (Spanish to Icelandic).
Multiple Exemplar Instruction (MEI). Multiple exemplar instruction is a procedure used to teach learners multiple examples of a behavior, or exemplars, with the goal of producing the same or similar behavior when novel stimuli are presented or when the same stimuli are presented in novel settings. In terms of verbal behavior, the learner may be taught to answer questions with several different stimulus sets and then tested to determine if they can then answer novel questions appropriately. When using MEI to teach verbal behavior, the trained response topographies are not similar to the response topography of the emergent behavior. For example, a child may be taught to mand for water and chips then following training mand for cookies without direct training. In contrast, training with multiple exemplars is often used to facilitate generalization. Training multiple exemplars may involve training behavior in multiple settings where the response topography is similar, and probing for the same behavior in a novel setting. For example, if an individual is taught to purchase groceries at three different groceries stores, they would then be tested to determine if they could purchase groceries in a novel setting (unknown grocery store in which the behavior was not directly taught). MEI and training multiple exemplars differ in that with MEI, different response topographies are trained while with multiple exemplar training the same response topography is trained.

MEI has been effective at facilitating the emergence of untaught behaviors as well as promoting generalization of behaviors (Fiorile & Greer, 2007; Greer et al., 2005; Hughes, Harmer, Killian, & Niarhos, 1995; Nuzzolo-Gomez & Greer, 2005; Taylor & O'Reilly, 2000). Specifically, MEI has been demonstrated to be effective at producing untaught verbal operants after training in only one verbal operant for mands (Nuzzolo-
Gomez & Greer, 2005), tacts (Fiorile & Greer, 2007; Nuzzolo-Gomez & Greer, 2005), and intraverbal responses (Greer et al., 2005).

Greer and colleagues (2005) examined the effects of MEI on the acquisition of joint spelling responses (written and vocal) in kindergarten students diagnosed with autism or language delays. Participants were first taught either a written or vocal spelling response, and probed for the untaught response. Following training in one response, emergence of the untaught response did not occur. MEI was then employed to train a set of words for both vocal and written responses. Finally, a third set was trained for one response and probed for the untaught response. Results indicated the untaught responses were derived following MEI across all participants.

**Functional Independence of Verbal Operants**

Skinner (1957) proposed that each of the elementary verbal operants were functionally independent, meaning that each must be taught separately and that learning one does not necessarily facilitate the ability to produce another. For example, if a child mands for "water" and is reinforced by a caregiver giving the child access to water, this does not necessarily mean the child will also be able to tact “water” when a cup or bottle with water is present in the environment. Although the word is the same, each verbal operant is controlled by different antecedent variables and maintained by different consequences. One implication of functional independence for establishing verbal behavior in children with autism suggests that each verbal operant will need to be taught separately. Second, verbal behavior training can become time consuming if each verbal operant must be taught separately. Therefore, the necessary time must be allotted in order to develop a verbal repertoire. Currently, there is a debate among researchers as to
whether verbal operants are in fact functionally independent as proposed by Skinner, or if teaching one may produce the emergence of additional untaught verbal operants. Empirical research has demonstrated support for both and will be presented in the following paragraphs.

**Empirical Support for Functional Independence.** Several empirical research studies have found support for Skinner's functional independence of verbal operants (Kelley, Schillingsburg, Castro, Addison, & LaRue, 2007; Miguel et al., 2005; Petursdottir et al., 2009; Schillingsburg, Kelley, Roane, Kisamore, & Brown, 2009; Twyman, 1996). Collectively, this research has demonstrated that after teaching one verbal operant, another may not emerge (or be within the participant's verbal repertoire) without direct training. Functional independence has held true in studies exploring mands (Kelley et al., 2007; Schillingsburg et al., 2009; Twyman 1996), tacts (Kelley et al., 2007; Schillingsburg et al., 2009), and intraverbals (Miguel et al., 2005; Petursdottir et al., 2009; Schillingsburg et al., 2009). These results have been demonstrated for typically developing individuals (Miguel et al., 2005; Petursdottir et al., 2009) as well as individuals with autism and other developmental disabilities (Kelley et al., 2007; Schillingsburg et al., 2009; Twyman 1996).

For example, Schillingsburg and colleagues (2009) sought to examine the functional use of yes-no responding as mands, tacts, and intraverbals, and to assess if there would be generalization for these responses across verbal operants. This study is highlighted because it examined emergence across three verbal operants. Participants were taught to make one response to a mastery criterion (either yes or no). For example, a mand would consist of the question "do you want chips?" while a tact would consist of the
question "is this a dog?" Subsequent stimuli were then probed for generalization. Results indicated that generalization within verbal operants occurred, but generalization across verbal operants did not occur. For example, once a child was taught the "yes" response as a mand, this response generalized to other mands; however, it did not generalize to the "yes" response for tacts or intraverbals. This study supports the functional independence of verbal operants by demonstrating that teaching one operant did not result in the topographically similar response to different verbal operants.

More relevant for the current study are the findings on functional independence of intraverbal responses. Miguel and colleagues (2005) examined whether tact training, receptive discrimination training, and direct intraverbal training would result in the emergence of thematically related intraverbal responses (i.e., musical instruments, kitchen items, etc.). Each child was exposed to all three training procedures with a different stimulus set. Results indicated that both receptive discrimination training and multiple tact training had little effect on intraverbal responses. While direct intraverbal training increased the number of intraverbals the participants emitted. These results show support for functional independence of verbal operants by showing that the speaker and listener repertoire were functionally independent and training on other verbal operants did not facilitate the number of intraverbal responses the participants could emit.

Finally, Petursdottir and colleagues (2008) examined the effects of intraverbal training and listener behavior training on the emergence of untrained categorization intraverbal relations. Similar to Miguel et al. (2005) participants also received listener behavior training and direct intraverbal training. Intraverbal training consisted of reinforcing the category name when given a spoken exemplar name, while listener
behavior training involved a match-to-sample (MTS) procedure in which the child was asked "which one is (category name)?" and then required to select the correct picture from an array of three stimuli. Results of this study indicated untrained relations did not emerge following intraverbal and listener behavior training for four of the five participants.

The studies illustrated here show support for Skinner's functional independence of verbal operants. After training one verbal operant (for example tacts) participants were not able to generalize this response to a different untaught verbal operant (for example intraverbals). These results demonstrate that unless a verbal operant is directly taught and reinforced, it is unlikely that it will emerge from previous training.

**Interdependence of Verbal Operants.** Despite the fact that several studies support functional independence of verbal operants, other studies have demonstrated the emergence of several verbal operants after teaching only one, including mands (Hernandez, Hanley, Ingvarsson, & Tiger, 2007; Nuzzolo-Gomez & Greer, 2005; Petursdottir et al., 2005; Wallace, Iwata, & Hanley, 2006), tacts (Egan & Barnes-Holmes, 2009; Greer, Chavez-Brown, & Rivera-Valdes, 2005; Nuzzolo-Gomez & Greer, 2005; Petursdottir et al., 2005), and intraverbals (Carp & Petursdottir, 2012; Greer et al., 2005; Partington & Bailey, 1993; Perez-Gonzalez, Antionio, Herszlikowicz, & Williams, 2008; Perez-Gonzalez, Garcia-Asenjo, Williams, & Carnerero, 2007; Petursdottir et al., 2008). Several studies have examined the effects of teaching either mands or tacts on the emergence of the untaught operant. The results of these studies have found that after teaching only one verbal operant (either mand or tact) the other can emerge without
additional training. This has also been found for intraverbal responses and will be the focus of the current study.

**Intraverbals.** Several research studies have indicated that intraverbal responses have emerged without direct training, demonstrating functional interdependence. Partington and Bailey (1993) taught participants to tact picture cards and examined if following tact training, intraverbal responses would emerge. In order to facilitate the emergence of intraverbal responses, a transfer of stimulus control procedure was implemented to bring the responses under the antecedent control of a verbal response (rather than a visual antecedent). Results indicated procedure was effective at producing the emergence of untaught intraverbal responses as evidenced by increased scores on the Verbal Fluency subtest of the McCarthy Scales (Bryant & Roffe, 1978). It should be noted that in this study, not all participants displayed the emergence of untaught intraverbal responses, suggesting that there may be some other factors influencing whether verbal operants will emerge.

Petursdottir et al. (2008) also investigated tact training on the emergence of intraverbal responses, particularly bidirectional intraverbal responses (Spanish-Icelandic and Icelandic-Spanish). Results of this study indicated that untaught intraverbal responses emerged as a result of tact training and listener behavior training; however, the responses were not always bidirectional. In sum, Petursdottir and colleagues (2008) and Partington and Bailey (1993) demonstrated the emergence of intraverbal responses following tact training. These studies support the interdependence of verbal operants suggesting that direct training on one operant can result in the emergence of an untaught verbal operant.
Studies have also demonstrated that untaught intraverbal responses can occur after training on some responses, indicating emergence within verbal operants. As described above, MEI has been an effective method for training verbal operants and for producing emergence of untaught intraverbals. Greer and colleagues (2005) demonstrated that MEI could facilitate joint spelling responses for children with language delays. Intraverbal spelling responses (written and verbal) were acquired after only one intraverbal response was taught following MEI. Results illustrated that untaught intraverbal responses could be acquired by bringing responses that were independent prior to training under the same stimulus control.

Perez-Gonzalez et al. (2008) also demonstrated the emergence of untaught intraverbal responses in three different experiments. In experiment one, participants were taught four intraverbal relations and probed for an additional eight untaught relations. Results indicated that training some intraverbal relations was effective at producing novel intraverbals for these participants; however, one of the participants acquired all eight relations, while others only obtained some of the relations. Experiment two was designed to teach potential prerequisite skills (naming exemplars of the categories: cities, parks, and countries) to determine if this would further facilitate the emergence of all untaught relations. Results of experiment two indicated that the additional teaching of these elementary operants (category name and exemplar name) helped facilitate the emergence of all eight untaught relations. Experiment 3 replicated results from experiment two, and also demonstrated that after learning additional elementary verbal operants novel relations of the same type emerged in fewer training sessions.
Finally, Carp and Petursdottir (2012) extended the study of Perez-Gonzalez and colleagues (2008) by training category name and exemplar name and testing for the emergence of untaught responses. Results indicated that following exemplar name and category name training, more participants displayed the emergence of untaught intraverbal responses than after baseline training alone. In sum, these studies help provide support for the emergence of untaught intraverbal responses both across and within verbal operants.

Stimulus Equivalence and Verbal Behavior

Stimulus equivalence is one way in which untaught relations can emerge without direct training (Sidman & Tailby, 1982). Stimulus equivalence involves teaching some conditional discriminations between stimuli which can result in the emergence of untrained relations; therefore, learners can gain some new behaviors for "free." For example, if a learner is taught to select a picture of the dog when the spoken word "dog" is provided, and also taught to select the printed word dog when the spoken word "dog" is provided. The learner may then also select the printed word dog when shown a picture of the dog, and read the printed word dog without further training.

Hall and Chase (1991) discussed the relationship between stimulus equivalence and verbal behavior. The authors state that verbal behavior does not always involve stimulus equivalence (e.g., verbal operants are sometimes directly taught and reinforced). In Skinner's definition of verbal behavior he states that verbal behavior is mediated by listeners who have been trained to reinforce the speaker's verbal behavior (Hall & Chase, 1991). Therefore, in the stimulus equivalence paradigm, when a participant selects a comparison stimulus when given a sample stimulus, this is an example of verbal behavior.
because it is being reinforced by the verbal community. Often, many equivalence classes include dictated words as one stimulus class.

The stimulus equivalence paradigm has been used to teach verbal behavior and increase the number of relations that a child will have within their repertoire without directly teaching each relation (Greer et al., 2005; Petursdottir et al., 2008; Ribiero, Elias, Goyos, & Miguel, 2010). Most studies that have found the emergence of verbal operants have used a MTS or listener training procedure (Greer et al., 2005; Petursdottir et al., 2008; Ribiero et al., 2010). Of consideration, recent research suggests that there may be other alternatives to the traditional stimulus equivalence paradigm in order to produce emergent behavior.

**Stimulus Pairing Observation Procedure (SPOP)**

The stimulus pairing observation procedure (SPOP) is a procedure in which stimuli are associated or paired in the environment, and the learner is not required to make a response. Following this association, tests are conducted for derived relations. This procedure has also been called *respondent type training* (Leader & Barnes-Holmes, 2001; Leader, Barnes-Holmes, & Smeets, 2000). The procedure was investigated to determine if equivalence relations could be derived without using an operant match-to-sample procedure (Kinloch, 2011). The SPOP mimics teaching styles in typical group classrooms or natural environment learning situations. For example, a teacher may introduce the class to a continent in a geography class. The teacher says "this is South America." The learner is not required to make a response, but they may be later tested on their comprehension when shown South America on an exam and asked "What continent
is this?" This procedure has been explored in depth in the basic literature; however, few applied studies on this procedure have been published to date.

**Basic Research on SPOP.** Basic research was pioneered by Leader and Barnes-Holmes, with the first published study in 1996 on what they termed *respondent type training*. The purpose of this study was to determine if equivalence relations would be formed with respondent as opposed to operant training procedures. Results of three experiments indicated that equivalence relations reliably emerged through respondent type training with a minimum of two exposures and a maximum of six. Results also demonstrated that the longer the delay between stimulus pairs, the more likely the participants were to demonstrate equivalence relations. Overall, this study was the first to demonstrate the effectiveness of a respondent type procedure for developing equivalence relations.

Smeets and Leader (1997) continued to expand on respondent type training by conducting experiments which demonstrated the formation of conditional discriminations and equivalence in adults and young children without the use of MTS training. Researchers examined different training procedures and testing arrangements in order to determine their effects on the formation of equivalence relations. Participants were trained on relations that involved pairing arbitrary stimuli (arrows) and subsequently tested for formation of equivalence (symmetry and transitivity). Results of these studies indicated that the most efficient training protocol to establish equivalence relations differed from the adults to the children participants. This study demonstrated that respondent type training was effective at forming equivalence relations for young children. It also suggested that the most efficient way to train equivalence relations
differed for the younger participants. Further research was conducted on establishing conditional discriminations and equivalence with young children using respondent type training by Leader and colleagues (2000). In this study typically developing five year old children participated in respondent type training using arbitrary stimuli. Experimenters found once again that conditional discriminations and equivalence relations can be established through respondent type training for young children.

Through their research Leader et al. (2000) were able to demonstrate that respondent-type training is effective at producing equivalence relations. However, the question that remained was how respondent-type training compared to MTS procedures in efficiency of developing equivalence. Leader and Barnes-Holmes (2001) compared these two procedures to determine if one procedure was more effective or efficient for forming equivalence. Participants were first trained using a respondent type training procedure and tested for equivalence through the use of a MTS procedure. Then they were trained using MTS procedures and subsequently given a MTS test. Results of these experiments demonstrated that in most cases, respondent type training was more effective than MTS procedures.

Clayton and Hayes (2004) also compared MTS and respondent type training. In their series of experiments they found MTS procedures to be more effective than respondent-type training. Some of the reasons they gave for the possible increased performance on the MTS procedure was that the training and testing conditions were similar, the participants were required to make an overt response during the MTS procedure and provided with feedback on their performance, and the MTS procedure was more complex (participants were required to meet a stringent mastery criterion versus
watching a computer screen while making no overt response). Currently, the research literature remains mixed as to whether MTS or respondent-type training may be more effective. However, it does indicate that both procedures are effective at forming equivalence relations.

More recently Minister, Elliffe, and Muthukumaraswamy (2011) conducted a study which once again demonstrated the effectiveness of SPOP. The goal of this study was to determine if stimulus correlations would result in the emergence of new stimulus relations that conflicted with previously reinforced relations. For example, when presented with a Japanese Kanji character the participant would select the character that had been paired with it in close temporal relation regardless of the relations that were reinforced during earlier training. Researchers found that stimulus pairing alone was sufficient to produce emergent relations under conditions of extinction. In this case, emergent relations had to be based on stimulus pairing, rather than reinforced relations, due to the fact that these relations had extinguished during training. Authors also note that in this case participants that had a history of reinforcement with conditional discriminations may respond consistently with that conditional discrimination on a novel discrimination task even when contingent feedback or reinforcement is not delivered. This finding suggests that after training in one conditional discrimination untaught novel discriminations may emerge from that training which would provide a more efficient method of producing multiple relations. These studies collectively established support for the effectiveness of SPOP to establish equivalence relations in the basic literature. However, few studies have used SPOP to develop relations with socially significant stimuli or target behaviors.
**Applied Research.** The first applied study that examined the use of SPOP was conducted in 2001 by Leader and Barnes Holmes. Three different experiments were conducted in order to determine if a respondent-type training procedure could establish fraction-decimal equivalence in 24 typically developing five year olds. Experimenters also assessed generalization based on formal similarity of stimuli. Three types of trials were used throughout these three experiments: 1) respondent type trials, 2) MTS test trials, and 3) MTS training trials. The purpose of experiment one was to examine if conditional discrimination training between fractions and decimals would result in the emergence of equivalence classes. Results indicated that participants reached mastery on each trained relation, and all untaught relations emerged demonstrating that these children formed equivalence classes between fractions, decimals, and pictorial representations. The purpose of experiment two was to replicate the findings of experiment one as well as to assess generalization of fractions and decimals as samples, and novel shapes as comparison stimuli. Generalization stimuli consisted of novel shapes with different shaded areas. Results once again indicated equivalence between these three stimuli; however, only 50% of the participants performed at criterion for all three generalization tests. Therefore, the purpose of experiment three was to determine if an additional test would improve performance on tests for generalization. Two generalization tests were compared: one in which the shaded segments of the shape were contiguous, and another in which the shaded segments were not contiguous. Results indicated all participants performed at 100% during all generalization tests following the first exposure.
Overall, Leader and Barnes demonstrated the effectiveness of respondent type training to develop equivalence relations between fractions and decimals with typically developing preschool age children. Not only were the children able to form equivalence relations, but these relations also generalized to similar and non-similar stimuli. This study was one of the first in the field to demonstrate the effectiveness of using respondent type training in an applied area.

Recently, Rosales, Rehfeldt, and Huffman (2012) examined the effectiveness of SPOP to teach a second language to typically developing preschool children whose first language was Spanish. The SPOP procedure was employed to train the participants in this study to tact English words (words selected included only those that were not easily translated due to formal similarity and ranged from one to three syllables). The design was a multiple probe design across four different stimulus sets which were counterbalanced across participants. SPOP was conducted as follows: once the participant was attending (evidenced by eye contact), the experimenter presented a picture of an item and stated "this is (name of item)." The participants were not required to make an overt response. The stimuli were presented in a random order with 1 second between trials. Following SPOP, the participants were exposed to tests for the emergence of tact and listener relations. Results indicated that some tact and listener relations emerged following SPOP, however not all relations emerged reliably. Multiple exemplar training (MET) was conducted if the participants did not reach mastery criterion. During MET, the participants were first trained on the stimuli using SPOP, and were then directly taught to tact stimuli by using verbal prompts. Following SPOP alone, participants were more likely to obtain listener relations than tact relations. After MET,
participants reached mastery criterion for the original stimulus sets, with the exception of one participant for one stimulus set. This study was the first to examine SPOP for teaching a second language to typically developing children; with results lending support for the effectiveness of SPOP to establish both listener and tact relations.

In one of the few studies examining the effectiveness of stimulus pairing for children with autism, Takahashi, Yamamoto, and Noro (2011) used a stimulus pairing procedure to teach two boys with autism relations among names (printed words) and faces and words and Kanji symbols. Two pictures were paired simultaneously during SPOP training, and subsequent MTS tests evaluated the emergence of equivalence relations. MTS trials blocks were conducted immediately following SPOP, and sessions were conducted until stable responding was observed during MTS blocks. Results indicated that for these two participants, SPOP resulted in increases in correct responses for the paired stimuli. It is important to note that this study illustrated that stimuli of different modalities can be paired and still result in emergent relations (in this study auditory-visual for one participant and visual-visual for the other).

The SPOP procedure has been shown to be an effective method for producing the emergence of derived relations for neurotypical individuals; however, it has not been explored extensively with the autism population. If SPOP is an effective teaching method for children with autism, this would be a way to help integrate aspects of typical teacher/learner interactions into their academic programming. The SPOP may also be a more efficient way of teaching children with autism if they have the prerequisite attending behavior due to the fact that an overt response is not required from the student. Therefore, the purpose of the current study was to examine and compare the SPOP to a
listener behavior procedure in order to determine if either or both procedures could lead to the emergence of untaught intraverbal responses. The second purpose of the study was to determine if it is necessary to require an overt response from the participant for untaught responses to emerge. Finally, we sought to examine what characteristics and prerequisite skills a child must possess in order for these methods to be utilized.
Method

Participants, Setting, and Materials

Participants included two children (ages six and seven) with a diagnosis of autism that were enrolled at a therapeutic center for educational and behavioral intervention services in Northeast Ohio. All participants had an established verbal repertoire consisting of mands, tacts, and some intraverbals. Specific components of the ABLLS-R assessment were used as a basis for establishing criteria that must be within a child's repertoire for inclusion in this study. For example, participants could mand using three to four word sentences, and make spontaneous requests. They could tact at least 50 common objects, and complete intraverbal fill-ins for at least three common childhood songs. Specific components of the VB-MAPP assessment were also conducted to determine each participant’s current verbal repertoire including: echoic, listener responses, tacts, and intraverbals. In addition, participants were under appropriate instructional control. For example, participants had a history of attending to materials during one-on-one instruction (i.e. appropriate sitting, eye contact, etc), and did not engage in problem behavior that would possibly interfere with their ability to attend for at least 15-20 minutes (i.e. falling out of the chair, aggression towards the instructor, frequent stereotypy, etc.)

All sessions took place in a classroom area (10 ft. by 10 ft.) containing a child size table and two to three chairs. Materials used for the study were placed on the table. The room contained some materials used for everyday classroom and academic programming unrelated to the current study, but the participant work space contained minimal distractions. Sessions were conducted four to five days per week and lasted
approximately 15-20 minutes per session. On average, one session was conducted per school day. Materials consisted of an apple iPad® which displayed all of the stimuli using Microsoft Powerpoint®. The stimuli were approximately 3” by 2” and were arranged equidistant from each other in a square on the screen (three rows of two stimuli). Stimuli were selected from the ABLLS-R (Partington & Sundberg, 1998) to ensure high social validity. Assessments were completed prior to the start of the study to ensure the responses to be trained were not already within each participant’s repertoire. If a participant was familiar with any of the stimuli selected for training, these were replaced with unfamiliar stimuli (see Table 1 for a listing of stimulus sets). There were six stimuli per set, and each stimulus was presented two times to yield 12 trial blocks. Two-three 12-trial blocks were conducted daily for each training procedure. Data was collected using paper and pencil by the experimenter (see Appendix A for an example of the data sheets used).

A token economy was implemented for one participant, John, in order to increase his motivation to attend to the training stimuli during sessions. The token economy consisted of stars which were fastened to the token economy board using hook-and-loop tape (laminated pieces of papers with blocks outlined to indicate where each token would be placed). John earned one token contingent upon each correct response during listener training sessions and direct intraverbal sessions (FR 1), and on a variable time schedule of 1 minute (VI 1) during pre-training, and post-training probes for proper attending behavior. Attending behavior was defined as the participants’ bottom staying in the seat, and the participant making eye contact with the materials for three consecutive seconds. During the SPOP condition, tokens were delivered on a variable interval schedule of 30
seconds (VI 30) contingent on compliance with instructions and appropriate attending behavior. After five tokens were earned, John was given access to preferred items (which were identified via a preference assessment described below).

**Experimental Design, Response Measurement, and Interobserver Agreement**

A multiple probe design across participants was used to examine the emergence of untaught intraverbal responses following each training procedure (Horner & Baer, 1978). Both listener training and SPOP training sessions were conducted simultaneously, but with different stimulus sets for each teaching procedure. Each participant was exposed to two different stimulus sets, one for listener training and one for SPOP. Stimulus sets were similar for each participant and counterbalanced across participants and training procedures in order to control for threats to internal validity. Stimulus sets were similar in difficulty; each intraverbal response was one word in length. The order in which the listener training trial blocks and SPOP trial blocks were implemented was rotated. For example, if the listener training trial block was completed first for training session one, during training session two the SPOP stimuli were introduced first.

The independent variable in this study was the specific training procedures (either listener training or SPOP). The dependent variable was the number of correct intraverbal responses the participant emitted following each training procedure. A correct intraverbal response was defined as a vocal response emitted within 5-10 seconds of an experimenter's question that contained the trained stimulus. For example, during listener training the participant was taught to point to a picture of a dime when given the verbal instruction "point to the coin worth 10 cents." Following training, when asked the question "what coin is worth 10 cents?" a correct response consisted of the participant
saying “dime.” An incorrect response was defined as a participant giving a response other than the response containing the trained stimulus or no response after 5-10 seconds.

During listener training, a correct response was defined as the participant pointing to or touching the appropriate stimulus on the screen following a verbal instruction within 5-10 seconds. For example, after the experimenter stated "point to the one you use to tell time" the participant was required to point to or touch the picture of a clock. Incorrect responses included the participant pointing to stimuli other than the target stimulus or not responding within 5-10 seconds of the instruction. During SPOP training, participants were required to make an observing response (advance the screen by pointing to an arrow) and eye contact with the stimuli, but no other responses were required. The experimenter recorded if the participant made eye contact with the picture while the experimenter gave the instruction, as well as noted if the participant engaged in any vocal verbal behavior (for example, echoing the instruction the experimenter provided or tacting the picture).

A second observer independently and simultaneously scored participants' responses, interobserver agreement (IOA), for approximately 50% of all sessions (including pre-training, training, and post-training). IOA was calculated using an exact agreement method. The number of agreements was divided by the number of agreements plus disagreements and multiplied by 100 to yield a percentage for each trial block. Interobserver agreement was collected for 58% of sessions for Aaron (mean 98.4%, range 83-100%); and 52% of sessions for John (mean 96.5%, range 58-100%).

Treatment integrity measures were also scored to ensure that procedures were implemented consistently. A trained observer scored the experimenter responses using a
checklist created for the purpose of this study during (see Appendix B). The observers assessed correct and incorrect responses made by the experimenter and data was summarized by summing the correctly implemented responses divided by the total number of responses possible for that trial block and multiplying by 100 to yield a percentage for each trial block. Training for secondary observers consisted of the experimenter providing access to data collection sheets and treatment integrity checklists, explaining the definitions of correct and incorrect responses, providing examples of each, and answering any questions the observers had during a one-on-one meeting with the experimenter prior to starting data collection. Treatment integrity was collected during 33% of all sessions for Aaron (mean 99.6%, range 93-100%) and during 32% of all sessions for John (mean 99.8%, range 97-100%).

Procedure

**VB-MAPP Assessment.** Sections of the VB-MAPP assessment were completed with both participants to determine their current verbal behavior repertoire. Sections that were assessed included: listener responses, echoics, tacts, and intraverbals. This assessment helped to determine the participants' current skill set.

**Preference Assessment.** The Reinforcement Assessment of Individuals with Severe Disabilities (RAISD; Fisher, Piazza, Bowman, & Almari, 1996) was conducted with each participant’s teacher(s). The RAISD is a questionnaire designed to determine a child's preferred activities, food and drink, and leisure items according to caregiver report that may function as reinforcers. Once the RAISD was completed, the items that teacher(s) indicated as preferred were included in a multiple stimulus without replacement (MSWO) preference assessment (DeLeon & Iwata, 1996) in order to
determine a ranking of the participant’s most highly preferred items. During this assessment, multiple items were placed in front of the participant and they were given the instruction to "choose one." Once the participant selected an item, they were given access to that item for one minute and then the item was removed. The experimenter then rearranged the positions of the remaining items and once again gave the instruction to "choose one." This process was repeated until the participant made a choice between the final two stimuli. The MSWO was completed for three trials in order to ensure reliability. Once the assessment was complete, the experimenter obtained a ranking of item preference by examining the order in which items were selected. To obtain a ranking, the order in which the item was selected was added across the three trials and divided by three in order to get an average ranking for each item. Participants were given the opportunity to work for items identified as preferred, and gain access to them contingent upon the completion of one trial block or earning the specified number of tokens required during training sessions.

**Pre-assessment probes.** Before pre-training probes, the experimenter presented stimuli that were familiar but unrelated to the present study on the iPad screen and gave the instruction (“point to ____.”) Given the varying instructional histories of each participant, specifically with use of an iPad, it was important to ensure all participants had the same training on navigating the iPad and exposure to the instructions that would be provided during the study to control for threats to internal validity, specifically history. For example, if a student had never been exposed the instruction "point to" they may respond incorrectly simply because they did not understand the instruction or what was expected of them. Pre-assessment probes ensured all participants had a similar history.
before starting the study, so that all incorrect responses could be attributed to the participants not knowing the correct response versus not understanding the instructions. Familiar stimuli that were included for pre-assessments were selected according to teacher report of previously mastered tasks. One to two pre-assessment sessions were conducted which lasted approximately 15 minutes.

**Tact Pre-Test.** Probes for tacts were presented for all the stimuli to be included in the study. The purpose of the tact pre-test was to ensure participants identified the pictures to be used in training so that correct and incorrect responses could be solely attributed to a listener response that was lacking or within their repertoire. The experimenter presented one picture in isolation paired with the instruction "what is this?" One 12-trial block was presented, with each target stimulus presented once in a quasi random order. Irrelevant stimuli were also included to ensure the participants' would not select the target stimulus during listener training based solely on familiarity due to previous exposure. If the participant tacted the stimuli, they were provided with response specific praise ("you're right, that is a pencil"). If the participant was did not tact the stimuli, an echoic prompt was provided followed by re-presentation of the same target stimulus and instruction. The echoic prompts were faded until the participant tacted each picture independently and met a mastery criterion of 12 out of 12 correct responses.

**Pre-training probes.** Pre-training probes consisted of one 12 trial block for each stimulus set (SPOP and Listener Training). Multiple probes were conducted before training began to ensure stability. For intraverbal pre-training probes, participants were asked a question, and given 5-10 s to provide a vocal response. A correct intraverbal response was defined as a vocal response emitted within 5-10 seconds of an
experimenter's question that contained the trained stimulus. An incorrect response was defined as a participant giving a response other than the response containing the trained stimulus or no response after 5-10 s. There were no consequences for correct or incorrect responses during pre-training probes, but participants attending behavior (i.e. working with the experimenter, attending to the stimuli) was reinforced on a VI 1 minute schedule followed by a break at the conclusion of each trial block. Participants gained access to preferred items for 1-4 min during each break.

**Listener Training.** Listener training was conducted in 12 trial blocks, with each stimulus presented two times in a quasi random order. Six stimuli were placed equidistant and in a square formation on the screen. The PowerPoint presentation which contained all of the stimuli was created ahead of time and the experimenter ensured the order of the stimuli was randomized. The data sheets indicated the order of the stimuli.

First, the participant was required to make a differential observing response (Walpole, Roscoe, & Dube, 2007). The observing response was a response the participant made before the target response to ensure they were attending to the stimuli. A blank white screen was presented, and the participant was required to press the arrow on the screen to advance to the next slide. If the participant did not comply with the instruction the experimenter prompted the correct response by modeling the response (pressing the arrow) and represented the instruction. Following the observing response, a screen with six pictures was presented on the screen and the participant was required to touch a sound icon which resulted in an auditory instruction (i.e., “point to the one you hear with.”). If the participant did not press the sound icon independently, the experimenter gave the instruction "point to the sound." Following delivery of the instruction, the participant was
provided with 5-10 s to respond independently (in this case, by pointing to a picture of ears on the computer screen). Correct independent responses as defined above were immediately followed by response specific praise (i.e., "You're right! You hear with your ears") and a token (for John only). Incorrect responses as defined above were immediately followed by a correction procedure which consisted of a least-to-most prompting hierarchy to select the correct response on the screen (gestural partial physical full physical prompt). Both participants responded to gestural prompts, and full physical prompts were not necessary. Mastery criterion for listener training was 11/12 correct responses in one trial block. One-two trial blocks were conducted during each training session.

**SPOP Training.** SPOP training was conducted in 12 trial blocks with each of the six stimuli presented two times each in a quasi random order. The experimenter first gained the participant's attention as evidenced by an observing response as described above. Following the observing response, the participant was presented with a single picture on the middle of the screen, instructed to press the sound icon (if this behavior did not occur independently), and presented with an auditory stimulus (i.e., "a penny is worth one cent" – when a picture of a penny was on the screen). Following presentation of each stimulus, a 3 s inter-trial interval was presented before the next picture and auditory stimulus were presented on the screen.

This procedure was repeated during each 12-trial block and a total of five SPOP sessions were conducted (Leader & Barnes-Holmes, 1996). Praise for attending to the screen, sitting nicely, and working was delivered on a VI 30 second schedule. The experimenter used an interval recording application on the iPhone that vibrated randomly
within a 30 second period to prompt delivery of the reinforcement. One to two trial
blocks were conducted during each training session

**Post-training probes.** Following each SPOP trial block the experimenter
conducted an intraverbal probe (same as pre-training probe described above) to determine
if any intraverbal responses had emerged. Following each listener training session for
John, an intraverbal post-training probe was conducted to determine the number of correct
intraverbal responses following each trial block. For Aaron, once mastery criterion was
met for listener training, post training probes were conducted. This procedure differed
due to the fact that the experimenters hoped to gain additional information regarding how
many trial blocks were necessary in order for the emergence of untaught intraverbals to
occur. Therefore, after training was completed for Aaron, intraverbal probes were
conducted following both SPOP and LT for John. Following post-training probes, if
participants scored below 11/12 correct responses for each 12 trial block remedial
training was conducted as described below.

**Remedial Training.** Following post-training probes, if participants scored below
11/12 correct responses for either 12 trial block, remedial training was conducted. For
LT, the procedure was repeated until the participant reached 11/12 correct responding
during one 12 trial block. For SPOP, two training sessions were conducted and post-
training probes were repeated as described above.

**Direct Intraverbal Training.** Following listener and SPOP training, if
intraverbal responses did not emerge, a transfer of stimulus control procedure which
included echoic prompting and a prompt delay was employed to directly teach the
intraverbal responses. The experimenter asked the participant a question (same as
intraverbal probes) and waited 5-10 s for the participant to respond. If the participant provided a correct response (as defined above) they received a token and descriptive praise. If the participant provided an incorrect response (as defined above) the experimenter immediately provided an echoic prompt and re-presented the instruction. The echoic prompt was selected due to the fact that it was more effective for this participant. A visual prompt was selected first (picture of the item) due to previous literature suggesting a visual prompt can be more effective and easier to fade (Finkel & Williams, 2001; Vendora, Meunier, & Mackay, 2009; Ingvarsson & Hollobaugh, 2011). This participant did not tact the picture without additional prompts to do so ("What is this?") therefore, the echoic prompt was selected. Prompted responses were not scored as correct on the data sheet. A progressive prompt delay was also implemented in which the experimenter initially provided the prompt immediately following presentation of the instruction. For example, if the question was "what do you use to tell time?" The experimenter would immediately say “clock” and require the participant to repeat the response. The experimenter then increased the delay by one second (i.e. 1 s, 2 s, 3 s, etc.) before providing the participant with the correct response. The time delay was increased by 1 s after two trial blocks at the current time delay. The time delay ended at 5 s, at which point the participant was responding independently and correctly. Mastery criterion was 11/12 correct responses during one 12 trial block.

**Generalization.** Generalization probes consisted of one 12-trial block per stimulus in which a novel person (individual who was not involved in the child's daily academic instruction) asked each of the questions included in both stimulus sets. Generalization probes took place in the same location as training and during the same
time period. The experimenter was always present during generalization probes. A total of three different instructors conducted one generalization probe on different days following the end of training.

**Maintenance.** Follow-up probes were conducted two weeks, and four weeks following post-training probes in the same manner as post-training probes.
Results

Results indicated that some intraverbal responses emerged following listener training and SPOP; however the number of correct responses varied across participants. Figure 1 displays results for Aaron and John.

Aaron. For Aaron, five probes were conducted prior to beginning training. He responded correctly on 1/12 trials during the first probe for SPOP and 0/12 trials for LT. During the second probe, Aaron responded correctly on 0/12 trials for both stimulus sets. The number of correct responses increased during the third probe (3/12) for each set. Finally, responses remained stable at 4/12 correct responses for both sets during the fourth and fifth probe conducted prior to training. Aaron responded correctly to the same two questions during both of these probes (i.e., “What shines in the sky in the day?” and “What keeps food cold?” for SPOP and “What do you use to tell time?” and “What do you find on top of the house?” for LT). He completed six trial blocks of LT to meet the mastery criterion of 11/12 correct responses and 10 trial blocks of SPOP before post-training, generalization, and follow-up probes were conducted. Ten trial blocks of SPOP were conducted due to the fact that intraverbal responses were close to mastery criterion (10/12) in order to attempt to reach 12/12 correct intraverbal responses. Aaron was responding incorrectly to the same question during both presentations (i.e., “What coin is worth 5 cents?”).

Following training, Aaron responded correctly on 12/12 trials for both SPOP and LT, which met the pre-determined mastery criterion for the emergence of intraverbal responses (see Figure 1). A second post-training probe was conducted one day following mastery which indicated that Aaron completed 12/12 correct intraverbal responses for LT.
and 10/12 for SPOP. For each session in which Aaron scored 10/12 correct intraverbal responses following training, he missed the same question on both presentations (i.e., “What coin is worth 5 cents?”).

On average, Aaron tacted the picture or repeated the instruction on 5/12 trials for LT and 6/12 trials for SPOP. In addition, Aaron’s responses generalized to three different instructors that were not part of the training procedures during generalization probes. That is, he responded correctly on 9/12 and 12/12 trials for SPOP and LT, respectively during the first probe; 11/12 and 12/12 for SPOP and LT, respectively, on the second probe; and 11/12 and 9/12 during the third probe. Intraverbal responses from the LT stimulus set remained higher than the SPOP set for two of the three generalization probes. Aaron's correct responses also maintained at the two week follow up probe (12/12 for both sets) and four week follow up probes (11/12 for both sets).

**John.** For John, seven probes were conducted prior to beginning training. He did not emit any correct responses throughout the pre-training probes for the SPOP set; and responded correctly on 1/12 trials during probes one and two, 2/12 during probe three, 0/12 during probes four and five, 1/12 during probe six, and 2/12 during probe seven for the LT set. This was the same question in which he responded correctly during all pre-training probes (i.e., “What state do you live in?”).

John completed 13 trial blocks of LT before he met mastery criterion of 11/12 correct responses. One additional trial block was conducted as a part of remedial training in which he also scored 11/12 correct responses before he moved on to direct intraverbal training, for a total of 14 trial blocks of LT. He completed 12 SPOP sessions before moving on to direct intraverbal training. Additional SPOP sessions were conducted in an
attempt to have a similar number of SPOP and LT trial blocks. On average, John repeated
the instruction or tacted the pictures for 5/12 trials during LT, and 3/12 trials on SPOP.

Following training, John responded correctly during 4/12 trials for SPOP (five
trial blocks). After remedial training, (additional two SPOP sessions for a total of seven
trial blocks) John completed 4/12 correct intraverbal responses. After 12 SPOP sessions
and before direct intraverbal training was conducted John responded correctly on 3/12
trials. During these intraverbal probes he responded correctly to the same two questions
(i.e., “What season do you pick up the leaves?” and “What do you find on top of the
house?”). Following mastery of LT, 8/12 correct intraverbal responses emerged.

Following remedial training (one additional LT session) at mastery criterion he scored
7/12 correct intraverbal responses. Finally, an additional probe was conducted before
direct intraverbal training in which he scored 7/12 correct intraverbal responses (see
Figure 1).

Following SPOP and LT, direct intraverbal training was implemented in order to
further increase John's correct intraverbal responses. During direct intraverbal training,
intraverbal probes were conducted in the same manner as pre-training and post-training
probes. Throughout the course of direct intraverbal training, nine intraverbal probes were
conducted. Results of direct intraverbal training are displayed in Figure 1. During the first
probe, John scored 5/12 for the SPOP set, and 7/12 for the LT set. For probe two, he
scored 7/12 for SPOP, and 8/12 for LT; probe three, he once again scored 8/12 for LT
and 6/12 for SPOP. On probe four John correctly responded on 7/12 trials for LT and
6/12 for SPOP. For probe five the number of correct intraverbal responses increased for
both sets with 9/12 correct responses. On probes six and seven John responded correctly
during 9/12 trials for LT, and 10/12 for SPOP, probe eight he scored 10/12 for LT and 9/12 for SPOP. Finally, on probe nine he scored 10/12 for both sets. For the final probe John responded incorrectly to two different questions one time, meaning he also got the same two questions correct one time. The questions he continued to miss involved the value of coins (i.e., “What coin is worth 10 cents?” and “What coin is worth 25 cents?”).
Discussion

Results indicate LT and SPOP were both effective at producing the emergence of untaught intraverbal responses for two participants with a diagnosis of autism. Listener training resulted in a greater number of correct intraverbal responses for one participant. This suggests the requirement of an overt response during LT (pointing to the pictures) may have played a role in the emergence of untaught verbal behavior. The number of correct intraverbal responses that emerged was variable across participants, suggesting that other variables (such as prerequisite skills) may play a role in determining if untaught responses will emerge following training.

The current study supports results of previous literature which has indicated that listener training, or match-to-sample procedures can be effective at producing the emergence of some untaught intraverbal responses. Petursdottir and colleagues (2008) demonstrated that through the use of a MTS procedure, typically developing participants learned to answer questions involving Spanish and Icelandic names. Results of this study indicated emergence occurred, however the number of correct responses that emerged was variable across participants. Participants were able to emit one relation (for example, Spanish to Icelandic) but not both (Spanish to Icelandic and Icelandic to Spanish).

These results are similar to what was demonstrated in the current study for two participants. Emergence occurred following listener training, however two participants did not reach mastery criterion while one did. Results of this study provide further support that listener training is an effective procedure to produce the emergence of untaught verbal behavior and extends these findings to participants with a diagnosis of autism. The rationale for examining the effects of listener training in the current study
was that results remained mixed on the effectiveness of this procedure for facilitating the emergence of untaught behavior. Results of this study counter findings from Miguel and colleagues (2005), and Petursdottir and colleagues (2009) who both demonstrated that listener training did not produce the emergence of any additional intraverbal categorization skills for their participants. It is important to note that these two studies examined listener training in order to increase categorization intraverbals while in the current study intraverbals included WH-questions mostly involving function of objects. The difference in target responses may have influenced the differing results of previous studies with the current study.

Results also support previous research indicating a stimulus pairing is an effective method to teach untaught verbal behavior with typically developing children (Rosales et al., 2012) and children with autism (Takahashi et al., 2011). Rosales and colleagues demonstrated that SPOP increased tact responses for children learning a second language. In this study, participants did not gain all tact responses without direct instruction. Therefore, although untaught responses emerged, they did not emerge at mastery criteria. These results were similar to John's data in the current study, which indicated that he gained some additional responses from SPOP, but responses did not reach mastery criterion. Takahashi and colleagues demonstrated that SPOP was effective for teaching relations between names, printed words, and faces, as well as printed words and Kanji symbols when pairing both auditory-visual and visual-visual stimuli. In the current study, this was most strongly demonstrated with one participant, Aaron. Future research should examine characteristics of participants for which this procedure is most effective. For example, Aaron had a more extensive verbal behavior skill set already within his
repertoire than John as evidenced by scores on the VB-MAPP. That is, Aaron scored higher than John on the intraverbal, listener, and tact sections of the VB-MAPP, indicating he had a more advanced verbal repertoire before the start of the study. It would have been interesting in this case to examine the effects of multiple exemplar instruction on the acquisition of novel untaught intraverbal responses for John. For example, teaching a participant to respond correctly to multiple stimulus sets, then returning to the original stimuli to determine if these responses subsequently emerge. Several studies have indicated the effectiveness of multiple exemplar instruction for facilitating the emergence of behavior that is not directly taught (Fiorile & Greer, 2007; Greer et al., 2005; Nuzzolo-Gomez & Greer, 2005). Future researchers should examine the effects of MEI if participants do not gain intraverbal responses that meet criterion following LT or SPOP.

One factor which may have influenced the effectiveness of SPOP and LT is the participants’ overt vocal response during either training condition. During training sessions, experimenters recorded if the participant tacted the picture or echoed the instruction. Aaron engaged in overt vocal responses during both training conditions. For example, during LT he would consistently tact the picture or state the function of the object (i.e., "you use a microwave to heat up food.") During SPOP, he repeated the instruction presented by the experimenter as well (i.e., "you use a clock to tell time.") After a few trial blocks during this training condition, Aaron gave the instruction independently before pressing the sound icon. In comparison, John engaged in fewer vocal responses during each training condition. He tacted the pictures of a few of the stimuli during LT and SPOP, but never repeated the instruction. For John, the intraverbal
responses that did emerge were for stimuli in which he engaged in overt vocal responses. This suggests an overt response may play a role in the emergence of untaught verbal behavior.

Other researchers have examined the role of naming in relation to emergent relations. In their description of the naming hypothesis, Horne, Lowe and Randel (2004) define naming as a relation between stimuli that involves a bidirectional listener-speaker behavior that is not directly taught. The components necessary to demonstrate naming include: listener behavior, echoic behavior, tacting, and the ability to produce tact and listener relations without direct instruction (Horne et al., 2004). Proponents of the naming hypothesis suggest that naming is a critical feature of equivalence, and that non-verbal animals cannot demonstrate equivalence for this very reason. That is, engaging in listener behavior alone will not produce equivalence. When working with participants with autism, naming may be absent or weak due to language delays (Fiorile & Greer, 2007). Therefore, it may be plausible to assume that if John did not have an extensive naming repertoire this may explain why he did not gain as many emergent relations as Aaron. Additionally, in this study the students were only required to engage in listener behavior, not name any of the stimuli. Future research should further explore how naming may play a role in the emergence of intraverbal responses.

Limitations and Future Directions

There are several limitations to the current study which will be discussed in the following paragraphs along with suggestions for ameliorating these limitations in future research. One limitation of the current data is that Aaron gained four correct intraverbal responses before training began. In addition, John responded correctly to two intraverbal
questions in the LT stimuli before training. Some of the responses to the questions may have been learned in everyday academic classroom instruction, or they may have had these responses in their repertoires, but did not respond consistently during all the pre-training probes. Aaron's responded correctly during two intraverbal probes and the level of responding was stable prior to implementation of the training. However, because there were four correct responses prior to training, we cannot attribute all of the gains solely on implementation of the independent variable. Aaron may have reached mastery criterion following each training procedure because of the higher number of correct responses already within his repertoire prior to training, while the number of correct responses for the other participants ranged from zero to two.

Second, it is difficult to determine if one procedure is more effective than the other due to the limited amount of data. For John, LT produced more untaught responses than the SPOP. However, John also had an advantage on the LT set because he has responded correctly on two questions prior to training. This may provide an account for the quicker acquisition during LT. These same results should be directly and systematically replicated with multiple participants before a conclusion is made with respect to the effectiveness and efficiency of each training condition.

Third, stimulus sets were counterbalanced across participants to control for threats to internal validity. However, Aaron’s stimulus sets were not exactly the same as John's. Two questions differed from Aaron's SPOP set and John's LT set due to correct responses emitted during the pre-assessment phase. All questions involved a one word response, so it is unlikely the difference in the questions influenced the findings. Different types of questions were included in the stimulus sets (i.e., function of items, seasons, emotions,
and value of coins). Some questions may have been too difficult for the participants’ academic level (specifically, the value of coins). Two of these questions were included in each participant's stimulus sets. Future research should examine different types of questions to determine if these procedures are more effective for specific types of questions (i.e. academic versus social).

Fourth, some of the questions included as part of each stimulus set had more than one correct response. For example, for the question "what do you use to heat up food?" the target stimulus was a microwave; however an oven and a toaster oven can also heat up food. Although these participants never provided a response other than the trained response; future studies should assess generalization for novel responses to questions included as part of training. The current study was only examining the effectiveness of these two procedures, and did not assess generalization to novel untaught stimuli.

Fifth, there were slight differences in the procedure for Aaron and John. That is, although an intraverbal probe was conducted following each SPOP session for both participants; intraverbal probes following LT sessions were only conducted for John. Future research should further examine the number of trial blocks that are necessary for each of these procedures before the emergence of untaught responses is demonstrated. The procedure for John also differed slightly from Aaron due to the fact that a token economy was used with John in order to increase his motivation to work with the experimenter. That is, John may have earned additional breaks during some of the LT sessions.

Sixth, inter-response time (IRT) for SPOP was not always three seconds due to some technical difficulties, and also the students having access to the iPAD. The slide
was pre-set to move ahead after three s; however the participant could tap the arrow ahead at any time. Future researchers should weigh the pros and cons when using technology such as an iPad or tablet to present stimuli.

Finally, all students in the current study had basic pre-requisite skills needed in order to answer questions including: mand using 3-4 words, tact at least 50 common objects, and complete intraverbal fill-ins for three common childhood songs. The current study did not assess more specific pre-requisite skills that the participants had within their repertoire. Future studies should examine more closely specific pre-requisite skills that are essential for students to have in order for these two teaching procedures to be most effective. Based on the results collected to date, it may be important to examine a student's current listener, echoic, and intraverbal repertoires before implementing these procedures, as well as ensure the students have advanced attending skills (i.e. attend to instructions for an extended period of time (15 minutes) without engaging in off-task behavior). The student's attending skills may play an integral role in their ability to gain untaught responses following these teaching procedures.

Overall, the current study demonstrated that both listener training and the stimulus pairing observation procedure may be used to produce the emergence of untaught intraverbal responses for students with autism. Since the applied research published to date remains limited on the effectiveness of SPOP, there are a wide range of research applications that can be explored in future studies.
References


Table 1. Stimulus Sets for John

<table>
<thead>
<tr>
<th>Intraverbal Probe</th>
<th>Correct Response</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LT</strong></td>
<td></td>
</tr>
<tr>
<td>1) What coin is worth 5 cents?</td>
<td>Nickel</td>
</tr>
<tr>
<td>2) What state do you live in?</td>
<td>Ohio</td>
</tr>
<tr>
<td>3) What season do the flowers bloom?</td>
<td>Spring</td>
</tr>
<tr>
<td>4) What do you do when you're happy?</td>
<td>Smile</td>
</tr>
<tr>
<td>5) What coin is worth 25 cents?</td>
<td>Quarter</td>
</tr>
<tr>
<td>6) What do you use to heat up food?</td>
<td>Microwave</td>
</tr>
<tr>
<td><strong>SPOP</strong></td>
<td></td>
</tr>
<tr>
<td>1) What coin is worth 10 cents?</td>
<td>Dime</td>
</tr>
<tr>
<td>2) What do you do when you're angry?</td>
<td>Yell</td>
</tr>
<tr>
<td>3) What do you use to tell time?</td>
<td>Clock</td>
</tr>
<tr>
<td>4) What season do you pick up the leaves?</td>
<td>Fall</td>
</tr>
<tr>
<td>5) What coin is worth 1 cent?</td>
<td>Penny</td>
</tr>
<tr>
<td>6) What do you find on top of the house?</td>
<td>Roof</td>
</tr>
</tbody>
</table>
### Table 2. Stimulus Sets for Aaron

<table>
<thead>
<tr>
<th>Intraverbal Probe</th>
<th>Correct Response</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LT</strong></td>
<td></td>
</tr>
<tr>
<td>1) What coin is worth 1 cent?</td>
<td>Penny</td>
</tr>
<tr>
<td>2) What do you find on top of the house?</td>
<td>Roof</td>
</tr>
<tr>
<td>3) What season do you pick up the leaves?</td>
<td>Fall</td>
</tr>
<tr>
<td>4) What do you do when you're angry?</td>
<td>Yell</td>
</tr>
<tr>
<td>5) What coin is worth 10 cents?</td>
<td>Dime</td>
</tr>
<tr>
<td>6) What do you use to tell time?</td>
<td>Clock</td>
</tr>
<tr>
<td><strong>SPOP</strong></td>
<td></td>
</tr>
<tr>
<td>1) What do you do when you're happy?</td>
<td>Smile</td>
</tr>
<tr>
<td>2) What shines in the sky in the day?</td>
<td>Sun</td>
</tr>
<tr>
<td>3) What keeps food cold?</td>
<td>Refrigerator</td>
</tr>
<tr>
<td>4) What season do the flowers bloom?</td>
<td>Spring</td>
</tr>
<tr>
<td>5) What coin is worth 5 cents?</td>
<td>Nickel</td>
</tr>
<tr>
<td>6) What coin is worth 25 cents?</td>
<td>Quarter</td>
</tr>
</tbody>
</table>
**Figure 1.** Number of correct intraverbal responses for Aaron and John during pre-training, post-training, and direct training.
### APPENDIX A
Listener Training Data Sheet

<table>
<thead>
<tr>
<th>Trial</th>
<th>Stimulus</th>
<th>Response</th>
<th>Vocal Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ohio</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Quarter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Spring</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Nickel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Microwave</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Smile</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Spring</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Ohio</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Nickel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Smile</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Quarter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Microwave</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
SPOP Data Sheet

Participant Initials: ___________  Session #: __________

Date: ___________  Stimulus Set #: ________

<table>
<thead>
<tr>
<th>Trial</th>
<th>Stimulus</th>
<th>Response</th>
<th>Vocal Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Yell</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Clock</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Dime</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Roof</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Penny</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Fall</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Clock</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Penny</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Yell</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Dime</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Roof</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Fall</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### APPENDIX B

#### Treatment Integrity Data Sheets

**Listener Training Treatment Integrity**

<table>
<thead>
<tr>
<th>Experimenter Response</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Experimenter clears the work area and prevents access to preferred items.</td>
<td>N   A</td>
<td>N   A</td>
<td>N   A</td>
<td>N   A</td>
<td>N   A</td>
<td>N   A</td>
<td>N   A</td>
<td>N   A</td>
<td>N   A</td>
<td>N   A</td>
<td>N   A</td>
<td>NA</td>
</tr>
<tr>
<td>2. Experimenter gives instruction &quot;point to the arrow&quot; or &quot;point to the sound&quot; if participant needs assistance with the PowerPoint.</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>3. Experimenter gives participant 5-10 seconds to respond.</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>4. If participant points to target stimulus, experimenter delivers descriptive feedback and praise (i.e. &quot;you're right, you write with a pencil nice job!&quot;).</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>5. If participant is incorrect or doesn't respond, experimenter prompts correct response (gestural then physical is necessary).</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>6. Experimenter records response on data sheet.</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>7. Experimenter gives participant a break after every trial block (1-4 minutes).</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>


**SPOP Treatment Integrity**

<table>
<thead>
<tr>
<th>Experimenter Response</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Experimenter clears the work area and prevents access to preferred items.</td>
<td>N</td>
<td>A</td>
<td>N</td>
<td>A</td>
<td>N</td>
<td>A</td>
<td>N</td>
<td>A</td>
<td>N</td>
<td>A</td>
<td>N</td>
<td>A</td>
</tr>
<tr>
<td>2. Experimenter gives instruction &quot;point to the arrow&quot; or &quot;point to the sound&quot; if participant needs assistance with the PowerPoint.</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>3. Experimenter records participant response on data sheet (eye contact/verbal responses).</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>4. Experimenter delivers token and praise for attending behavior approximately once per minute (i.e. &quot;I like how you are working&quot;).</td>
<td>N</td>
<td>A</td>
<td>N</td>
<td>A</td>
<td>N</td>
<td>A</td>
<td>N</td>
<td>A</td>
<td>N</td>
<td>A</td>
<td>N</td>
<td>A</td>
</tr>
<tr>
<td>5. Experimenter gives participant a break after every trial block (1-4 minutes).</td>
<td>N</td>
<td>A</td>
<td>N</td>
<td>A</td>
<td>N</td>
<td>A</td>
<td>N</td>
<td>A</td>
<td>N</td>
<td>A</td>
<td>N</td>
<td>A</td>
</tr>
</tbody>
</table>
### Pre-Training/Post-Training Probes Treatment Integrity (Listener Responses)

<table>
<thead>
<tr>
<th>Experimenter Response</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Experimenter clears the work area and prevents access to preferred items.</td>
<td>N</td>
<td>A</td>
<td>N</td>
<td>A</td>
<td>N</td>
<td>A</td>
<td>N</td>
<td>A</td>
<td>N</td>
<td>A</td>
<td>N</td>
<td>A</td>
</tr>
<tr>
<td>2. Experimenter delivers instruction &quot;point to the arrow&quot; if student needs assistance at any time with working the iPad.</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>3. Experimenter delivers instruction &quot;point to the sound&quot; if student needs assistance playing instruction.</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>4. Experimenter gives participant 5-10 seconds to respond.</td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>5. Experimenter provides no descriptive feedback for correct or incorrect responses.</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>7. Experimenter delivers praise for attending behavior once every 30 seconds - one minute (i.e. &quot;I like how you are working&quot;).</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>8. Experimenter gives participant a break after every trial block (1-4 minutes).</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
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</table>
Pre-Training/Post-Training Probes Treatment Integrity (Intraverbal Responses)

<table>
<thead>
<tr>
<th>Experimenter Response</th>
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<th>2</th>
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<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Experimenter clears the work area and prevents access to preferred items.</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>2. Experimenter asks participant one question at a time.</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Experimenter gives participant 5-10 seconds to respond</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>3. Experimenter provides no descriptive feedback for correct or incorrect responses.</td>
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<td>4. Experimenter records response on data sheet.</td>
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<td>5. Experimenter delivers praise for attending behavior every 30 seconds- 1minute (i.e. &quot;I like how you are working&quot;).</td>
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October 11, 2012

Dr. Rocio Rosales, Principal Investigator  
Ms. Mary Vallinger, Co-investigator  
Department of Psychology  
UNIVERSITY

RE: HSRC PROTOCOL NUMBER: 025-2013  
TITLE: A Comparison of Procedures to Establish Emergent Intraverbals in Children with Autism

Dear Dr. Rosales and Ms. Vallinger:

The Human Subjects Research Committee of Youngstown State University has reviewed your response to their concerns regarding the above mentioned protocol and determined that your protocol now meets YSU Human Subjects Research Guidelines. Therefore, I am pleased to inform you that your project has been fully approved.

Please note that your project is approved for one year. If your project extends beyond one year, you must submit a project Update form at that time.

Any changes in your research activity should be promptly reported to the Human Subjects Research Committee and may not be initiated without HSRC approval except where necessary to eliminate hazard to human subjects. Any unanticipated problems involving risks to subjects should also be promptly reported to the Human Subjects Research Committee.

We wish you well in your study.

Sincerely,

Peter J. Kasvinsky  
Associate Provost for Research  
Research Compliance Officer  
PJK:cc

c: Dr. Karen Giorgetti, Chair  
Department of Psychology