3-24-2015

Acquisition and Generalization of Tacts across Stimulus Modes in Children Diagnosed with Autism Spectrum Disorder

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by

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A thesis proposal submitted in partial fulfillment
of the requirements for the degree of
Master of Arts
Applied Behavior Analysis
Department of Child and Family Studies
College of Behavioral and Community Sciences
University of South Florida

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Date of Approval:
March 24, 2015

Keywords: Tact, Autism, Acquisition, Generalization, Stimulus Modes

ACKNOWLEDGMENTS

Thank you to my thesis advisor, Dr. Crosland, and my committee members for all your guidance. Thank you to all my research assistants for your dedication and support. Also, thank you to my husband, whose love, patience, and support kept me strong.

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ABSTRACT

This study evaluated the speed of acquisition and level of generalization of tacts across three different stimulus modes: picture-flashcard, video clip, and 3D object. Three young children diagnosed with autism participated in this study. The acquisition of tacts was evaluated during Discrete Trial Training sessions (DTT). Two of the three participants learned the tacts more rapidly in the video clip condition in contrast with the picture condition. All three participants generalized the three tacts learned through a specific stimulus mode to the remaining stimulus modes. One week after the generalization test, all participants generalized to all novel 3D objects.

CHAPTER ONE:

INTRODUCTION

Autism Spectrum Disorder (ASD) is defined as persistent deficit in social communication and social relations across settings, not accounted for by broad developmental delays, as well as constrained, repetitive patterns of behavior, activities or interests (American Psychiatric Association, 2013). According to the Center for Disease Control and Prevention (CDC, 2014) one in 68 children has been identified with ASD. One of the most common aspects that leads to the diagnosis of Autism is the restricted capacity to produce and understand verbal behavior (Bosseler & Massaro, 2003).

Some approaches to understanding and teaching receptive and expressive vocabulary to children diagnosed with ASD have been developed by applying Skinner's (1957) analysis of verbal behavior (Sundberg & Partington, 1998). Skinner defined verbal behavior as "behavior that is reinforced through the mediation of another person's behavior" (p. 2). Taking into consideration that language consists of an interaction between the speaker and the listener, the verbal operants (functional units of language) are cardinal in the evaluation and analysis of delayed language development (Sundberg & Michael, 2001).

Skinner (1957) used the term "tact" to describe verbal behavior under the control of a non-verbal discriminative stimulus followed by a generalized conditioned reinforcer. The tact is a type of verbal operant in which a speaker, who is in direct contact with the environment, labels different types of objects or events through any of the sense modes (Cooper, Heron, & Heward,

2007). For example, a child sees a bird and says “bird”, the nonverbal stimulus of the bird evoked the vocal response “bird.”

To label everyday objects and actions is a foundational skill for the development of language (Sundberg & Partington, 1998) which is vital for reading comprehension and proficiency in vocal communication (Wood, 2001). Tacting is a complex task that encompasses objects or events with arbitrary and particular names (Greer, Yuan, & Gautreux, 2005). For example, we use the word “lion” to name a picture of a lion, but we don’t use the word “lion” to name a picture of a couch. Teaching children to tact objects is one expressive language skill that is frequently taught almost immediately after the child has learned to echo words and imitate. Children diagnosed with ASD often have substantial delays in both expressive and receptive language (Riva, Rapin, & Zardini, 2006) and may experience significant communicative impediments as a result of a deficiency in the tact skill (Barbera & Kubina, 2005).

Many children with ASD frequently show substantial linguistic improvements as a result of intensive behavioral interventions (e.g., Lovaas, 1987; Maurice, Green, & Luce, 1996). The development of effective techniques for transferring stimulus control has a substantial benefit for children who show difficulty acquiring tacts (Barbera & Kubina, 2005). Sundberg and Partington (1998) and Sundberg and Michael (2001) developed a curricula and instructional method to teach and train language to children with autism founded on Skinner’s analysis of verbal behavior, known as Applied Verbal Behavior (AVB) (Leblanc, Esch, Sidener, & Firth, 2006). The AVB approach uses discrete trial teaching which incorporates a type of instruction called errorless learning (Kates-McElrath & Axelrod, 2006). Discrete Trial Training (DTT) is one of the most significant instructional methods to teach verbal behavior to children diagnosed with ASD, and it is also known as the best methodology to teach imitation, receptive and expressive

language (Smith, 2001). DTT as defined by Lovaas (1987) is a specified form of teaching that breaks down tasks into parts which involve: discriminative stimulus, prompt, student response, and reinforcement or corrective feedback. Additionally, there is an inter-trial interval which is described by Smith (2001) as a brief pause before presentation of the subsequent discriminative stimulus. An inter-trial interval occurs to make sure each trial is discrete from the next trial.

Errorless learning is a component of DTT that utilizes a most to least prompting procedure to ensure the child's success. In the course of this procedure the therapist presents the discriminative stimulus (SD), and prompts the response immediately which allows the learner to respond correctly in the presence of the SD. Once the child echoes the correct response, the next step is the “transfer trial” in which the SD is presented again, creating an opportunity for the child to respond without being prompted, or with minimal prompts (Reynolds, 2006). Procedures for transferring stimulus control are well fitted to teach tacts to children with autism, and are frequently used in both intensive and natural environment teaching (Barbera & Kubina, 2005).

After a specific skill is learned during DTT sessions, it is imperative to develop strategies to generalize the new skill across settings, materials and individuals (Bogin, Sullivan, Rogers, & Stabel, 2010). Generalization in children with autism might be accomplished not just by teaching new tacts in the natural environment but also by presenting different stimulus modes during DTT sessions which might include pictures of objects using flashcards, video clips or in vivo objects. The transfer stimulus from pictures to 3D objects and actions in vivo is often assumed as being a natural process that occurs in typically developing children and it is rarely studied on its own (Jowkar-Baniani & Schmuckler, 2011).

Welch and Pear (1980) compared flashcards with pictures, photographs and 3D objects to determine which of the stimulus modes facilitated generalization of tact responses from the

classroom to the natural environment for four children with intellectual disabilities. When the participants were trained with 3D objects compared to the training they received when pictures of photographs were presented, three of the four participants showed considerably better generalization to objects in the natural environment. These results are similar to Salmon, Pear, and Kuhn (1986) who taught four children with developmental disabilities tacts using 3D objects and pictures of the objects. This study found that participants demonstrated more generalization to 3D objects in the natural environment when trained with 3D objects. Hupp (1986) studied the acquisition, transfer, and generalization of receptive tacts across objects and photographs. Generalization to novel receptive tacts across the object stimulus mode was significantly better than with photographs, in which generalization did not occur. Even though there was no difference between stimulus modes during the acquisition of trained exemplars, the performance in the object condition during the generalization test was significantly better than in the photograph stimulus modes. This last result implied that generalization is more substantial when children are taught with 3D objects rather than with photographs. One of the rationales suggested is that it is possible that children with severe intellectual disabilities might have more experience with objects than with pictures.

Partington, Sundberg, Newhouse, and Spengler (1994) used pictures of objects and 3D objects to teach a non-vocal child with autism who had a history of failure to acquire tacts. The results of this study showed that tacts were rapidly acquired for both pictures and 3D objects. However, the participant met the mastery criterion for 3D objects before pictures. One advantage of picture-flashcards is that they are easy and inexpensive to produce. However, a picture is an artificial exemplification of a natural discriminative stimulus and may be problematic for acquiring stimulus control (Cuvo & Klatt, 1992). The transfer from pictures to 3D objects

presents substantial perceptual challenges. Picture-flashcards are smaller in size, which causes the acuteness of the image to be diminished compared to 3D objects, and some physical characteristics of the objects are lacking, or not present (Barr, 2010).

Lovaas (2003) and Leaf and McEachin (1999) recommended that in early language trainings, tacts should be taught using 3D objects supplemented by the complementary question ‘‘what is it?’’ or ‘‘what’s this?’’. Cuvo and Klatt (1992) suggested that using video clips to teach children may combine the advantages of flashcards, and simulate a close approximation to 3D objects present in the natural environment. Some of the advantages of using video clips during the acquisition of tacts are that they can be used repeatedly, take less time than teaching tacts to participants in community locations (natural environment), and can show objects or places that are not possible to show during DTT in a classroom or therapy room. Video clips are also a relatively low-cost material used to simulate the stimulus conditions found in the environment, and demonstrate behaviors required to be successful in the child’s environment (Knight, McKissick, & Saunders, 2013).

Research has shown that individuals with autism have benefited from various types of video interventions, specifically video modeling and video feedback (Thiemann & Goldstein, 2001). According to Calvert (1999) the use of features which appeal to the child’s senses, such as special effects and sounds, are more likely to attract the child’s attention, and are critical to the creation of interesting and reinforcing learning environments when using technology in the application of DTT. Therefore, Calvert (1999) postulated that similar technology features could be particularly effective for children who are very young or show atypical development.

In the review of the literature of video interventions, Reagon, Higbee, and Endicott (2007) did not find any studies that incorporate videos to teach tacts to young children. They

taught preschoolers diagnosed with autism to label objects. In this study, the session consisted of twenty pictures of objects presented as slideshow using a DVD player, and the participant was asked "what is it?" using verbal and textual prompts via the slideshow. All three participants learned to label multiple objects as a result of the video instruction procedure. These authors were the first to use pictures on a computer screen to teach tacts, however, they did not incorporate actual videos. One of the limitations of this study was the absence of a generalization test to evaluate the acquisition of novel exemplars through video instructions. Another limitation was that video instruction was not compared to traditional methods of instructions, such as pictures presented by the instructor, or to 3D objects.

Only one study was found that compared the effectiveness of two traditional instructional methods (flashcards and 3D objects) to video clips to teach sight words. This study by Cuvo and Klatt (1992) taught six teenagers with mild to moderate intellectual disabilities nine community-reference sign words and phrases. The unknown words were presented in three instructional methods or stimulus modes: flashcards with the sign word written on it, videotape recordings of the sign, and on naturally occurring signs in the community. The results of the study showed fast acquisition of all community-referenced words and phrases for each participant regardless of the instructional method. Also, the functional responses acquired though flashcards and videotape conditions generalized to a community setting, and a complete and correct performance of response was maintained during the follow-up. However the authors did not teach the signs using picture-flashcards. The authors suggested that the reason why there was no difference in the speed of acquisition during each instructional method could be due to use of the constant prompt delay procedures which have been shown to be an efficient approach to teach sight word, and

transfer stimulus control from the therapist prompt to the word itself (e.g., Ault, Gast & Wolery, 1988).

There is a lack of research that evaluates the speed of acquisition of tacts between the use of video clips, pictures and 3D objects presented during DTT sessions, to teach tacts to children diagnosed with ASD. It is also unknown if the video clip stimulus mode promotes better generalization of tacts, when comparing it with picture-flashcards and 3D objects. One of the limitations of teaching tacts with 3D objects is the variety of objects that could be taught in a clinic or school setting. For example, one can use a picture of a giraffe, or a stuffed animal to teach the tact "giraffe," but it would be impossible to teach this tact with a real giraffe present. Because technology is part of our daily lives, the use of videos to teach tacts to children with autism could make their learning environment more reinforcing, and enhance the efficiency and effectiveness of tact training during DTT sessions. Video clips may be useful for teachers or instructors who do not have easy access to a variety of settings, as well as for the development of verbal behavior teaching programs. Using video clips as a stimulus mode during tact training could furthermore, increase the speed of acquisition of tacts in comparison to the speed of acquisition from more traditional modes like flashcards (pictures), and might be as effective or more effective than 3D objects with regard to generalization to novel exemplars (e.g., Hupp, 1986; Partington et al., 1994; Salmon at al., 1986; Welch & Pear, 1980).

The efficiency of the acquisition and generalization of tacts may be enhanced if the therapist, parents, and educators know the most effective and efficient way to teach and increase the child's tact repertoire. Therefore, the purpose of this study was to evaluate the speed of acquisition and level of generalization of tacts across three different stimulus modes used during tact training in children diagnosed with ASD. Specifically, the comparison of three instructional

methods or stimulus modes: picture-flashcard, video clip of an object, and 3D object. It was expected that participants would acquire the tacts more quickly in the video clip and 3D object condition when compared with the picture-flashcard condition. It was also hypothesized that the video clip condition would result in the highest generalization of tacts.

CHAPTER TWO:

METHOD

Participants and Setting

The participants in the study were three Hispano-American boys diagnosed with autism, ages 5 to 7 years old. All participants' verbal skills were assessed with the Verbal Behavior Milestones Assessment and Placement Program (VB-MAPP; Sundberg, 2008) as part of their current program at the clinic. All three participants spoke in full sentences. AJ was 6 years old, and had been receiving ABA therapy for 2 years. LD was 7 years old, and had been receiving ABA therapy for 1 year. PA was 5 years old, and had been receiving behavioral services for 1.5 years.

To be included in this study, the participants needed to be in developmental level 2 or 3 of the VB-MAPP milestone assessment, which meant that the participants could tact at least 10 items (e.g., common objects, body parts, or people). AJ completed the VB-MAPP grid and was located at Tact Milestone 13-M (level 3) which indicated that he could tact four different adjectives, excluding color and shapes, and four adverbs. LD and PA completed the VB-MAPP grid and were located at Tact Milestone 10-M (level 2) which showed that both participants could tact 200 nouns and/or verbs, tested or from an accumulated list of known tacts. Another requirement to be part of the study was that the participants had the ability to clearly echo two syllable words.

A behavior analyst who was working in the clinic for 5 years and knew all the children in the clinic aided in the participant selection process. The children were selected as participants if

they covered all the requirements described above to participant in the study, and if they had received formal tact training to learn common objects. None of the participants engaged in any disruptive behavior that interfered with the study.

The study took place at a local behavior clinic that provides behavioral services based on the principles of Applied Behavior Analysis. The participants attended the clinic three times per week. Each session was conducted in an individual cubicle in the therapy room. The 3x3 m therapy room contained two individual cubicles. A 1.8 m wall divided the workspaces and each cubicle contained a child-sized table and chairs where the participants sat perpendicular to the therapist. All children at the clinic received therapy in this type of room.

Materials

Materials included the stimuli that the children tacted in the form of pictures (flashcards), video clips of the objects, and 3D objects, as well as tangible reinforcers such as toys or edibles. An iPad (24 cm x 19.5 cm) was used to show the video clips of the objects. A Sony Bloggie video camera (5 cm x 10.5 cm) was used to record all sessions across baseline, intervention, and generalization test across stimulus modes.

Data Collection

The dependent variable was a tact which was defined as a two-syllable noun emitted by the child within 5 s of the presentation of the vocal SD “what is it?” Responses were scored as correct, incorrect, or absence of a response. A correct response consisted of saying the word that corresponded with the nonverbal stimulus presented though the video clip, picture-flashcard, or the 3D object within 5 s of the SD by the therapist (“What is it?”).

An incorrect response consisted of saying a word that did not correspond with the nonverbal stimulus. The absence of a response consisted of no vocal response or saying "I don't know" within 5 s of the presentation of the nonverbal stimulus.

A trial block consisted of five trials of the target tact (interspersed with trials of mastered known tasks). Occurrence of a correct response was recorded as a plus (+), an incorrect response was recorded as a minus incorrect (– i), and the absence of the response was recorded as a minus absence (– a) on the data sheet (See Appendix A). The percentage of correct responses per session was calculated by dividing the number of pluses by five and then multiplying that number by 100.

Interobserver Agreement

Interobserver agreement (IOA) data were collected during treatment integrity, baseline, intervention, and generalization tests. The main investigator and additional trained therapists recorded the number of correct, incorrect, and absence of the responses by watching the recorded trials (See Appendix A). To have an agreement, two therapists needed to agree on the occurrence or nonoccurrence of the response and whether the response was correct, incorrect or absent. An agreement was defined as both observers recording the same response for each trial (e.g., both marking either +, – i or – a on the data sheet), while a disagreement was defined as one observer recording – and the other observer recording + on the data sheet. IOA was calculated by dividing the number of agreements by the number of agreements plus the number of disagreements and multiplying by 100. IOA was collected during 100% of all sessions for each participant. For AJ, the average agreement during baseline, intervention, and generalization tests were 100%. For LD, the average agreement during baseline was 100%, during intervention was 97%, and during

generalization tests were 100%. For PA, the average agreement obtained in baseline was 97%, in intervention was 98% and in generalization tests were 100%.

Treatment Integrity

The main investigator and an additional therapist collected treatment integrity on the delivery of a vocal SD ("what is it?") and the following steps of the DTT session by watching the recorded sessions and using a competency checklist for baseline and intervention (See Appendix B). The DTT checklist format was representative of a typical DTT procedure as it contained the main steps that DTT should have: discriminative stimulus or cue, prompt, student response, and reinforcement or corrective feedback (Smith, 2001). The DTT checklists used in this study incorporated all of these elements previously described with the addition of a type of instruction called errorless learning (Kates-McElrath & Axelrod, 2006) which utilizes most to least prompts, and transfer trials in which the SD is presented again by itself.

Each item on the DTT checklist was scored as either + for a correct step or – for an incorrect step to identify whether the therapist performed the steps appropriately. All steps on the checklist were evaluated on a trial by trial basis (See Appendix B). To obtain the percentage of correct steps, the total number of correct steps per trial were multiplied by 100 and then divided by the total number of steps on the checklist. The percentage of correct steps per session were obtained by adding the percentage of correct steps per trial, multiplying by 100, and then dividing by the total number of trials per session (15) multiplied by 100. The percentage of correct steps per session yielded a result above 95% for all therapists, therefore, no therapist needed retraining.

Treatment integrity was collected for 100% of all sessions of baseline and intervention for each participant. The main investigator trained the additional therapists to collect data and

score the sessions. The percentage agreement of treatment integrity for AJ 97%, for LD was 98%, and for PA was 98%.

Therapist Qualifications

The instructors and data collectors for this study were the main investigator and behavior therapists working at the clinic, all of whom had previous experience in the implementation of DTT during tact training. All therapists who took part in this study completed an intensive training and had ongoing evaluations (via treatment integrity measures) to ensure they were qualified to provide quality ABA services to children.

Preference Assessment

Before beginning baseline, a multiple stimulus without replacement assessment (MSWO, DeLeon & Iwata, 1996) was conducted with each participant (See appendix C). In this preference assessment the participant chose one item from a range of seven objects (edibles, toys, or electronic) which were previously reported by the participant's caregiver and therapists as preferred by the child. Each participant was instructed to pick an item. The participant selected the preferred item by expressing it vocally or by pointing or touching the item. Once the participant selected the item, all of the objects were removed from the table and the participant was allowed to play with the item for 30 s. The therapist continued to present the rest of the items until all the objects had been chosen. Once this process was repeated five times in the same way described above, the items were rated according to the order in which they were selected. The top three items were used as reinforcers during the intervention phase. For AJ were doritos, tablet, and legos. For LD, were tablet, plastic letters, and ball track. For PA were lays, doritos and three mini cars.

Echoic assessment

The Early Echoic Skills Assessment (EESA), a subtest of the VB-MAPP (Sundberg, 2008) (See appendix D), served as the echoic assessment for this study. The EESA measured the participants' ability to echo a speech exemplar. The ESSA is divided in five groups according to the speech developmental progression (birth to 30 months) with a total of 100 points. The items evaluated on the ESSA consisted of vowels, consonants, number of syllables, and intonation, duration and loudness of the echo. For the purpose of this study participants needed to have the ability to echo two syllable words. According to the EESA, a child can echo two syllable words if he or she scores at least 50 on the EESA subtest (at least 20 from group 2).

The main investigator administered the ESSA by asking each participant to repeat each test item (e.g., say "hat"), allowing the child the opportunity to echo up to three trials (if the first response did not correspond to the sound made by the investigator) and scoring the best response. The participant received a score of 1 point if his response corresponded with the sound emitted by the investigator. A ½ point was scored if the echoic response was recognizable but some consonants were incorrect or absent or if the participant echoed additional syllables. A score of 0 points was given for the absence of the response, incorrect vowels or omission of syllables. The scores of the echoic assessment for AJ, LD, and PA were 100, 95.5, and 99 respectively.

Preassessment

Only two-syllable tacts were included in the preassessment. Each of the nonverbal stimuli was presented across a 3D object, a picture on a flashcard of the 3D object, and a video clip of the 3D object. The main investigator and the participants' therapists determined the potential unknown tacts according to the participants' known tact repertoire. A list of 13 items was shown

to each of the participants: mirror, raccoon, basket, candle, blender, lobster, pitcher, stingray, hanger, lettuce, pepper, kiwi and compass.

To determine the unknown tacts that were used during the study, the main investigator instructed the participant to sit at the table perpendicular from her, and presented the nonverbal stimulus in random order to him through a specific stimulus mode randomly assigned to the tact, and asked, "What is it?" (e.g., lobster toy). If the child responded correctly within 5 s, praise was provided, and the main investigator proceeded to present the next nonverbal stimulus (e.g., video clip of a pitcher). If the participant gave an incorrect response or did not respond, the main investigator presented the same nonverbal stimulus utilizing a second kind of stimulus mode using the same procedure (e.g., the main investigator held a picture of the lobster toy and asked the participant "what is it?"). If the participant responded correctly within 5 s, praise was provided, and the main investigator proceeded to present the next nonverbal stimulus (e.g., picture of a mirror). If the participant responded incorrectly or did not emit a response within 5 s, the therapist presented the nonverbal stimulus using the third stimulus mode (e.g., the main investigator played a 6-s video clip of the lobster toy and asked the participant "what is it?"). If the participant responded correctly within 5 s, praise was provided, and the main investigator proceeded to present the next nonverbal stimulus (e.g., hanger/3D object). If the answer was incorrect or the response was absent, then it was determined that the participant could not tact that specific item. No feedback was given for incorrect responses. The therapist stopped testing the tacts when the participant had three incorrect responses (across the stimulus modes per tact).

By the end of the preassessment, the therapist obtained a list of three unknown nonverbal stimuli to tact for each participant, and to test across the three different stimulus modes. The

target tacts for LD were compass, hanger, and raccoon. For AJ, the target tacts were lettuce, pitcher, and stingray. For AP, the target tacts were blender, pepper, and lobster (See Table 1).

Experimental Design and Procedure

The experimental design for this study was a simultaneous treatment design embedded in a multiple baseline across participants. This design compared the speed of acquisition of tacts across three different stimulus modes. The three different stimulus modes were rapidly and frequently alternated every session to control for extraneous environmental variables such as time of day and amount of sleep. For all sessions in baseline, intervention, and generalization tests, the stimulus modes were presented in the same manner.

During the picture-flashcard stimulus mode, the therapist held a 8.89 cm^2 x 11.43cm^2 flashcard that contained a picture of the target tact (45 cm away from the child's face) and presented the vocal SD "what is it?" The picture used was one taken by the investigator of the 3D object with a white background. In the video clip stimulus mode, the therapist instructed the child to look at the screen and immediately played the 6-s video of the stimulus. The video was shown using an iPad. The video showed the same object used for the picture and 3D object stimulus modes, and scanned across the object, which was displayed against a black or white background for contrast. Once the video clip was over, the therapist immediately delivered the vocal SD "what is it?" The video clips showed the nonverbal stimulus in the absence of any external tacts like actions or people to avoid confounding the target tact with other types of tacts, also there was no sound in the video clips. For example, to teach the tact "stingray", the stingray toy was sitting on the floor and was not performing any actions and was not around any other ocean animals. During the 3D object stimulus mode the therapist showed the tangible nonverbal

stimulus (45 cm away from the child's face) and immediately delivered the vocal SD "what is it'?

Baseline

After determining the unknown tacts from the preassessment, the main investigator randomly assigned the three unknown tacts per participant into one of the stimulus modes (video clip, 3D object, picture-flash card). The randomization of the stimulus mode to the items to tact was done by writing the acquisition targets on small pieces of paper and drawing one for each stimulus mode. For LD the target tacts were compass (video clip), hanger (3D object) and raccoon (picture-flashcard). For AJ, the target tacts were lettuce (video clip), pitcher (3D object), and stingray (picture-flashcard). For PA, the target tacts were blender (video clip), pepper (3D object) and lobster (picture-flashcard).

The session started by showing the child an item through the assigned stimulus mode. There were five trials per acquisition target. No correction procedure took place for incorrect responses or the absence of a response within 5 s of the delivery of the vocal SD. Each acquisition target was presented in a random order created using an online list randomizing program and was interspersed with maintenance tasks. The maintenance tasks were a combination of verbal operant tasks that the participant had already acquired and maintained based on prior assessments at the clinic. The ratio of maintenance tasks to acquisition targets was 80% to 20% respectively. For example, each participant had a total of 75 trials per session, 60 of the trials were tasks that the participant had already mastered and maintained, and 15 of the trials were the acquisition targets. The session was divided into three trial blocks, each part consisted of 25 trials. For example, once the participant had completed 25 trials (five acquisition and 20 maintenance tasks), the participant had the opportunity to spend five minutes in the playroom

where they had access to any item except for the preferred reinforcers selected from the preference assessment. To control for rate and magnitude of reinforcement measures, a fixed ratio schedule of reinforcement of 25 per trial block, remained constant across baseline and intervention conditions.

To introduce the acquisition targets to the teaching procedure, the baseline needed to be at 0% correct for the target tacts.

Discrete trial training (DTT) – tact training

Before the beginning of each trial block, the therapist conducted a brief preference assessment in which the participant selected the item that was used as a reinforcer from the array of the top three items that were selected during the MSWO (DeLeon & Iwata, 1996).

During the training condition, the therapist conducted one session per day during the participants' regular verbal behavior session at the clinic. A session consisted of three intermix trial blocks in which the participant experienced all three stimulus modes within a session. Just as in baseline, the acquisitions targets to tact were randomly interspersed along with mastered tasks throughout the trial blocks (intermix trials). Feedback was given for correct and incorrect responses, as well as for the absence of the response. Each participant had a concurrent schedule in place. There was a FR1 schedule for correct responses of the acquisition targets during the training condition in which a reinforcer was delivered for 20 s (e.g., edible or item). Another FR1 was implemented for maintenance tasks, in which participants received praise for correct responses.

During the first trial of each of the acquisition targets that were taught per participant through DTT, the therapist used an errorless prompt procedure. In the course of the errorless prompt the therapist presented the item through its correspondent stimulus mode, accompanied

with the question “What is it?”, and immediately instructed the child to echo the correct answer (e.g., “say raccoon” or “raccoon”).

From the second trial on, the therapist presented the item through its correspondent stimulus mode, accompanied with the question “What is it?” If the child responded correctly, the therapist immediately delivered the reinforcer for 20 s and continued on the concurrent schedule of reinforcement. If the child’s response was incorrect or the child did not emit a response within 5 s, the therapist continued with the correction procedure in which the therapist represented the vocal discriminative stimulus (“what is it’?), and immediately instructed the child to echo the correct answer (e.g., “What is it?” “Say raccoon”). If the participant echoed the correct response (e.g., “raccoon”) the therapist immediately represented the vocal SD “What is it?” and allowed the participant 5 s to respond (first transfer trial). If the participant responded correctly during the transfer trial the therapist immediately delivered the reinforcer and continued with his or her concurrent schedule of reinforcement. If the child did not respond or responded incorrectly during the transfer trial, the therapist repeated the correction procedure and the transfer trial procedures up to three times. If the child did not emit the correct response during the correction procedures and/or transfer trials after three times, the trial was considered over and the therapist continued with the child’s FR1 schedule of reinforcement. The participant reached the mastery criterion when he scored 100% of correct responses for two consecutive sessions.

Generalization tests

Once a tact was mastered, a generalization test across stimulus modes was conducted for the mastered targets with each of the stimulus modes. This generalization test consisted of a single trial, and assessed whether a mastered target, that was taught through a specific stimulus mode was generalized to the others modes not taught. The novel tacts that were used to probe for

generalization of a mastered target differed from each other across stimuli. For example, once the acquisition target presented with a picture was mastered, the therapist immediately and randomly introduced 3D object, and a 6 s video clip of the object.

Once the participant had mastered each of the tacts across the three stimulus modes and had participated in the generalization test across stimulus modes for each one of the target tacts, a generalization test of novel exemplars took place one week later. During this generalization test, the participant was asked to tact nine objects. Six of the nine objects were the same objects used during the preassesment test which were still unknown to the participant. The other three objects were the novel objects that corresponded to the tacts learned during the study (e.g., a different blender, lobster, and pepper for PA).

Feedback was given after a correct response in the form of vocal praise (e.g., well done, that is right!). No feedback was given after an incorrect target tact response during both of the generalization tests. For the generalization test across stimulus modes, if the participant tacted correctly across all stimuli, it was determined that the child generalized the specific tact across all stimulus modes presented in the study. For the generalization test of novel exemplars, if the participant's response was correct when he was shown the novel object along with the vocal SD, it was determined that the participant generalized to a novel exemplar.

CHAPTER THREE:

RESULTS

Figure 1, shows the percentage of correct responses for all three participants within baseline and DTT (tact training) across stimulus modes. All participants displayed zero levels of correct tact responses throughout the baseline condition. Upon implementation of DTT, all participants acquired the tacts with all three stimulus modes. The percentage of incorrect responses and absence of the responses during baseline and intervention, as well as the type of incorrect responses the participants gave can be found in Table 2.

AJ started intervention in session two (See Figure 1). AJ reached the mastery criterion for video clip and 3D object stimulus modes in session four (session three of intervention). During session five and six, AJ obtained 100% correct tact responses for the picture-flashcard of the stingray, reaching the mastery criterion for the picture stimulus modes after five sessions of intervention.

In session seven, LD obtained 100% correct responses across the video clip and 3D object stimulus modes, reaching the mastery criterion for the video clip stimulus mode after four sessions of intervention. In the next session (fifth day of intervention), LD achieved the mastery criterion for the picture-flashcard stimulus mode. LD obtained 100% correct responses by tacting the hanger (3D object) five consecutive times during sessions eight and nine, and reached the mastery criterion for the 3D object stimulus mode in session six of intervention.

PA continued in baseline for five sessions and started with intervention in session six. In his third and fourth day of intervention, PA obtained 100% of correct responses across all stimulus modes, mastering all stimuli at the same time in session four of intervention (See Figure 1).

After mastering each of the tacts across the picture, the video, and the object modes, all participants started the generalization test across stimulus modes. In this test, each participant was asked to tact the item just mastered during tact training across the remaining stimulus modes in a random order and in combination with other mastered tasks. All participant responses were correct for all stimuli.

During the generalization test of novel exemplars, all three participants correctly tacted all 3D novel exemplars presented to them.

CHAPTER FOUR:

DISCUSSION

This study evaluated the speed of acquisition of tacts across three stimulus modes. Results indicated that the order in which each of the participants mastered the tacts across the video clip, 3D object and picture-flashcard stimulus mode differed. AJ reached the mastery criterion for the video clip and 3D object stimulus modes first. AJ's results were similar to the results shown by Partington et al. (1994) in which the participant met the mastery criterion for 3D objects before pictures. LD mastered tacting the nonverbal stimulus across video clip first, the picture-flashcard second, and the 3D object third. The third participant, PA, reached the mastery criterion for all stimulus modes at the same time during session nine (fourth day of intervention). These results are similar to the results obtained by Hupp (1986) and Cuvo and Klatt (1992), in which they showed fast acquisition of the target response regardless of the stimulus mode.

The results of the speed of acquisition of each of the participants showed that all three participants acquired the tacts across all stimulus modes relatively quickly. AJ and LD mastered the tacts across the video stimulus mode at the same time they mastered another stimulus mode. Specifically, during the same session, AJ mastered video and 3D object, and PA mastered video, 3D object and picture. LD was the only participant who mastered a tact across the video stimulus mode before the picture and 3D object. The order in which AJ and LD mastered a tact though the video clip stimulus mode may indicate that learning a tact though a video clip may facilitate the speed of acquisition of tacts for these two participants. More research is needed to determine if,

by using video clips to teach tacts, children would acquire tacts faster in comparison with 3D object and picture stimulus mode. Also, the fact that AJ and PA mastered the tact across the video and picture stimulus mode in the same session, may indicate that, for these participants, the video and 3D objects stimulus mode may be equally effective instructional methods for teaching tacts.

The results of the generalization test across stimulus modes showed that all of the participants could tact an item presented across a video clip, 3D object or picture-flashcard to the rest of the untrained stimulus modes. These results suggest that, independent of the stimulus mode used to teach the child the tact, the participant recognized and tacted the object learned via a specific stimulus mode to the rest of the stimulus modes. AJ and LD recognized that the objects they learned though a picture, 3D object or video clip, were the same objects that were shown though a different stimulus mode during the generalization test (e.g., AJ: “that looks like the lettuce in the video”, LD: “it is the same raccoon”).

During the generalization test of novel exemplars, all three participants generalized to all novel exemplars. For example, when the main investigator showed LD a new raccoon toy and asked him “what is it?” the participant tacted “a small raccoon”. The results of the generalization test of novel exemplars suggests, that independent of the stimulus mode used to teach a tact, a learner might generalize to a novel nonverbal stimulus that corresponds to the same response class. For example, after learning blender though a video clip (white-plastic blender), PA tacted “blender” when the main investigator showed him a different blender (glass-metallic blender).

One of the limitations of this study was that due to the errorless prompt, the participants’ maximum percentage of correct responses on the first day of intervention was 80%. A second limitation was that LD and PA had difficulty with the pronunciation of the words used for the

video stimulus mode. LD said several times during the session the word “hango” or “hange” which sound was very similar to “hanger”. PA’s best approximation of blender was “bleder”. It could be that the difficulty of the words (e.g., hanger and blender) may have had some influence on the speed of acquisition of tacts across the video stimulus mode. To avoid this difficulty, future studies should use a personalized echoic test to evaluate phonetic sounds that would be used during the study.

In contrast with Welch and Pear (1980); Salmon et al. (1986) and Hupp (1986) who found that the participants showed greater generalization to 3D objects in the natural environment when trained with 3D objects, the results of this study showed that the participants generalized to novel examples and across other stimulus modes, regardless of whether they were taught with pictures, objects or video clips. The generalization test took place at the clinic at the same table where the participants previously received tact training. Future studies should look into having a generalization test in the natural environment after the child has learned to tact an item across a specific stimulus mode to determine if any of the stimulus modes (picture, video or 3D object) provide better generalization across the remaining stimulus modes in the natural environment.

In addition, the generalization test of novel exemplars took place after the generalization test across stimulus modes. The timing of the generalization test across stimulus modes could have influenced the conclusions related to generalizing to novel exemplars. In the generalization test across stimulus modes, the participant was shown the 3D object, video and/or picture-flashcard one time for the nonverbal stimulus just mastered. The fact, that the participant saw the mastered tact across the remaining stimulus modes during the generalization test across stimulus modes, even though it was only one time, may have influenced he results of the generalization

test of novel exemplars. Future studies should conduct generalization tests of novel exemplars in the natural environment, immediately after the participant has mastered a tact across a specific stimulus mode, and before the participant receives the generalization test across stimulus modes. This change could help determine the influence the stimulus mode has on the generalization of novel exemplars in the natural environment.

It is important to note that this study used participants with a tact repertoire of over 200 tacts. Past studies comparing the speed of acquisition (e.g. Partington et al., 1994) and level of generalization of tacts (e.g. Partington et al., 1994; Salmon at al., 1986; Welch & Pear, 1980) across different stimulus modes used participant with a small or not existent tact repertoire. Due to the large tact repertoire of AJ, LD and PA, it is difficult to evaluate the results of past research to the results obtained in this study. Future investigations should carefully consider the tact repertoire of the participants to reliably compare their findings with past studies.

This study adds to the literature of tact training, not only by being the first study to incorporate actual video clips of 3D objects to teach tacts to children with autism, but also by comparing the speed of acquisition of each of the stimulus modes during tact training. The results of this study are preliminary and more research is necessary to determine which of the stimulus modes promotes faster acquisition of tacts across different stimuli. Future research in tact training aiming to evaluate the speed of acquisition of tacts should include a more novel tacts per stimulus mode to determine if the video clip, picture, or 3D object stimulus modes increase the speed of acquisition of tacts.

TABLES AND FIGURES

Table 1

List of Tacts

Stimulus Mode	AJ	LD	PA
Video Clip	lettuce	compass	blender
3D Object	pitcher	hanger	pepper
Picture-Flashcard	stingray	raccoon	lobster

Table 2

Percentage of Incorrect Responses and Absence of the Response During Baseline

Participant	Baseline % of –i	Incorrect Tacts	Baseline % of –a
AJ	100%	Lettuce (video): "fruit" Pitcher (3D object): "cup" Stingray (picture): "toy"	0%
LD	71%	Compass (video): "clock" Hanger (3D object): "batter" "tander" Raccoon (picture): "puppy" "dog"	13%
PA	55%	Blender (video): "cup" Pepper (3D object): "pear" Lobster (picture): "spider"	45%

Table 3

Percentage of Incorrect Responses and Absence of the Response During Intervention

Participant	Intervention % of –i	Incorrect Tacts	Intervention % of –a
AJ	0%	–	7%
LD	21%	Compass (video): “clock”, “hango” Hanger (3D object): “underwear”, ‘nail”, “hango”, “hange” Raccoon (picture): “dog”, “rando”, “arroon”	15%
PA	8.7%	Blender (video): “cup”	3.5%

Acquisition Graph

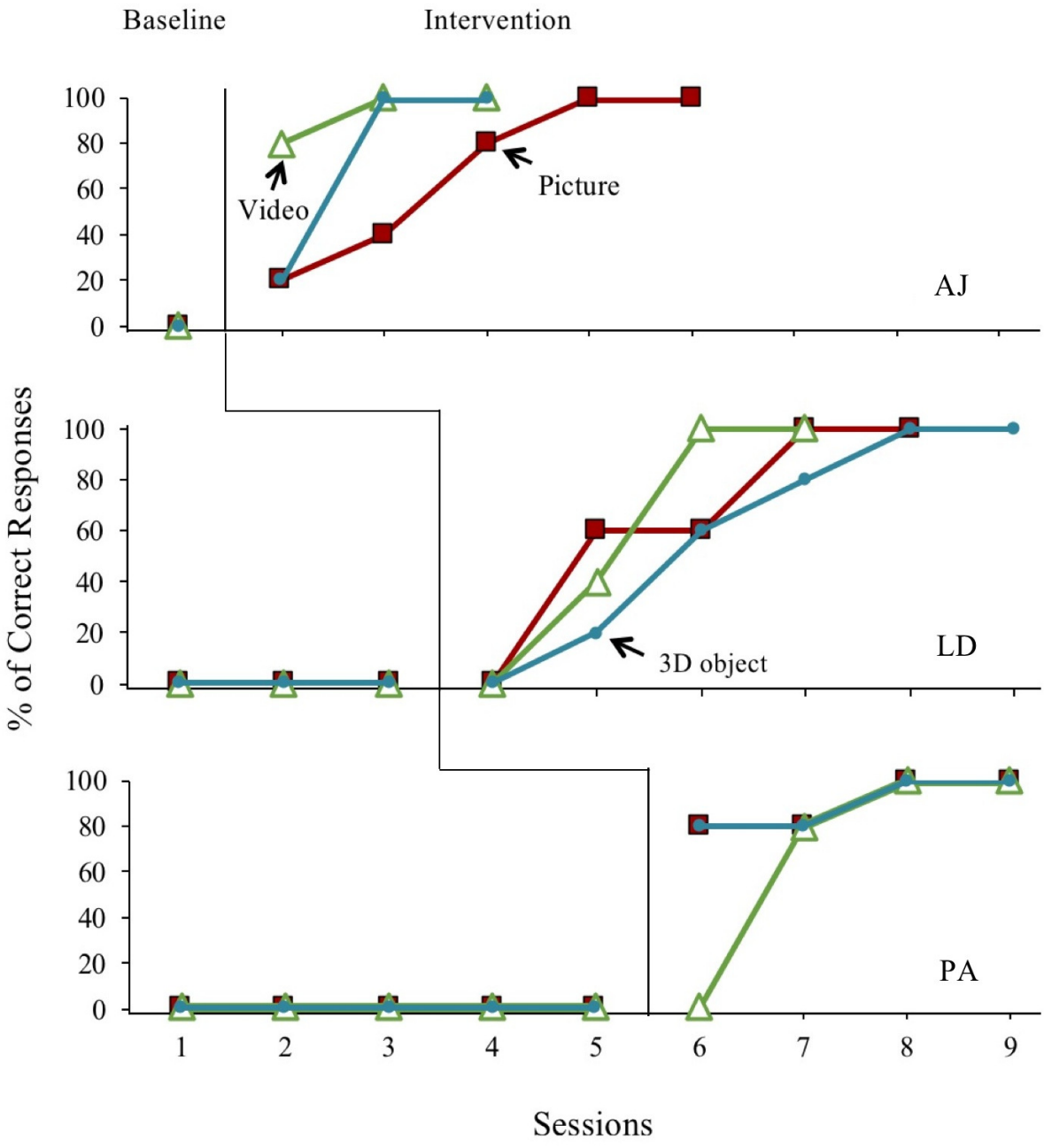

Figure 1. Shows the percentage of correct target tact responses within baseline and tact training across 3D object, picture-flashcard, and video clip stimulus modes.

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APPENDIX A:

Percentile Data Sheet

Child's initials: ________________
Therapist initials: ______________

Date	Tact	Stimulus mode	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	% correct response

Child's initials: ________________
Therapist initials: ______________

Date	Tact	Stimulus mode	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	% correct response

Child's initials: ________________
Therapist initials: ______________

Date	Tact	Stimulus mode	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	% correct response

APPENDIX B:

Therapist Review Checklist (DTT review)

BASELINE

Therapist: _____ Evaluator: _____

Date	
Participant	

Task	**01**	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**12**	**13**	**14**	**15**
Is the task presentation clear?															
Are the materials for the task present?															
Are they following the order according to the LIST															
Instruction (Sd)															
Is the instructions clear and concise?															
Was the Sd presented only 1 time before either a response or correction procedure?															
Tone of voice is natural.															
Total of Correct Responses															
% of Correct Responses															

Total number of correct mastered target responses that were reinforced: ____/60

Total percentage of correct mastered target responses that were reinforced: ____

Was the schedule of reinforcement 25-FR	**Trial Block 1**	**Trial Block 2**	**Trial Block 3**

Environment	
Are the program materials organized and ready?	
Is the environment free from distractions?	
Are the reinforcers easily accessible?	
Is the therapist exhibiting appropriate professional behavior?	

Therapist Review Checklist (DTT review)

INTERVENTION

Therapist: _____ Evaluator: _____

Date	
Participant	

Task	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
Is the task presentation clear?															
Are the materials for the task present?															
Are they following the order according to the LIST															
Instruction (Sd)															
Is the instructions clear and concise?															
Was the Sd presented only 1 time before either a response or correction procedure?															
Was there only a 5 second delay between the Sd and the response or prompt?															
Tone of voice is natural.															
Consequences															
Do the consequences serve as feedback to the child? (appropriate descriptive feedback given based on child's response)															
Were corrective procedures implemented appropriately (after incorrect response, waiting a beat, and then representing Sd and 0 second delay prompt)?															
Were prompts offered if the child was unsure of the correct response?															
Was differential reinforcement used based on the prompt given?															
Was reinforcement (praise and preferred reinforcer) provided immediately after A CORRECT INDEPENDENT acquisition response?															
Was the reinforcement time for the child an appropriate length? (15-20 sec)															
Trials															
Is the therapist using TT?															
Were effective transfer trials used in order to appropriately fade prompts? (immediately represented Sd if response was prompted while fading)															
Total of Correct Responses															
% of Correct Responses															

Total number of correct mastered target responses that were reinforced: ____/60

Total percentage of correct mastered target responses that were reinforced: ____

Was the schedule of reinforcement 25-FR	**Trial Block 1**	**Trial Block 2**	**Trial Block 3**
Confirms MO of the learner (prompt the child to select a reinforcer from the 3 assigned reinforcers)			

Environment	
Are the program materials organized and ready?	
Is the environment free from distractions?	
Are the reinforcers easily accessible?	
Is the therapist exhibiting appropriate professional behavior?	

APPENDIX C:

Multiple Stimuli without Replacement (MSWO) Data Sheet

DeLeon, I. G., & Iwata, B. A. (1996).

Child's Name: _____ Leisure/Food (Circle one)

Evaluator: _____ Date: _____

List of Items:

_____	_____	_____	_____
_____	_____	_____	_____

Preference Assessment #1	
Order of items selected	# times chosen/ # of times available
1.	
2.	
3.	
4.	
5.	
6.	
7.	

Preference Assessment #2	
Order of items selected	# times chosen/ # times available
1.	
2.	
3.	
4.	
5.	
6.	
7.	

Preference Assessment #3	
Order of items selected	# times chosen/ # of times available
1.	
2.	
3.	
4.	
5.	
6.	
7.	

Preference Assessment #4	
Order of items selected	# times chosen/ # times available
1.	
2.	
3.	
4.	
5.	
6.	
7.	

Preference Assessment #5	
Order of items selected	# times chosen/ # of times available
1.	
2.	
3.	
4.	
5.	
6.	
7.	

Summary (high to low)	
Item	Total % Selected
1.	
2.	
3.	
4.	
5.	
6.	
7.	

APPENDIX D:

Early Echoic Skills Assessment (EESA)

Barbara E. Esch, Ph.D., BCBA, CCC-SLP

Scoring Group 1-3: For each item, score the best response of up to 3 trials
X = correct sounds and correct number of syllables (1 point)
/ = recognizable response, but incorrect or missing consonants or extra syllables (1/2 point)
Blank = no response, incorrect vowels, or missing syllables (0 points)

Group 1: Simple and reduplicated Syllables
Targets: vowels, diphthongs, consonants p, b, m, n, h, w

TOTAL RAW SCORE (Groups 1-5) ☐

☐ ah	☐ bye bye	☐ one	☐ moo	☐ we
☐ wow	☐ hop	☐ my	☐ up	☐ boy
☐ bee	☐ mama	☐ boo	☐ may	☐ wa wa
☐ knee	☐ papa	☐ no no	☐ pop	☐ toy
☐ o	☐ me	☐ oh	☐ too	☐ baa

Sub-total (Group 1) ☐

Group 2: 2-syllable combination
Targets: Add consonants k, g, t, d, f, y, ng

☐ baby	☐ window	☐ open	☐ taco	☐ icky
☐ go eat	☐ funny	☐ oh boy	☐ foo-ey	☐ too hot
☐ nighttime	☐ meow	☐ yumm-o	☐ hankie	☐ monkey
☐ bunny	☐ kitty	☐ potty	☐ too bad	☐ uh-oh
☐ my foot	☐ bow wow	☐ pay day	☐ cookie	☐ daddy
☐ yucky	☐ mommy	☐ pokey	☐ puppy	☐ Hot dog

Sub-total (Group 2) ☐

Group 3: 3-syllable combination

☐ tubby toy	☐ potato	☐ do high five	☐ tiny pan	☐ how many
☐ banana	☐ go bye bye	☐ oh foo-ey	☐ peek a boo	☐ potty time
☐ fee fi foe	☐ fat doggy	☐ binky boo	☐ teddy bear	☐ giddy-up
☐ yummy food	☐ goofy goat	☐ one cookie	☐ doggy bone	☐ wet mitten
☐ daddy up	☐ hey me too	☐ open up	☐ funny king	☐ teepee boat
☐ in a boat	☐ my big toe	☐ peanut hat	☐ a hiccup	☐ puppet game

Sub-total (Group 3) ☐

Group 4: Prosody: spoken phrases (Model: Emphasize syllables in ***bold italics***)
X = emphasis on correct syllables (1 point)
/ = emphasis on non-target syllables (1/2 point)
Blank = monotone response (no emphasis) (0 points)

☐ no **WAY**	☐ **ONE** bunny	☐ in a **MIN**-ute	☐ **TAKE** it	☐ My **MOM**-my
☐ bug-a **BOO**	☐ **UH**-oh	☐ **MY** mommy	☐ Bow-**WOW**	☐ **BUG**-a-boo

Sub-total (Group 4) ☐

Group 5: Prosody: other contexts
X = response correct or nearly so (1 point)
Blank = response does not closely match model (0 points)

pitch

☐ Echoes pitch variations in 1-2 lines of a familiar song

☐ Echoes continuous warble (fire truck OO-oo- OO-oo- OO)

Loudness

☐ Echoes whispering

☐ Echoes quiet/loud voice (*bye-bye* vs. **BYE-BYE**)

Duration

☐ Sustains *ahh* doe 3 seconds, echoically

Sub-total (Group 5) ☐

APPENDIX E:

IRB Approval

RESEARCH INTEGRITY AND COMPLIANCE
Institutional Review Boards, FWA No. 00001669
12901 Bruce B. Downs Blvd., MDC035 • Tampa, FL 33612-4799
(813) 974-5638 • FAX (813) 974-7091

November 20, 2014

Luz Correa Gómez
ABA-Applied Behavior Analysis
Tampa, FL 33612

RE: **Expedited Approval for Initial Review**
IRB#: Pro00019674
Title: Acquisition and Generalization of Tacts across Stimulus Modes in Children Diagnosed with Autism Spectrum Disorder (ASD)

Study Approval Period: 11/20/2014 to 11/20/2015

Dear Ms. Correa Gómez :

On 11/20/2014, the Institutional Review Board (IRB) reviewed and **APPROVED** the above application and all documents outlined below.

Approved Item(s):
Protocol Document(s):
Protocol (Aquisition and Generalization of Tacts across Stimulus Modes)

Consent/Assent Document(s)*:
Consent form (parental permission) .pdf

*Please use only the official IRB stamped informed consent/assent document(s) found under the "Attachments" tab. Please note, these consent/assent document(s) are only valid during the approval period indicated at the top of the form(s).

It was the determination of the IRB that your study qualified for expedited review which includes activities that (1) present no more than minimal risk to human subjects, and (2) involve only procedures listed in one or more of the categories outlined below. The IRB may review research through the expedited review procedure authorized by 45CFR46.110 and 21 CFR 56.110. The research proposed in this study is categorized under the following expedited review category:

(6) Collection of data from voice, video, digital, or image recordings made for research purposes.

(7) Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

As the principal investigator of this study, it is your responsibility to conduct this study in accordance with IRB policies and procedures and as approved by the IRB. Any changes to the approved research must be submitted to the IRB for review and approval by an amendment.

We appreciate your dedication to the ethical conduct of human subject research at the University of South Florida and your continued commitment to human research protections. If you have any questions regarding this matter, please call 813-974-5638.

Sincerely,

John A Schinka, Ph.D.

John Schinka, Ph.D., Chairperson
USF Institutional Review Board