Comparing Prompt Delay and Total Communication for Training Vocal Intraverbals in Children with Autism

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Comparing Prompt Delay and Total Communication for Training

Vocal Intraverbals in Children with Autism

by

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A thesis submitted in partial fulfillment of the requirements for the degree of
Master of Arts
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Abstract

Verbal behavior encompasses a wide range of aspects in our everyday lives and in the activities of a society. Many verbal behavior interventions often include programs to teach answering questions, these responses are referred to as intraverbals. Previous research has demonstrated a higher rate of acquisition of verbal targets such as mands and tacts for children with a limited verbal repertoire when a presentation of both sign and vocal prompts occur simultaneously (Total Communication), in comparison to sign-alone or vocal-alone trainings. However, an important variable not often examined in the literature is the comparison of Total Communication (TC) and Prompt Delay (PD) to further evaluate which leads to higher rates of acquisition. The current study extends previous research by evaluating the relative effectiveness of TC and PD in teaching intraverbal skills to three children who have been diagnosed with autism. During the TC condition the participants were required to emit a vocal and sign response simultaneously during training. During the PD condition, participants were required to emit only a vocal response during training. The results suggest that there was no clinically relevant difference between the two conditions in the acquisition of intraverbals for these participants.
Introduction

Autism spectrum disorder (ASD) is a type of pervasive developmental disorder typically appearing during the first three years of life that has multiple components, symptoms, and variations. Deficits include social, language, cognitive, and developmental delays (American Psychiatric Association, 2000). The dramatic increase in the diagnosing of ASD in recent years to an estimated 1 in 88 births (Center for Disease Control, 2012) highlights the importance of researching the most effective methods for language training programs. From social interactions to problem solving in academics, verbal behavior encompasses a wide range of aspects of our everyday lives, laws, and activities of a society.

Many of these verbal behavior interventions often include programs to teach answering questions. Skinner’s (1957) *Verbal Behavior* characterizes question answering as intraverbal responding, which is defined as verbal responses to verbal stimuli that have no point-to-point correspondence between the verbal stimulus and the response. Intraverbals play an important role for individuals in typical social interactions, problem solving in academics, safety skills, laws, daily living skills and activities. In the context of social interactions, inadequate vocal verbal training may result in social deficits not being addressed. To ameliorate these deficits, there are myriad interventions including sign-alone, vocal-alone, prompt delay, and Picture Exchange Communication Systems (P.E.C.S). These various procedures are often found to be implemented both as individual
interventions as well as combined interventions in clinical settings such as Total communication.
Total Communication

Research investigating sign language plus vocal training (Total Communication) has been limited over the years. Total Communication (TC) is a simultaneous communication training method used in verbal behavior training programs in which the adult signs to the child while at the same time speaking to him or her. The expectation is that systematically pairing signs with spoken words will trigger or facilitate appropriate speech. Research on TC includes comparing TC with a variation of other treatment combinations such as TC vs. vocal alone (Barrera & Sulzer-Azaroff, 1983; Carbone et al., 2006; Sisson & Barrett, 1984), TC vs. sign alone (Clarke, Remington, & Light, 1988), and TC vs. vocal alone vs. sign alone (Barrera, Lobato-Barrera, & Sulzer-Azaroff, 1980; Brady & Smouse, 1978). These areas of research have looked at targeting tacts, mands, and receptive skills in children with an array of diagnoses. Research on TC in the early 1970’s was not easily accepted due to its contradiction in the stimulus over-selectivity research (Lovaas & Schreibman, 1971; Pronovost, Wakstein, & Wakstein, 1966), and the controversy of teaching less functional sign language skills to vocal children (Rincover & Koegel, 1975).

The issue often raised by caregivers and teachers of teaching less functional sign language skills to vocal children was evaluated by Goodwyn, Acredolo, and Brown (2000). They looked at the effect of teaching signs to hearing infants on verbal language development by conducting a comparison between the sign training condition versus the non-intervention control group. The analysis indicated an advantage for the sign training
group on a vast majority of language acquisition measures. This notion of sign language increasing verbal behavior is the basis for the development of successful TC research.

One of the most significant early investigations of TC was by Brady and Smouse (1978). They conducted a simultaneous comparison of vocal alone, sign alone, and TC on receptive skills training of a six-year old boy with autism. The participant had a significant vocal and motor imitative repertoire. The procedure used combinations of nine words: yellow, blue, red, give, tap, slide, ring, block, and stick. Training was conducted using three experiments, in which the child was presented with an object, and the $S^D$, for example tap yellow block. For experiment 1 utilizing vocal behavior, the experimenter modeled the appropriate behavior by tapping the block, then guided the child’s hand throughout the tapping process while vocalizing “tap yellow block,” followed by reinforcement. For experiment 2 involving signing, the child was presented with an object, and the $S^D$ was the manual sign for “tap yellow block.” For experiment 3, the TC treatment differed from the other two only in the change of the $S^D$ which was a combination of the spoken word and a sign simultaneously presented.

After the 21-session treatment phase, participants showed significant acquisition of receptive skills in the TC condition, decreased vocalizations in the vocal alone condition and no significant effect on receptive skills in the sign-alone condition. This research was the first to suggest that the combined treatment may contribute to improved performance when language training.

Barrera et al. (1980) compared vocal-alone, sign-alone, and TC. The participant was a four-year-old child diagnosed with autism and was labeled as “mute.” The child displayed a four word repertoire and good motor imitation skills. The procedures
consisted of four phases: adaptation period, training prerequisite attending behaviors, training model comparison, and intensive training. The third phase which focused on training model comparison consisted of the child receiving 20 minutes a day of direct language training with oral, sign-alone, and TC. Training on all three models continued until the child’s responses met a preset criterion for acquisition on all five words within one of the categories. A replication was then conducted using the remaining three matched word groups. These two comparison tests were followed by Phase IV of the study, which consisted of a period of intensive training using only the training model that promoted best performance, which was TC.

TC resulted in far superior acquisition of expressive language skills to either vocal or sign alone. A total of eighteen words were learned throughout treatment phase (10 from TC) in 14 days, and an additional 11 words in three days of an additional TC phase. This study was significant because they were the first to look at eliminating words from the repertoire of the participant and categorizing the words into difficulty levels before beginning the intervention.

Barrera and Sulzer-Azaroff (1983) replicated this study in an alternating treatment comparison of vocal-alone and TC to teach tacts to children with autism with an echolalic repertoire. This study is significant because it addressed a possible intervention for children with autism who engage in echolalia. Researchers have found evidence to suggest that echolalia in autism may reflect a general strategy for responding to verbal stimuli which are not understood. Thus, once a verbal stimulus takes on meaning, echolalic responding to that stimulus dissipates (Carr, Schreibman, & Lovaas, 1975).
The study was conducted in four separate phases: adaptation; prerequisite attending training; imitative response training; and oral language/TC training. Prior to conducting phases III and IV, lists of approximately 100 nouns representing familiar and common objects from the children’s environment were constructed. Any words that had been observed to be within the child’s current repertoire or recorded as previously known in therapy were deleted. Each list of words was then rated by three language specialists on the basis of difficulty in pronunciation and number of syllables. In addition to the analysis, two 45-min expressive and receptive tests were conducted on the remaining words in each child’s list. These analyses were conducted in the training environment using real objects from the children’s environment as stimuli. Two 45 minute receptive and two 45 minute expressive pretests were run with each child to assess potential training words. The expressive test consisted of presenting each of the objects five times, in random order, while varying each of three locative questions (“what is this?”). The receptive test was conducted by the therapist presenting three objects to the child on a small table placed directly between them. The therapist then requested a response by asking the child to “give me (one of the objects)”. If the child correctly labeled an object one or more times during the expressive test, the name of that object was eliminated from that word pool.

During phase IV, the oral language (therapist only using vocal cues) and TC training (therapist using simultaneous vocal and gestural cues) was compared giving each child 30-45 minutes of direct language training with each model four days per week. TC was shown to be most effective for all three participants who learned all the target words in this condition and either zero or one target in vocal-alone. This study added to the
body of research by including prompt delay (correct response would result in
reinforcement being delivered sooner than if waiting for prompt), and a time-out
procedure. This was one of the first studies that noted one of their participants utilizing
the sign as self-prompt to evoke the vocal tact. This lead to an increasing number of
studies that looked at addressing some of the controversial findings of TC research, and
the identification of the roles that the vocal and sign play in the successful acquisition of
verbal behavior through TC.

The studies on TC from the late 1980’s address issues from previous TC research
such as the vague pretreatment levels of children (repertoires and mental age levels),
anecdotal outcomes, long term maintenance and generalization, and identifying the role
that the visual (sign and picture) cues, auditory, kinesthetic, and tactile cues play in TC
training. Before beginning treatment, Sisson and Barrett (1984) also looked at the number
of training words in the repertoire of the child and difficulty levels of each word (as
described in Barrera and Sulzer-Azaroff, 1983). This study used an alternating treatments
comparison of vocal and TC training with three children that were minimally verbal and
diagnosed with mental retardation. The results showed that TC increased correct
responding more rapidly, while the vocal alone conditional had small or no gains to the
target response. The target response was the repetition of four word sentences. Three
sentence pairs that were equivalent were constructed. For example, “the tree is green”, or
“the shirt is blue.” In order to ensure equivalence, a speech therapist and a special
education teacher rated each sentence, using a 7-point Likert Scale. Raters were asked to
consider difficulty of concepts, difficulty of articulation, the fine motor skills needed to
form the signs, and how well the signs symbolize the words in their ratings. The study
utilized picture cues to minimize individual differences of attentiveness, characteristics of individuals, and short term memory. Furthermore, they were one of the first to require both sign and vocal responses for the TC condition to teach imitation of four word sentences using an errorless teaching procedure (0 s time delay).

Clarke et al. (1988) looked at the role of referential speech in sign learning by children diagnosed with mental retardation through the comparison of TC and sign-alone training. The first part of the study looked at training words that were receptively known to the four children diagnosed with mental retardation. Six pretests were conducted using picture prompts, and sign imitation training before tact training. During sign imitation training, the experimenters ensured that the signs could be performed by the child before they were taught to use them. During both conditions, the procedures were the same, except that during the TC condition, the teacher spoke the name of the item simultaneously with the sign as the stimulus picture was presented. In each condition, training was continued until the child’s performance met criterion, in which probes and posttests were initiated.

Both training groups mastered the targets; however, the TC group acquired the tacts in half the number of trials as sign-alone training. The second part of the study was a replication of the first study but conducted with a child that had a poor imitative repertoire. This study added to the literature by looking closer at the effects of individual characteristics of the participants, and the use of picture stimuli discriminative stimuli (SD). An extensive review of the research literature yielded no studies on TC after Clarke et al. (1988) until Carbone et al. (2006), and Carbone, Sweeney-Kerwin, Attanasio, and Kasper (2010).
Carbone et al. (2006) compared TC versus vocal-alone training to increase tacts for pictured objects. An additional purpose of this study was to extend previous research on TC to children who have developed a vocal response repertoire in one operant class but failed in another. The participant was a seven-year old girl with autism and an echoic repertoire who had previous unsuccessful mand, tact, and intraverbal training. In the six months prior to the study no new tacts or intraverbals had been acquired.

The study consisted of forty-hours a week of DTT and NET training using teaching and testing trials, and errorless teaching procedures. In the treatment phase, each session lasted 20 minutes, and ten tacts were targeted in each of the two conditions. A correct response in both conditions was a vocal tact response emitted within three seconds of the presentation of the $S^D$. Similarly, an incorrect response was a vocal response that did not correspond to the target picture or if the participant failed to respond within three seconds of the presentations of the $S^D$. Prompts were provided during teaching trials, but not the probe trials, and mastery criteria was 100% correct across two consecutive sessions and two researchers. For the TC condition, during the teaching trials an incorrect sign plus a correct vocal response was considered an error, and an errorless teaching procedure was used. Mastery criteria were the same as in the vocal-alone condition, and the study used an alternating treatments design with a random sequence of both experimental conditions during each session. Despite the additional trials in the vocal-alone condition (the vocal-alone condition consisted of 267 trials and the TC condition had 234 trials) TC resulted in four times as many tacts acquired throughout the study.
This study has several limitations. First, the findings of only one participant are reported, and no formal maintenance data were collected. Additionally, the participant had a well developed vocal mand repertoire but failed to develop and maintain a vocal tact repertoire. Despite the seemingly less powerful social reinforcement associated with the tact response, the manual signs appeared to act as supplementary stimulation leading to the increased acquisition of vocal tact responses. This is important since most verbal behavior is maintained by generalized forms of reinforcements, and therefore most functions of verbal responding may be susceptible to the effects of total communication training with manual sign language. However, the effects of the sign, or the evaluations of which component of the sign specifically effects the acquisition of tact responses is not evaluated. One hypothesis is that sign language, because of its emphasis on visual rather than auditory stimuli, may remove an important obstacle to the acquisition of complex verbal behavior. It could also be said that the addition of a kinesthetic (motion of sign) cue relates to success of TC.

Lastly, the effects of the use of picture prompts and prompt delay are not evaluated, and may have had an impact on the success of the TC condition. The researchers also suggest that future research may want to determine the effectiveness of TC for learners who emit echoic responses and vocal mands, but fail to emit high rate vocal intraverbal responses.

A few years later, Carbone et al. (2010) looked at increasing vocal mand responses of children with autism and developmental disabilities using manual sign training and prompt delay. The study included three participants from a private school for children with developmental disabilities, one with Down’s syndrome, and two with
autism. Two of the participants had ten to fifteen manual sign mands, and one had no independent manual sign mand repertoire. The target measure was the occurrence of unprompted and prompted vocal responses including speech sounds, word approximations, or adult word forms. An unprompted response was a vocal and sign emitted simultaneously, a vocal plus a prompted sign, or a vocal plus a sign emitted after a five second (5 s) prompt delay. A prompted response was a correct vocal emitted after the presentation of the $S^D$. A multiple baseline across participants design was used to present the six target mands for each participant consisting of edibles, toys, and movies. Sessions occurred twice a day, and consisted of fifty trials each in which the target items were presented in a random sequence.

During the baseline condition, if the participant declared motivation for an item (i.e. reached for the item) and emitted the target manual sign mand within 5 s of the item’s presentation, the instructor delivered the item immediately while saying the name of the item. This is similar to TC training where the vocal is paired with the sign. During the prompt delay and vocal prompt condition, when the participant demonstrated motivation for the item and signed, the instructor did not immediately deliver the reinforcer, but instead a 5 s prompt delay occurred. If the participant emitted a sound without the sign, the instructor implemented the prompt sequence for the manual sign and then the 5 s prompt delay procedure began. During this 5 s prompt delay; if the participant emitted any vocal response, it resulted in immediate delivery of the manded item. If the participant did not emit a vocal response during the prompt delay, the instructor said the name of the desired item as a vocal prompt and waited 2 s for a response. If a vocal response occurred within 2 s, the instructor delivered the desired
item. If no vocal response occurred, the instructor re-presented the vocal prompt two additional times. The instructor delivered the manded item immediately after the occurrence of a vocal response following any of the vocal prompts. If no vocal response occurred, the instructor delivered the desired item at the end of the sequence of presentations of three vocal prompts in order to ensure the sign was not placed on extinction.

According to the results of the study the treatment produced an increase in the number of vocal responses that accompanied the manual sign mands for all participants. One of the participants showed a threefold increase in the mean of unprompted vocal responding from the prompt delay procedure, while the other two participants showed a substantial increase. The researchers suggested that prompt delay and vocal prompting can be implemented with manual sign language to produce an increase in vocal responses in children with developmental disabilities who emit a few vocal responses. As TC research literature suggests, this combination of manual sign and vocal training increases the likelihood that the verbal behavior of the children will control the behavior of the listener.

One of the limitations of this study is the discussion of the results do not match those seen in the data. The researchers state that both Ralph’s and Nick’s manual sign mands demonstrated substantial increases in unprompted vocalizations during treatment. However, they did not show substantial increase. Looking at the graph, Nick’s unprompted data stream is flat-lined at zero occurrences of unprompted manual sign mands per session from baseline session 17 until the last session 28. Nick’s prompted
mands per session increased after the intervention was implemented from 0 mands per session to 15 prompted mands per session in session 28.

The procedures of this study also generate some confusion. The researchers explain that during the prompt-delay and vocal prompt condition, if the participant emitted a sound without the sign, the instructor implemented the prompt sequence for the manual sign, and then the 5 s prompt delay began in which, if the participant emitted any vocal response, it resulted in delivery of the manded item immediately. If the participant is already emitting a vocal response, why implement a 5 s prompt delay in which another vocal would result in reinforcement? If you are implementing a 5 s delay after a vocal to prompt for the manual sign, then a combination of vocal and sign should be required for the delivery of reinforcement. Or if the sign is not emitted after the prompt, the instructor should prompt the sign again, and wait 2 s. If the vocal and sign occurred at this point, the instructor should deliver the reinforcement. If no vocal and sign response occurred, the instructor should represent the sign prompt two additional times. If no simultaneous sign and vocal response occurred, then at this point the instructor would deliverer the desired item.

Lastly, the researchers did not conduct an evaluation of the increased unprompted mand responses as being attributed to the use of the prompt delay procedure or TC as opposed to the use of the sign and vocal training. The addition of the prompt delay procedure may have significantly affected the results of this study, and should be evaluated, as should the effects of TC on the occurrence of unprompted vocal responses.

The purpose of this study was to extend previous research on intraverbal behavior trainings by comparing the relative effectiveness of using prompt delay and total
communication training methods for teaching vocal intraverbals to children with autism.

This research contributed to the literature by evaluating the multiple cues of these two training methods to determine the most effective treatment procedure for this population.
Method

Participants

This study’s participants were four male children (Marcelo, Sebastian, Javier, & Carlos) between 4-6 years old diagnosed with minimal to moderate ASD. All the children had echoic and mand vocal repertoires but failed to demonstrate a consistent or functional vocal intraverbal repertoire. All participants were able to imitate motor movements and vocalizations simultaneously. The participants functioned with mild to moderate impairments in the areas of language, problem behavior, repetitive behavior, and ability to interact with others as ascertained by their previous therapy and exposure to the Assessment of Basic Language and Learning Skills-Revised (ABLLS-R; Partington, 2006). Participants were included in the study if they had mastered the necessary prerequisite skills for one of the advanced intraverbal programs outlined in the ABLLS-R but had not met the mastery criteria for that program (sample intraverbal programs from the ABLLS-R can be found in Appendix D). Participants did not have any known hearing, vision, or gross/fine motor impairments in the use of their upper extremities. Participants were excluded in this study if they had exhibited rates of disruptive behavior high enough to interfere with teaching.

Sebastian. Sebastian was 5-years-old and had been utilizing sign language inconsistently as part of his pre-existing VB programs. The ABLLS-R program chosen for Sebastian was Fill-ins (H6) (ex. we wash our…hands). He was extremely motivated for both IPad and Skittles. Sebastian’s weak intraverbal repertoire was partly due to the
fact that his behavior was under poor stimulus control and would just echo the last word or part of a word in the $S^D$, or the last answer that was reinforced (ex. We sit in a…sit). In addition, though Sebastian had been assessed as having mastered the motor imitation ABLLS-R program, he had the weakest motor imitation of all the participants and would try to resist full physical prompts for a sign by pulling his hands away. Sebastian attended the clinic three times a week; however, his attendance was not consistent throughout the study.

**Marcelo.** Marcelo was four-years-old and had not been utilizing sign language in his VB programs. The ABLLS-R program chosen for Marcelo was Associations (H7) (ex. something that goes with a chair is…a table). Marcelo was motivated for a wide array of items including Ipad, balloons, dragons, dinosaurs, cars, and bubbles which he could vocally mand for. All of these items were made readily available for him throughout the sessions. Marcelo attended the clinic three times a week but his parents agreed to bring him in one extra day per week for the purposes of the study.

**Javier.** Javier was five-years-old and had been utilizing sign language consistently as part of his pre-existing VB programs. Javier attended the clinic three days per week on a consistent basis. The ABLLS-R program chosen for Javier was Associations (H7). Javier was motivated for movies, Ipad, IPhone, and candy.

**Carlos.** Carlos was six-years-old and had been utilizing sign language inconsistently as part of his pre-existing VB programs. The ABLLS-R program chosen for Carlos was both Fill-ins, and Associations. Carlos’ preferred items included Ipad, and an array of edibles provided by his parents.
**Setting**

The study was conducted in a local verbal behavior clinic that served children with ASD from a behavior analytic perspective. Sessions conducted at the clinic coincided with the regularly scheduled weekly therapy times for all participants except Marcelo who was brought in one extra day a week for the study. During all sessions, the participants sat at the same instructional table in the same private room and only one therapist was present. In some cases, an additional trained therapist was present in the room throughout the study for the purposes of determining inter-observer agreement. The room contained a child-sized table and chairs where the participants sat perpendicular to the therapist. All necessary stimuli and materials were placed next to the therapist [i.e. target stimuli (two-dimensional pictures, symbols, or words, three-dimensional objects)]. In addition, reinforcers, stopwatches, timers, data collection-sheets, and a video-camera were within reach of the therapist.

**Dependent Variables and Measures**

The dependent variable measured in the study was the total number of intraverbals mastered in each condition. These data were the acquired and mastered targets collected across intraverbal targets per session. The mastery criterion for each participant was two “yes’s” on the percentage correct/probe data sheet (See Appendix A/B) across two consecutive sessions and a “yes” on the mastery probe conducted on the following session. A “yes” on the percentage correct sheet was defined as a score of 90% correct or higher on the 10 trials, and had to include a correct response on the first trial of the session (Appendix B: Section E). The therapist selected 3 target intraverbal responses for each participant per session based on a pre-experimental assessment that indicated
that the participants had not previously been exposed to these targets. Sessions were conducted once a day and consisted of 10 trials for each target response during which the target items were presented in quasi random order (systematically random as no more than two consecutive sessions of the same condition can be presented) interspersed with mastered targets. No more than two acquisition targets were presented in a row during sessions. New targets were introduced as soon as any one target was mastered. Thereafter, the targets were quasi randomly rotated with the other two targets. Targets were placed “on hold” (no longer targeted) after four consecutive sessions with a stable trend based on a localized level or downward trend to promote success in both conditions. This ensured that the participants’ acquisition of new targets was not delayed if they are having trouble acquiring the response of one particular target for an extended period of time. No targets were placed “on hold” throughout the study for any participant.

Additional probe data was collected for each target. An initial cold probe was conducted for the very first presentation of each target before beginning training to function as an assessment probe to ensure the participant had not acquired the response since the initial pretest was conducted. An additional mastery probe was conducted for each target after two consecutive “yes’s” on the percentage correct data sheet to function as a test for mastering the target. During these probes only the vocal response was required for a correct response during both conditions and was recorded under the probe data column. A “yes” on a probe was defined as the participant saying the correct vocal only response to the intraverbal before the delivery of the controlling prompt (a prompt that ensures a correct response, ex. saying and signing “Cow” in response to “What says moo?”). During probes, no prompts or reinforcement was provided, additionally, manual
signs were not required in both conditions for a response to be considered correct. An error was defined as the participant saying anything other than the correct answer to the intraverbal before the delivery of the controlling prompt. If a mastery probe was incorrect, then the target would be represented, and an additional two consecutive “yes’s” were needed before re-probing the target.

An errorless teaching procedure, and transfer trials were used to transfer stimulus control. To balance the number of trials across categories, all trainings during this phase were conducted on the basis of discrete trials which began with the presentation of the training stimuli (paired with the therapist’s question), and ended with the delivery of the reinforcer. A fixed amount of time was used between instruction and the prompt according to a constant time delay prompt fading strategy across both conditions. During all sessions breaks, the participants were provided access to age-appropriate toys, IPad, or DVD’s selected immediately before each session from the clinic’s materials or snacks provided by the parents.

**Data Collection and Interobserver Agreement**

The therapist served as the primary data recorder for the dependent variables during the session. Due to Javier’s problem behavior (increased self-stimulatory behavior) an additional therapist was fully trained to conduct data collection during study sessions. Two other therapists were initially trained for data collection and conducting sessions but ended up never being used to conduct sessions independently. Two of these therapists were trained to observe and record video-taped sessions independently for the purpose of determining interobserver agreement and treatment fidelity. These therapists were University of South Florida Applied Behavior Analysis master’s level students.
During each trial, the therapist recorded data on the intraverbal responses using percentage correct/probe data sheets (Appendix A/B) that were prepared specifically for each session and for each condition. The therapists also recorded the prompt level necessary to evoke the manual sign intraverbal, correct and incorrect responses, and the occurrence of any prompted or unprompted vocal responses.

In the TC condition, a correct response on the TC percentage correct/probe data sheet (Appendix B) was defined as an independent correct vocal response within 5 seconds of the presentation of the $S^D$, and an incorrect (or no) manual sign accompanied by the correct vocalization. The response initially had to be emitted simultaneously with the correct manual sign; however, one participant began emitting the correct vocal response consistently without a sign. It was determined that this was not allowing for an accurate account of the acquisition rate in the TC condition and therefore the requirements for all participants were changed. An analysis of the sign was then conducted in this condition in order to determine the percentage of time that the sign occurred with a correct response. If the sign was not emitted, the vocal response would still be reinforced but the therapist would prompt the correct manual sign before delivering a tangible reinforcer. An error in the this condition was defined as the participant not responding during the delay interval before the delivery of the controlling prompt, an incorrect vocal, the correct manual sign response accompanied by the incorrect (or no) vocal, or any response requiring prompting.

In the PD condition, a correct response on the percentage correct data sheet (Appendix A) was defined as the participant saying the correct vocal only response to the intraverbal during the 5 s delay interval before the delivery of the controlling prompt. No
manual signs were required and an error was defined as the participant saying anything other than the correct answer to the intraverbal during the delay interval before the delivery of the controlling prompt.

The data recorded by the primary observer was then compared to those of the secondary observers. Interobserver agreement was calculated by dividing trial by trial agreements by agreements plus disagreements and converting the ratio to a percentage by multiplying by 100. Interobserver agreement was conducted for at least 33% of all sessions for all participants (Sebastian, Marcelo, and Carlos 33%, Javier 37%). Agreement for Sebastian was 97.2%, Marcelo was 94.7%, Javier was 99.3%, and Carlos was 98.3% (an average of 97.4% across all four participants).

**Therapist Training**

Specific protocols (Appendix C) were developed based on the skills targeted using a modified checklist that is currently being used at the VB clinic. These were the same ones used to determine treatment integrity throughout the study. Behavioral skills training (BST) consisting of instructions, modeling, rehearsal, and feedback were used to train the therapists on the TC and PD procedures. Therapists were required to score at least 90% on the protocols three consecutive times before performing the procedures independently. Furthermore, certain areas integral to the reinforcement contingency were graded separately (i.e. appropriate $S^D$ was stated, appropriate prompt was provided based on the criteria, following the prompt fading guidelines, reinforcement was provided appropriately based on the reinforcement contingency, and appropriate trial by trial data were collected) and had to occur at 100%. The first therapy session that a therapist had with a child was monitored by the principal investigator in person, and feedback was
delivered as necessary. The principal investigator was able to conduct all sessions independently except for those done by Javier’s therapist where the principal investigator remained in the room for treatment integrity collection.

**Treatment Integrity**

All sessions were videotaped, and treatment integrity was collected for an average of 38% of all sessions in all conditions (Sebastian and Carlos 33%, Javier 44.5%, and Carlos 40%). Each item on the protocol was scored to identify whether the principal investigator performed the step correctly. Some items on the protocol were evaluated once (i.e. materials are organized and ready), while other items on the protocol were evaluated on a trial by trial basis. The number correct was divided by the total number of items on the protocol to yield an overall percentage correct by multiplying by 100. Javier’s was at 98.5%, Marcelo at 98%, Carlos at 99.6%, and Sebastian at 99%. These percentages include the sessions for which the principal investigator was training two additional therapists which affected the results. If treatment integrity fell below 90% overall on the protocol on two consecutive occasions, the therapist would have retrained using BST procedures before the next session took place. These procedures did not have to be implemented for any of the trained therapists. In addition, if the treatment integrity fell below 100% on two consecutive occasions for the steps integral to the reinforcement contingency stated above, BST would have been used to retrain the therapist before the next session takes place. This procedure did have to be implemented for one of the therapists, but this therapist was not used for any further trainings or data collection in the study.
**Experimental Design**

To empirically demonstrate the relative efficacy of the two training methods, an alternating treatments design was utilized (Koegel & Schreibman, 1977). Alternating treatments design is the alteration of two different treatments or conditions in a single subject for an equal amount of time. One experimental condition was conducted per session, and the sequence of the two treatment conditions were alternated randomly across the sessions for each participant with approximately three sessions a week. The order of the conditions was determined by the flip of a coin prior to starting the session. The same condition was never presented more than two sessions consecutively, according to the requirements of an alternating treatment design (Baer, Wolf, & Risley, 1968). All sessions were of equal length, and only one session per day per participant was conducted.

**Procedure**

**Preference Assessment.** Each session began with a brief preference assessment which involved allowing the child to choose which reinforcer he or she wanted to earn from an array of edibles, age-appropriate toys, IPad, or DVD’s located in the participant’s bin. Choice was expressed either vocally or by physical selection of the item. As a within session rule, any four trials of no responding, or incorrect responding resulted in halting the session to conduct another preference assessment to ensure motivation was high. The sessions commenced following identification of preferred stimuli.

**Pretest.** Requisite attending and adaptation skills were evaluated to ensure the child was well adjusted to the training environment, could sit and engage for extended periods, and could maintain occasional eye contact. Furthermore, a list of 40 intraverbal
sets (Appendix D) that could be prompted (vocally or with a sign) was evaluated by the therapists and parents of the participants. Each participant’s teacher and parents agreed to refrain from targeting these question sets throughout the duration of the study. Any intraverbals observed to be within the participant’s current repertoire or recorded as previously known or worked on in therapy were omitted. During this condition, there were no prompts and no feedback. There were a total of 120 trials (3 trial presentations per intraverbal) distributed across typical sessions and randomly presented.

A total of 10 to 15 targets were probed each session such that the pretest will be completed in approximately one week. The questions that were answered incorrectly on all three assessment trials were considered unknown for that participant. A different set of unknown questions were assigned to the TC or PD conditions only if the participant was able to echo the relevant answers or make some approximation of the sign/vocal. In order to determine which unknown questions were assigned to each condition, the list was rated on the basis of difficulty in pronunciation, the number of syllables, and the fine motor skills needed to form the signs. This process was facilitated by only selecting targets from one ABLLS-R program at a time per participant. These programs were already divided into similar targets (ex. What goes with dog?–“cat”; or What goes with cow? - “pig”).

**Total Communication Procedures.** (Appendix B) In this treatment condition, three targets were presented per session, with 10 trials per target for a total of 30 trials per session. All trials were distributed throughout one block of the session and all three targets were run concurrently. New targets were introduced as soon as any one target was mastered. Targets were randomly rotated along with mastered targets and acquisition targets throughout the session block. Differential Reinforcement of Alternative Behavior
(DRA) was used and the reinforcer delivered was contingent on the level of independence of the response for both conditions. Data collection in this condition included whether the vocal response was correct or incorrect, whether the correct sign occurred with the vocal or not, and which prompting level was used during each trial.

The prompting used for this condition was most to least. The most to least prompting hierarchy was 1) full physical/full vocal, 2) partial physical/partial vocal, 3) full model, and 4) 5 s prompt delay. The fading procedure was used for the sign, the vocal, or both. Therefore, if the correct vocal response was emitted, praise would be delivered immediately for the vocal response but the prompting procedure for the sign would be initiated (Appendix B: Section D). If an incorrect vocal (or not vocal) and an incorrect sign (or no sign) occurred simultaneously (Appendix B: Section C), then prompting would occur for both the vocal and the sign at the same time. The criteria for fading were two consecutive trials at a particular level of prompting. On the third trial, (Appendix B: Section A) the level of prompting was reduced according to the previously specified hierarchy. If successful, the level of prompting continued in accordance with the hierarchy. If unsuccessful (Appendix B: Section B), the level of prompting would return to the previous and more intrusive level and an additional two sessions would be conducted at that level before fading would occur.

A correct response in which no prompting was needed during a trial did count as a trial at a particular level. For example (Appendix B: Section G), if the sixth trial was at the partial vocal/ partial physical level, and the seventh trial was correct, then if the eighth trial was incorrect the level would be faded and modeling would be used. In the event that there was a correct response on the first and second trials (Appendix B: Section
F), followed by an incorrect (or no) response, the fading procedure changed to least-to-
most prompting only for that trial. So if the first two trials were correct and the third trial
was an incorrect vocal response, the therapist would then prompt with a full model. If the
model prompt did not work, then they would work backwards up the specified hierarchy.
The fading rules would then go back to two additional consecutive sessions at that
prompting level before fading to the less intrusive level.

These fading rules were implemented to ensure treatment integrity and so that the
participant would not get prompt dependent, and based on their previous correct
responding a model prompt tended to serve as a sufficient prompt for the correct
response. A very detailed TC percentage correct/probe data sheet (Appendix B) was
created to facilitate the data collection during this condition and to serve as a tool for the
therapist to carry out the fading rules proficiently. The data sheet included an area to note
whether or not the participant emitted the correct sign, the correct vocal, what prompting
level was used, and whether the prompting level worked or not. In addition, the way the
data sheet was set up allowed the therapist to mark which prompting level was coming up
next in the event the participant answered incorrectly or did not emit the sign
independently.

**Prompt Delay Procedures.** (Appendix E) During this condition, the therapist
presented the \( S^D \) and initiated the 5 s prompt delay, if the participant emitted a correct
vocal response at any time during the 5 s delay; the therapist delivered the reinforcer
immediately. If the participant did not emit a vocal response during the 5 s delay, the
therapist would represent the \( S^D \) along with the correct response (ex. We paint on… say
“paper”). If the participant did not echo the vocal prompt the therapist represented the SD
along with the correct response again. If the participant echoed the correct response the therapist praised and immediately represented the $S^D$ and allowed the participant 5 s to respond (first transfer trial).

If after the therapist represents the SD along with the response a second time the participant echoed the response incorrectly, the therapist would represent the SD along with the correct response a third time. If the participant did echo the response correctly after the therapist represented the SD along with the response a second time, the therapist would praise and then immediately represent the $S^D$ and allow the participant 5 s to respond (first transfer trial).

If after this first transfer trial the participant responded correctly, the therapist delivered a smaller amount of the reinforcer immediately. If after this same first transfer trial the participant responded incorrectly the trial was over and a high probability mastered demand was presented before delivering a smaller amount of the reinforcer (such as “tap the table”).

If the participant echoed the response correctly after the therapist represented the SD along with the response a third time, the therapist would praise and then immediately represent the $S^D$ and allow the participant 5 s to respond (first transfer trial). If after the therapist represented the SD along with the response a third time, the participant echoed the response incorrectly (or not at all), the trial was over and a high probability mastered demand would be presented before delivering a smaller amount of the reinforcer.

During the transfer trial that occurred after the first time representing the SD/correct response combination, if the participant said the correct vocal response within the 5 s, the therapist delivered a smaller amount of reinforcer immediately. If the participant
did not respond or responded incorrectly, the therapist represented the SD along with the correct response a second time. At this point a correct response would result in another presentation of the SD and the participant was allowed 5 s to respond (2nd transfer trial). If the participant responds incorrectly after the therapist presented the SD and correct response combination a second time, the therapist would represent the SD along with the response a third time.

If after the second transfer trial the participant responded incorrectly (or not at all), the therapist would represent the SD along with the correct response for a third time. If after the second transfer trial the participant responded correctly, the therapist immediately delivered a smaller amount of the reinforcer.

If the participant responds incorrectly after the third time that the therapist represented the SD along with the correct response, the trial was over and a high probability mastered demand would be presented before delivering a smaller amount of the reinforcer. If the participant responded correctly, the therapist immediately delivered a smaller amount of the reinforcer.

Three targets were presented per session, with 10 trials per target for a total of 30 trials per session. New targets were introduced as soon as any one target was mastered. All trials were distributed throughout one block of the session and all three targets were run concurrently. Targets were randomly rotated along with mastered targets and the study’s acquisition targets throughout this session block.
Results

The results for the Pretest (Figure 1a) for Marcelo show that all but four of the targets from the Fill-ins-H6 program probed correctly for at least one of the three trials. All of these intraverbals from this program were not targeted in the study; therefore an additional program (Associations-H7) was tested. All but one of the targets from this program probed at 0% across all three trials. The targets for the study were chosen from this program except for the one known target. Sebastian (Figure 1b) had four targets which he probed correctly for at least one of the three trials in the Fill-ins-H6 program. These targets were thrown out and the remaining unknown targets were used for the study. Javier (Figure 1c) probed correctly on all but three of the targets from the Fill-ins-H6 program for at least one of the three trials. All of these intraverbals were not targeted in the study. All but three of the targets from the Associations-H7 program probed at 0% across all three trials. The targets for the study were chosen from this program except for the three known targets. Carlos (Figure 1d) had two targets which he probed correctly for at least one of the three trials in the Fill-ins-H6 program. He also had six targets which he probed correctly for at least one of the three trials in the Associations-H7 program. These targets were thrown out and the remaining unknown targets were used for the study.

The results of the percentage of trials correct per session in the TC condition (Figure 2: a-d) for all participants indicate what a typical within analysis of the number of trials to acquisition for a target would look like. In addition, the initial cold probe, mastery probe, and the percentage of time the sign occurred with the vocal are displayed.
The graphs of the first and last targets acquired are shown for each participant in order to demonstrate the varying level of use of the sign across different targets throughout the study, as well as the varying number of sessions to acquisition across the study.

Marcelo showed a reduction in the trials to acquisition between the first targets to the last targets (from 10 trials to 4 trials). Marcelo was the only participant given a generalization probe for all targets acquired in both conditions. After a one month vacation, Marcelo was able to recall all of his mastered targets in the TC condition, and two additional targets that were just missing a mastery probe. Sebastian also showed a reduction in the trials to acquisition between the first targets to the last targets (from 7 trials to 3 trials, with his longest being 13 trials for one target). Javier’s trials to acquisition increased from 10 to 13 in the first and last targets. Carlos also showed a decrease in trails to acquisition between the first targets and the last ones. His first three were 7, 10, and 11 while his last three were 3, 4, and 5. Carlos had very consistent upward trend for his individual target data paths, however, he was the only participant to fail a mastery probe and have a target represented.

The result of the percentage of trials correct per session in the PD condition (Figure 3) for all participants indicate what a typical within analysis of the number of trials to acquisition for a target would look like; along with the initial cold probe, and mastery probe. The within analysis of the sessions to acquisition in the PD condition for Marcelo show a decrease from six sessions to three sessions for the first and last targets. Marcelo had a total of 24 sessions throughout the study, which was the least out of all participants. In the Sebastian decreased from 9 sessions to acquisition in his first PD target to 4 sessions in his last PD target. Sebastian had a total of 31 sessions throughout
the study (15 for TC, and 16 for PD). Javier had a total of 27 sessions during which he showed a relatively steady trend. Javier’s first PD target was acquired at 8 sessions and his last target was at 7 sessions. Carlos had a total of 37 sessions all together (20 for TC and 17 for PD). Carlos also had a decreasing trend for targets acquired within the PD condition. His first PD target was acquired in 7 sessions and he acquired his last target in 4 sessions. Marcelo acquired a total of 4 targets in each of the two conditions. Sebastian acquired a total of 5 targets in each of the two conditions. Javier acquired 3 targets in the TC condition, and 4 targets in the PD condition. Lastly, Carlos acquired a total of 8 targets in the TC condition, and 9 targets in the TC condition. Three out of the four participants had slightly less trials in the PD condition (Marcelo: 3 less, Carlos: 1 less, and Javier: 3 less), and one participant had slightly less trials in the TC condition (Sebastian: 1 less).

Lastly, we analyzed the use of the sign to determine whether the addition of a sign prompt would, 1) ensure acquisition of the intraverbal targets and, 2) whether or not the same effect could be achieved with PD alone. Sebastian only emitted a correct vocal paired with a correct manual sign 4% of the time, Marcelo paired the sign 63% of the time, Javier 75% of the time, and Carlos 55% of the time. A within analysis of Marcelo’s data show that he paired the sign consistently with the vocal in about the first 4 sessions but then discontinued using the sign towards the last sessions. Sebastian used the sign at near zero levels throughout the entire study. Javier consistently paired the sign with the correct vocal response throughout the study (91% of the time), while Carlos’ use of the sign was variable throughout the study and across targets.


Discussion

The results of the study showed that all four participants acquired intraverbal targets in both conditions and both procedures were effective at teaching intraverbal skills to all participants. No clinically significant differences were found in the sessions to acquisition or in session lengths, and a separate analysis of the sign found that three out of the four participants did not emit the sign with a correct vocal response. It was initially hypothesized that the TC condition would result in higher rates of acquisition than the PD condition. However, an analysis of the results (Figure 4a-b) showed that all participants acquired relatively the same number of intraverbal targets in both conditions. These results take into account the design of the study, which dictates that each condition had to have generally the same amount of sessions for each condition per participant. In addition, Carlos’ data were carried out for the longest number of sessions in order to evaluate whether the trend of the data would stay the same. Carlos attended the clinic five days a week which enabled us to conduct this assessment to determine whether there would be a differentiation in the data path if carried out an extended number of sessions (37 total sessions). Based on the trend of these data (as well as Marcelo and Sebastian’s), an assumption could be made that these participants would continue to acquire targets in both conditions at a similar rate.

It was also hypothesized that the TC condition would require a fewer number of sessions to reach mastery criterion for each target response than the PD condition. However, an analysis between the TC and PD conditions (Figure 5) show that there was

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no significant difference in the number of trials to criterion between the two conditions for each participant and that these numbers were not significant enough to determine whether one procedure was more efficient. Furthermore, all participants acquired approximately the same number of intraverbal targets at similar rates in both conditions; therefore, neither condition was seemingly more effective based on the number of targets acquired or acquisition rates. However, different analyses were conducted to evaluate whether a distinction would be evident in other components like data collection and session length.

Regarding data collection, the primary investigator of the study was the sole therapist trainer and found that the PD procedures were much easier to implement and train than the TC procedures. Though the procedures for both conditions were intricate, the data collection for the PD procedure was very straightforward (either a + or – for each trial). The TC data collection required the therapist to keep track of which prompting procedure to use, whether the sign occurred or not, whether the vocal was correct or incorrect, and if the prompting procedure used was effective or not. This may have hindered progress because of the amount of time needed to refer back to the data sheet between each trial, as opposed to the PD data collection which proceeded more fluidly.

Additionally, no specific data were taken on the lengths of each session, but an analysis of the videos of each session showed that Carlos’ average session length for PD was 14 minutes and 16 minutes for TC; Javier was at 25 minutes for PD and 26 minutes for TC; Marcelo averaged 14 minutes in PD and 25 minutes for TC; and Sebastian averaged 12 minutes for PD and 19 minutes in TC. These numbers are just estimates and
do include some down time within the session (though any outlier sessions with long
periods of problems behaviors were eliminated from this analysis). There were no
differences for three out of the four participants; however, Marcelo’s PD condition was
on average 11 minutes shorter than his TC condition, and Sebastian’s was on average 7
minutes shorter. Depending on how many programs the child has and their session
length, 11 minutes could have an effect on procedural choices. In the future, an in depth
analysis should be conducted using a stop watch in order to accurately time the session
lengths and exclude any breaks or time spent dealing with problem behavior. Several
additional factors may have contributed to the lack of differentiation in the data for both
of these procedures. These include issues dealing with problem behaviors, each
participant’s characteristics and repertoires, extraneous and unforeseen variables, and
issues with protocol development which yield further analysis into the results of the
study.

Some of these issues dealing with problem behaviors may be used to explain the
within analysis of the trials to acquisition for each condition that shows a reduction from
the first to last target for three out of the four participants. For example, Marcelo’s
reduction could have been due in part to some of the behavioral problems encountered in
the first few trials, and the amount of time needed for him to develop stimulus control
over the two condition procedures which were different from his regular therapy.
Marcelo had a history of only working with one particular therapist which was not the
principal investigator. In the first five sessions, Marcelo engaged in problem behaviors
such as hitting, crying, pinching, and slapping the research therapist. Data collection was
stopped while pairing sessions and a more in-depth preference assessment was
conducted. Once these changes were put in place, near zero levels of problem behavior occurred throughout the rest of the study. Marcelo had the lowest number of sessions (25), because two months into the study his parent’s notified the research therapist a week before that they were going out of town for a month. A generalization probe was conducted when he came back into town to access his retention of the skills.

Sebastian’s reduction in the sessions to acquisition may have been influenced by his inconsistent attendance, his weak motor imitation repertoire in comparison to the other participants, along with adjusting to the new procedures. Javier was the one participant who did not show a reduction in trial to acquisition within the conditions. His single target data trend was high in variability unlike any other participant. Javier began to have high rates of problem behavior towards the end of the study which most likely affected these numbers. The high rates of problem behaviors occurred during his regularly scheduled therapy sessions and were determined to function for access to tangibles (electronics). His problem behaviors were high rates of self-stimulatory behavior (wiggling his fingers behind his back while making loud noises) while engaging with these items. When these items were removed he would cry, scream, and continuously request IPad. His parents requested that we no longer use these items as reinforcers during any therapy sessions. His primary therapist conducted and in-depth preference assessment and found DVD cases of preferred movies and candy to be potential motivators. However, these did not generalize into the study’s sessions and did not significantly or consistently reduce the problem behavior in his regular sessions. Furthermore, his parents also asked that only his primary therapist use the candy due to some diet restraints.
We attempted to continue to use the electronics as motivators but continued seeing even higher rates of problem behavior. We attempted to shape up the use of a token board for him to earn the electronics, but we were not successful. We also attempted to use pre-session exposure to the electronics, but we did not see a decrease in the behaviors and as stated before we did not have the support of the parents to continue assessing this. We also trained Javier’s primary therapist so that she could conduct the sessions in his regular therapy room but his problem behavior persisted. Due to time restraints to deal with his problem behavior and limit on the use of potential reinforcers we stopped Javier’s data collection at 27 sessions (only three more than the initially proposed 24 sessions).

In addition to issues with problem behaviors, an analysis of the participants’ characteristics and their repertoire is essential for interpreting the results of any study and determining treatment procedures. As is the case with most ABA programs, the decision whether to use PD or TC in a verbal behavior program must be based on the individual for whom it’s intended. Though no differences appeared in this study for these participants, the decision should then be in part based on characteristics of the individuals. For example, does the individual have a functional vocal repertoire? In this study, Sebastian, Carlos, and Javier had previous exposure to sign prompts in their existing programs. The reason for this was because of their inconsistent functional vocal repertoire. Right before the study began, both Carlos and Javier’s functional vocal repertoire had improved to the level of no longer needing to require the sign in the regular therapy. In their case, a program requiring them to sign would not be necessary for their acquisition of the target skills. Sebastian, however, would be a candidate for a
program like TC which required him to sign because of his weaker functional vocal repertoire.

Although Sebastian was a good candidate for this procedure other individual characteristics should have been taken into account. For example, Sebastian had an inconsistent motor imitation repertoire and engaged in problem behavior whenever the therapist implemented the full physical prompting procedures throughout the study. In this case, TC would not be an effective procedure for this individual and perhaps a shaping program should be implemented instead to work on his functional vocal repertoire before having him attempt to acquire intraverbals.

An individual like Javier, who was able to acquire the signs very quickly and consistently, would be a good candidate for the TC condition, especially when he had a hard time transitioning to the PD condition (where we had to implement a procedure for holding his hands down to prevent him from signing). When a candidate is great for both conditions, a decision may be based on the length of sessions (given that his PD condition was on average 11 minutes shorter), or based on the amount of time available for training the therapist to collect data proficiently and reliably.

The individuals’ repertoire in respects to sign language also factored in to the results of this study. The inconsistent use of the sign for three out of the four participants demonstrated that for these participants the sign was not necessary for the acquisition of the targets in the TC condition. In fact, a within analysis of the eight targets acquired by Carlos in the TC condition show that in the first four targets he used the sign 90.5% of the time and acquired these targets in 9.5 sessions, while he only used the sign 12.25% of the time in the last four targets and acquired these at an average rate of 3.75 sessions.
Furthermore, while Javier used the sign at an average of 91% of the time, he had the highest rate of sessions to acquisition (10.7) of all the participants, a rate that was three sessions higher than his PD condition. Furthermore, Javier’s extensive repertoire of signs made it initially difficult for him to transition well to not using signs in the Prompt Delay condition. In the first few sessions of the PD condition, Javier would produce the sign for the target intraverbal even though he had not been prompted to do so. We then implemented a blocking procedure where we would prompt his hand down on the table and place our hands down on top of them before delivering the $S^D$. We did this in order to ensure that the acquisition of the responses was due to the PD procedure, and so that the sign would not interfere with that. We were able to fade this procedure throughout the study and had him establish stimulus control over the two conditions.

While the repertoire of the participants should be an important part of selecting treatment procedures as they may influence the results, the context in which training occurs should be considered as well. These include taking into account extraneous or unforeseeable variables when interpreting the results. For example, Sebastian attended the clinic three times a week; however, his attendance was not consistent throughout the study, despite addressing it with the parents. This could have also contributed to his lower levels of acquisition in comparison to Carlos who only received three more sessions than him. In the future, only participants who attend the clinic for a minimum of four days should be included in the study. This ensures that in the event of an absence you are still able to get a minimum of three sessions per week. Furthermore, future studies should try to include individuals who on average attend the clinic the same number of days per week, or analyze if there are any differences in the effectiveness of a
procedure if they are implemented with individuals who attend the clinic different number of days per week.

Additionally, issues with the development of the protocols for both procedures could have contributed to the initial slow acquisition of the targets as a result of trial and error sessions while developing new protocol. An initial TC session of all the participants was not implemented correctly as far as the fading procedures. The TC data sheet had not been developed and instead the same data sheet was used for both conditions. This proved to be ineffective and a new data sheet was developed in order to facilitate the data collection in this condition. In addition, the flow chart was developed during the study after having encountered several different scenarios we had not accounted for during the initial write-up of the procedures. This may have affected the data within the sessions because the correct prompting procedures were not implemented during these trials.

However, the study contributed to the literature by creating these specific protocols for recording the implementation of a most-to-least fading procedures and prompt delay procedures. These were very detailed protocols that were created to ensure treatment integrity of the procedures as well as to train therapists. The protocols explained in-depth how the therapist would respond in a myriad of scenarios that could have occurred in both conditions. These protocols were revised throughout the study to ensure the most precise protocols were in place. Previous most-to-least prompting procedures in the literature provided very little details about how these fading procedures were implemented and monitored.

Furthermore, based on the analysis of the data of these participants the argument could be made that the same results could have been achieved without the
implementation of the sign. These findings are an essential contribution to the literature because previous research on the effectiveness of Total Communication had not provided an analysis of the sign. Like this study, past literature required the sign and prompted it only during the training, but the vocal response alone was required for acquisition. The percentage of time the sign occurred simultaneously with the independent vocal had not been reported in TC literature. These data are extremely important, because some of the theories behind the TC research said that the addition of the sign paired with the vocal was the reason for its effectiveness. If the participant did not pair the sign with correct vocal, or emit the sign independently at all then the unanswered question remains, what aspect of TC makes it so effective? Future studies should further analyze this question and replicate these findings taking into consideration the previously stated limitations of the study and other limitations including those dealing with unforeseeable circumstances with each individual participant, environmental factors, changes in the mastery criteria, therapist training, and number of targets acquired, participants, and sessions.

Unforeseeable circumstances with each participant include Marcelo having to leave the study a month earlier than expected which limited the number of targets he acquired and sessions conducted with him. In the future, an exclusion criterion should be put in place for anyone who may be going out of town for an extended period of time. In addition, Sebastian’s motor imitative repertoire should have been further analyzed before including him in the study. Despite having mastered the prerequisite program of motor imitation in the ABLLS-R curriculum, his motor imitative repertoire was lower than all the other participants’. In addition, Javier’s unforeseen problem behavior interfered with his data towards the last couple of weeks of the study and also limited the number of
sessions conducted and targets acquired during this time period. In the future, a full preference assessment should be conducted to identify a myriad of reinforcing items with all participants so that there would not be a limited number of items available. Furthermore, an initial agreement should be made that all changes in teaching procedures and reinforcers used for the participants should not affect the study’s procedures.

An additional limitation of the study concerned environmental factors, such as where the sessions took place. The first few sessions of the study were conducted in the participants’ regular therapy room and proved to be extremely distracting both to the therapist and the participant. A private room was not available in the clinic where the study took place, so the remaining study sessions were conducted in the clinic’s kitchen area. This proved to be extremely difficult to keep people from walking in and out of during the study sessions, despite a sign posted on the door notifying individuals that the study was in session. After meeting with the owner of the clinic, she agreed to notify all the therapists that they could not enter the kitchen area for 15 minutes during the study’s sessions, and that the end time of the 15 would be posted prior to beginning the session. This was very effective at reducing the distractions (people walking in and out, heating up their lunch, etc.); however, we were unable to limit distractions during any session lasting over 15 minutes. As long as the distraction didn’t occur while presenting the $S^D$, most of the time the distractions did not interfere with the therapy, as the therapist would have allowed the participant to take a break during those times. When assessing potential sites for conducting sessions, the principal investigator should strive to acquire a room that offers sufficient time for private sessions.
An additional limitation of the study deals with the protocol for mastering targets in the TC condition which dictated that the participant must emit both a vocal and sign response for a target to be correct. Slow acquisition of the targets in the TC condition, however, yielded a revision of the mastery criterion after a month of data collection. For example, Marcelo had emitted correct vocal responses 100% of the time across two sessions for two targets, but had not emitted the correct sign response consistently and was therefore not mastered out of the targets. It was concluded that the criterion was too stringent as the data were not representative of the increasing acquisition of the functional vocal responses of the participants.

Some of the limitations in therapist training may have affected two sessions of Marcelo and Javier’s trainings. Two therapists were trained for the purposes of collecting inter-observer reliability and were trained on both procedures. After several observations, role-playing, and receiving feedback from the principal investigator, the therapists were provided with an opportunity to conduct a session. The therapists each failed one of the training protocol tests with the participants. However, those sessions should not have been conducted with the participants of the study because the treatment integrity of those sessions was compromised. For all future trainings, a separate child not included in the study was used for protocol testing.

Furthermore, future studies should address the limitation of the study in respects to the number of targets acquired, the number of participants, and total sessions conducted for each participant. Ideally future studies should include more participants utilizing a multiple baseline design in order to analyze the data between the subjects, carry out additional sessions so the number of targets acquired is greater, and conduct a
larger number of sessions to evaluate whether that would show a differentiation in the
data paths of the conditions.

Overall, the study was significant because of its contributions to literature.

Protocols for evaluating treatment fidelity with most-to-least fading procedures and
prompt-delay procedures, as well as the analysis of the sign paired with a vocal in the TC
condition, are two examples. Both procedures were effective at increasing vocal
intraverbals in all four participants with similar acquisition rates and session lengths. In
the future, when selecting a method to use for intraverbal training the therapist should
look at the optimal individual characteristics for each procedure as described in this
study.
Figure 1a.- The percent correct out of three trials for each target probed in the pretest for Marcelo (0%, 33%, or 100%).

Figure 1b.- The percent correct out of three trials for each target probed in the pretest for Sebastian (0%, 33%, or 100%).
Figure 1c. The percent correct out of three trials for each target probed in the pretest for Javier (0%, 33%, or 100%).

Figure 1d. The percent correct out of three trials for each target probed in the pretest for Carlos (0%, 33%, or 100%).
Figure 2a. The percentage of trials correct per session in the TC condition for the first and last targets acquired for Marcelo. Includes the number of trials to acquisition including the initial cold probe, mastery probe, and the percentage of time the sign occurred with the vocal (lighter data series).

Figure 2b: The percentage of trials correct per session in the TC condition for the first and last targets acquired for Sebastian. Includes the number of trials to acquisition including the initial cold probe, mastery probe, and the percentage of time the sign occurred with the vocal (lighter data series).
Figure 2c: The percentage of trials correct per session in the TC condition for the first and last targets acquired for Javier. Includes the number of trials to acquisition including the initial cold probe, mastery probe, and the percentage of time the sign occurred with the vocal (lighter data series).

Figure 2d. The percentage of trials correct per session in the TC condition for the first and last targets acquired for Carlos. Includes the number of trials to acquisition including the initial cold probe, mastery probe, and the percentage of time the sign occurred with the vocal (lighter data series).
Figure 3: The percentage of trials correct per session in the PD condition for the first targets acquired for each participant. Includes the number of trials to acquisition, the initial cold probe, and mastery probe.
Figure 4a. An alternating treatments design shows the cumulative number of intraverbals mastered across sessions with Total Communication and Prompt Delay for each participant.
Figure 4b. An alternating treatments design shows the cumulative number of intraverbals mastered across sessions with Total Communication and Prompt Delay for Carlos.
Table 1: The comparison of the sessions to acquisition in both conditions for each participant along with the standard deviation for each. Also includes the analysis of the percentage of times the sign accompanied a correct vocal response.

<table>
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<tr>
<th></th>
<th>Sessions to Acquisition:</th>
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<th>Sign</th>
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<td>PD</td>
<td>TC</td>
</tr>
<tr>
<td>Sebastian</td>
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</tr>
<tr>
<td>Marcelo</td>
<td>9.5</td>
<td>6.75</td>
<td>3.7</td>
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<tr>
<td>Javier</td>
<td>10.7</td>
<td>8</td>
<td>2.1</td>
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<td>Carlos</td>
<td>6.2</td>
<td>5.1</td>
<td>3.4</td>
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</tbody>
</table>
References


doi:10.1901/jaba.1968.1-91

doi:10.1007/BF02408430


doi:10.1007/BF01539630


## Appendix A: PD Percentage Correct Data Sheet

<table>
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<tr>
<th>Skill</th>
<th>Date</th>
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<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>% correct</th>
<th>% Yes/No</th>
<th>Probe Yes/No</th>
</tr>
</thead>
<tbody>
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<td>4</td>
<td>5</td>
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<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>% correct</td>
<td>% Yes/No</td>
<td>Probe Yes/No</td>
</tr>
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### Appendix B: TC Percentage Correct/ Probe Data Sheet

<table>
<thead>
<tr>
<th>Total Communication: Percentage Correct/ Probe Data Sheet</th>
<th>Participant Name: ANNABELLA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skill</td>
<td>Date / Initials</td>
</tr>
<tr>
<td>-------</td>
<td>----------------</td>
</tr>
<tr>
<td>Dog - cat</td>
<td>FF</td>
</tr>
<tr>
<td></td>
<td>PP</td>
</tr>
<tr>
<td></td>
<td>M</td>
</tr>
<tr>
<td></td>
<td>PD</td>
</tr>
<tr>
<td></td>
<td>Ind</td>
</tr>
<tr>
<td>Chair - table</td>
<td>FF</td>
</tr>
<tr>
<td></td>
<td>PP</td>
</tr>
<tr>
<td></td>
<td>M</td>
</tr>
<tr>
<td></td>
<td>PD</td>
</tr>
<tr>
<td></td>
<td>Ind</td>
</tr>
<tr>
<td>Cow - horse</td>
<td>FP</td>
</tr>
<tr>
<td></td>
<td>PP</td>
</tr>
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<td>Ind</td>
</tr>
</tbody>
</table>

Additional target Probe: 

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
</table>

56
## Appendix C: Treatment Integrity Form/Training Protocol

Therapist: __________

Client: __________

Date of Review: ______________

Time of Review: ______________

### Environment

<table>
<thead>
<tr>
<th>Question</th>
<th>Y</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are the program materials organized and ready?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is the environment free from distractions?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are the reinforcers easily accessible?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Preference Assessment

<table>
<thead>
<tr>
<th>Question</th>
<th>Y</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appropriate preference assessment was conducted.</td>
<td></td>
<td></td>
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### Task

<table>
<thead>
<tr>
<th>Task</th>
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<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are materials for the task ready?</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
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</tr>
<tr>
<td>Are the tasks mixed and varied between verbal operants?</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Are there 80% mastered tasks mixed with 20% acquisition tasks (4:1)?</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
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### Instruction (S<sup>D</sup>)

<table>
<thead>
<tr>
<th>Instruction</th>
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<th>3</th>
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<th>7</th>
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<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>States appropriate S&lt;sup&gt;D&lt;/sup&gt;.</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>S&lt;sup&gt;D&lt;/sup&gt; was presented only 1 time before either a response or correction procedure.</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>There was only a 2-5 second delay between the S&lt;sup&gt;D&lt;/sup&gt; and response or correction procedure. (Depending on Condition)</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
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<td>Y</td>
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<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
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<tr>
<td>-----------------------------------------------------------------------</td>
<td>---</td>
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<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>----</td>
</tr>
<tr>
<td>The time between each trial was no more than 3 seconds</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
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<td>Y</td>
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<td>7</td>
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<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Corrective procedures were implemented correctly according to prompt fading guidelines (Most-to-least Hierarchy Criteria for TC).</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
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<tr>
<td>Correct fading rules implemented for Most-to-least prompts (2 consecutive trials at a particular level).</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
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<td>Y</td>
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<tr>
<td>Correct transfer trials were used following error correction procedures (immediately represent $S^D$ and remove prompt).</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
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<td>Y</td>
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</tr>
<tr>
<td>Reinforcement was provided immediately for independent, correct responding.</td>
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<td>Y</td>
<td>Y</td>
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<td>Y</td>
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<tr>
<td>Reinforcement was provided appropriately using differential reinforcement.</td>
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<td>9</td>
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</tr>
<tr>
<td>Correctly implements escape extinction.</td>
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<td>Y</td>
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<td>Y</td>
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</tr>
<tr>
<td>Appropriate trial by trial data were collected.</td>
<td>Y</td>
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<td>Y</td>
<td>Y</td>
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<td>Y</td>
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</table>

TC- Number Correct/ Total (144): ___________________

PD- Number Correct/ Total (124): ___________________

Comments:________________________________________________________________________

________________________________________________________________________
### Appendix D: Sample ABLLS-R Programs

#### H6- Intraverbal fill-in Mastery Sheet

<table>
<thead>
<tr>
<th>Sd</th>
<th>Response</th>
<th>Date Introduced</th>
<th>Date Mastered</th>
</tr>
</thead>
<tbody>
<tr>
<td>We wash our</td>
<td>hands</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sit in the</td>
<td>chair</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Put on our</td>
<td>shoes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Close the</td>
<td>door</td>
<td></td>
<td></td>
</tr>
<tr>
<td>We watch a</td>
<td>movie</td>
<td></td>
<td></td>
</tr>
<tr>
<td>We turn on a</td>
<td>light</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lets go play</td>
<td>outside</td>
<td></td>
<td></td>
</tr>
<tr>
<td>We ride our</td>
<td>bike</td>
<td></td>
<td></td>
</tr>
<tr>
<td>We paint on the</td>
<td>Paper</td>
<td></td>
<td></td>
</tr>
<tr>
<td>We cut</td>
<td>paper</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lets press</td>
<td>play</td>
<td></td>
<td></td>
</tr>
<tr>
<td>We eat our</td>
<td>food</td>
<td></td>
<td></td>
</tr>
<tr>
<td>We drink our</td>
<td>juice</td>
<td></td>
<td></td>
</tr>
<tr>
<td>We roll the</td>
<td>Ball/car</td>
<td></td>
<td></td>
</tr>
<tr>
<td>We stack the</td>
<td>blocks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>We talk on the</td>
<td>phone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>We play the</td>
<td>game</td>
<td></td>
<td></td>
</tr>
<tr>
<td>We take out the</td>
<td>trash</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sd</td>
<td>Response</td>
<td>Date Introduced</td>
<td>Date Mastered</td>
</tr>
<tr>
<td>----------</td>
<td>-------------------------</td>
<td>-----------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Red</td>
<td>Green, blue, yellow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Green</td>
<td>Red, blue, yellow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blue</td>
<td>Yellow, green, red</td>
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<td></td>
</tr>
<tr>
<td>Yellow</td>
<td>Red, green, blue</td>
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<td></td>
</tr>
<tr>
<td>Circle</td>
<td>Square, triangle, rectangle</td>
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<td></td>
</tr>
<tr>
<td>Square</td>
<td>Circle, triangle, rectangle</td>
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</tr>
<tr>
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<td>Cat</td>
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</tr>
<tr>
<td>Cat</td>
<td>Dog, mouse</td>
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<td></td>
</tr>
<tr>
<td>Horse</td>
<td>pig, cow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cow</td>
<td>pig, horse</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shirt</td>
<td>Shorts, pants, shoes</td>
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<td></td>
</tr>
<tr>
<td>Pants</td>
<td>Shirt, shorts, shoes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shorts</td>
<td>Shirt, pants, shoes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shoes</td>
<td>Shirt, pants, shorts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apple</td>
<td>Banana, orange, grapes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orange</td>
<td>Apple, banana, grapes</td>
<td></td>
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</tr>
</tbody>
</table>
Appendix E: PD Procedures Flow Chart

Present SD and initiate 5 second prompt delay

- Correct: Deliver Reinforcer immediately!
- Incorrect: Re-present SD along w/ the correct response (1st)

Re-present SD along w/ the correct response (1st)

- Correct: Praise and immediately re-present the SD (allow 5s to respond) 1st Transfer Trial
- Incorrect: Re-present the SD along with the correct response (2nd)

Re-present the SD along with the correct response (2nd)

- Correct: Praise and immediately re-present the SD (allow 5s to respond) 2nd Transfer Trial
- Incorrect: Re-present the SD along with the correct response (3rd)

Re-present the SD along with the correct response (3rd)

- Correct: Deliver smaller amount of Reinforcer immediately!
- Incorrect: Trial over. Present an easy mastered demand and then deliver the reinforcer immediately!

Deliver smaller amount of Reinforcer immediately!
Appendix F: IRB Approval Form

April 19, 2012

Rosana Pesantez
ABA-Applied Behavior Analysis

RE: Expedited Approval for Initial Review
IRB#: Pro00007854
Title: Comparing Prompt Delay and Total Communication for Training Vocal Intraverbals in Children with Autism

Dear Rosana Pesantez:

On 4/18/2012 the Institutional Review Board (IRB) reviewed and APPROVED the above referenced protocol. Please note that your approval for this study will expire on 4/18/2013.

Approved Items:
Protocol Document(s):

Total Communication vs. Prompt Delay 4/13/2012 3:17 PM 0.03
This study involving data pertaining to children falls under 45 CFR 46.404 – Research not involving greater than minimal risk

Consent/Assent Documents:

Name Modified Version
Consent Forms.pdf 4/19/2012 11:25 AM 0.01

Please note, the informed consent/assent documents are valid during the period indicated by the official, IRB-Approval stamp located on the form—which can be found under the Attachment Tab. Valid consent must be documented on a copy of the most recently IRB-approved consent form.
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 45 CFR 46.110 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 Schinka, PhD, Chairperson
USF Institutional Review Board

Cc: Various Menzel, CCRP
    USF IRB Professional Staff