The Effect of Manual Sign Mand Training and Prompt Delay on the Acquisition of Vocal-Verbal Behavior by a Two-Year-Old with PDD-NOS

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Abstract

Vocal verbal responding of a participant with PDD-NOS was targeted for improvement. A multiple baseline across signs format was utilized to compare vocal verbal behavior acquisition for each sign mand that was trained. Prompt delay procedures with a vocal prompt were introduced once manual sign mastery criteria were achieved. The prompt delay and vocal prompt procedure was successful at increasing overall vocal responding for this individual. Generalization effects of the vocal verbal behavior training procedure are also discussed.

*Keywords:* Vocal Verbal Behavior, Prompt Delay, Vocal Prompt
The Effect of Manual Sign Mand Training and Prompt Delay on the Acquisition of Vocal-Verbal Behavior by a Two-Year-Old with PDD-NOS

Individuals with developmental disabilities often have difficulty forming a functional verbal behavior repertoire. Verbal behavior is any form of language that is used to communicate. For infants, initial verbal behavior is usually in the form of crying. As an individual ages from 1-3 years-old, vocal verbal behavior (speech) should begin to develop. However, vocal verbal behavior deficits are common in children with developmental disabilities (American Psychiatric Association, 2000). When considering the diagnosis of autism spectrum disorders, approximately 50% of children diagnosed will remain functionally mute in adulthood (Peeters & Gillberg, 1999). Even with the extra attention of early intervention and speech instruction, children may continue to fail to acquire useful speech (Lovaas, 1987).

If there is not significant development of vocal verbal behavior, an individual will begin to utilize aberrant verbal behaviors in its stead. These aberrant forms of communication can have varied topographies, such as self-injurious behavior, tantrums, dropping to the ground (flopping), and aggression (hitting, kicking, biting, etc.), to name a few. In addition to further hampering vocal verbal behavior development, these aberrant behaviors can interfere with academics, the development of appropriate social responses, and overall quality of life. Therefore, providing a developmentally disabled child with the best vocal verbal behavior training technology available should be a top priority.
Early research by Carr and Durand (1985) showed that functional communication training (FCT) could be used to directly target the reduction of problem behavior in older individuals without speech. By teaching their participants to evoke attention and/or assistance when needed through the differential reinforcement of FCT, the experimenters saw a reduction in problem behavior (SIB, aggression, and tantrum) over time. They concluded that this supported their hypothesis that problem behavior was simply a maladaptive form of communication. This was an important early study showing the importance of functional communication as a replacement behavior for maladaptive communication. It may be that individuals learn that FCT is more efficient than tantrums, SIB, or aggression to achieve the same consequences. Therefore, FCT could be considered a functionally equivalent replacement behavior.

Durand and Carr (1991) then conducted another study that further investigated the effects of FCT. They used FCT with three children that displayed attention and escape maintained self-injurious behavior that occurred during academics. Much like the previous study, they taught the students how to evoke attention and how to ask for help. The authors successfully used a prompt fading and time delay procedure to increase the independence of assistance and attention-seeking responses while ignoring and blocking any challenging behavior that occurred. The authors saw a reduction in behavior, generalization to other academic tasks, classrooms, and teachers. They showed that the affects of FCT training remained stable for 18-24 months following completion of the training. This study is important because it shows that FCT can be generalized outside of the confines of an experiment. It is of
the utmost importance that if an individual learns FCT as a replacement for aberrant behaviors, then this success transfers to parents in-home as well.

Like any form of behavior, verbal behavior can be broken down into a three term contingency; that is, antecedent (environmental stimuli), behavior (response form), and consequence (reinforcement, extinction, or punishment). In the behavior analysis model, language is divided into four functional categories referred to as verbal operants. These four verbal operants are as follows: mand (requesting), echoic (vocal or manual sign imitation), tact (labeling), and intraverbal (answering “Wh” questions). As in the Carr and Durrand studies (1985 and 1991), the mand should be the first operant targeted for training.

There are several reasons that the mand should be the initial operant selected for training. It has been shown that manding reduces problem behavior (Durand & Carr, 1991, increases social initiations (Sundberg & Sundberg, 1990), and increases overall communication attempts (Carbone, 2010; Koegel et al., 1998). Most recently, Plavnic and Ferreri (2012) showed that not only can mand training reduce the frequency of problem behaviors, but it can also increase the rate of appropriate non-targeted behaviors, such as orientation to a speaker and compliance with directions. The fact that the mand is the only verbal response that directly benefits the speaker may increase its functional value to the learner, which may lead to quicker acquisition than if tacting was the first targeted operant.

As previously stated, despite early intervention and speech therapy, many developmentally disabled individuals will continue to remain mute. Therefore, more successful and efficient technology must be researched and used as intervention.
Also, while vocal verbal behavior is targeted for improvement, an alternate form of functional communication must be taught for the quality of life benefit to the child. There are several forms of alternative communication investigated in the published literature that can be considered when a clinician is deciding which communication package is most applicable for their client. The two most commonly researched are the Picture Exchange Communication System (PECS) and manual sign language.

In 2004, Matt Tincani compared the effects of PECS and manual sign language training on the acquisition of mands for students with Autism Spectrum Disorder. The training procedure used progressive time delay to increase independent manding. This study showed that for one participant, sign language training produced a higher percentage of independent mands. PECS produced a higher percentage of vocalizations for the other. The participant acquired more responses with signing also correctly imitated twice as many motor imitations than the other prior to intervention. Both participants experienced a higher percentage of vocalizations during training when compared to baseline. The authors concluded that acquisition of PECS and sign language may vary as a function of individual student characteristics. However, they noted that the presence or absence of motor imitations skills would directly affect the ability of a student to acquire manual sign manding skills. Therefore, testing should be conducted to determine an individual's motor imitations skills prior to the initiation of sign training. They also stated that further research is needed to determine the optimal training procedures for both PECS and manual sign manding.
Adkins and Axelrod (2001) published the first study designed to directly compare the success of PECS and sign language. They compared sign language and PECS training for a child with pervasive developmental disorder. The participant required fewer trials to reach mastery criterion and more generalized responses in the PECS condition. However, there were several limitations of the study that should be considered. The experimenters did not utilize systematic procedures for selecting preferred items and failed to control for history of exposure to sign and PECS prior to the study.

In 2006, Tincani et al. published an investigation for a training procedure using the PECS technology. They again showed that the training of PECS increased the manding frequency of two individuals with developmental disabilities. With a third individual, they introduced differential reinforcement with a 3-5 second delay of reinforcement following a correct mand. They demonstrated that the addition of this reinforcement delay was more effective at increasing vocal response rate than simply reinforcing correct mands immediately.

As Tincani (2004) concluded, while PECS has proved to be an effective technology, it may not be the most efficient for some individuals. There is sufficient empirical support to conclude that sign language can be an effective form of communication as well. There are several reports that conclude that the use of manual sign manding will produce a functional communication repertoire (Millar, Light, & Schlosser, 2006, Schlosser & Wendt, 2008a). Sundberg and Sundberg (1990) and Wraikat et al. (1991) found better response acquisition with sign language training when compared to PECS. However, it should be noted that they selected
participants that demonstrated the manual dexterity that allowed for correct sign formation. Schlosser & Wendt (2008a), in a review of all published research on the topic, concluded that the research on manual sign for children with autism show strong intervention effectiveness scores for symbol acquisition and production, speech comprehension and speech production. These results suggest that the use of manual signing is a very effective communication option for children with autism.

Schlosser and Wendt (2008b) conducted another systematic review of the literature to directly focus on studies utilizing alternative communication to improve speech production. Of the nine studies, five were PECS studies (two demonstrated an increase in vocal production) and only one focused on the use of manual sign (which showed an increase in vocal production). This review revealed that manual sign is a promising modality in vocal production training, although it has yet to be researched extensively.

One argument for the utilization of manual sign versus PECS is the consideration of the concept of response effort. When an individual uses a PECS book, there are several individual responses that must occur. If a PECS user wants water, he must conduct a series of responses to achieve the consequence of getting water: locate his PECS book, open the book, turn to the correct page, locate the corresponding water icon on the page, remove the icon from the page, exchange that icon with the listener. In comparison, manual sign is much more comparable to the response effort a speaker produces when saying “water”, as all a signer must do is manually sign “water”. The higher response effort of PECS brings it closer to the response effort of the aberrant behaviors it was designed to abolish.
Another drawback of PECS design is its overall complexity in that it is a communication system located outside of the human body. The PECS book must be constructed by a trained individual and consists of many parts: book, laminated pages, Velcro strips, laminated icons, and a separate sentence strip. The experiments that are published are controlled studies with an abundance of supervision in the teaching environment. The reality is that it can be inefficient to moderate the PECS system. Whether trying to graduate the student appropriately through the phases at the correct time or simply making copies of icons when they are lost or damaged, ripped, or even ingested. It can be time consuming for caregivers and teachers alike. Worst case scenario, a student that only functionally communicates with a PECS books loses his book, or destroys it: he will be effectively without a way to communicate until that book is replaced.

Carbone et al. (2010) conducted a study to replicate previous findings related to prompt delay (Tincani, 2006), but using manual sign language instead of PECS. They conducted the study with three participants: Tony (age 4), Ralph (age 4), and Nick (age 6). Tony had a diagnosis of autism and was able to mand for 15 items using manual sign. Ralph had a diagnosis of Down Syndrome and was able to mand for 10 items using manual sign. Nick had a diagnosis of autism and a weak manual sign repertoire, needing partial or full physical prompting to sign. They conducted the study in the students’ classrooms in a private and publicly funded school serving children with developmental disabilities.

The study targeted the training of six sign mands each to then be utilized for the prompt delay and vocal prompting procedure. The experimenters conducted 2
sessions per day with 50 trials of the six items (toys, edibles, movies) presented in a random rotation. They selected the items used based on observed motivation. Throughout each session, they recorded the following: occurrence of aberrant behaviors, the prompt level for sign, prompted or unprompted vocal responses, and the phonetic transcription of each vocal response. Following a correct sign mand, the prompt delay utilized was a length of five seconds. If the participant emitted any vocal response during those five seconds, then the reinforcer was immediately delivered. If there was no vocal response, then a vocal prompt (“name of item”) was delivered. If there was no vocal response in the next two seconds, then another vocal prompt was delivered. If there was still no vocal response after the third vocal prompt, then the reinforcer was still delivered to avoid extinction of correct sign manding.

This study was able to replicate previous findings showing that prompt delay and vocal prompting procedure increased unprompted vocal responses in two out of the three participants. Nick did not emit any unprompted vocal responses. However, this participant did not have any independent manding skills prior to the start of the study. He was able to increase his frequency of prompted vocal responses over time. If the data collection period of the study was extended, then Nick may have continued to make progress toward unprompted vocal responding. The authors noted that by recording the phonetic transcription of each vocal response, operant shaping toward the adult word from of each word could be conducted in future training. This study also demonstrated that manual sign can be used as a functional form of communication during vocal response training.
While the results of the Carbone et al. (2010) study were positive, the procedures used were conducted with individuals four and six years-old. The participants also had significant sign manding experience and possible experience with discreet trial training. The purpose of the current study was to increase the vocal verbal behavior of a 2 year-old with PDD-NOS utilizing manual sign manding with prompt delay and vocal prompt methods as described by Carbone et al. (2010).

Method

Participant, Setting, and Data Collection

The participant of the study was a 2 year-old male diagnosed with autism. He received in-home ABA services six days per week for a total of 38 hours. At intake, the participant (Drew) had no observable functional communication. He exhibited babbling and verbalized infrequent and non-contextual “Nooo” and was not observed to use any other approximated, partial, or adult word forms. Drew’s parents reported that he used to say some words, but regressed and lost all previously achieved vocal verbal responses. Drew was not known to have any other genetic or medical conditions and no known sensory impairments. However, he had a varied behavioral history that included: tantrums, self-injurious behavior (head-to-floor hitting), and flopping.

For this study, tantrum behavior was operationally defined as follows: crying/yelling with or without tears for more than five seconds. An episode ended with one minute of non-occurrence. Self-injurious behavior (SIB) was defined as any instance of his head making contact with the floor and producing an audible sound. Flopping was defined as any drop to the ground without permission and any drop
from a standing position while inappropriately standing on a chair. Throughout the study, instances of these challenging maladaptive behaviors were recorded and resulted in the termination of the session (after following the protocol in his behavioral treatment plan). Per his behavior support plan, tantrum, SIB, and flopping were treated as escape maintained behavior. Therefore, antecedent conditions were maintained until compliance and non-occurrence of the challenging behavior occurred.

Data were collected in a home setting over a period of several weeks. Sessions were conducted in a bedroom approximately 10 by 12 feet, located on the second floor. The room contained a small table, chairs, a bed, dresser, two windows, designated materials for each session, and various children’s toys. While the bedroom contained a number of toys not utilized in the experiment, they were put away, out of reach, and out of line of sight of the child before each session began.

The stimuli selected for the study were done so by utilizing a previously established reinforcer and multiple stimulus without replacement preference assessments. Several assessments were conducted to determine preferred stimuli that did not start with the same letter (i.e. bear, ball, book) so as not to confound or limit the results of vocal-verbal behavior training. A movie on the play setting (any hypothesized preferred video played on a portable electronic device) was included as it was a previously established reinforcer and selected by the client’s clinicians as the first mand to be trained (due to a high level of observed declared motivation: reaching, grabbing, and attending). The other stimuli selected were as follows: “Play-doh” (pliable non-toxic dough that is presented in a small container),
“crocodile” (a crocodile shaped toy with a hole at the mouth designed to be squeezed to eject a small plastic ball), and “Ernie” (an electronic device that can be manipulated to show pictures, letters, and provide matching audio and songs).

The dependent variables measured in the study were the occurrence of prompted and unprompted manding, both through modified sign and vocal-verbal behavior. Data were collected using a trial-by-trial collection method numbered on a sheet of paper developed by the staff of the Carbone Clinic (Valley Cottage, NY). The stimuli of each trial was recorded, as well as the necessary prompt level for manding and any vocal-verbal response that was emitted in conjunction with, or as, the mand response. The prompt levels for sign manding were as follows: independent (Ind), full physical (fp), partial physical (pp), and gestural prompt (gp). A “fp” was recorded any time the therapist needed to completely manipulate Drew’s hands to form the correct sign. A “pp” was recorded any time the therapist needed to slightly manipulate Drew’s hands to form the correct sign, even if just a touch cue of his hands. A “gp” was recorded any time the therapist only needed to provide a model of the sign to evoke the correct sign response. Any vocal-verbal responses emitted during the instance of the mand were transcribed phonetically. A “v” was recorded during vocal-verbal response training if a vocal model prompt was utilized to achieve a vocal response from the participant.

Interobserver agreement (IOA) was assessed by having a second observer simultaneously, but independently, record data with the first observer. IOA was conducted for the experiment using the trial-by-trial method for the consideration of all intervals it was collected. IOA was conducted for 5.6% of sessions and found to
be 100% for signing and 92.31% for the occurrence of vocal-verbal behavior. This was calculated by dividing the number of agreement trials by the total number of trials and multiplying by 100%.

Procedure

Pre-experimental Treatment. Prior to the initiation of the study, Drew had received therapy per his treatment plan for home ABA services. Amid other programming, he was initially being taught 8 signs concurrently: “movie”, “bear”, “book”, “juice”, “ball”, “car”, and “jump”. Due to lack of significant progress, training was reduced to focusing singly on the sign “movie.” The movie was chosen as his primary mand to be trained due to the stimuli’s observed declared motivation and its ease of use as a reinforcer for other programming.

Sign training was conducted utilizing an informal prompt hierarchy of independent (Ind), partial physical (Pp) and full physical (Fp) prompting. An Ind sign was any correct sign that Drew produced to mand for the desired item. A Pp was any prompting given to Drew that was less intrusive than a full physical prompt, which could be moving part of the hand or a simple touch prompt. A full physical prompt was recorded anytime the therapist completely manipulated Drew’s hands to form the correct sign. Data was collected during naturalistic environmental training sessions where Drew declared motivation for an item and the therapist initiated the prompt hierarchy. When Drew manded for an item, the therapist presented it to him. If Drew did not comply with prompting, then the item became temporarily unavailable. Data was collected in this fashion for a total of 118 sessions. Sessions
took place approximately 6 days per week 1-2 times per day over a period of 3.0-4.5 hours each.

**Structured Trial Presentation.** A structured trial presentation design was first conducted that systematically replicated the procedures described by Carbone et al. (2010). During each session, Drew was seated at a table in the upstairs bedroom, or on a child’s armchair (a seemingly more comfortable chair elevated only slightly above the floor). A multiple baseline across signs design was employed to allow demonstration of experimental control.

“Movie” was the first stimuli introduced for training. This stimulus was a hypothesized preferred movie depicted on a portable DVD player, which was placed on the paused setting. The “movie” was presented in a randomized order with the three other stimuli throughout a 60-trial session. Each time “movie” was presented, the DVD player was moved into the participant’s view at approximately eye level. If there was no declared motivation within five seconds, then the item was withdrawn and the next item was presented. The three other stimuli (“Play-doh”, “crocodile”, and “Ernie”) were also presented, but Drew was not prompted for the appropriate sign, allowing baseline data to be collected. If Drew did not emit the appropriate adult word-form or correctly sign for the item, then the item was removed despite declared motivation. In accordance with the multiple baseline across signs design, each of the three additional signs were introduced in a staggered format, in this case, after 3, 4, and then 5 sessions, respectively.

During sign acquisition training, when Drew declared motivation for an item without displaying the correct sign, the prompt hierarchy was utilized. In a manner
slightly different from that of the pre-training procedure, this prompt hierarchy consisted of the following: independent (Ind), gestural prompt (Gp), partial physical prompt (Pp), and full physical prompt (Fp). The gestural prompt, like that used by Carbone et al. (2010) procedure, was a therapist provided model of the correct sign. This prompt offered the least intrusion, but still resulted in production of the correct sign mand from Drew. Therefore, it was the first prompt of the hierarchy.

The prompt hierarchy was utilized in conjunction with a prompt fading procedure. This procedure, a systematic replication of the Carbone et al. (2010) procedure, was designed to transfer stimulus control of Drew’s manding from the therapists prompt to the presence of the desired item. If motivation for the item is displayed and Drew did not emit the correct sign within five seconds, then the prompt sequence was initiated (from Gp, Pp, to FP). The least intrusive prompt necessary to elicit the correct sign from Drew was recorded. Prompted or independent correct signs were paired with the therapist stating the corresponding “name of item” out loud. Any vocal verbal behavior exhibited by Drew at the instance of manding was phonetically recorded for analysis.

Following a prompted or unprompted correct sign trial, the item was immediately presented to Drew for a thirty seconds or until he terminated the period. If Drew signed or declared motivation for an item other than what was offered in the randomized presentation, then the item was removed and the therapist displayed the next item in the rotation. If Drew made a vocal response without the manual sign, then the therapist did not deliver reinforcement and initiated the prompt sequence for manual sign.
The criterion for mastery of a sign was 100% independent signing for 5 consecutive sessions. Once mastery of an individual sign was achieved, the sign then received vocal-verbal behavior training (V-VBT) while the other signs remained in acquisition. Trial presentation occurred in the same structured fashion, while the prompting method changed as described. V-VBT occurred each time Drew signed for an item. Instead of delivering the item upon correct signing, a prompt delay with vocal prompt procedure was initiated. The prompt delay lasted for five seconds or until Drew emitted the appropriate corresponding adult word form or an approximated vocal response.

An approximated vocal response included any utterance containing the first sound/letter of the adult word form, second syllable of the adult word form, or a combination of both. Some examples of these approximations are: “mah” for movie, “pah-peh” for play-doh, “cah” for crocodile, and “er” for Ernie. When one of these vocal responses was emitted, the corresponding item was immediately delivered for the reinforcement period. If Drew did not emit one of these vocal responses, the therapist then said out loud the “name of the item” and waited for two seconds for a vocal-verbal response. If Drew made a satisfactory vocal response, the therapist delivered the item. If there was still no vocal response, then the above vocal prompt procedure was presented an additional two more times. If there was still no vocal response after the third vocal prompt, then the item was delivered for the reinforcement period (to avoid extinction of the manual sign mand).

*Naturalistic Environment Teaching.* Following the unsuccessful results of the structured trial presentation procedure, modifications were made to attempt to
increase efficacy. The prompt hierarchy, prompt fading procedure, criterion for mastery, and V-VBT procedure were identical to that of the structured trial method. The changes implemented for the Naturalistic Environment Teaching (NET) were imbedded in the general procedure. Instead of a randomized presentation of the four items for manual sign training, Drew chose the item for each trial. Sessions were conducted while he was seated at the table.

The four target items were placed on the table-top to demonstrate to Drew that they were available. Drew could then choose which item with which to interact. After Drew indicated his selection, the therapist temporarily blocked access to the chosen item and initiated the prompting hierarchy or V-VBT prompt delay with vocal prompt. Following a prompted or independent correct mand, Drew retained access to the manded item for the thirty seconds. However, he could then choose to mand for the same item in consecutive trials. During each reinforcement period, the therapist manipulated unselected items to encourage non-consecutive choices. Sessions were terminated when Drew moved more than three feet from his chair for more than thirty seconds (in the absence of aberrant behaviors).

Results

The results of the pre-experimental teaching are depicted in Figure 1. The data show slow progress towards independent signing during the first 43 sessions where “movie” was trained concurrently with 6 other signs. When the “movie” sign was trained in isolation, the rate of acquisition improved. Drew began signing for “movie” independently at a low percentage after 13 sessions. However, he did not achieve the criterion for mastery despite the fact that his independent signing
fluctuated between 59% and 100% for 34 sessions. A decreasing trend in percent independence then followed as motor imitation, with models such as clapping and tapping the table, was introduced. This suggested that Drew did not discriminate between the stimuli and a new teaching procedure was needed to improve teaching efficacy.

The results of the Structured Trial presentation procedure are depicted in Figures 2-5. Figure 2 shows that while Drew’s independent signing increased in the second session, he did not maintain that level of performance and independent signing declined to 0% of opportunities. Figure 3 shows that the number of “movie” trials with declared motivation teaching opportunities for the sign “movie” was consistently low. Figure 3 also shows that the number of possible teaching opportunities for “movie” decreased across sessions and stabilized at 0 for three consecutive sessions (sessions 5-7). Figure 4 shows that the total number of trials with declared motivation (all four items) and the overall number of presented trials decreased across sessions and stabilized at 0 for sessions 5-7. Figure 5 displays the frequency and/or duration of aberrant behaviors that occurred during each session. The averages of these behaviors across the 7 sessions are as follows: tantrum frequency of 2.43, tantrum duration of 25.02 min., flopping frequency of 33.29, SIB frequency of 1.71. Sessions 5-7 are shown to have an increasing trend in both the frequency and duration of tantrum behavior.

The results of the Naturalistic Environment Teaching are graphed in Figures 6-9. Figure 6 shows experimental control utilizing a multiple baseline across signs design. Drew began signing for “movie” with 100% independence beginning in
Session 9 and continued through Session 18. He mastered the “movie” sign in Session 13 and entered V-VBT for the remaining sessions. Drew signed for “play-doh” with 100% independence beginning in Session 15 (12 sessions of teaching). Drew was one session of 100% independence away from meeting mastery criterion when data collection terminated. Signing for “play-doh” had a 65.65% ratio of gestural prompts prior to reaching 100% independence, whereas “movie” had a Gp ratio of only 24.92% on average. “Crocodile” and “Ernie” were not manded for at all independently. Both signs required Fp prompting for all teaching opportunities. Figure 7 shows the discrepancy in number of teaching opportunities per item each session that were determined by Drew’s declared motivation. The average opportunities per session for each sign are as follows: 15.94 for “movie”, 10.39 for “play-doh”, 2.5 for “crocodile”, and 1.11 for “Ernie.” Figure 8 depicts the occurrence rates of aberrant behaviors during NET sessions. As the figure shows, there were 0 instances of tantrum behavior, flopping, and SIB throughout all 18 sessions.

Data for all vocal-verbal behavior and V-VBT are depicted in Figure 9. It shows that only “movie” reached mastery for the manual sign and entered into V-VBT prior to data collection conclusion. Once V-VBT was introduced, the percent of trials with vocal-verbal behavior increased to 100% for the next 5 consecutive sessions. The percent of trials with approximated target vocal-verbal behavior increased over the first 3 trials of V-VBT to 42.9%, but then decreased to 23.1% over the final two sessions. Without direct V-VBT, signing for “play-doh” during the final 5 trials (when “movie” was in V-VBT) increased in both percent of trials with vocal-verbal behavior and percent of trials with a response approximating the adult word
form. Percent of trials with an approximation reached 100% for the final 3 consecutive sessions. “Play-doh” shows a more rapid increase in percent of approximation than “movie.” “Crocodile” and “Ernie” signing opportunities also have a high percentage of approximated vocal verbal behavior (62.43% and 28.58%, respectively).

Discussion

The findings of this study support previous conclusions that the utilization of a prompt-delay with verbal prompt procedure can increase the VVB of a developmentally delayed individual. This study also supports using manual sign as the alternative form of functional communication when paired with the prompt delay and verbal prompt procedure. Although the systematic replication of the Carbone et al. (2010) study was unsuccessful, small procedural changes made to the studied procedure individualized it and made it successful for this learner.

Although the Carbone et al. (2010) ST method had shown success, the participant of this study had several inherent differences from their participants that may have affected the procedure’s success. One of these differences was that Drew was only 2 years-old during this investigation, whereas the Carbone et al. participants were 4-6 years of age. This meant that they had a more substantial learning history that could have affected acquisition. It also may have been that the Carbone et al. participants had more experience with discrete trial learning (i.e. sitting at a table and given consecutive demands), than Drew who had minimal experience. Unlike the participants in the Carbone et al. study, Drew had weak motor imitation skills and little experience with manual sign. Drew’s manding repertoire more closely
resembled the previous study’s third participant (Nick) who made the least progress of the other four participants (as discussed above). Drew’s aberrant behaviors that occurred during ST also inhibited the procedure’s success. With more discreet trial teaching experience and stimulus control, Drew’s aberrant behaviors may have decreased. For these reasons, the NET method described in this study should be considered when implementing early intervention programs for toddlers with VVB delays.

The NET method was an efficient teaching method for this individual. The “movie” sign reached mastery criterion in 14 sessions, as opposed to the 118 sessions of the unsuccessful pre-experiment procedure. The NET method also appeared less aversive to the participant. The decrease in tantrum duration from an average of 25.02 min. across 7 sessions to an average of 0 min. across 18 sessions is highly significant and cannot be overlooked. The non-occurrence of aberrant behaviors during NET led to an increased number of teaching opportunities presented. It may also be that the zero rates of aberrant behaviors allowed for the increase in continued motivation for consecutive trials, as the trials of declared motivation for all four items increased. The non-occurrence of aberrant behaviors during early intervention teaching could therefore lead to higher rates of acquisition across all programming.

When considering the differences between the NET and pre-experiment procedures, the importance of the gestural prompt should not be overlooked. The data indicate that the gestural prompt may have facilitated acquisition of the manual signs. This can best be argued from the data for “play-doh”. As discussed in the results, there was a higher proportion of gestural prompts during the training of “play-
doh” than there was during the training of “movie”. This may be attributable to the pre-experimental procedure creating a level of prompt dependency in the learner. Without the non-tactile prompting bridge created by the gestural prompt, the progression from partial physical to independent manding may have been too great, causing prompt-fading to be more difficult.

The V-VBT was significantly and clearly successful with this individual. With the introduction of V-VBT for the “movie” sign, the percent of trials with VVB increased with not just “movie”, but with each of the other three items as well. This suggests that despite not entering V-VBT, there was some generalization of the use of VVB to mand for items. More specifically, V-VBT increased the percent of trials with VVB to 100% for 5 consecutive sessions for the “movie” sign. Also, although it was on a decreasing trend, the percent of trials with approximated VVB for “movie” increased over the first 3 sessions of V-VBT.

Discriminated manding was demonstrated for both signing and VVB. Drew nearly mastered the “play-doh” sign during NET, showing discrimination between it and the mastered “movie” sign. Without reaching V-VBT, Drew showed significant gain with “play-doh”, “crocodile” and “Ernie” in approximated VVB. These data also suggest that when each additional item that was introduced for mand training, it produced an earlier vocal-verbal approximation of the adult form. This indicates that although the three signs were not mastered, discrimination of the VVB manding requirement was already developing. This study also supports the conclusion by Carbone et al. (2010) that manual sign is an effective form of functional communication that can be used to develop an initial manding repertoire.
This study also goes against the findings of Tincani (2004) that initial manding repertoires cannot be built efficiently using manual sign when the child has a weak motor imitation repertoire. The correct utilization of the prompt hierarchy and prompt fading procedures may allow the bypassing of motor imitation training. Although not preferred, this procedure provides a successful initial mand training program when time constraints do not allow for extensive motor imitation programming.

This study had several limitations that should be considered. The most important limitation is the low percentage of IOA and lack of procedural integrity testing. IOA was only conducted for one session during the NET phase of the experiment because of the implications of an in-home setting. Scheduling difficulties outside of the experimenter’s control did not allow for the scheduling of additional therapists and therefore the conducting of multiple IOA sessions. It should also be noted that Drew did not reach mastery for three out of four of the manual signs in training. This failure could be attributed to the premature termination of data collection. Due to the initial ST design failing and the time with which the implementation of a redesign required, the NET could not be conducted for the desired number of sessions (“Ernie” in training for only 6 sessions).

Another limitation of the study is that Drew acquired approximated vocal verbal behavior for some tacts and mands outside of the study. While any VVB gain is a desired outcome, without structured data collected on the prompting and reinforcement procedure of every person coming into contact with Drew, the acquisition of non-targeted tacts and mands cannot be analyzed. Due to time
constraints and ethical reasons, it was not possible to control for the sequence effects of the ST and NET methods. If possible, it would have been interesting to at least determine if the reintroduction of the ST procedure evoked the occurrence of aberrant behaviors. But, due to the nature of the setting and the severity of aberrant behaviors previously observed, this did not seem ethical. This study was also only included one participant. Better experimental control and procedural efficacy could have been demonstrated with the addition of more participants.

Future study could be conducted utilizing the NET procedure as early intervention for the VVB development for other individuals. A faster rate of acquisition may occur if this procedure is implemented initially following intake. The VVB development of an individual could be further tracked utilizing the phonetic transcription of utterances and improved via shaping procedures. It would also be interesting to compare that shaping procedure with the absence and addition of echoic training of non-target speech sounds.

The results of this study showed that the participant gained an initial functional communication repertoire using manual sign. He also increased his frequency of vocal-verbal behavior when he manded.
References


Figure Captions

*Figure 1.* Pre-experimental signing data for “movie.”

*Figure 2.* Structured Trial presentation signing data for “movie.”

*Figure 3.* Structured Trial presentation data for declared motivation trials of “movie” per possible teaching opportunities.

*Figure 4.* Structured Trial presentation data of trials with demonstrated motivation (all four items) out of total trials offered.

*Figure 5.* Structured Trial presentation data of instances of challenging maladaptive behavior.

*Figure 6.* Naturalistic Environment Teaching presentation signing data in multiple baseline format.

*Figure 7.* Naturalistic Environment Teaching data for frequency of teaching opportunities by sign.

*Figure 8.* Naturalistic Environment Teaching data of instances of challenging maladaptive behavior.

*Figure 9.* Naturalistic Environment Teaching data of percent of trials with approximated vocal-verbal behavior versus percent of trials with any vocal-verbal behavior.
Figure 1. Pre-experimental signing data for “movie.”
Figure 2. Structured Trial presentation signing data for “movie.”

Figure 3. Structured Trial presentation data for declared motivation trials of “movie” per possible teaching opportunities.
Figure 4. Structured Trial presentation data of trials with demonstrated motivation (all four items) out of total trials offered.

Figure 5. Structured Trial presentation data of instances of challenging maladaptive behavior.
Figure 6. Naturalistic Environment Teaching presentation signing data in multiple baseline format.
Figure 7. Naturalistic Environment Teaching data for frequency of teaching opportunities by sign.

Figure 8. Naturalistic Environment Teaching data of instances of challenging maladaptive behavior.
Figure 9. Naturalistic Environment Teaching data of percent of trials with approximated vocal-verbal behavior versus percent of trials with any vocal-verbal behavior.