

Increasing Vocalizations of Children with Autism Using Sign Language and Mand Training

Vivian Attanasio

Vincent J. Carbone

Lisa Delaney

Gina Zecchin-Tirri

Emily J. Sweeney-Kerwin

Carbone Clinic

Valley Cottage, NY

www.drcarbone.net

- Manual sign language has been shown to support the development of vocal verbal behavior in some individuals with autism and developmental disabilities (Mirenda & Erickson, 2000; Mirenda, 2003; Tincani, 2004).
- However, there is a subset of children with autism for whom sign language may not facilitate vocal production (Mirenda, 2003). In those cases it may be necessary to add other behavioral interventions to increase the development of vocal responding.
- Language training programs that manipulate motivative variables to teach manding have been shown to increase spontaneity (Shafer, 1994) and vocalizations (Charlop-Christy, Carpenter, LeBlanc & Kellett, 2002).
- The mand is a verbal response which is evoked by some condition of deprivation, satiation, or aversion and reinforced by a consequence specific to the motivational variable (Skinner, 1957).

- Several studies have noted the effects of implementing a time delay or prompt delay procedure following the presentation of a vocal model to increase vocal spontaneity and production (Halle, Marshall, & Spradlin 1979; Halle, Baer, & Spradlin, 1981; Carr & Kologinsky, 1983; Charlop, Schreibman, & Thibodeau, 1985; Bennett, Gast, Wolery, & Schuster, 1986; Matson, Sevin, Frideley, & Love, 1990; Ingenmey & Van Houten, 1991; Charlop & Trasowech, 1991; Matson, Sevin, Box, & Francis, 1993).
- The time delay procedure described in these studies usually involved arranging the conditions under which the vocal response had occurred with a prompt and then waiting for several seconds before delivering the prompt giving the learner the opportunity to emit the response without supplemental support.
- While this procedure had been shown to be effective with participants who had a vocal repertoire that was dependent upon prompting, the time delay procedure had not been previously tested for its value in evoking novel vocal responses in children with autism who emitted very few vocalizations and instead used sign language as the primary form of verbal behavior.
- The purpose of this study was to determine the effects of sign mand training combined with a time delay, vocal prompt and differential reinforcement procedure on the development of vocalizations in children with autism for whom sign language mand training alone had not produced vocal responding.

METHODS

Participants

- Tony was a four (4) year old boy with autism.
- Tony manded for 15 items with American Sign Language (ASL) when the item was present and the motivation for the item was strong.
- Prior to baseline a two (2) hour sound inventory was conducted during which the frequency and variety of vocalizations were recorded. Tony vocalized at a rate of about two (2) vocal responses every three (3) minutes. In addition, he produced a variety 31 different vocal responses, e.g. “eee” and “nana”.
- A modified Kaufman Speech Praxis Assessment (1995) was also conducted. The Kaufman Assessment contains a vocal imitation inventory divided into categories of syllable forms such as vowels, vowel to vowel movement, simple consonant production and other simple and complex syllabic combinations (Kaufman, 1995). The results of this assessment indicated Tony had a weak echoic repertoire and was only able to produce approximations to CVC words, such as “oh no” and “oboe”.

- Tony had limited receptive, tact and intraverbal repertoires.
- Tony demonstrated frequent out of seat behavior, high levels of distractibility and minimal eye contact.
- **Ralph** was a four (4) year old boy with Down's Syndrome.
- Ralph manded for 10 items with manual sign language when the item was present and the motivation for the item was strong.
- During the two (2) hour sound inventory, Ralph produced vocalizations at a rate of about one (1) vocal response every two (2) minutes. Only four (4) different vocal responses including "mmm", "eh", "ah" and "hmmm" were produced during the sound inventory.
- Ralph did not echo any sounds presented during the modified Kaufman Speech Praxis Assessment (1995).
- Ralph had limited receptive, tact and intraverbal repertoires.

- **Nick** was a six (6) year old boy with autism.
- Nick had a weak mand repertoire with sign language and required partial physical prompts or full physical prompts to produce his manual sign mands.
- The sound inventory indicated that he vocalized at an average rate of about one (1) vocal response every two (2) minutes and demonstrated a limited variety of vocal responses that included, “ticka,” “dah” and “sah.”
- Nick did not echo any vocal responses presented during the modified Kaufman Speech Praxis Assessment (1995).
- Nick had limited receptive, tact and intraverbal repertoires.

Setting

- The study was conducted in each participant's classroom in a private publicly funded school serving mostly children with developmental disabilities. The classrooms were standard size and similarly equipped to most special education classrooms. There were six (6) to eight (8) children in each room with at least three (3) adults.

Response Definition

- The dependent variable measured in the study was the occurrence of a vocalizations during sign manding either following a time delay or after the presentation of a vocal prompt.
 - Vocalizations were defined as any sound made by the participant.
 - A word approximation was defined as a vowel-consonant (VC) or consonant-vowel (CV) combination that were contained in the name of the item being requested.

Recording Procedure

- The participants' instructors served as the response recorder for the dependent variables. Additional instructors were trained to record observations of the dependent variable simultaneously but independently for the purposes of inter-observer agreement (IOA).
- The participants' instructor and the observer were seated next to the child at a table with their data sheets on individual clipboards.
- The targeted potential reinforcing items were placed on the table approximately one (1) foot from the learner.
- The data sheet included a column for recording the manded item, a column for recording the prompt level necessary to evoke the sign mand and four (4) columns for recording vocalizations or word approximations that occurred during the time delay or after one (1) of the three(3) echoic trials.
- Vocalizations or word approximations were recorded by writing the phonetic spelling of each vocal response in the column corresponding with the prompt level necessary to evoke the vocal response.

- For the purposes of inter-observer agreement, an agreement was scored when both observers recorded exactly the same vocalization or approximation during the time delay or the same echoic trial. A disagreement was scored when the observers did not record exactly the same vocalization or approximation, did not record a vocalization or approximation during the time delay or same echoic trial, or when one observer recorded the occurrence of a vocalization or approximation that the other observer did not record.
- Inter-observer agreement was calculated by dividing agreements by agreements plus disagreements and multiplying by 100.
- Inter-observer agreement was conducted for 30% of all sessions.
- Inter-observer agreement ranged between 96%-100% with an average of 99% percent agreement.

Experimental Design

- A multiple baseline across participants was used to verify the effectiveness of the independent variable (Baer, Wolf, & Risely, 1968).

Experimental Conditions

Baseline

- The experimenter sat at a table approximately two (2) feet across from the participant. All targeted items were placed on the table in the participants' view but next to the experimenter.
- All participants had six (6) different reinforcers present at every session.
- The items included edibles, toys and movies.
- The items were presented in a random rotation throughout the session.

- Each session consisted of 50 trials and there two (2) sessions per day.
- Each trial began with the experimenter holding the item at the participant's eye level in order to signal the availability of reinforcement.
- If the participant signed for the item with the correct ASL sign within five (5) seconds of the presentation, the item was delivered immediately.
- If the learner did not sign for the item immediately or signed incorrectly, the experimenter provided a manual or gestural prompt to evoke the response.
- The experimenter recorded any vocalization or word approximation that occurred when the learner signed, before the delivery of the reinforcer.

Time Delay and Vocal Prompt

- The examiner sat at a table approximately two (2) feet across from the participant in his classroom. The items the participant would potentially mand for were on the table next to the experimenter. All participants had six (6) different reinforcers present at every session. Each session consisted of 50 trials and there were two (2) sessions per day.
- A trial began with the experimenter holding the item at eye level as a signal to the participant that the appropriate sign for the item would result in the delivery of this item.
- When the participant signed, the reinforcer was not immediately delivered and instead a five (5) second time delay was implemented.
- During the five (5) second delay, any vocalization by the participant resulted in delivery of the reinforcer immediately.

- If the participant did not vocalize during the time delay interval, the experimenter would say the name of the desired item as a vocal prompt and wait two (2) seconds for a response.
- If a vocalization occurred within two (2) seconds of the presentation of the vocal stimulus the reinforcer was delivered immediately.
- If no vocalization occurred, the vocal prompt was re-presented two (2) additional times.
- The reinforcer was delivered immediately upon hearing any vocalization or word approximation from the participant following any of the vocal prompts.
- If no vocalization or word approximation occurred the reinforcer was delivered at the end of the sequence of presentations of the vocal prompts.

Maintenance

- Ten months following the completion of the experimental condition, maintenance data were collected for each participant.
- Maintenance data were collected by a supervisor trained in the data recording procedures, implementing the same procedures that were conducted during baseline.
- Four (4) sessions of maintenance data were conducted during which each targeted item was presented once.
- Each session consisted of six (6) trials and there was one (1) session a day for four consecutive days.
- Each trial began with the experimenter holding up the item to the participant's eye level in order to signal the availability of the reinforcer.

- If the participant signed for the item with the correct ASL sign within five (5) seconds of the presentation the item was delivered immediately.
- If the participant did not sign for the item immediately or signed incorrectly, the experimenter provided a manual or gestural prompt to evoke the response.
- The experimenter recorded the occurrence of any vocalization or word approximation that the participant produced when he signed.
- The same response definition for vocalization and word approximations were used as during the experimental condition.

- Inter-observer agreement was conducted under the same way as during baseline.
- Inter-observer agreement was conducted for 30% of all maintenance sessions.
- An agreement was defined as both observers recording any vocalization or word approximation heard during the time delay. A disagreement occurred when one of the observers heard a vocalization or word approximation and the other observer did not.
- Inter-observer agreement was calculated by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100.
- Inter-observer agreement was 100% across all participants.

RESULTS

- Figure 1 provides a graphic display of the percentage of vocalizations produced by all participants during baseline, treatment and maintenance conditions.
- As shown in Figure 1, baseline responding was stable for all of the learners before changing to the treatment condition for one (1) of the participants.
- In general, all subjects showed a substantial treatment effect when conditions change from baseline to treatment, therefore verifying the effectiveness of the independent variables.
- Note that immediately upon implementing the treatment procedure, Tony's percentage of trials with vocalizations or word approximations changed from an average of about 20% during baseline to about 95% in treatment. Tony maintained an average of about 95% of vocalizations or word approximations while manding during maintenance sessions.

- The treatment condition led to a substantial increase in vocal responding for Ralph as well.
- The frequency of vocalizations or word approximations for Ralph immediately increased to approximately 70% from a baseline percentage of near zero (0) upon entering treatment and then stabilized with about 95% of trials containing vocal responses for the last few treatment sessions. 10 month follow up data indicates that Ralph's vocalizations during sign manding were maintained at a level substantially higher than baseline.
- The treatment effect was less dramatic for Nick but nevertheless the independent variable had a substantial effect upon the production of vocalizations.
- His vocalizations immediately increased to approximately 10% upon entering treatment and steadily increased to 40% throughout treatments sessions as compared to a baseline percentage of near zero (0). 10 month follow up data indicated that Nick's vocalizations while sign manding were maintained at a level substantially higher than baseline.
- Figure 2 displays a set of bar graphs showing the distribution of vocal responses across the time delay interval and the three (3) vocal prompt presentations during treatment conditions.

- The time delay procedure was effective in producing a substantial increase in vocal production in two (2) of the three (3) participants as seen in Figure 2. Only Nick did not produce vocal responding during the time delay interval.
- Figure 3 is a bar graph displaying the percentage of trials across baseline, treatment and maintenance conditions in which each of the participants produced a vocal approximation to the name of the item being manded for with manual sign.
- Note that both Tony and Ralph showed increases in word approximations as a function of the independent variable while Nick did not produce any word approximations in baseline or treatment conditions.
- Throughout the treatment condition, Tony's signs were accompanied by word approximations for more than 60% of the trials indicating a substantial improvement in vocal responding.
- Two (2) of the three (3) participants showed a substantial increase in not only frequency of vocalizations but variety indicating the production of novel sounds.

DISCUSSION

- The results of the current study demonstrate that manual sign mand opportunities combined with a prompt delay procedure and vocal prompting with differential reinforcement for sound production can increase the frequency and variety of vocalizations in children with autism and other developmental disabilities.
- All three (3) subjects in this study showed a substantial increase in vocalizations as a result of the independent variables. Two (2) of the three (3) participants developed word approximations for the items they manded with manual sign language.
- The independent variables had a differential effect on the responding of the three (3) participants.
- Tony demonstrated the highest percentage of trials with vocalizations and word approximations and was the only participant to develop the production of a word, movie as a mand to view a video.
- He entered the study with the strongest vocal repertoire in that he produced the greatest number and variety of sounds during the baseline sound inventory.

- It appears that the differential effects across participants may have been related to their baseline levels of vocal responding.
- Maintenance data show that Tony and Ralph continued to vocalize at a high rate while sign manding despite no treatment for a 10 month period.
- The fact that the time delay procedure produced a relatively higher rate of vocalizations as compared to the vocal prompt procedure implicates the role of extinction.
- It appears that failure to reinforce the sign mand immediately during treatment may have led to response variation in the form of vocal responses consistent with the side-effects frequently associated with extinction (Lerman and Iwata, 1996).

- Additional research will be needed to determine the contribution of the baseline level of vocal strength in the differential effects of this treatment package.
- In addition, future researchers may want to determine if the implementation of a shaping procedure would refine the form of the vocal responses to produce closer approximations to words.
- Additional research is needed to determine whether generality related to vocal responding will occur across untrained sign topographies, persons, and settings.

References

- Baer, D., Wolf, M., & Risley, T. (1968). Some current dimensions of applied behavioral analysis. *Journal of Applied Behavioral Analysis, 1*, 91-97.
- Bennett, D. L., Gast, D. L., Wolery, M., & Schuster, J. (1986). Time delay and system of least prompts: A comparison in teaching manual sign production. *Education and Training of the Mentally Retarded, June*, 117-129.
- Carr, E.G., & Kologinsky, E. (1983). Acquisition of sign language by autistic children using a time delay procedure. *Journal of Applied Behavioral Analysis, 16*, 297-314.
- Charlop-Christy, M., Carpenter, M. L., LeBlanc, L. A., & Kellet, K. (2002). Using the picture exchange communication system (PECS) with children with autism: Assessment of PECS acquisition, speech, social-communicative behavior, and problem behavior. *Journal of Applied Behavior Analysis, 3*, 213-232.
- Charlop, M. H., Schreibman, L., & Thibodeau, M. G. (1985). Increasing spontaneous verbal responding in autistic children using a time delay procedure. *Journal of Applied Behavioral Analysis, 18*, 155-166.
- Charlop, M. H. & Trasowech, J. E. (1991). Increasing autistic children's daily spontaneous speech. *Journal of Applied Behavioral Analysis, 24*, 747-761.
- Halle, J. W., Baer, D. M., & Spradline, J. E. (1981). Teacher's generalized use of delay as a stimulus control procedure to increase language use in handicapped children. *Journal of Applied Behavioral Analysis, 14*, 389-409.
- Halle, J. W., Marshall, A. M., & Spradline, J. E. (1979). Time Delay: A technique to increase language use and facilitate generalization in retarded children. *Journal of Applied Behavior Analysis, 12*, 431-439.
- Ingenmey, R. & Houten, R. V. (1991). Using time delay to promote spontaneous speech in an autistic child. *Journal of Applied Behavioral Analysis, 24*, 591-596.
- Lerman, D. & Iwata, B. (1996). Developing a technology for the use of operant extinction in clinical settings: An examination of basic and applied research. *Journal of Applied Behavior Analysis, 29*, 345-382.

- Matson, J. L., Sevin, J. A., Fridley, D., & Love, S. R. (1990). Increasing spontaneous language in three autistic children. *Journal of Applied Behavioral Analysis, 23*, 227-233.
- Matson, J. L., Sevin, J. A., Box, M. L., Francis, K. L., & Sevin, B. M. (1993). An evaluation of two methods for increasing self-initiated verbalizations in autistic children. *Journal of Applied Behavioral Analysis, 26*, 389-398.
- Mirenda, P. (2002). Toward functional augmentative and alternative communication for students with autism: Manual signs, graphic symbols, and voice output communication aids, *Language, Speech, and Hearing Services in Schools, 34*, 203-216.
- Mirenda, P., & Erickson, K. A.. (2000). Augmentative communication and literacy. In Wetherby, A. M., & Prizant, B. M. (Eds.), *Autism spectrum disorders v 9* (pp. 333-367). Baltimore: Paul. H. Brookes.
- Shafer, E. (1994). A review of interventions to teach a mand repertoire. *The Analysis of Verbal Behavior, 12*, 53-66.
- Tincani, M. (2004). Comparing picture exchange communication system and sign language training with children with autism. *Focus on Autism and Other Developmental Disabilities, 19*, 152-163.

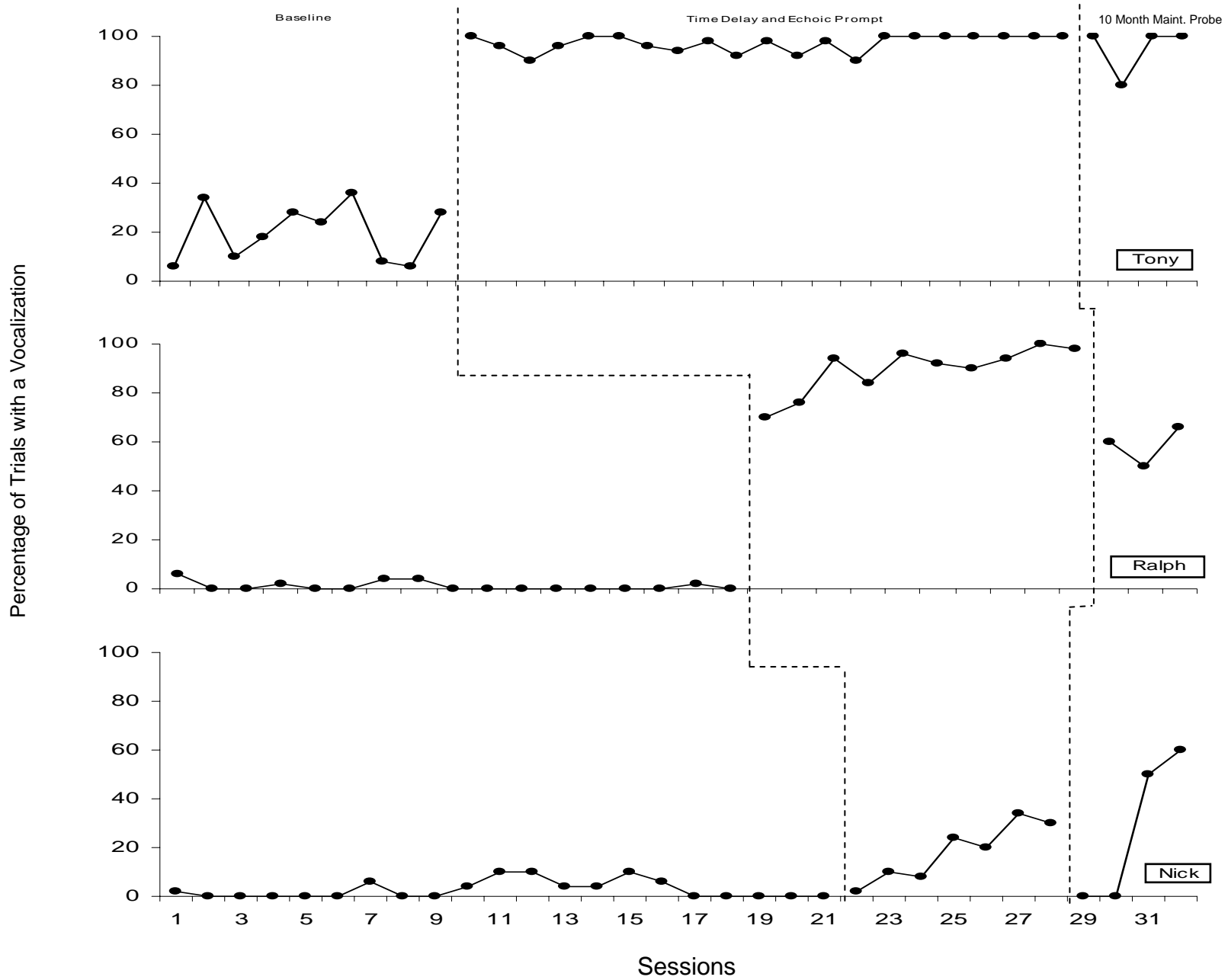


Figure 1. The percentage of trials with any vocalization during baseline, treatment, and maintenance conditions for all learners.

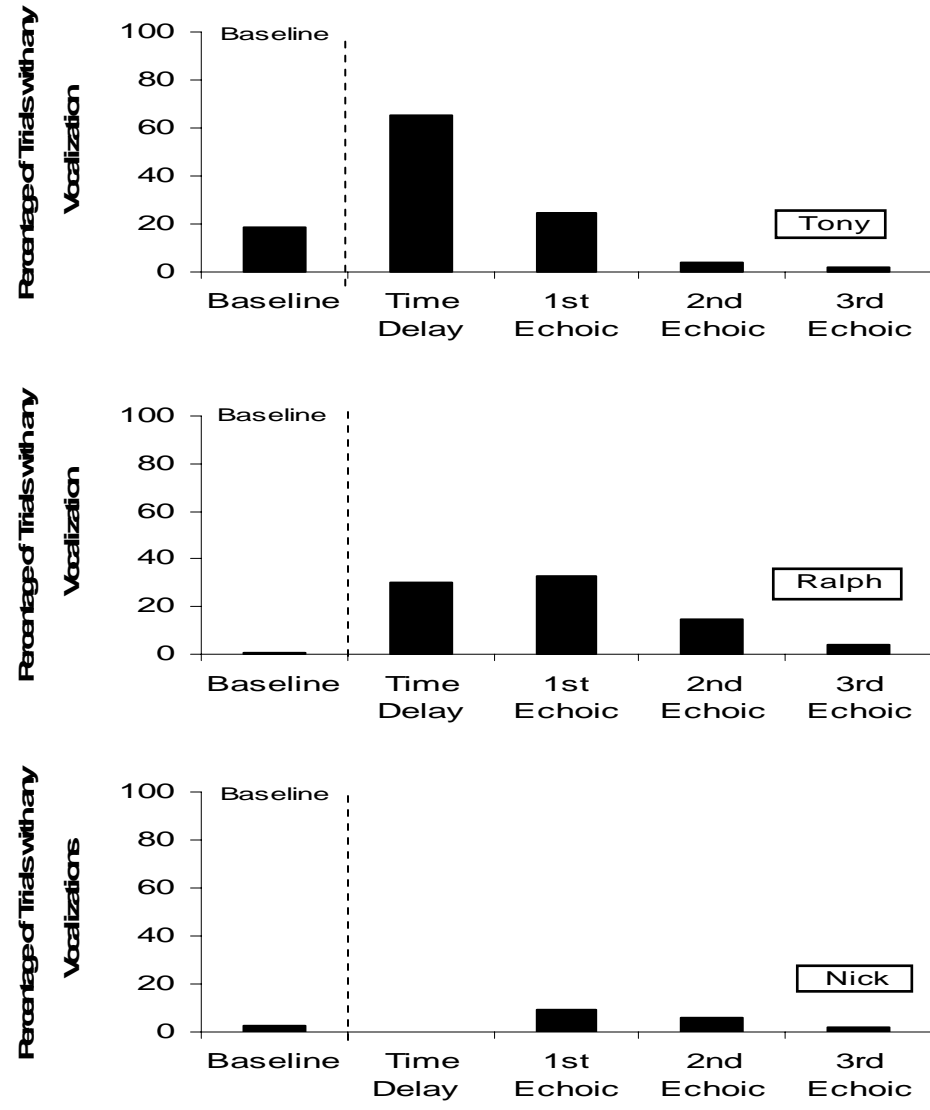


Figure 2. Percentage of trials with any vocalizations across baseline and treatment conditions.

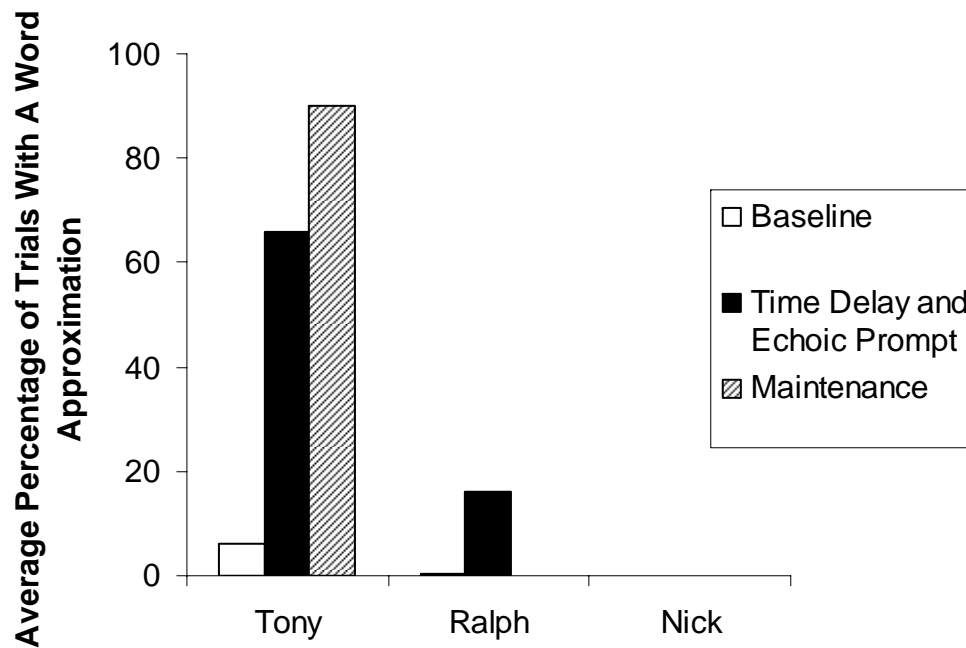


Figure 3. Percentage of trials with word approximations across baseline, treatment, and maintenance conditions.