Comparing Echoic and Textual Prompts for Teaching Intraverbal Behavior

A Thesis Presented
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In partial fulfillment of the requirements
for the degree of
Master of Science
in the field of
Applied Behavior Analysis

Northeastern University
Boston, MA

August 2009
NORTHEASTERN UNIVERSITY
Bouvé College of Health Sciences Graduate School

Thesis Title: Comparing Echoic and Textual Prompts for Teaching Intraverbal Behavior

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Submitted in partial fulfillment of the requirements for the degree of
Master of Science in Applied Behavior Analysis
in the Bouvé College of Health Sciences Graduate School
of Northeastern University, August 2009
Acknowledgements

The author would like to thank the New England Center for Children for its continued dedication to improving the lives of children with autism. The author would also like to thank her thesis committee, Dr. William Ahearn, Dr. Rachel Thompson, and Dr. Rebecca MacDonald for their helpfulness and expertise throughout this study and in preparing this manuscript. Special thanks go to Dr. William Ahearn for his patience, expertise, and dedication to teaching the future generations of behavior analysts. Finally, the author would like to thank Meghan Robinson, Beth Williams, Zara McCambridge, and Tessa Piantedosi for their help with IOA collection, procedural integrity data collection, and moral support in completing this endeavor.
Comparing Echoic and Textual Prompts For Teaching Intraverbal Behavior

A. Abstract ........................................................................................................................................... 2
B. Introduction
   1. Language deficits in autism spectrum disorders .......................................................... 3
   2. Intraverbal behavior ........................................................................................................ 3
   3. Echoic prompting ........................................................................................................... 4
   4. Textual prompting .......................................................................................................... 5
   5. Purpose ............................................................................................................................ 7
C. Method
   1. Participants, setting, and materials .................................................................................. 7
   2. Dependent variables and operational definitions ......................................................... 8
   3. Measurement and observation procedures ..................................................................... 9
   4. Experimental design ....................................................................................................... 10
   5. Procedures ......................................................................................................................... 10
      a. Preference assessment
      b. Baseline
      c. Pre-training
      d. Training
         1. Transfer of stimulus control
      e. Post-training
      f. Generalization
      g. Follow-up
D. Results .......................................................................................................................................... 12
E. Discussion .................................................................................................................................... 28
F. References ................................................................................................................................... 34
G. Appendix ...................................................................................................................................... 36
H. Tables ........................................................................................................................................... 38
I. Figure Captions ......................................................................................................................... 40
J. Figures ........................................................................................................................................... 42
Abstract

We compared the use of echoic and textual prompts to teach intraverbal behavior, answering questions, to three children with an autism spectrum disorder. Previous research has suggested that both echoic and textual prompts are effective methods for teaching verbal behavior. Finkel and Williams (2001) found that textual prompts were more effective than echoic prompts for teaching intraverbal responses whereas Keenan, Ahearn, and Miguel (in prep) found that echoic prompts were more effective than textual prompts. Each child was taught to answer 12 social questions using either a textual or an echoic prompting procedure. A multiple probe design across sets of questions was used and observers measured the following: (a) the number of trials to criteria during acquisition in each condition; (b) the number of correct full sentence answers to the target questions during probe sessions for each condition; and (c) the number of correct partial answers to the target questions during probe sessions for each condition. The effects of the prompting procedures were assessed across acquisition trials, post-training, and generalization probes, as well as throughout a 3-week follow-up phase. During the probe sessions, questions were posed both vocally and as a textual script. The results showed that, for all three participants, with the exception of the last set of questions for one participant, echoic prompts were more effective than textual prompts for teaching intraverbal behavior and that acquisition of the target response occurred faster with the use of echoic prompts. Acquisition data showed that echoic prompts required fewer trials to reach criteria than textual prompts across participants. Probe session data showed that, after training was implemented, responding increased across all participants with the exception of textual prompts for one participant during set 1. Responding was maintained throughout follow-up for all participants. These data indicate that children with autism may be more likely to learn to answer questions more rapidly when taught with echoic prompting.
Comparing Echoic and Textual Prompts For Teaching Intraverbal Behavior

Children with autism generally show profound delays and impairments in various aspects of language, with even more pronounced deficits seeming in expressive communication (Secan, Egel, & Tilley, 1989). These impairments in communication can include, but are not limited to, a lack of functional receptive and/or expressive language; delayed or defective mand, tact, and intraverbal repertoires; speech that is repetitive or nonsensical; or well-developed speech that is not used socially (Green, 1996). Past research has shown that these deficits and delays can be readily observed in the child’s communicative repertoire with notable delays in several types of verbal operants, including: (a) tacts, (b) mands, and (c) intraverbal behavior. Skinner (1957) defines a tact as “a verbal operant in which a response of a given form is evoked (or at least strengthened) by a particular object or event or property of an object or event.” He then defines a mand as “a verbal operant in which the response is reinforced by a characteristic consequence and is therefore under the control of relevant conditions of deprivation or aversive stimulation.” Intraverbal behavior is then defined as “verbal responses that show no point-to-point correspondence with the verbal stimuli which evoke them.”

When Kanner (1943) first described autism, he summarized that it was a developmental disorder that encompassed a number of social deficits such as a marked failure in developing and using language appropriately, having a difficult time forming social relationships, and having excessive stereotypical behavior. Children with autism may also have difficulties with reciprocal social interactions such as conversational exchanges, which could, in part, be due to a limited intraverbal behavior. Verbal operants such as tacts, mands, and intraverbal exchanges are considered functionally independent of one another and, because of this are usually taught individually and explicitly to children with autism as separate repertoires (Hall & Sundberg, 1987; Lamarre & Holland, 1985; Skinner, 1957). When verbal operants are said to be functionally independent of one another, it means that the skill of tacting an object such as “I see a ball,” does not mean that the same person could mand for that object (“Give me the ball.”) or answer questions about the item (i.e., in response to, “What color is the ball?” saying, “The ball is blue.”).

Several procedures have been described in past research for teaching subjects to tact and mand for objects. Discrete trial procedures have been proven effective for teaching both manding for and the
tacting of items such as novel objects and letters (Arntzen & Almas, 2002; Hernandez, Hanley, Ingvarsson, & Tiger, 2007; Petursdottir, Carr, & Michael 2005; Yamamoto & Mochizuki, 1988). Alternative methods have also been used for mand training. One such alternative has been to use picture cards combined with a discrete trial format to teach participants to mand for pictured items (Gutierrez, et al.2007). It should be noted, however, that in the Gutierrez et al. study, discrimination training alone did not teach the participants to mand for items and, for most participants, topographically distinct mands had to be taught using both picture cards and a vocal prompt. Researchers have also used incidental teaching to establish manding repertoires in subjects with autism. In a study by Simic and Bucher (1980), experimenters manipulated the establishing operations (such as having food or objects present or not present) to increase and decrease the probability that the subject would mand for a particular item. It is possible that natural cues such as those found in the incidental teaching procedures were not sufficient for manding to develop in these children with autism. Vocal prompts were needed to develop a more complete manding repertoire for each of these subjects.

Similar methods have been used to teach expressive language across a range of persons with learning disabilities. For example, incidental teaching has proven effective as a structured training procedure for persons with disabilities as demonstrated by McGee, Krantz, and McClannahan (1985). In this study, each child received 1:1 instruction during daily academic programming that used both traditional and incidental teaching procedures. During traditional teaching procedures and while the child was seated at a desk, the teacher presented stimulus materials and asked “Where is the ___?” During incidental teaching procedures, a teaching episode was initiated when a child named or requested the item and the teacher asked, “Where is the ___?” The results suggested that incidental teaching produced greater generalization of the use of prepositions than the traditional techniques.

There are three main types of prompting strategies that have been used to teach mands, tacts, and intraverbal behavior and they are (a) echoic prompting, (b) textual prompting, and (c) pictoral prompting. An echoic prompt is a prompting strategy in which the experimenter provides a vocal model prompt and subsequently requires the participant to repeat the same response. Echoic prompts could include one-word directives or complete sentences (Ahearn, MacDonald, Graff & Dube, 2007). The echoic prompt is then
faded by adding a time delay to the presentation of the vocal model or by thinning the entirety of the vocal model (e.g., by providing a partial vocal model versus a complete vocal model). The effectiveness of echoic prompting has been demonstrated by several studies including the Seckan, Egel, and Tilley (1989) study during which children were taught, using echoic prompts, to correctly respond to wh-questions (e.g., “What is in your lunch?” or “What store is this?”) when presented with pictures.

When a textual prompt is delivered, the experimenter provides a written script as a model and subsequently requires the participant to respond to the written text. Textual prompts can include written words, lists, or instructions and can be used as written scripts to initiate conversations with teachers or peers (Ahearn et al., 2007). The scripts can then be faded in a backward chain similar to the echoic prompting strategy (i.e. paired with a time delay). This method has proven useful in teaching children to engage in intraverbal behavior (conversations) with an adult (Krantz & McLannaghan, 1993; Sarokoff et al., 2001).

Lastly, a pictoral prompt is a prompting strategy in which the experimenter provides a picture as a model and subsequently requires the participant to respond to the picture presented. Pictoral prompts can be used to prompt various tasks such as self-help and meal preparation and are sometimes paired with other types of prompting procedures to establish the target responses (Ahearn et al., 2007). Pictoral prompts are commonly faded using a time delay procedure. The effectiveness of pictoral prompts was assessed as part of a transfer of stimulus control experiment conducted by Goldsmith (2006). The experimenters used a transfer of stimulus control procedure to teach categorical intraverbals to children with autism by combining tact prompts, errorless learning, and schedule thinning to transfer the response from the picture prompt to a vocal discriminative stimulus. After training was implemented, participants engaged in intraverbal exchanges pertaining to the categories, but maintenance and generalization effects were limited.

The first study to systematically compare and evaluate the effects of a textual prompting strategy and an echoic prompting strategy was conducted by Finkel and Williams (2001). The purpose of the study was to compare and evaluate the effects of textual and echoic prompting strategies on the intraverbal skills of a six year-old boy with autism. The results of the study indicated that textual
prompts, rather than echoic prompts, resulted in higher acquisition rates of intraverbal behavior for this particular student. The authors suggested that the social interactions that are implicit in echoic prompting may be more distracting or punishing for some students with autism. They suggested that textual prompts may be more beneficial because they do not require as much direct social interaction as echoic prompts and thus may be less aversive. One major limitation to this study, however, was that only one subject participated in the study, severely limiting its generality.

As a follow up experiment to the Finkel and Williams (2001) study, Keenan, Miguel, and Ahearn (in prep) compared the effects of textual and echoic prompts on acquisition of intraverbal responses among three preschoolers diagnosed with autism. As in the Finkel and Williams study, participants were taught to vocally answer twelve age-appropriate social questions using either echoic or textual prompts. The questions were divided into three sets of questions per individual; each set contained four questions. Two questions for each set were taught using an echoic prompt while the other two were taught using a textual prompt. For all sessions questions were asked vocally and never as a textual script by the experimenter. The study was conducted in a multiple probe design across stimulus sets.

The results of this study indicated that echoic prompts, rather than textual prompts, produced quicker acquisition for intraverbal responses among children with autism. These findings contradict the previous work of Finkel and Williams (2001). The differences in the results obtained may have resulted from multiple factors. First, according to Keenan (in prep) and colleagues, the use of auditory stimuli may have facilitated the transfer of control from the echoic prompt to the initial verbal stimulus more efficiently than visual stimuli. It is also possible that the participants in the Keenan study had limited experience with textual prompting and that the student used in the Finkel and Williams study had more experience with textual prompts. Additionally, Keenean and colleagues suggested that the difference in reading levels between the participants in the two studies may have led to the discrepancies in the outcomes.

The authors went on to discuss two major limitations to their study. First, the criteria to end the training phase were based solely on the subject’s performance in the training sessions and did not take into account performance during the probe sessions. Second, probes were conducted in only the vocal
mode. This means that during the probes, all questions regardless of whether or not the answers were taught using echoic or textual prompts, were delivered vocally. Thus the only time textual stimuli were present was during the textual prompting sequences.

The purpose of the current study was to systematically replicate and extend the Keenan et al. (in prep) and Finkel and William (2001) studies by comparing both textual and vocal probes before, during, and after training to determine whether echoic or textual prompts better facilitated intraverbal exchanges. For echoic prompting trials, each question was presented vocally and was followed by a full verbal model of the correct answer; prompts were then systematically faded using a backward chaining procedure. The textual prompting trials were conducted in the same manner except the questions and answers were presented as textual scripts. Probe sessions were conducted at predetermined times and were presented both vocally and as a textual script for all questions.

Method

Participants & Setting

Participants were three preschool-aged students diagnosed with an autism spectrum disorder. They attended a 30-hour a week intensive day program at a school designed for children with autism. All students had limited reading repertoires and had experience with discrete trial training. Additionally, all participants echoed 4 to 6 word utterances but showed deficits in intraverbal behavior including delays in answering social questions. All children had previous exposure to answering basic social questions but typically responded with only 1 to 2 word answers and did not reliably answer untrained questions.

Walker was a 5-year-old boy diagnosed with Pervasive Developmental Disorder – Not Otherwise Specified (PDD-NOS). He received a standard score of 75 and an age equivalent of 4 years, 8 months on the Peabody Picture Vocabulary Test (PPVT-4A) and a standard score of 49 and an age equivalent of 4 years, 8 months on the Expressive One Word Picture Vocabulary Test (EOWPVT). During pre-testing of reading skills, Walker identified 69.2% of the words that were used in the study. Parker was a 7-year-old boy diagnosed with an autism spectrum disorder. He received a standard score of 79 and an age equivalent of 5 years on the Peabody Picture Vocabulary Test (PPVT-4A) and a standard score of 74 and an age equivalent of 4 years, 5 months on the Expressive One Word Picture Vocabulary Test (EOWPVT).
During pre-testing of reading skills, Parker identified 88.9% of the words that were used in the study. Benjamin was a 5-year-old boy diagnosed with an autism spectrum disorder. At the time of the study, Benjamin had no formal speech and language testing. His speech and language pathologist reported that he communicated primarily through vocal speech and gestures, such as pointing and reaching when requesting, greeting a teacher or peer, protesting, or labeling. This vocal speech, however, did not occur in the context of answering social questions such as those included in the study. During pre-testing of reading skills, he identified 38.2% of the words that were used in the study.

All sessions took place at the school in the child’s assigned workspace with limited distractions. The participant and experimenter were seated diagonally at the child’s table in his assigned workspace or in a quiet area of his typical classroom. Edible reinforcers, a table, chairs, and stimuli used for textual prompting trials (i.e. the printed scripts) were present during discrete trial sessions and textual probe sessions. Scripts used for the textual prompting trials were not available during the echoic prompting trials.

**Dependent Variables and Operational Definitions**

The targeted dependent variables during this study were (a) the number of trials to criteria during acquisition, (b) the number of full independent, grammatically correct answers provided during probes, and, (c) the number of partially correct answers provided during probe sessions. The criteria to end training was three consecutive sets of 90% or higher independent responding during a training session, across 2 teachers and 2 settings. Probe data were not taken into account for mastery criteria.

A *correct-full answer* was defined as any answer given in a full, grammatically correct sentence. Examples of correct-full answers included, “a pilot flies a plane” in response to the question, “who flies a plane?” or, “I ride in a cab” in response to the question, “how do you get to school?” A *correct-partial answer* was defined as any answer that could be verified as correct but did not occur as part of a full, grammatically correct answer. Examples of partially-correct answers included, “a pilot” in response to the question, “who flies a plane?” or, “a cab” in response to the question, “how do you get to school?” An *incorrect answer* was defined as any non-grammatically correct answers, answers that could not be
verified as correct, or answers that had no significance to the question being asked. Examples of incorrect answers included, “flies” or, “zookeeper” in response to the question, “who flies a plane.”

**Measurement and Interobserver Agreement**

The primary data collector for each student was the lead experimenter of the study. Data were collected during all discrete trial sessions as well as all probe sessions. A probe data sheet consisting of student specific questions, possible correct answers, and an area to record whether the answers were fully correct, partially correct, or incorrect were used for baseline, probe, generalization, and follow-up sessions. The discrete trial data sheet consisted of 10-trial sessions as well as a coded section for the experimenter to specify whether or not the answer was full correct (+), partial correct (P), or incorrect (-), as well as whether or not the answer was produced independently (I) or was prompted (+p).

Interobserver agreement (IOA) data were collected during 36.4% of probe sessions across all phases and during 33.3% of training sessions across all participants. To collect IOA data, a second trained observer independently collected data using the same methods as the primary observer. IOA scores were calculated by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100%. An agreement was defined as both the experimenter and trained observer independently recording a correct or incorrect response for whether or not the participant answered the question correctly and if it was independent or prompted; the recordings had to be the same, otherwise a disagreement was scored. IOA for probe sessions across all participants was 95.8% (range, 91.7-100%). IOA for training sessions across all participants was 98.0% (range, 90-100%). Individual values for each participant can be seen in Table 1.

Procedural integrity (PI) data were also collected during 36.4% of probe sessions across all participants and 35.5% of training sessions across all participants and ranged from 90-100%. Multiple sessions per condition were observed and scored by independent observers. The trials within the sessions were scored as correctly implemented if the experimenter provided the correct prompt, reinforcement, and recorded data at the correct times; otherwise it was scored as incorrect. Procedural integrity scores were calculated by dividing the number of correctly implemented trials by the total number of trials conducted and multiplying by 100%. PI for probe sessions across all participants was 99.0% (range, 95.4-100%). PI
Teaching Intraverbal Behavior 10

for training sessions across all participants was 98.4% (range, 90-100%). Individual values for each participant can be seen in Table 2.

Experimental Design and Procedures

A multiple probe design across stimulus sets was used to determine the effects of echoic and textual prompts on the acquisition of intraverbal responding. Prior the start of the study, a brief MSWO preference assessment was conducted to identify the three most highly preferred edibles that served as reinforcers throughout the study.

Baseline. Baseline procedures consisted of three test probe sessions. During test probes, the participants were asked each of the 12 of the target questions (Appendix A) two times; once vocally and once as a textual script. No prompting was delivered and praise was delivered intermittently for other responses such as sitting and attending to the therapist. Once test probe sessions were completed, participants were given an item identified as moderately preferred from the preference assessment for participating in each session.

Pre-training. Pre-training sessions were conducted to assess and teach, if necessary, the participants to read the unknown words that were used as prompts or as questions during the textual probes and prompting conditions. Pre-training was split into two phases. During Phase 1, each participant was presented with all of the words that would appear as a textual script throughout the study. This included each word used as a textual prompt and each of the words included in the questions from all three sets. To ensure that the presentation of the script would not act as a prompt for the response during the pre-training procedures, the autoclitic frame (such as I see or I hear) and the intraverbal response were presented independently. Data were recorded on whether or not the participant expressively identified the text. During Phase 1, Walker correctly identified 69.2% of the words, Parker correctly identified 88.9% of the words, and Benjamin correctly identified 38.2% of the words. During Phase 2, each subject was taught to expressively identify the unknown words from Phase 1. Pre-training continued until the participants read all of the words included in the study with 100% accuracy.

Training. Participants were taught to correctly respond to social questions provided by the experimenter with either an echoic or textual prompting procedure. Questions were randomly assigned
prior to training to one of the questions sets and prompting procedures. An attempt was made to evenly
distribute the number of words included in each question and answer across prompt types to equate effort.
Session lengths were dependent on each participant’s performance but lasted between 10 and 20 min.
Prior to the start of each session, the participant chose among the three most highly preferred edible
stimuli as determined by the MSWO (DeLeon & Iwata, 1996) or a generalized conditioned reinforcer
used during typical academic instruction with that participant (i.e., tokens). The experimenter conducted
one training session (10 trials) using either the echoic prompting procedure or textual prompting
procedure. A short break was allowed and another training session was conducted using the other
prompting procedure. The order of the sessions was counterbalanced daily such that neither prompting
procedure was conducted first more often than the other. Only the production of full-correct answers was
reinforced with the previously selected edible reinforcer during training sessions.

*Echoic Prompts.* For echoic prompting sessions the experimenter always presented the target
question vocally. The experimenter then vocally presented the participant with the full target answer.
After the initial immediate prompt, the presentation of the echoic prompt was delayed by 2 seconds and
was then systematically faded using a backward chain (Appendix B). The criteria to increase to a less
restrictive prompt was 90% correct (prompted or unprompted) for two sessions with full correct
responses.

*Textual Prompts.* The textual condition was identical to the echoic condition with the following
exceptions: questions and target answers were always presented as textual scripts; that is, they were never
presented vocally during training sessions.

The error correction procedure for both prompting conditions included looking away from the
participant and removing all materials for 2 s. The trial was then re-presented with a full textual or vocal
model dependent on the prompting procedure. If two errors occurred consecutively during the discrete
trials, or if three errors occurred throughout the session, the previous, more restrictive prompt was re-
introduced. Training was completed when the participant independently answered 90% of the questions
across 2 teachers and 2 settings for three consecutive sessions with full correct answers.
Transfer of stimulus control (Benjamin only). During training and probe sessions for question set 1, Benjamin did not respond to the question when presented as a textual script and only responded if the training materials, such as the backing used for textual prompts, were also present. Therefore a transfer of stimulus control procedure was introduced. For set 1, each question, regardless of whether or not the answer was previously taught using echoic or textual prompts, was presented as a textual script. The participant then read the script and was immediately presented with the full correct answer as a textual script. The question was then immediately represented but was not followed by the printed answer the second time. This procedure was conducted for all four questions a total of two times. A probe was then conducted after each of these presentations.

Post training. Post training procedures were identical to those in baseline. Post training probes were conducted after all answers to each question set had been taught to mastery.

Generalization. Generalization procedures were also identical to those used during baseline. However, another experimenter who did not participate in the training conducted the generalization probes.

Follow-up. Follow-up procedures were identical to those used during baseline. Probe sessions were conducted 1, 2, and 3 weeks after the completion of the training probes to assess maintenance of these skills.

Results

Figure 1 shows the number of trials each participant required to meet criteria for each set of stimuli. Figure 2 shows the cumulative number of trials to meet criteria across all sets of questions and the percent of words correctly identified during pre-training phase I. Walker required a total of 150 training trials to meet criteria for the three answer sets taught with echoic prompts (M = 50; range, 50 to 100) and a total of 200 training trials to meet criteria for the three answer sets taught with textual prompts (M = 66.7; range, 60 to 80). Parker required a total of 320 training trials to meet criteria for the four answer sets taught with echoic prompts (M = 80; range, 50 to 120) and a total of 480 training trials to meet criteria for the four answer sets taught with textual prompts (M = 120; range, 50 to 200). Benjamin required a total of 300 training trials to meet criteria for the three answer sets taught with echoic prompts.
Teaching Intraverbal Behavior 13

(M = 100; range, 80 to 110) and a total of 320 training trials to meet criteria for the three answer sets taught with textual prompts (M = 106.7; range, 80 to 130).

The number of questions Walker answered correctly during probe sessions, including partially correct answers, is depicted in Figure 3 for answers taught with echoic prompts and Figure 4 for answers taught with textual prompts. The number of questions Walker answered with only correct full answers during test probes is depicted in Figure 5 for answers taught with echoic prompts and Figure 6 for answers taught with textual prompts.

The following data are for the answers taught with echoic prompts for set 1 for Walker. When partially correct answers were included, Walker answered 0 out of 2 questions correctly across all vocal baseline sessions (M = .2 out of 2) and answered 0 out of 2 questions correctly across all textual baseline sessions (M = .5 out of 2; see Figure 3). Without including partially correct answers, Walker answered 0 out of 2 questions correctly across all vocal baseline sessions (M = 0 out of 2) and answered 0 out of 2 questions correctly across all textual baseline sessions (M = 0 out of 2; see Figure 5).

The introduction of pre-training had little effect on the number of full correct responses. The mean number of questions answered correctly including partially correct answers during pre-training sessions was .5 out of 2 when presented vocally and .3 out of 2 when presented textually. Without including partially correct answers, Walker answered 0 out of 2 when presented vocally and 0 out of 2 when presented textually. After the implementation of echoic prompting, there was an almost immediate increase in the number of questions Walker answered correctly. During the second test probe during the training phase, Walker answered 2 out of 2 possible questions correctly with complete full sentence responses regardless of the mode that the question was presented in. This performance was maintained throughout the rest of the training as well as post-training (follow-up) and generalization.

The mean number of questions answered correctly, including partially correct answers after the implementation of the echoic prompt training was 1.6 out of 2 when presented vocally and was 1.6 out of 2 when presented textually. The mean number of questions answered with full correct answers was 1.5 out of 2 when presented vocally and 1.5 out of 2 when presented textually. During the follow-up phase the mean number of questions answered with full correct answers was 2 out of 2 when presented vocally.
and 2 out of 2 when presented in a textual format. Walker never responded with only a partially correct answer after the first probe session of training. Walker required 50 total trials to meet acquisition and mastery criteria.

The following data are for the answers taught with textual prompts for set 1 for Walker. When partially correct answers were included, Walker answered 0 out of 2 questions with correct answers across all vocal baseline sessions (M = .2 out of 2) and 0 out of 2 baseline sessions (M = .5 out of 2; see Figure 4). Without including partially correct answers, Walker answered 0 out of 2 questions correctly across all vocal baseline sessions (M = 0 out of 2) and answered 0 out of 2 questions correctly across all textual baseline sessions (M = 0 out of 2; see Figure 6).

The introduction of pre-training had no substantial effect on the number of correct responses. The mean number of questions answered correctly including partially correct answers during pre-training sessions was 1 out of 2 when presented vocally and .9 out of 2 when presented textually. Without including partially correct answers, Walker answered 0 out of 2 when asked vocally and 0 out of 2 when presented textually. Much like the echoic prompting trials, after the implementation of textual prompting for set 1, there was an almost immediate increase in the number of questions Walker answered correctly. During the second test probe during the training phase, Walker answered 2 out of 2 questions correctly with full sentence responses regardless of the mode that the question was presented in. This performance was maintained throughout the rest of training as well as post-training (follow-up) and generalization.

The mean number of questions answered correctly, including partially correct answers after the implementation of the textual prompt training was 1.5 out of 2 when presented vocally and was 1.8 out of 2 when presented textually. The mean number of questions answered with full correct answers was 1.3 out of 2 when presented vocally and 1.5 out of 2 possible when presented textually. During follow-up, the mean number of questions answered correctly with full sentence answers when presented vocally was 2 out of 2 and 2 out of 2 when presented textually. Walker required 80 total trials to meet acquisition and mastery criteria.

The following data are for the answers taught using echoic prompts for set 2 for Walker. When partially correct answers were included, Walker answered 0 out of 2 possible questions correctly across
all vocal baseline sessions (M = .2 out of 2) and answered 0 out of 2 possible questions correctly across all textual baseline sessions (M = 0 out of 2; see Figure 3). Without including partially correct answers, Walker answered 0 out of 2 questions correctly across all vocal baseline sessions (M = 0 out of 2) and answered 0 out of 2 questions correctly across all textual baseline sessions (M = 0 out of 2; see Figure 5).

The introduction of pre-training had no effect on the number of correct responses. The mean number of questions answered correctly including partially correct answers during pre-training sessions was .5 out of 2 when presented vocally and .3 out of 2 when presented textually. After the implementation of echoic prompting for set 2, there was an almost immediate increase in the number of questions Walker answered correctly. Again, during the second test probe during the training phase, Walker answered 2 out of 2 questions correctly with full sentence responses regardless of the mode the question was presented in. This performance was maintained throughout the rest of the training as well as post-training (follow-up) and generalization.

The mean number of questions answered correctly, including partially correct answers after the implementation of the echoic prompt training was 1.5 out of 2 when presented vocally and was 1.63 out of 2 when the question was presented textually. The mean number of questions answered with full correct answers was 1.5 out of 2 when presented vocally and 1.5 out of 2 when presented textually. During the follow-up phase, the mean number of questions answered correctly including partially correct answers was 1.8 out of 2 when presented vocally and 2 out of 2 when presented textually. The mean number of questions answered correctly without including partially correct answers during the follow-up phase was 1.7 out of 2 when presented vocally and 2 out of 2 when presented textually. Walker required 50 total trials to meet acquisition and mastery criteria.

The following data are for the answers taught using textual prompts for set 2 for Walker. When partially correct answers were included, Walker answered 0 out of 2 possible questions correctly across all vocal baseline sessions (M = 1 out of 2) and 0 out of 2 possible textual baseline sessions (M = .7 out of 2; see Figure 4). Without including partially correct answers, Walker answered 0 out of 2 possible questions correctly across all vocal baseline sessions (M = 0 out of 2) and answered 0 out of 2 possible questions correctly across all textual baseline sessions (M = 0 out of 2; see Figure 6).
The introduction of pre-training had no substantial effect on the number of correct responses. The mean number of questions answered correctly including partially correct answers during pre-training sessions was 1 out of 2 when presented both vocally and textually. Without including partially correct answers, Walker answered 0 out of 2 possible when presented both vocally and textually. Much like echoic prompting trials, after the implementation of textual prompting for set 2, there was an almost immediate increase in the number of questions Walker answered correctly. During the second test probe during the training phase, Walker answered 2 out of 2 questions correctly with full sentence responses regardless of the mode that the discriminative stimulus was presented in. This performance was maintained throughout the rest of training as well as post-training (follow-up) and generalization.

The mean number of questions answered correctly, including partially correct answers after the implementation of the textual prompt training was 1.8 out of 2 when presented both vocally and textually. The mean number of questions answered with full correct answers was 1.5 out of 2 when presented both vocally and textually. During follow-up, the mean number of questions answered correctly with full sentence answers was 2 out of 2 when presented both vocally and textually. Walker required 80 total trials to meet acquisition and mastery criteria.

The following data are for the answers taught with echoic prompts for set 3 for Walker. When partially correct answers were included, Walker answered 0 out of a possible 2 questions correctly across all vocal baseline sessions (M = .1 out of 2) and answered 0 out 2 questions correctly across all textual baseline sessions (M = 0 out of 2; see Figure 3). Without including partially correct answers, Walker answered 0 out of 2 questions correctly across all vocal and textual baseline sessions (M = 0 out of 2; see Figure 5). There were no pre-training data for this question set because Walker began answering the questions in the previous question set 3 while training for sets 1 and 2 were being conducted. Therefore another pool of questions was formed and from this pool, new questions were introduced. No pre-training was required for this data set. After the implementation of echoic prompting for set 3, there was an almost immediate increase in the number of questions Walker answered correctly. During the second test probe during the training phase, Walker answered 2 out of 2 questions correctly with a full sentence
response regardless of the mode that the question was presented in. This performance was maintained throughout the rest of the training as well as post-training (follow-up) and generalization.

The mean number of questions answered correctly, including partially correct answers after the implementation of the echoic prompt training was 1.6 out of 2 when presented vocally and was 1.5 out of 2 when presented textually. The mean number of questions answered with full correct answers was 1.5 out of 2 when presented vocally and 1.5 out of 2 when presented textually. During follow-up, the mean number of questions answered with correct full sentence answers was 2 out of 2 when presented both vocally and textually. Walker required 50 total trials to meet acquisition and mastery criteria.

The following data are for the answers taught using textual prompts for set 3 for Walker. When partially correct answers were both included and not included, Walker answered 0 out of 2 possible questions correctly across all vocal and textual baseline sessions (M = 0 out of 2; see Figures 4 & 6). Again, there were no pre-training data for this question set because the previous question set 3 had been mastered. Therefore another pool of questions was formed and from this pool, new questions were introduced. No pre-training was required for this set of questions. Much like the echoic prompting trials, after the implementation of textual prompting, there was an almost immediate increase in the number of questions Walker answered correctly. During the second test probe during the training phase, Walker answered 2 out of 2 possible questions correctly with full sentence responses regardless of the mode that the discriminative stimulus was presented in. This performance was maintained throughout the rest of training as well as post-training (follow-up) and generalization.

The mean number of questions answered correctly, including partially correct answers after the implementation of the echoic prompt training was 1.4 out of 2 when presented vocally and 1.4 out of 2 presented textually. The mean number of questions answered with full correct answers was 1.5 out of 2 when presented both vocally and textually. During follow-up, the mean number of questions answered with full correct sentence answers was 2 out of 2 when presented both vocally and textually. Walker required 60 total trials to meet acquisition and mastery criteria.

The number of questions Parker answered correctly during test probes, including partially correct answers, is depicted in Figure 7 for answers taught with echoic prompts and Figure 8 for answers taught
Teaching Intraverbal Behavior 18

with textual prompts. The number of questions Parker answered with only correct full answers during test probes is depicted in Figure 9 for answers taught with echoic prompts and Figure 10 for answers taught with textual prompts.

The following data are for the answers taught with echoic prompts for set 1 for Parker. When partially correct answers were both included and no included, Parker answered 0 out of a 2 possible questions correctly across all vocal and textual baseline sessions (M = 0 out of 2; see Figures 7 & 9). The introduction of pre-training had little effect on the number of full correct responses. The mean number of questions answered correctly including partially correct answers during pre-training sessions was .3 out of 2 when presented vocally and 0 out of 2 when presented textually. Without including partially correct answers, Parker answered 0 out of 2 when presented vocally and 0 out of 2 when presented textually. After the implementation of echoic prompting, there was an immediate increase in the number of questions Parker answered correctly. During the fifth test probe during the training phase, Parker answered 2 out of a possible 2 questions correctly with a full sentence response regardless of the mode that the question was presented in. This performance was maintained throughout most of the training as well as post-training (follow-up) and generalization.

The mean number of questions answered correctly, including partially correct answers after the implementation of the echoic prompt training was 1.8 out of 2 when presented vocally and was 1.5 out of 2 when the question was presented textually. The mean number of questions answered with full correct answers was 1.7 out of 2 when presented vocally and 1.3 out of 2 when presented textually. During the follow-up phase the mean number of questions correctly answered including partially corrected answers was 2 out of 2 when presented vocally and 1.8 out of 2 possible when presented textually. The mean number of questions answered with complete sentences was 2 out of 2 when presented vocally and was 1.7 out of 2 when presented textually. Parker required 80 total trials to meet acquisition and mastery criteria.

The following data are for the answers taught with textual prompts for set 1 for Parker. When partially correct answers were both included and not included, Parker answered 0 out of 2 questions correctly across all vocal and textual baseline sessions (M = 0 out of 2; see Figures 8 & 10). The
introduction of pre-training had no effect on the number of correct responses. The mean number of questions answered correctly including partially correct answers and without including partially correct answers during pre-training sessions was 0 out of 2 when presented both vocally and textually. Unlike echoic prompting trials, after the implementation of textual prompting for set 1, there was almost no increase in the number of questions Parker answered correctly (including partially correct answers, vocal probes: $M = .1$ out of 2; textual probes: $M = 0$ out of 2; with no partially correct answers vocal probes: $M = 0$ out of 2, vocal probes: $M = 0$ out of 2). Due to insufficient progress and prior to the 5th probe session, echoic prompting was implemented in place of textual prompting.

After the prompting change and including partially correct answers, Parker answered a mean of 1.9 out of 2 questions correctly when presented vocally and a mean of 1.8 out of 2 questions when presented textually. Without the inclusion of partially correct answers, Parker answered a mean of 1.7 out of 2 when presented both vocally and textually. This performance was maintained throughout the rest of training as well as post-training (follow-up) and generalization. During the follow-up phase, the mean number of questions answered correctly including partially correct answers was 2 out of 2 when presented vocally and 1.8 out of 2 when presented textually. The mean number of questions answered with full correct answers was 2 out of 2 when presented vocally and 1.7 out of 2 when presented textually. Parker required 200 total trials to meet acquisition and mastery criteria.

The following data are for the answers taught with echoic prompts for set 2 for Parker. When partially correct answers were included, Parker answered 0 out of 2 questions correctly across all vocal baseline sessions ($M = .2$ out of 2) and answered 0 out of 2 possible questions correctly across all textual baseline sessions ($M = 0$ out of 2; see Figure 7). Without including partially correct answers, Parker answered 0 out of 2 possible questions correctly across all vocal and textual baseline sessions ($M = 0$ out of 2; see Figure 9).

The introduction of pre-training had little effect on the number of full correct responses. The mean number of questions answered correctly including partially correct answers during pre-training was .1 out of 2 when presented vocally and textually. Without including partially correct answers, Parker answered 0 out of 2 questions when presented vocally and textually. After the implementation of echoic
prompting for set 2, there was an immediate increase in the number of questions Parker answered correctly. During the third test probe during the training phase, Parker answered 2 out of a possible 2 questions correctly with a full sentence response regardless of the mode that the question was presented in. This performance was maintained throughout the training as well as post-training (follow-up) and generalization.

The mean number of questions answered correctly, including partially correct answers after the implementation of the echoic prompt training was 1.6 out of 2 questions when presented vocally and was 1.7 out of 2 when the question was presented textually. The mean number of questions answered with full correct answers was 1.5 out of 2 when the question was presented vocally and 1.7 out of 2 when presented textually. During the follow-up phase the mean number of questions answered with full correct answers was 2 out of 2 questions when presented vocally and textually. Parker required 120 total trials to meet acquisition and mastery criteria.

The following data are for the answers taught with textual prompts for set 2 for Parker. When partially correct answers were included, Parker answered 0 out of a 2 questions correctly across all vocal baseline sessions (M = 0 out of 2) and answered 0 out of 2 questions correctly across all textual baseline sessions (M = .8 out of 2; see Figure 8). Without including partially correct answers, Parker answered 0 out of 2 questions correctly across all vocal and textual baseline sessions (M = 0 out of 2; see Figure 10).

The introduction of pre-training had no effect on the number of full correct responses. The mean number of questions answered correctly including partially correct answers and without including partially correct answers during pre-training sessions was 0 out of 2 when presented vocally and textually. After the implementation of textual prompting, there was an immediate increase in the number of questions Parker answered correctly during vocal probes. During the fifth test probe during the training phase, Parker answered 2 out of a possible 2 questions correctly with a full sentence response regardless of the mode that the question was presented in. This performance was maintained throughout the rest of the training as well as post-training (follow-up) and generalization.

The mean number of questions answered correctly, including partially correct answers, after the implementation of the textual prompt training was 1.3 out of 2 when presented vocally and was .8 out of 2
when presented textually. The mean number of questions answered with full correct answers was 1 out of 2 when presented vocally and .7 out of 2 when presented textually. During the follow-up phase, the mean number of questions answered with full correct answers was 2 out of 2 when presented vocally and textually. Parker required 120 total trials to meet acquisition and mastery criteria.

The following data are for the answers taught with echoic prompts for set 3 for Parker. When partially correct answers were included and not included, Parker answered 0 out of a 2 possible questions correctly across all vocal and textual baseline sessions (M = 0 out of 2; see Figures 7 & 9).

The introduction of pre-training had little effect on the number of full correct responses. The mean number of questions answered correctly including partially correct answers and without including partially correct answers during pre-training sessions when presented vocally and textually was 0 out of 2. After the implementation of echoic prompting, there was an immediate increase in the number of questions Parker answered correctly. During the second test probe during the training phase, Parker answered 2 out of a possible 2 questions correctly with a full sentence response regardless of the mode that the question was presented in. This performance was maintained throughout most of the training as well as post-training (follow-up) and generalization.

The mean number of questions answered correctly, including partially correct answers, after the implementation of the echoic prompt training was 1.9 out of 2 when presented vocally and textually. The mean number of questions answered with only full correct answers was 1.7 out of 2 when presented vocally and textually. During the follow-up phase the mean number of questions answered with full correct answers was 2 out of 2 when presented vocally and textually. Parker required 70 total trials to meet acquisition and mastery criteria.

The following data are for the answers taught with textual prompts for set 3 for Parker. When partially correct answers were included, Parker answered 0 out of 2 possible questions correctly across all vocal baseline sessions (M = 0.5 out of 2) and answered 0 out of 2 possible questions correctly across all textual baseline sessions (M = 0.5 out of 2; see Figure 8). Without including partially correct answers, Parker answered 0 out of 2 questions correctly across all vocal and textual baseline sessions (M = 0 out of 2; see Figure 8).
The introduction of pre-training had no effect on the number of full correct responses. The mean number of questions answered correctly including partially correct answers and without including partially correct answers during pre-training sessions was 0 out of 2 when presented vocally and textually. After the implementation of textual prompting, there was an almost immediate increase in the number of questions Parker answered correctly. During the fourth test probe during the training phase, Parker answered 2 out of a possible 2 questions correctly with a full sentence response regardless of the mode that the question was presented in. This performance was maintained throughout the rest of the training as well as post-training (follow-up) and generalization.

The mean number of questions answered correctly, including partially correct answers after the implementation of the textual prompt training was 1.6 out of 2 when presented vocally and was 1.4 out of 2 when presented textually. The mean number of questions answered with full correct answers was 1.6 out of 2 when presented vocally and 1.4 out of 2 when presented textually. The mean number of questions answered correctly during the follow-up phase when questions were asked vocally and textually was 2 out of 2 possible. No partial answers were ever given during follow-up. Parker required 110 total trials to meet acquisition and mastery criteria.

Because of the results from set 1, an additional set of questions for Parker were included to ensure that it was the prompting procedures that influenced his acquisition and not inexperience with the procedures. The following data are for answers taught using echoic prompts for set 4 for Parker. When partially correct answers were included, Parker answered 0 out of 2 possible questions correctly across all vocal baseline sessions (M = 0 out of 2) and answered .5 out of 2 possible questions correctly across all textual baseline sessions (M = .5 out of 2; see Figure 7). Without including partially correct answers, Parker answered 0 out of 2 when the question was presented vocally and textually (see Figure 9). Pre-training was not needed for this question set. After the implementation of echoic prompting, there was an immediate increase in the number of questions Parker answered correctly. During the first test probe during the training phase, Parker answered 2 out of a possible 2 questions correctly with a full sentence response regardless of the mode that the question was presented in. This performance was maintained throughout the rest of the training as well as post-training (follow-up) and generalization.
The mean number of questions answered correctly with full sentence answers after the implementation of the echoic prompt training when the question was asked vocally and textually was 2 out of 2. The mean number of questions answered correctly during the follow-up phase when questions were asked vocally and textually was 2 out of 2. After the introduction of training, Parker only responded with full complete answers. Parker required 50 total trials to meet acquisition and mastery criteria.

The following data are for the answers taught using textual prompts for set 4, for Parker. When partially correct answers were included and not included, Parker answered 0 out of 2 possible questions correctly across all vocal and textual baseline sessions (M = 0 out of 2; see Figures 8 & 10). Pre-training was again not needed for this question set. After the implementation of textual prompting, there was an immediate increase in the number of questions Parker answered correctly. During the first test probe during the training phase, Parker answered 2 out of 2 questions correctly with a full sentence response regardless of the mode that the question was presented in. This performance was maintained throughout the rest of the training as well as post-training (follow-up) and generalization.

The number of questions Benjamin answered correctly during test probes, including partially correct answers, are depicted in Figure 11 for answers taught with echoic prompts and Figure 12 for answers taught with textual prompts. The number of questions Benjamin answered with only correct full answers during test probes is depicted in Figure 13 for answers taught with echoic prompts and Figure 14 for answers taught with textual prompts.

The following data are for the answers taught with echoic prompts for set 1 for Benjamin. When partially correct answers were included and not included, Benjamin answered 0 out of 2 possible questions correctly across all vocal and textual baseline sessions (M = 0 out of 2; see Figures 11 & 13).
The introduction of pre-training had little effect on the number of full correct responses. The mean number of questions answered correctly including partially correct answers and without including partially correct answers during pre-training sessions when presented vocally and textually was 0 out of 2. After the implementation of echoic prompting, there was an immediate increase in the number of questions Benjamin answered correctly when asked vocally. During the third test probe during the training phase, Benjamin answered 2 out of a possible 2 questions correctly with a full sentence response but only when asked vocally.

Prior to the transfer of stimulus control procedure, the mean number of questions answered correctly including partially correct answers was 1.6 out of 2 when presented vocally and was 0 out of 2 when presented textually. Without including partially correct answers, the mean number of questions answered correctly was 1.5 out of 2 when presented vocally and 0 out of 2 when presented textually. It was only after the transfer of stimulus control procedure that Benjamin responded correctly to the textual probes. After the transfer of stimulus control procedure, the mean number of questions including partially correct answers that Benjamin answered was 1.8 out of 2 when presented vocally and 2 out of 2 when asked in a textual format. Without including partially correct answers, the mean number of questions answered correct was 1.5 out of 2 when presented vocally and 2 out of 2 when presented textually. This performance was maintained throughout most of the training as well as post-training (follow-up) and generalization. During the follow-up phase the mean number of questions answered with full correct answers was 2 out of 2 when presented vocally and textually. Benjamin required 110 total trials to meet acquisition and mastery criteria.

The following data are for the answers taught with textual prompts for set 1 for Benjamin. When partially correct answers were included and not included, Benjamin answered 0 out of a 2 possible questions correctly across all vocal and textual baseline sessions (M = 0 out of 2; see Figures 12 & 14). The introduction of pre-training had little effect on the number of full correct responses. The mean number of questions answered correctly including partially correct answers and without including partially correct answers during pre-training sessions when presented vocally and textually was 0 out of 2. After the implementation of textual prompting, there was an immediate increase in the number of
questions Benjamin answered correctly when asked vocally. During the third test probe during the
training phase, Benjamin answered 2 out of a possible 2 questions correctly with a full sentence response
but only when asked vocally.

Prior to the transfer of stimulus control procedure, the mean number of questions answered
correctly including partially correct answers and without including partially correct answers was 1.7 out
of 2 when presented vocally and was 0 out of 2 when presented textually. It was only after the transfer of
stimulus control procedure that Benjamin responded correctly to the textual probes. After the transfer of
stimulus control procedure, the mean number of questions that Benjamin answered including partially
correct answers and not including partially correct answers was 2 out of 2 when presented vocally and
textually. This performance was maintained throughout most of the training as well as post-training
(follow-up) and generalization. During the follow-up phase the mean number of questions answered with
full correct answers was 2 out of 2 when presented vocally and textually. Benjamin required 130 total
trials to meet acquisition and mastery criteria.

The following data are for the answers taught with echoic prompts for set 2 for Benjamin. When
partially correct answers were included and not included, Benjamin answered 0 out of a 2 possible
questions correctly across all vocal and textual baseline sessions (M = 0 out of 2; see Figures 11 & 13).
The introduction of pre-training had no effect on the number of full correct responses. The mean number
of questions answered correctly including partially correct answers and without including partially correct
answers during pre-training sessions when presented vocally and textually was 0 out of 2. After the
implementation of echoic prompting, there was an immediate increase in the number of questions
Benjamin answered correctly. It should be noted that during the probes during the training phase,
Benjamin never answered all four questions correctly with full correct answers regardless of the mode
that the questions were asked in. However, there was a significant increase in the amount of questions
answered correctly. The mean number of questions answered correctly, including partially correct
answers, after the implementation of the echoic prompt training was 1.6 out of 2 when presented vocally
and was .9 out of 2 when presented textually. The mean number of questions answered with only full
correct answers was 1.4 out of 2 when presented vocally and .6 out of 2 when presented textually. During
the follow-up phase the mean number of questions answered with full correct answers was 2 out of 2 when presented vocally and textually. Benjamin required 80 total trials to meet acquisition and mastery criteria.

The following data are for the answers taught with textual prompts for set 2 for Benjamin. When partially correct answers were included and not included, Benjamin answered 0 out of a 2 questions correctly across all vocal and textual baseline sessions (M = 0 out of 2; see Figures 12 & 14). The introduction of pre-training had little effect on the number of full correct responses. The mean number of questions answered correctly including partially correct answers during pre-training sessions was 0 out of 2 when presented vocally and 0.3 out of 2 when presented textually. Without including partially correct answers, Benjamin answered 0 out of 2 questions when presented vocally and textually. After the implementation of textual prompting, there was an immediate increase in the number of questions Benjamin answered correctly. It should be noted that during the probes during the training phase, Benjamin never answered all four questions correctly with full correct answers regardless of the mode that the questions were asked in. However, there was a significant increase in the amount of questions answered correctly. This performance was maintained throughout the rest of the training as well as post-training (follow-up) and generalization.

The mean number of questions answered correctly, including partially correct answers, after the implementation of the textual prompt training was 1.7 out of 2 when presented vocally and was 1.3 out of 2 when presented textually. The mean number of questions answered with full correct answers was 1.4 out of 2 when presented vocally and 1.2 out of 2 when presented textually. During the follow-up phase, the mean number of questions answered including partially correct answers was 2 out of 2 when presented vocally and 1.8 out of 2 when presented textually. The mean number of questions answered without partially correct answers was 2 out of 2 when presented vocally and 1.7 out of 2 when presented textually. Benjamin required 110 total trials to meet acquisition and mastery criteria.

The following data are for the answers taught with echoic prompts for set 3 for Benjamin. When partially correct answers were included and not included, Benjamin answered 0 out of 2 questions correctly across all vocal and textual baseline sessions (M = 0 out of 2; see Figures 11 & 13). The
introduction of pre-training had no effect on the number of full correct responses. The mean number of questions answered correctly including partially correct answers and without including partially correct answers during pre-training sessions was 0 out of 2 when presented vocally and textually. It should be noted that Benjamin never responded with a full and complete answer during the pre-training phase regardless of the mode the probe was conducted in. After the implementation of echoic prompting for set 3, there was an immediate increase in the number of questions Benjamin answered correctly. During the fourth test probe during the training phase, Benjamin answered 2 out of a possible 2 questions correctly with a full sentence response regardless of the mode the question was asked in. This performance was maintained throughout most of the training as well as post-training (follow-up) and generalization.

The mean number of questions answered correctly, including partially correct answers, after the implementation of the echoic prompt training was 1.4 out of 2 when presented vocally and textually. The mean number of questions answered with only full correct answers was .8 out of 2 when presented vocally and 1 out of 2 when presented textually. During the follow-up phase the mean number of questions answered with full correct answers was 2 out of 2 when presented both vocally and textually. Benjamin required 110 total trials to meet acquisition and mastery criteria.

The following data are for the answers taught with textual prompts for set 3 for Benjamin. When partially correct answers were included and not included, Benjamin answered 0 out of 2 questions correctly across all vocal and textual baseline sessions (M = 0 out of 2; see Figures 12 & 14). The introduction of pre-training had no effect on the number of full correct responses. The mean number of questions answered correctly including partially correct answers during pre-training sessions was .1 out of 2 when presented vocally and textually. Without including partially correct answers, Benjamin answered 0 out of 2 questions when presented vocally and textually. It should be noted that Benjamin never responded with a full and complete answer during the pretraining phase regardless of the mode the probe was conducted in. After the implementation of textual prompting, there was an immediate increase in the number of questions Benjamin answered correctly. During the second test probe during the training phase, Benjamin answered 2 out of a possible 2 questions correctly with a full sentence response
regardless of the mode the question was asked in. This performance was maintained throughout most of the training as well as post-training (follow-up) and generalization.

The mean number of questions answered correctly, including partially correct answers, after the implementation of the textual prompt training was 1.8 out of 2 when presented vocally and was 2 out of 2 when presented textually. The mean number of questions answered with only full correct answers was 1.5 out of 2 when presented vocally and 2 out of 2 when presented textually. During the follow-up phase the mean number of questions answered with full correct answers was 2 out of 2 when presented both vocally and textually. Benjamin required 80 total trials to meet acquisition and mastery criteria.

Discussion

Overall, these findings replicate those of Keenan, et al. (in prep) who found that echoic prompts resulted in faster acquisition when compared to textual prompts, but conflict with the findings of Finkel and Williams (2001) who found that textual prompts resulted in faster acquisition than echoic prompts. In the current study, echoic and textual prompting were effective in teaching children with autism to respond appropriately to intraverbal exchanges such as social questions. The results of the comparison of the two procedures suggest that echoic prompting strategies were more effective for the three participants included in the study with the exception of Benjamin’s third set of questions.

Acquisition data for Walker show that the total number of trials required to meet criteria were lower when the answers were taught using echoic prompts. Additionally, visual inspection of the data during post-training, generalization, and maintenance show that, regardless of the discriminative stimulus provided, Walker consistently produced full correct answers previously taught with echoic prompts. Additionally, the total number of training trials Walker required to meet criteria for textually prompted answers declined after set 1, suggesting that with repeated exposure to the prompting strategy, the procedure could become more efficient. It’s important to note, however, that the number of trials required for answers taught with the echoic prompts was consistent across the three question sets, suggesting that more stable levels of responding may be associated with this prompt type.

There are a couple of possible explanations as to why Walker acquired the correct response prior to training for the original third set of questions. First, incidental teaching may have occurred outside the
context of training. That is, the correct answers may have become part of Walker’s repertoire through teaching that occurred outside of the study. Second, it is possible that the previous teaching of intraverbal responses led to response generalization for the third set. The second possibility lends to the importance of requiring grammatically correct sentences for intraverbal exchanges from children with autism. If a skill generalizes after a small amount of repeated exposures, less training could be necessary for other exchanges.

Acquisition data for Parker also show that the total number of trials required to meet mastery criteria were lower when the answers were taught using echoic prompts. Again, visual inspection of the data during post-training, generalization, and maintenance show that Parker responded correctly to both textual and vocal discriminative stimuli appropriately over a period of time. Parker’s data differ from Walker’s data in that he did not originally respond in the presence of the questions presented in a textual format. Upon visual inspection of the data, it did not appear that Parker was acquiring the correct responses through the textual prompts during set 1. An initial lack in responding to the question when presented as a textual script led us to this conclusion. Because of this lack of acquisition, the prompting strategy was changed from textual to echoic prompts. Later an increase in accurate responding during set 2 indicated that it may have been unfamiliarity with the procedures rather than a lack of skill acquisition that resulted in the slower acquisition rates seen in set 1. By including the 4th set of questions we verified that Parker acquired the skill through both prompts types and further solidified the hypothesis that unfamiliarity rather than a flaw in the procedures resulted in lower acquisition rates for textual prompts rather than echoic prompts.

Benjamin’s results differ from the other two participants’ results. Acquisition data for Benjamin show that the total number of trials required to meet criteria were also lower when the answers were taught using echoic prompts for sets 1 and 2. However, textual prompting actually resulted in faster acquisition for set 3 then echoic prompting. It is unclear as to why this occurred; however the following are a few possible explanations. First, similar to Parker, acquisition rates could have increased for textual prompts due to familiarity with the procedures. Secondly, when the prompts were presented in a textual format, the script remained in front of the participant and allowed him to refer back to the script. This is
very unlike an echoic prompt that occurs at a certain point in time and then is gone. The presence of the
textual script may allow more time for the participant to attend to and process the prompt. Third and
anecdotally, Benjamin seemed to have a hard time producing the response, “Massachusetts” for one of the
questions in set 3 that was taught by echoic prompts. Perhaps, then, it was the lack of familiarity with the
word or an articulation problem and not the training procedures that impacted his acquisition for this
question set.

Additionally, Benjamin’s results are interesting in that he acquired the skill to respond to the
question regardless of the mode it was presented in only after a transfer of stimulus control procedure was
implemented. Prior to the transfer of control procedure, Benjamin only responded to the question
appropriately when it was presented vocally and would only respond to the question when presented in a
textual format when the training materials were also present. The transfer of control procedure allowed
the control to transfer from the training materials to the textual script. Again this could have been due to
a lack of familiarity with the procedures as responding vocally to textual questions may not have been in
his repertoire prior to training.

There are several reasons why the echoic prompts may have been more effective than the textual
prompts for most participants. First, as discussed by Keenan et al. (in prep), it is possible “that the use of
auditory stimuli facilitated the transfer of control from the echoic prompt to the initial verbal stimulus
more efficiently than the textual stimuli.” However, the possibility of facilitation by the auditory stimuli
was controlled for by presenting the questions used for textual prompts as a textual script. Presenting all
questions both vocally and textually during probe sessions may have also controlled for the possibility of
auditory stimuli facilitation. It is important to note, however, that the auditory stimuli produced by each of
the participants’ responses was more similar to the auditory stimulus presented in the echoic prompting
trials and may have played a part in the faster acquisition rates. It is possible that facilitation by the
auditory stimuli could be controlled for by requiring the participants to respond in a textual format during
the textual probes and prompting procedures. This responding in a textual format could be achieved by
requiring the participant to respond by writing his response or by choosing from an array of words in a
textual format.
Keenan and colleagues (in prep) also hypothesized that echoic prompts may have resulted in quicker acquisition rates due to the reading abilities of the students. Similarly, according to Finkel and Williams (2001), the participant in their study had higher than average reading abilities. The participants in both the Keenan study and the current study had a wide range of reading abilities. Like the Keenan study, the results showed that while echoic prompting was more effective across participants, the magnitude of the difference was not constant across them. However, this is where similarities end. For example, although Walker read fewer words at baseline than Parker, he acquired the answers to the question sets faster than Parker. Conversely, Parker read more words at baseline than Walker, but required four sets of questions to determine accurate acquisition rates. These data may discredit the hypothesis by Keenan and colleagues that the more words the participant could read prior to the study, the more efficiently stimulus control was transferred from the textual prompt to the initial verbal stimulus. Benjamin’s data support this claim in that he read only 38.2% of words at baseline, but was the only participant who had a set of answers in which textual prompting better facilitated acquisition for at least one question set.

The findings of this study support most of the findings of Keenan (2007) but also lend some support to the findings of the Finkel and Williams (2001) study. The use of textual prompts may not be superior to teach intraverbal behavior to children with autism but still result in the acquisition of intraverbal behavior. For Walker, it took slightly less trials to reach criteria for answers taught with echoic prompts than textual prompts. For Parker, it took the same amount of trials to reach criteria for echoic and textual prompts for two data sets. For Benjamin, it took fewer trials to reach criteria for textual prompts than echoic prompts for one data set.

It should be noted that the lengths of sessions for textual prompting were longer than those for echoic prompting. The length of sessions may be important when determining which prompting type one should use to teach a skill such as intraverbal behavior. The time delay and backward fading procedures may have also helped to facilitate both prompting strategies because they allowed for independent responses to occur before the prompt was provided. An error history was never formed for any of the
participants in this study, however, participants in future research may require a more intrusive prompting procedure such that an error history is not formed.

Despite the importance of the results of this study, it still has its limitations. Like the Keenan study, the current study did not take probe data into account when determining the criteria for mastery. Taking these data into consideration may have resulted in faster acquisition as evidenced by several participants’ data. For example, during his first set, Walker independently produced full correct answers during the second probe session during training regardless of the mode the question was presented in. However, he required 50 total trials to reach mastery criteria for the responses taught with echoic prompts and 80 total trials to reach mastery criteria for the responses taught with textual probes. In future research probe data should be taken into account when determining mastery criteria.

Another limitation was that the participant was always required to respond vocally regardless of the prompting procedure. As stated previously, the act of responding vocally more closely resembled the auditory stimulus of the echoic prompts. Anecdotally one must note that although the participants were never instructed to either read the question when presented textually or to read them aloud, every participant always engaged in both of these behaviors. The responses being produced vocally may have resulted in faster acquisition with echoic prompts. Future research should investigate the impact that requiring the participant to respond in a textual format to textual questions or when taught using textual prompts would have.

Here we must note that an attempt was made to evenly distribute the number of words across textually and echoically prompted responses. This included both questions and answers such that the participants did not have to either listen to or read more words in either mode. This was done as a precaution to equate effort across textual and echoic prompts. All questions and examples of grammatically correct answers can be seen in Appendix A.

Although these data also lend support to the idea that participant specific criteria should be taken into consideration when choosing prompting strategies for children with autism, future research should expand and test these prompting strategies with children with echolalia. The use of textual prompts may
provide a break in the behavior chain associated with echolalia and may allow for more independent responding.

As it stands, numerous studies have demonstrated the effectiveness of both echoic and textual prompting procedures. However, more research needs to be conducted to determine the efficiency of both procedures which may or may not include the amount of time that is required to prepare the materials needed for both prompting strategies. The amount of time that goes into preparing the scripts and stimuli used in textual prompting may not be worth spending depending on the rates of acquisition associated with that prompting style for some participants. The aforementioned criteria must all be taken into account when determining the best prompting procedures for each student.
References


### Appendix A: Questions Taught

<table>
<thead>
<tr>
<th>Walker</th>
<th>Question Set 1</th>
<th>Question Set 2</th>
<th>Question Set 3</th>
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<tr>
<td>E</td>
<td>What do dentists do?</td>
<td>Who flies a plane?</td>
<td>When do you eat lunch?</td>
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<tr>
<td>E</td>
<td>What classroom are you in?</td>
<td>What state do you live in?</td>
<td>How do you get clean?</td>
</tr>
<tr>
<td>T</td>
<td>When do you sleep?</td>
<td>What color is the sky?</td>
<td>When do you laugh?</td>
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<tr>
<td>T</td>
<td>What is your full name?</td>
<td>Who drives a tractor?</td>
<td>How do you get to school?</td>
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</table>

<table>
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<tr>
<th>Parker</th>
<th>Question Set 1</th>
<th>Question Set 2</th>
<th>Set 3</th>
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</thead>
<tbody>
<tr>
<td>E</td>
<td>What do you cut with?</td>
<td>What do you bounce?</td>
<td>Where do you buy food?</td>
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<tr>
<td>E</td>
<td>What do firefighters do?</td>
<td>What state do you live in?</td>
<td>How do you get clean?</td>
</tr>
<tr>
<td>T</td>
<td>What do you write with?</td>
<td>What do you read?</td>
<td>How do you get to school?</td>
</tr>
<tr>
<td>T</td>
<td>What do dentists do?</td>
<td>Who helps you when you're sick?</td>
<td>When do you sleep?</td>
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#### Parker Question Set 4

| E | What do you cut with? |
| E | What do firefighters do? |
| T | What do you write with? |
| T | What do dentists do? |

<table>
<thead>
<tr>
<th>Benjamin</th>
<th>Set 1</th>
<th>Set 2</th>
<th>Set 3</th>
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<tbody>
<tr>
<td>E</td>
<td>What is your dad's name?</td>
<td>What is your mom's name?</td>
<td>What is your address?</td>
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<td>E</td>
<td>What do you see with?</td>
<td>What do you hear with?</td>
<td>What state do you live in?</td>
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<tr>
<td>T</td>
<td>What is your last name?</td>
<td>What is your phone number?</td>
<td>What is your full name?</td>
</tr>
<tr>
<td>T</td>
<td>What do you drink from?</td>
<td>What is your brother's name?</td>
<td>What color is the sky?</td>
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Appendix B: Prompting Steps

Echoic Prompting

Sd: “What do you cut with?”

Step 0: “I cut with scissors.”
Step 1: “I cut with”
Step 2: “I cut”
Step 3: “I”
Step 4: no prompt given

Textual Prompting

Sd: What do you cut with?

Step 0: I cut with scissors.
Step 1: I cut with
Step 2: I cut
Step 3: I
Step 4: no prompt given
Table 1.

*Training Sessions IOA*

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<th>Benjamin</th>
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*Probe Sessions IOA*

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Table 2

Procedural Integrity (PI) for Training Sessions

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Procedural Integrity (PI) for Probe Sessions

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Figure Captions

Figure 1. Trials to criteria across all participants.

Figure 2. Cumulative trials to criteria and percentage of words read during pretraining phase 1.

Figure 3. The number of questions Walker answered including partially correct answers during test probes for answers taught with echoic prompts.

Figure 4. The number of questions Walker answered including partially correct answers during test probes for answers taught with textual prompts.

Figure 5. The number of questions Walker answered without including partially correct answers during test probes for answers taught with echoic prompts.

Figure 6. The number of questions Walker answered without including partially correct answers during test probes for answers taught with textual prompts.

Figure 7. The number of questions Parker answered including partially correct answers during test probes for answers taught with echoic prompts.

Figure 8. The number of questions Parker answered including partially correct answers during test probes for answers taught with textual prompts.

Figure 9. The number of questions Parker answered without including partially correct answers during test probes for answers taught with echoic prompts.

Figure 10. The number of questions Parker answered without including partially correct answers during test probes for answers taught with textual prompts.

Figure 11. The number of questions Benjamin answered including partially correct answers during test probes for answers taught with echoic prompts.

Figure 12. The number of questions Benjamin answered including partially correct answers during test probes for answers taught with textual prompts.

Figure 13. The number of questions Benjamin answered without including partially correct answers during test probes for answers taught with echoic prompts.

Figure 14. The number of questions Benjamin answered without including partially correct answers during test probes for answers taught with textual prompts.
Figure 15. Acquisition rates for sets 1, 2, and 3 for Walker.

Figure 16. Acquisition rates for sets 1, 2, 3, and 4 for Parker.

Figure 17. Acquisition rates for sets 1, 2, and 3 for Benjamin.
Figure 1.
Figure 2.

Cumulative Number of Trials to Criterion

Percentage of words read

Walker 69.2%  Parker 88.9%  Benjamin 38.2%

Echoic
Textual
Figure 3
Figure 4
Figure 5
Figure 7
Figure 8
Figure 9

Teaching Intraverbal Behavior 50
Figure 10
Figure 11
Figure 14
Figure 15

Teaching Intraverbal Behavior 56
Figure 17