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Using Mand Training to Establish an Echoic Repertoire in Young Children with Autism

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This research describes a method that initially establishes a mand repertoire as the first component in producing echoic and tact repertoires in young children with limited verbal repertoires. The subjects were 3 nonverbal children with autism, aged 2.5 to 3.5 years. The results indicated that establishing a mand repertoire as the starting point for echoic training produced the acquisition of an initial echoic repertoire in all 3 children within the first 10 sessions. Two of the children also began tacting during the same period. A mand repertoire was acquired by all subjects by the sixth session. Negative vocal behavior was rapidly reduced without the use of aversive contingencies by shaping inappropriate vocalizations into acceptable vocal mands. Our discussion analyzes those contingencies that contribute to the effectiveness of the manding procedure and compares this procedure with the conventional vocal imitation model. We also discuss variables that may contribute to the long-term success of language training programs and describe strategies for preventing language delay in typical infants and children.

One of the most challenging tasks in establishing functional verbal repertoires in autistic and other language-delayed children is teaching vocal imitation to children who have no speech and no ability to imitate. Unfortunately, many professionals have abandoned these children entirely because of the effort required (Koegel, O'Dell, & Dunlap, 1988). For many years, the conventional approach to teaching verbal behavior to nonverbal autistic children was to target vocal imitation as the first step. This approach was based on the assumption that verbal behavior was acquired by imitating an adult model. Behavioral language research originated with verbal imitation training because successful imitation made the teaching of other forms of verbal behavior possible (Sundberg, 1990). During the 1970s a number of behavioral language programs that incorporated vocal imitation as the first step began to appear (Drash & Leibowitz, 1973; Guess, Sailor, & Baer, 1976; Kent, 1974; Lovaas, 1977). Imitative vocal behavior was shaped by reinforcing successive approximations to the therapist's sounds and then shaping the sounds into words, phrases, and sentences.

These early language programs emphasized basic operant techniques such as reinforcement, prompting, shaping, chaining, and stimulus control (Sundberg, 1990). However, this extensive body of research made almost no use of the concepts that appear in Skinner's (1957) *Verbal Behavior* (Michael, 1984). Although some researchers and

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therapists had success with imitative models, teaching echoic behavior to nonverbal children continues to be more of an art than a science. According to Lovaas, there are only a few professionals who can teach verbal imitation (Johnson, 1994).

Researchers have recently shown an interest in applying Skinner's (1957) analysis of verbal behavior to teaching vocal language to the developmentally disabled (Sundberg, 1990, 1991). In particular, the mand as a class of verbal behavior has attracted interest because of the emphasis on functionality as the criterion by which programs for the developmentally disabled are evaluated. As stated by Shafer (1994),

> When the characteristics of the mand are compared with those of other verbal operants, the advantages of teaching a mand repertoire become evident. The reinforcement for the mand is the item or event manded and directly benefits the speaker. . . . Since . . . the establishing operations that control the mand are often powerful, these factors strongly indicate that a mand repertoire would be acquired more rapidly than a tact repertoire by learners who have limited verbal behavior. (p. 58)

This same analysis also suggests that a mand repertoire would be acquired more rapidly than an echoic repertoire.

Techniques for establishing mand repertoires have been investigated by many researchers and are the subject of reviews by Shafer (1994) and Brady, Saunders, and Spradlin (1994). Hall and Sundberg (1987) evaluated the effects of teaching mands by manipulating conditioned establishing operations (CEOs) (Michael, 1982, 1988, 1993; Sundberg, 1993) as the independent variable. The procedure involved teaching subjects to complete chains of behavior ending in reinforcement. Stimulus items needed to complete the chain were then omitted. For example, a subject was first taught to obtain candy from a vending machine and then was required to mand for coins. Subjects were taught to mand for omitted items through tact or imitative prompting. Stimulus control was then successfully transferred to CEOs by fading tact and echoic prompts. The results showed that mands occurred reliably only after direct mand training, demonstrating the functional independence of mand and tact repertoires. Tact and echoic prompts were equally effective in producing a mand repertoire. These results demonstrated the importance of manipulating CEOs as an independent variable in mand training. In other research Stafford, Sundberg, and Braam (1988) investigated the relative effectiveness of specific reinforcement (i.e., the item requested) versus nonspecific reinforcement (i.e., an item not requested) in establishing verbal behavior. Specific reinforcers produced stronger verbal behavior than did nonspecific reinforcers when response strength was measured in terms of latency and stimulus preference. The subject selected specific reinforcers and responded more rapidly when they were available.

In a related study, Braam and Sundberg (1991) further evaluated the effects of specific versus nonspecific reinforcement on the acquisition of tact responding. The results demonstrated that these two consequences had an equal effect on the rate of acquisition and resistance to extinction of tact responses. However, specific reinforcers produced more untrained mand compliance (receptive commands), whereas nonspecific reinforcers produced greater generalization to multiply controlled mand conditions (i.e., a combination of EOs [mand], nonverbal stimuli [tact], and verbal stimuli [intraverbal]).

As a result of these and other investigations, researchers are increasingly recommending that request making should be the starting point for training learners with limited verbal ability (Brady et al., 1994; Shafer, 1994). Research by Carroll and Hesse (1987) provides further evidence to support this training approach. They compared tact-only training with an alternating mand-tact procedure in order to establish a tact repertoire. Their results

showed that in the multiply controlled mand-tact training condition, tacts were acquired faster and were retained longer than in the tact-only training condition. Because the subjects of the study were typical preschool children with a previously established echoic repertoire, the study did not address whether mand training might facilitate the acquisition of an echoic repertoire. However, because echoic responding was used to establish the tact repertoire in both training conditions, it would be useful to determine whether manding could also facilitate the acquisition of an echoic repertoire.

The purpose of this paper is to describe a method that begins with shaping a mand repertoire as the first step in establishing both an echoic and a tact repertoire in nonverbal children. In contrast to other studies that used echoic prompts to shape a mand repertoire (Carroll & Hesse, 1987; Hall & Sundberg, 1987), in this procedure the subject does not need a preexisting echoic repertoire, because the mands are independently shaped. Although creating a mand repertoire is a necessary prerequisite, our emphasis is not on creating a mand repertoire per se. Rather, the objective is to demonstrate the effectiveness of using the mand as the starting point for establishing an echoic repertoire. Our experience suggests that the use of this strategy usually begins to produce correct imitation of sounds within the first 10 to 20 sessions of therapy, even with severely language-delayed children. This approach utilizes a functional analysis of language acquisition in infants that suggests that the mand is typically the first verbal operant to be acquired (Bijou, 1993; Bijou & Baer, 1965; Drash & Tudor, 1993; Schlinger, 1995; Skinner, 1957).

THE MAND AS THE INITIAL VERBAL OPERANT

In previous research, we presented a behavioral analysis of how most normal infants begin to acquire language and how and why some infants fail to acquire language (Drash & Tudor, 1993). Our analysis suggests that the first verbal operants acquired from birth to about 12 months are not predominantly echoics, as was once believed. Rather, mands appear to be the first verbal operants acquired. The infant's initial reflexive cries are rapidly converted to mands when reinforced by the responses of the parent. Typically, imitation training by parents does not begin until children are about 1 year old. By this age infants usually have a well-developed mand repertoire.

In the early stages of shaping verbal behavior, the parent usually provides reinforcement whenever the infant cries. The cry is the primary vocal mand that produces reinforcement in the form of parental attention and affection (Schlinger, 1995). Subsequently, the parent differentially reinforces those sounds that more closely approximate the sounds of words. When infants and young children begin to emit sounds, such as *baba,* that more closely approximate words, parents often react with delight and amazement and provide a reinforcer with a similar verbal topography, such as *bottle.* Such reactions strengthen the subsequent production of sounds that more closely approximate those of the parent. This creates an ongoing contingency whereby the child is increasingly more likely to produce sounds that will eventually lead to words.

As children begin to produce sounds that approximate those of their parents, their own verbal behavior may become automatically reinforcing, and vocal responses that resemble the parents' will be strengthened more than those that do not. Automatic reinforcement has been described by various authors, including Bijou and Baer (1965), Schlinger (1995), Skinner (1957), Smith, Michael, and Sundberg (1996), Sundberg, Michael, Partington, and Sundberg (1996), and Vaughan and Michael (1982). Sundberg et al. re-

cently demonstrated the effect of automatic reinforcement by showing how 5 children between the ages of 2 and 4 years acquired new vocal responses when the experimenter's targeted vocal response was paired with established forms of conditioned or unconditioned reinforcement (i.e., stimulus–stimulus pairing). Four of the 5 subjects had moderate to severe language delays, and 1 was developing normally. Novel vocal responses were emitted without direct reinforcement, echoic training, or prompting. In a related experiment with 2 nondelayed infants, ages 11 and 14 months, Smith et al. (1996) demonstrated that when the experimenter's vocalizations were paired with positive reinforcement (stimulus–stimulus pairing) the same responses of the infant increased in frequency in 75% of the sessions, whereas experimenter responses paired with mild aversive verbal stimuli produced a rapid decrease in the infant's responses.

After children begin to produce a variety of different sounds as verbal mands, the parent assigns words to these sounds. Over time parents become relatively skilled at identifying children's needs or wants (i.e., probable reinforcers) by attending to multiple stimuli, including the sounds themselves, the child's visual and physical orientation toward particular items, and the time of day (Bruner, 1983). Each mand or sound a child emits may correspond to several possible reinforcers depending on which are available in the child's immediate environment. For example, at times when the child vocalizes "buh," *bottle* may function as the reinforcer, whereas at other times *ball* may function as the reinforcer.

There are several differences between a mand approach to establishing an echoic repertoire and the conventional vocal imitation procedure. When vocal imitation is the first step in language acquisition, the mand phase is largely bypassed. Thus an important function of language, that is, as a method of controlling the behavior of the listener to produce reinforcement, is partially, if not completely, omitted. It is also possible that, in some cases, the imitative procedure may be incompatible with the already existing mand repertoire of the child, because the routine stimuli and the reinforcers selected by the therapist may not be those that are most reinforcing to a particular child (Koegel, O'Dell, & Koegel, 1987). Because the primary function of the behavior of speakers is to produce reinforcement through others (Skinner, 1957), it stands to reason that the mand should be established first before proceeding to echoic behavior. This also appears to follow more closely the normal sequence of events in an infant's developing verbal repertoire.

METHOD

Subjects

The subjects were 3 nonverbal boys with autism between the ages of 2 years 6 months and 3 years 6 months. All 3 children were outpatients in an applied behavior analysis clinic specializing in teaching language and preacademic and academic skills to young children with autism. All children were severely language delayed, and none produced functional language at the onset of therapy. The parents reported that none of them could imitate consistently.

As a part of the intervention, parents were encouraged to conduct behavioral language training sessions on a daily basis. All parents reported providing some in-home training (Maurice, Green, & Luce, 1996). The amount and type of home training were variable from family to family, and the information parents provided was of a general rather than a specific nature.

Verbal repertoires before therapy. All children were patients who had been admitted for behavioral language therapy. Apart from an evaluation of each child's initial level of mands, echoics, and tacts assessed during intake, no formal baseline sessions were conducted. However, 2 of the 3 children had also received comprehensive

interdisciplinary evaluations by the University of South Florida Early Intervention Program prior to admission.

Subject 1. This child was 2 years 8 months of age when therapy began. He had been diagnosed with autism 2 weeks before beginning therapy. Their assessment placed his language level at 16 months with a language quotient of 50. For 3 months prior to admission he had received two sessions per week of speech therapy, but reportedly had made very little progress. At admission, his parents reported that they had heard him speak 10 to 15 words but none were functional, and he would not vocally imitate them. The parents also reported that he frequently engaged in task refusal and negative behavior when "he did not get his way." During the intake session this child imitated seven sounds (*ah, bu, de, du, eee, iii,* and *mm*) and two words (*do* and *eat*) at 40% accuracy. No tact responses were emitted. Vocal responses to prompts (manding) occurred on 71% of the trials. Twenty-four nonresponses and one inappropriate behavior occurred.

During therapy the child received one 60-min session per week of behavioral language training that incorporated the manding procedure (described below). His mother attended all sessions and was instructed in how to use the manding procedure and other behavioral techniques. The parents also began an in-home applied behavior analysis program for 20 to 30 hr per week shortly after beginning therapy. The in-home teaching assistants attended several therapy sessions and learned how to implement the manding procedure.

Subject 2. This child was 2 years 6 months of age when he began therapy. He had been diagnosed with autism at our center. He received no formal speech therapy prior to our intake evaluation. At admission, his mother reported that he spoke no words functionally and rarely imitated sounds or words. His functional language level was measured to be between 12 and 14 months. During the intake session this child imitated two sounds (*ee* and *yaya*) and three words (*hey, say,* and *yeah*) at 25% accuracy. He emitted no tact responses. Vocal responses to prompts (mands) occurred on 53% of the trials. No disruptive or inappropriate behavior occurred. However, he was quite nonresponsive; no response occurred to 47% of the prompts presented. Subsequently, he received two 1-hr behavioral language therapy sessions per week. His mother and the child's home-care worker attended each therapy session and were instructed in the implementation of the manding procedure and other behavioral language training techniques. Implementation of training at home occurred inconsistently.

Subject 3. This child was 3 years 6 months of age when he began behavioral language therapy. His mother reported that the child's language development ceased when he was about 12 months old. At 2 years 2 months of age he had been diagnosed as having pervasive developmental disorder with autistic symptoms. At that time his language age was evaluated to be at the 10-month level. Prior to being admitted to our program, he had received speech therapy two to three times per week for 1 year with little progress. Four months prior to admission, the parents implemented an in-home behavioral program that consisted of about 16 hr per week of behavioral training. They reported that although the child made some progress in acquiring certain motor behaviors, he made little progress in verbal skills. During the intake evaluation, his mother reported that he occasionally said, "give" or "give me," for food. She also said that he had spoken about four other words, including *more, mama, baba,* and *go,* but these were not used functionally. She reported that he did not imitate sounds or words consistently for her. During the intake session, this child imitated four sounds (*buh, ee, ii,* and *mm*) and five words (*bite, give, go, mama,* and *more*) at

54% accuracy. He emitted no tact responses. Vocal responses to prompts (mands) occurred on 95% of the trials. No response occurred to 5% of the prompts presented, and no inappropriate behavior occurred.

Setting and Apparatus

All sessions were conducted at an outpatient applied behavior analysis treatment center. Each session was conducted in a therapy room (3 m by 3 m). Stimuli consisted of a wide variety of toys, noisemakers, pictures and picture books, audio and videotapes, foods, and other items that had been effective as reinforcers for other similar aged children with autism in past research and therapy. In addition to these materials, parents provided a variety of preferred foods and toys. Each child sat facing the therapist in a Rifton chair (E87) with a table top. The secured top guaranteed the child's safety and insured that he would remain seated in a position that maintained eye level with the therapist.

The recording instrumentation included two five-place manual counters (Veeder-Root), a stopwatch, a hand calculator, and accompanying data sheets.

Procedure

Trial format, recording system, and response definition. All children received one or two 1-hr sessions of behavioral language therapy per week. The treatment program and the recording system were based on the Talk Language and Cognitive Development Program, which has been described previously (Drash & Tudor, 1989, 1990, 1991). The data for all subjects were recorded routinely during therapy. Therapy was conducted in a discrete-trial format. A trial began when the therapist prompted the child for a vocal response, for example, "Would you like the ball? Say 'buh.' " Each prompt and response were recorded on one of two-five place counters. Mand and echoic prompts and responses were recorded on one counter, and tact prompts and responses were recorded on a second. A response was defined as any vocal sound emitted by the child within approximately 5 s following the therapist's prompt. Each response was classified and recorded as occurring in one of four categories: correct (C), error (E), no response (NR), or inappropriate behavior (IB). Verbal responses that were partially correct were classified as either correct or error, depending upon the criterion in place at the time. The different sounds and words the child emitted were also recorded on the data sheet.

Dependent variables. Five dependent measures were calculated for each session: (a) percentage of mands, which were operationally defined as any vocal response (AVR) to prompt, excluding inappropriate vocal behavior ($C + E/S^D$); (b) percentage of correct echoic responses (C/S^D); (c) percentage of error responses (E/S^D); (d) percentage of no responses and inappropriate behavior combined ($NR + IB/S^D$); and (e) percentage of tact responses (C/S^D).

Establishing the therapy setting as a reinforcing environment. During therapy sessions the child's parent remained in the therapy room. This served the dual purpose of providing assurance to the child and training opportunities for the parent. As soon as the child was seated, he was given one or two preferred toys to play with for about 2 min and one or more preferred food reinforcers, such as a cookie or juice. Noncontingent reinforcement was also provided periodically during each therapy session.

The reinforcing nature of the therapeutic environment was evidenced by the fact that each child voluntarily walked or ran to the therapy room, climbed into the chair without urging, and participated actively during therapy.

Establishing operations. EO assessments were conducted to increase the probability that highly reinforcing stimuli would be available to the child during therapy. To accomplish this,

parents provided a list of the child's favorite foods and toys. The reinforcers were foods and novel or preferred toys that had moving parts or made noise. To enhance food as a reinforcer, parents were asked to refrain from feeding their child for 1 or 2 hr before therapy. Stimulus items and activities were varied frequently during therapy to insure that highly reinforcing stimuli were available.

Shaping the mand repertoire by using EOs and specific reinforcers. The first step in shaping an acceptable vocal mand repertoire was to arrange the contingencies so that the child received a preferred reinforcer only for an appropriate vocalization, but never for inappropriate vocalizations such as crying, yelling, or screaming. Shaping was used to create the mand repertoire. The EO of presenting a preferred toy or food stimulus just beyond the reach of the child was designed to increase the probability that the child would vocalize. The verbal prompt, which was intentionally varied from trial to trial, usually took the form of a question such as, "Do you want this?," "What do you want?," "Do you want more?," or simply, "This?" During the first few sessions, any vocalization following the therapist's prompt, other than a cry or a scream, was reinforced. As acceptable vocal mands were emitted more frequently, reinforcement was delivered more intermittently.

Reduction of NR/IB during mand training. In previous research we discussed the critical importance of eliminating negative behavior and nonresponding before functional verbal behavior can be established (Drash & Tudor, 1990, 1993). Screaming, crying, and similar negative vocalizations were counted as instances of inappropriate behavior (IB) and were never reinforced. The response of the therapist to these behaviors was reinforcement of an incompatible verbal behavior, that is, an acceptable vocal response. If a child began to cry or scream, a reinforcer was presented at the very beginning of the scream when the volume was quite low. This differentially reinforced a low-volume vocalization that was later shaped into an acceptable vocal mand. On a few occasions reinforcement of an alternative behavior was combined with the therapist's verbal instruction, such as, "No fussing. Do good talking."

The method for reducing or eliminating nonresponding (NR) was different. If the child did not produce a vocal response to a prompt within about 5 s after being shown the reinforcer, it was moved closer to the child until it was located just beyond his grasp. Typically, when reaching for the reinforcer, the child also vocalized and thus immediately received the reinforcer. If he did not emit a vocal response, a variety of reinforcers, both foods and toys, were presented in rapid succession until one evoked a vocal response. At other times the child was given the opportunity to choose one of several reinforcers presented simultaneously.

Using the mand to produce an echoic repertoire. After establishing a mand repertoire, a manding (requesting) procedure was used to shape an echoic repertoire. As NR/IBs decreased in frequency, different sounds were differentially reinforced to occur at a high rate. These sounds were used to begin echoic training during mand training. When three criteria were met, the target response was changed from reinforcing any vocal response to reinforcing specific echoic responses for individual sounds or words. The three criteria were (a) the percentage of mand responses (i.e., any vocal response to prompt) reached 80% or greater, (b) the percentage of NR/IB was reduced to 10% or less, and (c) the number of frequently occurring sounds or words increased to between 10 and 15. In the process of shaping a mand repertoire, each child typically emitted a few sounds at a much higher frequency than others. For example, the sounds *ah, buh, eee,* and *mmm* were often emitted at a higher rate than other sounds. During mand and initial echoic training, these high-rate sounds were

paired with specific reinforcers having similar vocal topographies (Braam & Sundberg, 1991; Stafford et al., 1988). For example, *ah* was reinforced with a bite of apple, and *mmm* was reinforced with an M&M. By immediately repeating the child's sounds and prompting him to imitate prior to being given the reinforcer, the child's vocal responses became multiply controlled as mands (for the specific reinforcer), echoics (of the therapist's prompt), and tacts (the name of the reinforcer) from the early stages of therapy. As more specific echoic training began, the probability was greater that the child would imitate. This procedure is similar to the "quick transfer" procedure described by Sundberg and Partington (1998).

Expanding the echoic repertoire. As the number of sounds and words correctly imitated increased, new stimuli were gradually introduced. These included toys and pictures of toys, animals, and other items. Because the child was beginning to acquire a generalized imitative repertoire, the procedure for producing imitation for these items was modified. Rather than presenting an echoic prompt for a preferred food or toy, the child was shown a novel toy or picture and given an imitative prompt, such as, "This is a fish. Say 'fish.' " If the child did not respond, the child was presented with a preferred food (a cookie) and the toy or picture and asked, "Do you want a bite? Say 'fish.' " Periodically during echoic training, probes for tact responses were conducted.

Using the echoic repertoire and the manding procedure to shape a tact repertoire. As the child's echoic repertoire expanded to between 10 and 15 different sounds or words at 80% correct, stimulus control was gradually transferred from a prompt for an echoic response to a prompt for a tact response. For example, the child was prompted by asking, "What's this?" and delaying the echoic prompt by about 5 to 10 s. If the child named the item before the echoic prompt was given, a reinforcer was delivered. During initial tact training, many of the objects previously used as stimuli were paired with specific reinforcers. The response to these items was multiply controlled as a mand and a tact. As tact training progressed, the manding technique was faded, new stimuli were introduced, and the child was required to tact pictures and new stimuli without prior mand training.

RESULTS

Figures 1 through 3 present data that show the course of acquisition of mand, echoic, and tact repertoires by these children. The following data are presented as a percentage of responses made to allow a direct comparison when the number of prompts given differed from session to session for each child and when the number of prompts given varied across verbal response classes. Each data point for each subject represents the percentage of times during a session that the subject responded to the therapist's vocal prompts across the three verbal response classes (i.e., mands, echoics, and tacts).

Overall, all 3 children rapidly acquired mand and echoic repertoires. Two of the children also acquired an initial tact repertoire. Mand repertoires of 90% responses to prompts for all children occurred by the sixth session. Echoic repertoires of 70% accuracy (on four or more sounds and nine or more words) occurred after seven training sessions for all 3 children. By the 10th session both Subjects 1 and 2 began to tact toys and picture card stimuli. A comparison of Figures 1 and 2 shows that the acquisition pattern for Subjects 1 and 2 was quite similar. Both subjects initially engaged in a high percentage of NR/IB, approximately 29% and 48%, respectively. The negative vocal responses were reduced to less than 5% by the eighth session for both subjects. There was an inverse relationship between negative behavior and both mand and echoic re-

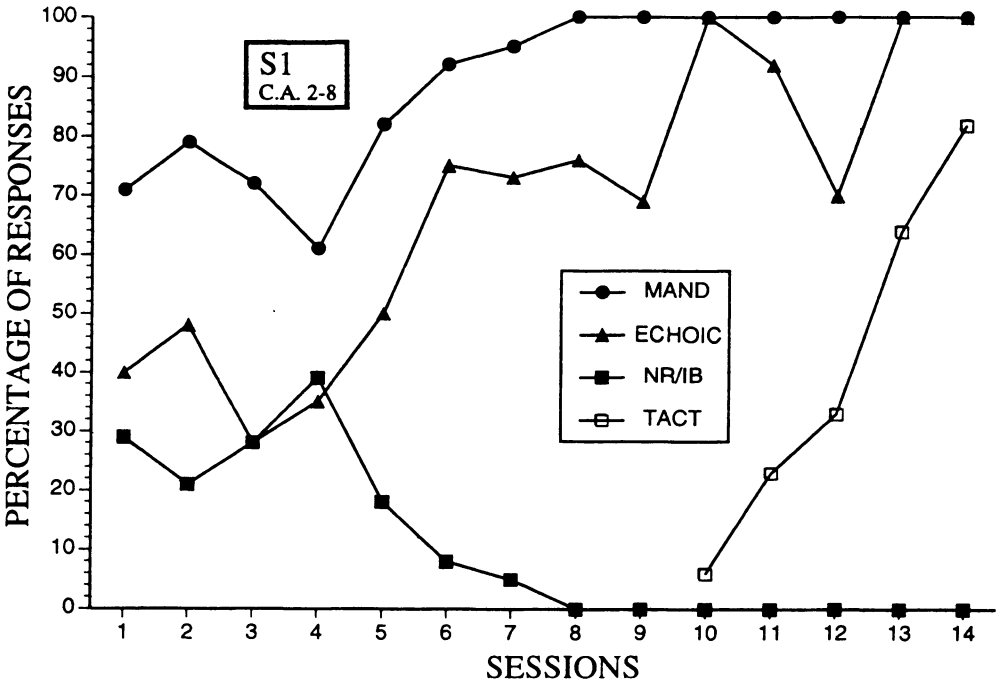

Fig. 1. Acquisition of a mand, echoic, and initial tact repertoire by Subject 1.

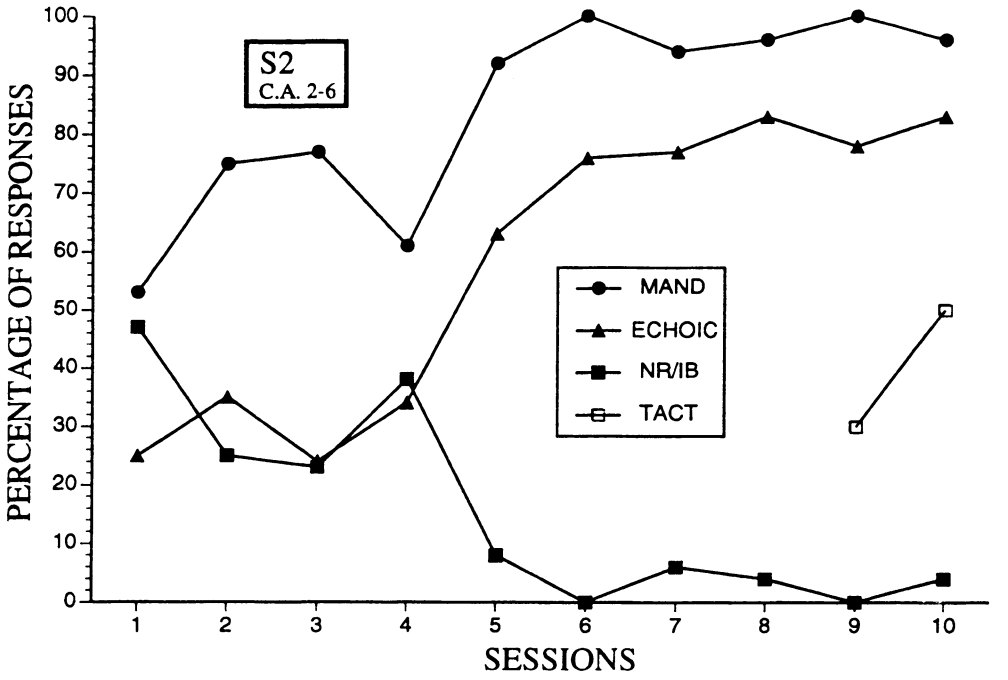

Fig. 2. Acquisition of a mand, echoic, and initial tact repertoire by Subject 2.

sponding: As the percentage of reinforced mand and echoic responses increased, the percentage of NR/IB rapidly decreased.

Subject 1. Data for the 1st child are presented in Figure 1. This child responded at 92% vocal responses to prompts (i.e., a mand repertoire) in only six sessions. By Session 8 he achieved 100% vocal responses to prompts and continued at this level for the remaining sessions. This child initially had a relatively high percentage (29%) of IBs such as crying, screaming, and kicking. These reached a high of 39% during Session 4, but subsequently decreased rapidly to near zero by Session 8.

Figure 1 also shows a gradual increase in correct echoic responses ranging from 40% based on seven sounds (*ah, bu, de, du, ee, ii,* and *mm*) and two words (*eat* and *do*) during the first session. By the sixth session echoic responding increased to 76% accuracy on 11 words (*apple, bye bye, do, down, eat, give, go, meow, more, up,* and *yeah*) and eight sounds (*ah, ba, buh, ee, ha, mm, oh,* and *ya*). By Session 14 echoic responding had increased to 100% on 25 words (*apple, baby, ball, bear, bite, boat, bubbles, bye bye, car, cat, choo choo, cookie, cow, do, dog, down, drum, eat, go, hi, horse, I, more, push,* and *up*), and 23 sounds (sounds of alphabet cards). By Session 10 this child had also begun to tact objects and picture card stimuli. By Session 14 tact responses reached 82% accuracy based on 10 different picture card stimuli that he had previously imitated. After 14 sessions the child's mother reported that he was beginning to name objects and make requests at home using one- and two-word phrases, such as *get down, all done,* and *more bite.*

Subject 2. Figure 2 presents the data for the 2nd child. This child initially had a very high percentage (47%) of nonresponding but very few inappropriate behaviors. The percentage of nonresponding decreased to 24% during Session 3. In Session 4 nonresponding occurred in combination with fussing or screaming, and NR/IB reached 38%. By the fifth session, both nonresponding and screaming had been reduced to less than 10% and remained at that level. As the child's reinforced mand and echoic responses increased, NR/IB rapidly decreased. By the fifth session, manding in response to prompt reached 92% and remained above 90% for all subsequent sessions.

Figure 2 also presents the percentage of correct imitations for each session. During the intake evaluation the child imitated two sounds (*ee* and *yaya*) and three words (*hey, say,* and *yeah*) at 25% accuracy. During the fourth session the child imitated four sounds (*ee, ii, yi yi,* and *mm*) and four words (*bite, go, yeah,* and *set*) at 33% accuracy. By Session 6 the number of different words imitated increased to 21 at 75% accuracy. By Session 10 echoic responding reached 83% accuracy based on 25 different words and five sounds. Words imitated included *apple, eat, dada, do, go, hi, hug, kiss, more, out, ready, see, set, up, yeah, cat, meow, cow, moo, duck, quack, pig, oink, sheep,* and *spider.* Tact responding to picture card stimuli of animals and objects that the child had previously imitated began on Session 9. By the 10th session this child emitted correct tact responses to 50% of 16 different pictures of animals and objects. His mother also reported that he was beginning to name objects spontaneously at home.

Subject 3. Figure 3 presents the data for the 3rd child. This child initially emitted a vocal response to a prompt 95% of the time and continued to mand at 90% accuracy or greater over the remaining 10 sessions. In contrast to the first 2 children, this child never engaged in a significant amount of nonresponding or negative behavior. He was very cooperative, and food was a potent reinforcer. This made it relatively easy to establish and maintain a mand repertoire.

Figure 3 also presents the percentage

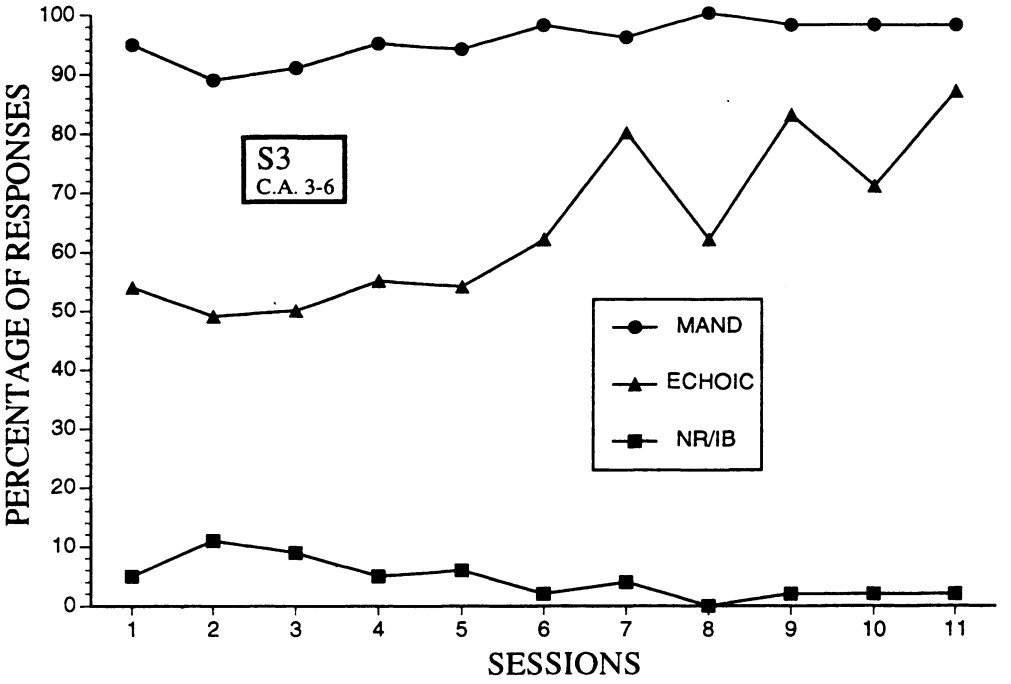

Fig. 3. Acquisition of a mand and echoic repertoire by Subject 3.

of correct imitations for this child during each session. This child initially imitated at 54% accuracy based on four sounds (*buh, ee, ii,* and *mm*) and five words (*bite, give, go, mama,* and *more*). His echoic repertoire increased to 79% accuracy based on nine words and four sounds by the seventh session. Echoic responding was inconsistent between Sessions 7 and 11, but by the end of the 11th session imitation had improved to 87% accuracy on 12 words (*apple, baby, bite, bottle, eat, give, go, here, mama, me, more,* and *yes*) and six sounds (*ah, be, duh, ee, ii,* and *mm*).

DISCUSSION

This research suggests that the strategy of initially establishing a mand repertoire as the first step in creating an echoic repertoire may be an effective procedure for some nonverbal children with autism. The mand repertoire was readily shaped by manipulating EOs and specific reinforcers. These results support and extend the conclusion of previous researchers that manding should be the starting point for training learners with limited verbal repertoires (Shafer, 1994). Establishing a mand repertoire as the foundation for acquiring subsequent verbal behavior also appears to follow more closely the usual course of language acquisition in normal infants. Because it has often been extremely difficult and sometimes impossible to produce an echoic repertoire in nonverbal autistic children, it is useful to compare the manding procedure with the vocal imitation model to identify and isolate those variables that contribute to the effectiveness of the manding procedure.

Differences between the manding procedure and the traditional vocal imitation model. In the manding procedure, the item manded for directly reinforces the mand response of the speaker, whereas in the imitation model the item named or imitated is not itself necessarily a specific reinforcer. The first steps of the vocal imitation procedure include reinforcing imitation

of sounds, then words and then phrases. A predetermined sequence of sounds, such as *ah, ba,* and *mm* is often followed regardless of relevance to a particular child. Echoic and tact repertoires are typically the first two classes of verbal behavior targeted. The basis for this strategy is that as the child is more able to imitate words and phrases and tact objects and pictures, he or she will also use these words and phrases to mand for reinforcement. However, because a mand repertoire is not directly reinforced, the designed contingencies do not necessarily cause the child to produce verbal behavior to obtain reinforcers through others. Results of previous research confirm that mand and tact repertoires are independent and that teaching one will not necessarily generalize to the production of the other (Hall & Sundberg, 1987; Stafford et al., 1988).

A second important difference between the two models is that by design the manding procedure creates a highly reinforcing therapeutic environment conducive to acquiring language (i.e., "keeping the child happy"). This occurs by initially providing reinforcers that are not contingent on any specific vocal response. Creating such a reinforcing treatment environment is not necessarily a high priority of the vocal imitation model. In that model it is not uncommon for fussing and crying to continue for many sessions. Thus, the entire therapeutic environment may become a conditioned aversive stimulus that the child will seek to avoid by engaging in behaviors that have terminated similar stimuli in the past (Sundberg, 1993).

Contingencies that produce rapid acquisition of a vocal mand repertoire. Figures 1, 2, and 3 show that a vocal mand repertoire of 90% or greater was established in all children by the sixth session. In the manding procedure, the major independent variable producing the mand repertoire is the EO (Hall & Sundberg, 1987; Michael, 1993; Sundberg, 1993). In therapy, the EOs of placing multiple highly reinforcing food and toy stimuli just beyond the child's grasp, along with creating a mild degree of deprivation, greatly increases the probability that the child will reach and vocalize to obtain the reinforcers.

Another innovative aspect of this method that contributes to the rapid acquisition of a vocal mand repertoire is that by defining a mand as any nonaversive vocal response to prompt, the procedure builds on an already existing gestural mand or aversive vocal mand repertoire (crying) of the child. By the age of 1 to 2 years most children, including many if not most severely delayed nonverbal children, have developed a substantial "looking-reaching-grasping-vocalizing" mand repertoire. If potent reinforcers are within reach, the child will usually reach for them without assistance and without vocalizing. If the reinforcers are beyond reach, the child will often visually fixate on, reach toward, point to, or pull a parent to the reinforcer and wait for its presentation. If the reinforcer is not provided quickly, the child may begin to scream or engage in other negative behavior. This constitutes a physical mand or an aversive vocal mand as opposed to a vocal mand (Drash & Tudor, 1993).

Therefore, with this strategy it is not necessary to create an entirely new mand repertoire. It is only necessary (a) to convert the existing physical mand or aversive vocal mand into an acceptable vocal mand (as defined by the therapist) and (b) to bring the vocal mand under the discriminative control of the therapist's vocal prompt. Initially vocal responses emitted are often the beginning of a cry or a scream. However, if the reinforcer is delivered at the onset of the scream or cry, these vocalizations will be replaced by sounds that more closely approximate speech. These vocalizations can then be paired with specific reinforcers with similar verbal topographies.

Rapid elimination of nonresponding and inappropriate behavior without use of aversive contingencies. Figures

1 and 2 show that the NR/IB of Subjects 1 and 2 was reduced to less than 10% by Session 6. (NR/IB was never a problem in the 3rd child.) Negative behavior is highly characteristic of the repertoire of many autistic children (Romanczyk, 1996), and aversive verbal behavior, such as crying or screaming, often functions as a mand to terminate demands or obtain reinforcers (Carr & Durand, 1985a, 1985b; Drash & Tudor, 1993). These behaviors are difficult to eliminate and in the past have been reduced by using aversive consequences (Lovaas, 1987; Repp & Singh, 1990).

The rapid elimination of NR/IB in our 2 children without the use of aversive consequences may be explained in two ways. First, by initially providing the children with noncontingent reinforcers, the therapy setting becomes a conditioned positive reinforcer. Second, by making reinforcement contingent on *any* positive vocalization and withholding reinforcement for aversive vocal behavior, a repertoire of acceptable verbal behaviors that are incompatible with crying is strengthened. Because the topography of a brief acceptable vocalization is less complex and requires less physical effort than screaming, both the natural contingencies and the contrived contingencies more easily support an acceptable vocal response.

Contingencies that favor the rapid transfer from a mand to an echoic repertoire. Data presented in Figures 1, 2, and 3 show that all children began to imitate sounds or words in response to a prompt at 80% or greater after as few as 10 sessions. The ease of establishing echoic behavior by using manding as the first step may be explained in at least two ways. First, by reinforcing an acceptable vocal mand repertoire, the child's vocal repertoire is altered in that almost any reinforcer can be obtained during therapy by simply emitting a brief nonaversive vocal response. The tendency to emit acceptable verbal behavior is thus strengthened well before imitation training begins. Second, by initially using the child's sounds as prompts during mand training, the sounds become multiply controlled as both mands and echoics, thus increasing the probability that the child will imitate during echoic training.

Role of in-home behavioral training. The total number of behavioral training hours per week provided to a child is widely recognized as a critical variable (Lovaas, 1987; Maurice et al., 1996). The in-home training in these three cases was administered by the parents and was not a formal aspect of this study. The effects of in-home training were, therefore, never explicitly measured or evaluated. It is, however, quite possible that the children may not have progressed as rapidly without such in-home training. Future research may specifically compare the effects of the manding approach both with and without in-home training.

Using a standard recording method to facilitate programming an echoic repertoire. In addition to the manding procedures described above, it is important to analyze the relationship between a standard recording procedure and the shaping of verbal behavior. We have previously described a standard method for recording, analyzing, and shaping verbal behavior (Drash & Tudor, 1991). A major advantage of standardization is that the effects of reinforcement contingencies on verbal behavior are immediately visible. The therapist can rapidly determine whether or not a child is progressing. If the percentage of correct responses is not increasing, or if the percentage of NR/IB is not decreasing, the therapist can quickly alter the contingencies and evaluate their effects. The advantages are particularly evident during the early stages of therapy when progress may be so subtle as to go undetected from one session to the next.

Other variables that affect the long-term success of language training of children with autism. Although creation of an initial echoic repertoire is important, it is also necessary to view

echoic training within the overall context of acquiring functional language. Several variables that may affect long-term outcomes in language acquisition programs have been previously described (Drash & Tudor, 1990). Three appear to be particularly critical. The age of the child when therapy begins is considered one of the most critical variables. The average initial age of the Lovaas experimental group was less than 3 years (34.6 months) (Lovaas, 1987). Perhaps some of the difficulty researchers have encountered in teaching verbal repertoires to nonverbal children may be attributable, at least in part, to the initial age of the child rather than to the procedures used.

A second important variable is the weekly number of hours of behavioral language training the child receives. Regardless of the techniques implemented, functional language may not be acquired unless contingencies that create functional language are in place throughout most of the day, every day of the year. Children in the Lovaas (1987) experimental group received an average of 40 hr weekly of individual behavior therapy for at least 2 years. Gains in the control group were minimal despite having received up to 10 hr per week of behavior therapy. Parents and therapists of nonverbal children should, therefore, consider some form of in-home behavioral training for 20 to 40 hr weekly (Lovaas, 1987, 1996; Maurice, 1993; Maurice et al., 1996).

The third variable related to long-term outcome involves the reduction or elimination of negative, noncompliant, and task-avoidance behavior, both within and outside of therapy. Negative behaviors are major factors that may prevent autistic children from acquiring normal language and social behavior (Drash & Tudor, 1993). Figures 1 and 2 show that negative and task-avoidance behavior can often be reduced or eliminated rapidly during therapy. Unless parents and teachers also implement behavior-reduction procedures at home and school, it is possible that the child may not acquire the necessary language and social skills required for independent functioning.

Implications for preventing language delay in normal infants and children. The effectiveness of the manding procedure in creating verbal repertoires in nonverbal children with autism has important implications for research on preventing language delay in normal infants and children. Although few children develop language delays as severe as those in autism, it is estimated that 10% of elementary school children have communication disorders (Owens, 1984). The elements of the manding procedure that are effective in creating verbal behavior in children with autism may also be used to promote language development and prevent language delay in normal infants and children (Drash, 1992). At least two important recommendations for helping parents promote normal language development in infancy come from our research. First, parents should avoid providing reinforcers when their child engages in aversive vocal manding, such as screaming. They should wait until the screaming subsides and an acceptable vocalization occurs before providing reinforcement. Second, parents should avoid anticipating their child's needs and wants, even when the need seems apparent; instead, they should wait for the child to emit an appropriate vocalization before providing the desired item. If parents and caregivers would routinely incorporate these two powerful techniques into their daily child-rearing practices, the potential reduction of language delay in infants and young children could be substantial.

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