

*A METHODOLOGY FOR ASSESSING THE FUNCTIONS OF  
EMERGING SPEECH IN CHILDREN WITH  
DEVELOPMENTAL DISABILITIES*

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An approach based on Skinner's (1957) theory of verbal behavior has been developed to understand and teach elementary communication skills to children with autism and developmental disabilities (Sundberg & Partington, 1998). However, few studies have directly examined the characteristics of emerging language in children with developmental disabilities. The purpose of this study was to develop and evaluate an assessment for identifying the elementary functions of vocal speech in children. Participants were 4 children with developmental disabilities, aged 6 years to 12 years, who exhibited at least one distinguishable vocal response (word or phrase) frequently in the natural environment. The assessment focused on three verbal operants delineated by Skinner (mand, tact, and intraverbal). One or more functions were identified for at least one vocal response of each child. Results suggested that this assessment would be useful for (a) evaluating Skinner's theory, (b) guiding decisions about language training for individual children, and (c) studying the nature of expressive language development in children with developmental disabilities.

DESCRIPTORS: autism, communication training, developmental disabilities, functional analysis, language, speech, verbal behavior

Language delays are a significant concern for parents and teachers of children with autism and developmental disabilities. It is estimated that only about one half of children with autism and related disorders will acquire some speech as a mode of communication (Lord & Paul, 1997). Even then, functional communication skills never fully develop for the majority of the children who begin to speak. Many children with communication deficits also engage in severe destructive behaviors, such as self-injury, aggression, and disruption (Carr & Durand, 1985; Koegel, Koegel, & Surratt, 1992). The acquisition of spoken language prior to age 5 is considered to be a good predictor of long-term outcomes in other areas (e.g., adaptive skills, academic achievement; Gillberg, 1991; Venter, Lord, & Schopler, 1993). However, little is

known about why some children fail to acquire this mode of communication.

Interventions based on operant learning theory have been shown to be highly effective in teaching communication skills to children with developmental disabilities (Maurice, Green, & Luce, 1996). To improve the efficacy of these interventions, an approach based on Skinner's (1957) theory of verbal behavior has been developed to understand and teach communication skills to children with autism and developmental disabilities (Sundberg & Partington, 1998). Unlike some traditional models of language development, Skinner's theory does not assume that children learn the meanings of words independent of context and then use the words correctly for different purposes. Instead, the same vocal responses have separate functions, depending on the context. The focus is not on the topography of the response (e.g., a child says "book") but on its functional unit. This functional unit, or verbal operant, consists of the response and its controlling antecedents and consequences (e.g.,

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doi: 10.1901/jaba.2005.106-04

a child says “book” when receipt of a book would be a potent reinforcer, and the listener gives the child a book).

Skinner (1957) described seven elementary verbal operants that are considered the bases of more advanced language. Four of these verbal operants (echoic, mand, tact, and intraverbal) are relevant to vocal communication skills. With the echoic, the form of the response is controlled by a prior verbal stimulus that resembles the response, and the response is maintained by some type of generalized reinforcer, such as praise. For example, a child might say “apple” when he or she hears a teacher say “apple” and then receives praise from the teacher for correctly imitating the response. The form of the mand is under the control of a relevant establishing operation (EO) for a specific reinforcer, and the response is maintained by access to this reinforcer. For example, a child might say “apple” to a parent when the child has not eaten for several hours and then receives an apple from the parent. With the tact, the form of the response is controlled by a nonverbal stimulus, and the response is maintained by some type of generalized reinforcer, such as praise. For example, a child might say “apple” when he or she sees an apple on the teacher’s desk and then receives praise from the teacher for correctly naming the object. Finally, the form of the intraverbal is controlled by a verbal stimulus that does not resemble the vocal response, and the response is maintained by some type of generalized reinforcer, such as praise. For example, the child may say “apple” when the teacher says “What did you have for lunch?” and then receives praise from the teacher for conversing appropriately.

Skinner (1957) also emphasized the role of the listener in determining the occasion on which a particular response will be reinforced and, thus, the resulting control that a listener will acquire over the form and occurrence of a verbal operant. The presence of a particular

object or deprivation for a particular reinforcer may or may not occasion a tact or mand, respectively, even in the presence of a listener. A verbal operant is more likely to occur under stimulus conditions that resemble those that were present when a listener previously reinforced the verbal operant. Thus, certain stimuli may gain control (beyond the mere presence of a listener) if the listener has been more likely to provide reinforcement when these stimuli were present. Skinner noted that such stimuli might include verbal statements of the listener (e.g., “What is that?” for tacts or “What do you want?” for mands) and other factors (e.g., the presence of desired objects for mands) that are associated with an increased probability of reinforcement for the verbal operant.

An important implication of this theory is that each verbal operant must be acquired as language develops. Thus, a particular vocal response may or may not have multiple functions, depending on the individual’s learning history. Moreover, the occasion on which a particular verbal operant will be emitted may be controlled by other stimuli that have been differentially associated with reinforcement. Preliminary research findings have supported Skinner’s (1957) theory. For example, several studies with typically developing children and individuals with developmental disabilities showed that the acquisition of one verbal operant (a tact) was not associated with the acquisition of another verbal operant (a mand) without specific training (e.g., Hall & Sundberg, 1987; Lamarre & Holland, 1985; Reichle, Barrett, Tetlie, & McQuarter, 1987). However, few studies have directly examined the characteristics of emerging language in children by observing these responses under controlled conditions.

The recent focus on Skinner’s (1957) theory of verbal behavior has led to changes in the way that language is taught to children with autism and other developmental disabilities (Michael & Sundberg, 2001). Early communication

training commonly focused on teaching the names of objects and other words under the assumption that the child would then spontaneously use the words in a variety of situations (i.e., to request the objects, to name the objects, to converse about the objects). The importance of targeting the separate functions of verbal operants when teaching language is now emphasized in many early intervention programs (see Handleman & Harris, 2001; Leaf & McEachin, 1999; Maurice et al., 1996). Skinner's theory also highlights the benefits of focusing on the mand when first teaching language and has led to an interest in teaching intraverbals, which had been neglected in language training (Michael & Sundberg, 1998).

Assessment methods for identifying the functions of emerging speech in children would greatly advance research in this area. As noted above, few studies have directly examined the characteristics of emerging language in children with developmental disabilities. This methodology would be useful for (a) evaluating Skinner's (1957) theory, (b) guiding decisions about communication training for individual children, and (c) studying language development in children with autism and developmental disabilities. For example, very little is known about longitudinal patterns of speech development or precursor forms of communication, such as pointing and leading (Prizant, 1996). A method to assess the functions of a child's current forms of communication also would advance clinical intervention. Information about key strengths and deficits prior to formal language training would permit practitioners to focus on verbal operants that have not yet been acquired and to determine if certain types of communication functions (e.g., mands) should be taught before others (e.g., intraverbals).

Recently, several authors have described indirect and descriptive assessments of communication skills that are based on the functional properties of language (e.g., Duker, 1999; Sundberg & Partington, 1998). For example,

a caregiver may be asked to indicate if a child uses 5 to 10 words to ask for reinforcers or can fill in a few missing words from songs or phrases (Sundberg & Partington). This information, which may specify whether the child has acquired one or more of the verbal operants delineated by Skinner (1957), is useful for prioritizing language training goals (i.e., determining the amount of instruction parents and teachers should devote to mands, tacts, etc.). However, these assessments are not designed to identify the functions of specific responses that are already in the child's repertoire. Indirect and descriptive analyses of behavior also have a number of limitations with respect to identifying functional relations (see Lerman & Iwata, 1993, for a discussion).

An experimental analysis methodology has been refined and widely used over the past 20 years to identify the learned functions of behavior disorders, such as self-injury and aggression (Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994). The level or amount of problem behavior is examined under a variety of controlled conditions that are designed to identify specific functions of behavior. The functional analysis methodology has led to a greater understanding of these behavior disorders and the development of more effective treatments (see Hanley, Iwata, & McCord, 2003, for a review). Recently, this methodology has been successfully extended to the assessment of appropriate behavior, such as task compliance (Lerman, Vorndran, Addison, & Kuhn, 2004), oral reading (Daly, Martens, Hamler, Dool, & Eckert, 1999), spelling (McComas et al., 1996), and homework completion (Cooper, Wacker, Sasso, Reimers, & Donn, 1990). Results of these assessments have been useful for identifying effective interventions for these skills.

A similar methodology that incorporates the framework first proposed by Skinner (1957) and expanded on by others (e.g., Michael & Sundberg, 2001) could be used to assess

emerging language in children. The purpose of this study was to develop a method for identifying the functions of emerging vocal speech in children with autism and other developmental disabilities. The assessment focused on the four main verbal operants that are relevant to vocal communication skills (echoic, mand, tact, and intraverbal). The goal of the assessment was to identify the functions of specific vocal responses that a child exhibited frequently in the natural environment. That is, would the assessment reliably identify the conditions under which a verbal response would and would not occur?

## METHOD

### *Participants and Settings*

Four children who had been diagnosed with developmental disabilities participated. These children were the first 4 individuals who met the following criteria after the inception of the study: (a) Their teachers reported that they engaged in relatively little or no functional speech, (b) they were observed to exhibit at least one distinguishable vocal response (word or phrase) frequently in the natural environment, and (c) their teachers reported that they engaged in problem behavior, such as self-injury, aggression, or disruption. Jim was a 7-year-old boy who had been diagnosed with autism, cerebral palsy, and visual impairment. He attended a self-contained classroom for children with developmental disabilities at a school for students with visual impairment. Jim engaged in one- to two-word utterances and occasionally spoke in complete sentences, which his teacher described as delayed echolalia. Jenny was a 6-year-old girl who attended a self-contained classroom for students with developmental disabilities. Although she had no formal diagnoses, she appeared to function within the moderate level of mental retardation. She exhibited primarily one- to three-word utterances and rarely spoke in complete sentences. Her teacher described much of her speech as echolalic. Karen was

9 years old and had been diagnosed with severe developmental disabilities, autism, and visual impairment. She attended a self-contained classroom for children with developmental disabilities at a school for students with visual impairment. Karen exhibited two- to three-word utterances and occasionally spoke in complete sentences, which her teacher described as immediate and delayed echolalia. Linda was a 12-year-old girl who had been diagnosed with severe mental retardation. She exhibited one-word utterances only and had approximately 25 words in her repertoire, including people's names, "yes," "no," food items, and curse words. Much of her speech was perseverative and did not appear to occur in contexts relevant to its semantic content. All sessions were conducted in unused rooms at the children's school. The rooms contained tables, chairs, and materials necessary to conduct the experimental conditions. All materials used were identical or similar to those present in the child's natural environment (school or home).

### *Response Measurement and Reliability*

The children's teachers were asked to identify vocal responses that the children exhibited frequently in the classroom and then were questioned about the possible communicative functions or purposes of these responses. One or two responses were selected for each child on the basis of teacher-reported frequency (i.e., those with the highest frequency) and function (i.e., those with unclear purposes). The vocal response identified for Jim was "toy." The vocal responses identified for Jenny were "baby" and "vegetables." The vocal response identified for Karen was "baby." The vocal responses identified for Linda were "cake" and "baby." Data on the frequency of these vocal responses during test and control conditions were collected on laptop computers by previously trained undergraduate and graduate students. Data on the frequency of the vocal responses in each session were expressed as a rate by dividing the total number of responses by the total session time

Table 1  
Controlling Variables Associated with Four Verbal Operants, as Outlined by Skinner (1957)

Verbal operant	Controlling variables	
	Antecedent	Consequence
Echoic	Listener plus verbal stimulus (resembles response)	Generalized reinforcement (e.g., praise)
Mand	Listener plus deprivation for a specific reinforcer	Access to the specific reinforcer
Tact	Listener plus nonverbal stimulus	Generalized reinforcement (e.g., praise)
Intraverbal	Listener plus verbal stimulus (does not resemble response)	Generalized reinforcement (e.g., praise)

*Note.* "Listener" refers to the presence of a listener and other related controlling stimuli.

(10 min). Data also were collected on therapist behaviors, including delivery of praise and access to the item.

A second observer collected data independently on all targeted responses during at least 50% of the sessions for each child. Mean occurrence agreement for the vocal responses was 96% (range, 92% to 98%) for Jim, 97% (range, 88% to 98%) for Jenny, 98% (range, 67% to 100%) for Karen, and 98% (range, 90% to 100%) for Linda.

#### *Verbal Assessment: Procedure and Design*

As delineated by Skinner (1957), a verbal operant is defined by the variables that control the form and occurrence of a specific vocal response. The controlling variables for four verbal operants described by Skinner are shown in Table 1. These controlling variables include the antecedents that occasion the response (specific verbal or nonverbal stimuli that control the form of the response, as well as other stimuli that have been associated with an increased likelihood of reinforcement; these are labeled "listener" in the table) and the consequence that maintains the response in the natural environment. These controlling variables were manipulated in three or four separate test conditions to determine if the targeted vocal response had acquired one or more of the functions identified by Skinner. Each test condition was repeatedly alternated with a control condition at least three times via a multielement design during separate phases of the analysis. Each putative function was evaluated by ensuring that the antecedents

and consequences for the other functions were specifically excluded during the sessions. For example, the tact was tested while the child had free access to the referenced object, thus removing deprivation for the object. Furthermore, unique control conditions were developed for comparison with each test condition. The control condition in each phase excluded the factors that were manipulated in the corresponding test condition. For example, in the control condition for the mand, the child had free access to the referenced object, a listener (i.e., therapist) was not seated nearby, and occurrences of the vocal response produced no programmed consequences.

Additional listener variables (beyond the close proximity of the therapist) were included in two test conditions (mand and tact) to increase the likelihood of occasioning the verbal operant and to enhance discrimination (see further description below). These additional stimuli (e.g., verbal statements by the therapist) were selected because they were similar to those described by Skinner (1957) and seemed likely to be differentially associated with reinforcement in the natural environment. Table 2 displays the antecedents and consequences that were explicitly included and excluded from each condition. A function was identified if responding was consistently higher in a test condition than in its corresponding control condition. The echoic was evaluated only if results of the assessment indicated that the response did not function as a mand, tact, or intraverbal. All sessions were 10 min. Two to four sessions were

Table 2  
Variables Included (X) and Excluded (0) in the Test and Control Conditions for Each Verbal Operant

	Conditions							
	Mand		Tact		Intraverbal		Echoic	
	Test	Control	Test	Control	Test	Control	Test	Control
Antecedent								
Listener	X	0	X	0	X	X	X	0
Object restricted	X	0	0	0	0	0	0	0
Object present	0	X	X	0	0	0	0	0
Object statement	0	0	0	0	X	0	0	0
Object spoken name	0	0	0	0	0	0	X	0
Consequence								
Praise	0	0	X	0	X	0	X	0
Named object	X	0	0	0	0	0	0	0

*Note.* “Listener” refers to the close proximity of therapist as well as other listener-related controlling stimuli.

conducted per day, 3 to 5 days per week. Each of the assessments was completed across 6 to 11 days.

Prior to the assessment, stimulus objects that were present in the child’s classroom or home and that were relevant to the vocal responses were identified for each child (a packaged cupcake for the vocal response “cake,” a baby doll for the vocal response “baby,” plastic toy vegetables for the vocal response “vegetables,” and several toys that were found to be highly preferred, as indicated by the results of a stimulus preference assessment, for the vocal response “toy”). These items were used in the following test and control conditions.

*Mand test.* Sessions were conducted when the child had not interacted with the relevant object during the 60 min prior to the session (e.g., no access to any type of cake if the vocal response was “cake,” no access to any toys if the vocal response was “toy”). At the start of the session, the therapist showed the object to the child and then placed the object in a bag while remaining in close proximity to the child. If the relevant vocal response occurred, the therapist removed the item from the bag and handed it to the child. The child received a small piece of the named food item or 20-s access to named nonfood items. The object was then returned to the bag while the child was observing. (For Jim and Karen, the items were simply removed.)

The therapist presented the verbal prompt (“What do you want?”) every 20 s if the vocal response had not occurred since the last prompt or object removal. The therapist also briefly removed the object from the bag if the vocal response had not occurred for 1 min. (For Jim and Karen, the therapist briefly activated the toys or baby doll.) All other behaviors were ignored.

*Mand control.* Sessions were conducted after the child had interacted with the relevant object during the preceding 60 min. The child had access to the object continuously during the session, and the therapist was seated across the room from the child rather than in close proximity. For food items, the therapist replenished the food as it was consumed so that the child had access to the food for the entire session. No consequences were provided for any vocal responses.

*Tact test.* Sessions were conducted after the child had interacted with the relevant object during the preceding 60 min. The child had access to the object continuously during the session, regardless of whether a vocal response occurred. The therapist was seated in close proximity to the child. For food items, the therapist replenished the food as it was consumed so that the child had access to the food for the entire session. The therapist asked the child “What is that?” every 20 s if the

relevant vocal response had not occurred since the last prompt. Each time the vocal response occurred, the therapist provided brief praise (e.g., “good job” or “nice talking”) but did not include the name of the object in the praise statement. All other behaviors were ignored.

*Tact control.* Sessions were conducted after the child had interacted with the relevant object during the preceding 60 min. The object was not present in the room, and the therapist was seated across the room from the child rather than in close proximity. No consequences were provided for the vocal response.

*Intraverbal test.* Sessions were conducted after the child had interacted with the relevant object during the preceding 60 min. The object was not present in the room. The therapist was seated next to the child. Every 20 s, the therapist delivered one of four or five statements that were relevant to the vocal response (in fill-in-the-blank form) but did not contain the vocal response. For example, when the vocal response was “baby,” the therapist stated, “Cry like a —,” or “Feed the bottle to the —.” Words that seemed highly likely to be associated with the specific vocal response in the natural environment were selected for these statements. Each time the vocal response occurred, the therapist provided brief praise (e.g., “good job” or “nice talking”) but did not include the name of the object in the praise statement. All other behaviors were ignored.

*Intraverbal control.* Procedures were identical to those in the intraverbal test condition with the following exceptions: (a) Every 20 s, the therapist delivered one of four or five statements that were not relevant to the vocal response and did not contain the vocal response; for example, when the vocal response was “baby,” the therapist stated, “I ride the —,” or “I like to eat —,” and (b) no consequences were provided for any vocal responses. Thus, the therapist remained in close proximity and delivered the same number of statements across both intraverbal conditions.

*Echoic test.* Sessions were conducted after the child had interacted with the relevant object during the preceding 60 min. The object was not present in the room. The therapist was seated next to the child. Every 20 s, the therapist emitted the target vocal response. Each time the child exhibited the vocal response, the therapist provided brief praise (“good job” or “nice talking”). All other responses were ignored.

*Echoic control.* Procedures were identical to those in the echoic test condition except that the therapist was seated across the room and did not interact with the child, and no consequences were provided for any vocal responses.

## RESULTS

Number of responses per minute of the targeted vocal responses were compared across the test and control conditions in each phase. Results indicated that one or more functions were identified for at least one vocal response for each child. For Jim (Figure 1), “toy” rarely occurred in the tact or intraverbal test and control sessions of the assessment. The response occurred at high levels in the mand test sessions but rarely occurred in the corresponding mand control sessions, indicating that this response functioned as a mand. These findings suggest that Jim would benefit from tact and intraverbal training.

Assessment results for Jenny’s two verbal responses are shown in Figure 2. “Baby” was high in the first tact test session but rapidly decreased to zero. The response reemerged during the mand test sessions, and levels in these test sessions remained higher than those in the mand control sessions across the final three sessions. This finding indicates that “baby” functioned as a mand but not as a tact. In the intraverbal phase, the response occurred frequently in the test sessions but never occurred in the control sessions, indicating that the response also functioned as an intraverbal. However, it is possible that the high levels of

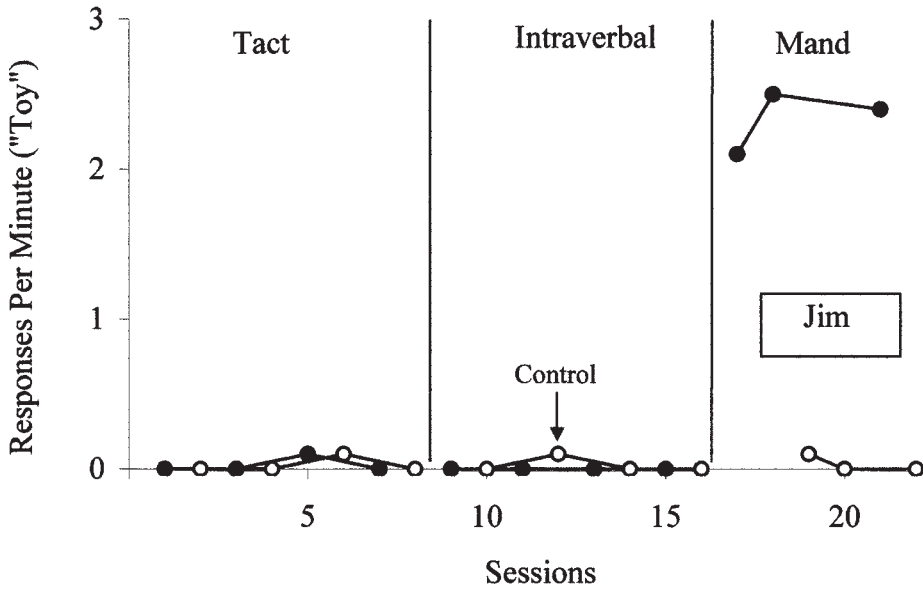


Figure 1. Responses per minute of Jim's vocal response "toy" during the test and control sessions for each verbal operant.

responding in the intraverbal test sessions were due to carryover effects from the mand test sessions. On the other hand, carryover effects probably would have been observed in both the test and control sessions of the intraverbal phase, which differed only with respect to the content of the verbal statements made by the therapist and delivery of praise for the vocal response. All other antecedents and consequences were held constant. Results for Jenny's other verbal response, "vegetable," suggested that this response functioned as a mand because levels of responding in the mand test sessions were higher than those in three of the four mand control sessions. The response rarely occurred in the intraverbal test or control sessions. Results for the tact were less clear. Low and variable levels of responding occurred in the tact test sessions, but responding was consistently higher in the test sessions than in the corresponding control sessions. Together, findings for both vocal responses indicated that Jenny would benefit from tact and intraverbal training.

Results for Karen are shown in Figure 3. "Baby" rarely occurred during the test sessions

for the intraverbal or mand but emerged during the tact test sessions. Responding never occurred in the tact control sessions. These results indicate that the response functioned as a tact. Thus, Karen would benefit from mand and intraverbal training.

Results for Linda are shown in Figure 4. "Cake" appeared to function as a mand, in that responding was much higher in the mand test sessions than in the mand control sessions. Levels of responding also were higher in the tact test sessions than in the tact control sessions, indicating that the response functioned as a tact. Although it is also possible that the results for the tact were due to carryover effects from the previous mand test sessions, this seems unlikely because (a) Linda had free access to cake throughout the tact test session, which eliminated the EO for the mand, (b) conditions in the tact test sessions were identical to those in the mand control sessions (with the exception of contingent praise in the tact test sessions), and (c) the response rarely occurred in the tact control sessions, which also would have shown carryover effects from the previous mand test condition. The results for the intraverbal were less clear.



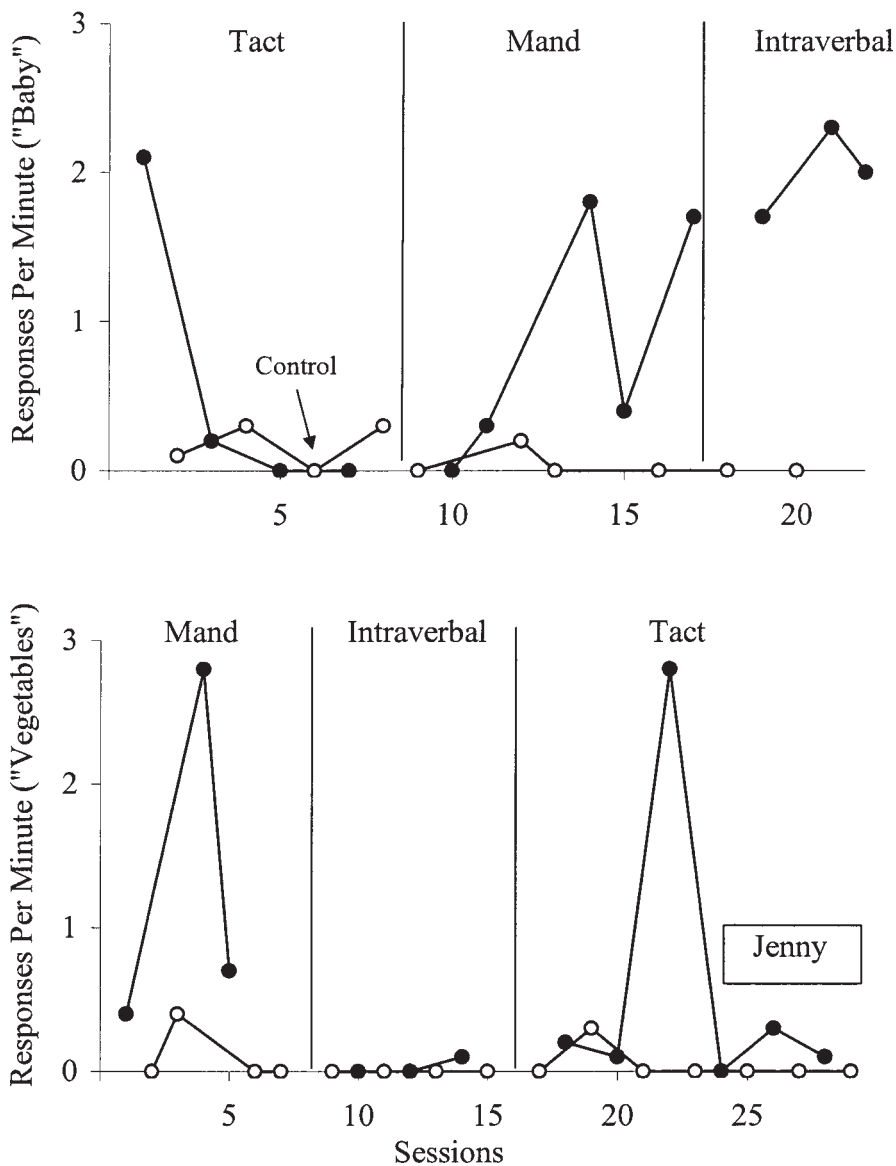


Figure 2. Responses per minute of Jenny's vocal responses "baby" and "vegetable" during the test and control sessions for each verbal operant.

Responding was low in the intraverbal test sessions but did appear to be maintained across the test sessions, and levels in the test sessions were clearly higher than those in the control sessions. Overall, however, these findings indicate that Linda would benefit from intraverbal training.

Linda's response "baby" did not appear to function as a mand, tact, or intraverbal because

little responding occurred in any of the test conditions. The response also occurred just once or twice during each echoic test session and never occurred in the echoic control sessions. Thus, a clear function was not identified for this response, but the spoken word did appear to occasion the response at least periodically during a 10-min session.

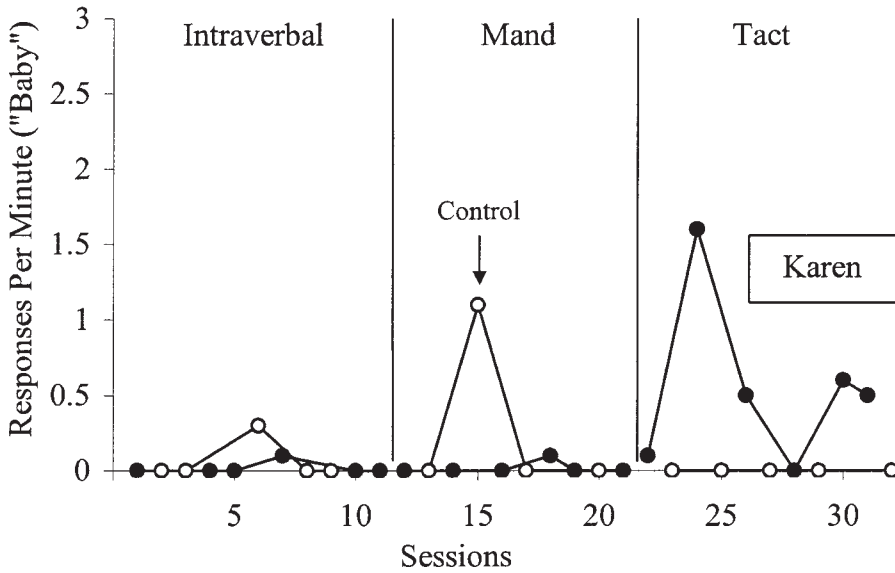


Figure 3. Responses per minute of Karen's vocal response "baby" during the test and control sessions for each verbal operant.

## DISCUSSION

These findings show that an experimental analysis was useful for identifying the functions of vocal responses (intelligible words) exhibited by children with developmental disabilities. Occurrences of the responses depended on the presence of specific antecedents and consequences, an outcome that was consistent with Skinner's (1957) theory of verbal behavior. For all children, response rates were differentiated across the test and control conditions of at least one verbal operant as well as across the various test conditions that were included in the assessment. For example, some participants who reliably exhibited the response as a request (mand) did not do so when asked to name the object (tact) or to complete statements about the object (intraverbal). In fact, every response with at least one identified function appeared to serve as a mand, with the exception of "baby" for Karen. This finding suggests that children with developmental disabilities may commonly acquire mands prior to other verbal operants (i.e., tacts and intraverbals), a pattern that has

been observed in typically developing children (Bijou & Baer, 1965). Alternatively, the reinforcing consequences for mands simply may be more potent than those for other verbal operants.

Experimental analyses of a child's communication responses may be valuable for guiding decisions about language training. Commonly used standardized language assessments (e.g., the Peabody Picture Vocabulary Test) focus on the topographies of the child's communication (e.g., object names that the child does and does not know) rather than on the function of the responses or the contexts under which they occur. Some authors have described indirect and descriptive assessments of communication skills that are based on the functional properties of language (e.g., Duker, 1999; Sundberg & Partington, 1998). However, these assessments are not designed to identify the functions of specific responses that are already in the child's repertoire. Nevertheless, these assessments probably are better suited than experimental analyses for conducting global assessments of a child's language skills. Combining

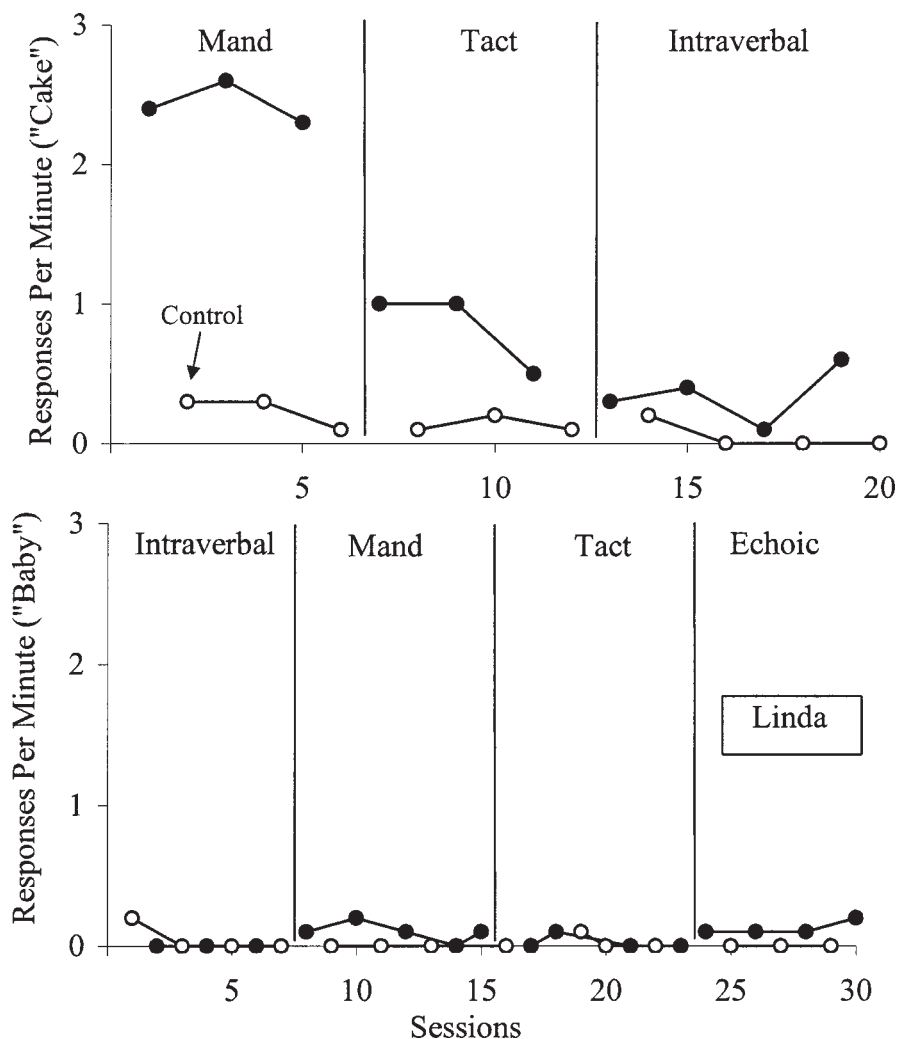


Figure 4. Responses per minute of Linda's vocal responses "cake" and "baby" during the test and control sessions for each verbal operant.

these types of global assessments with a functional analysis of the child's current communication repertoire would provide a more complete account of the child's language skills and help caregivers to select instructional goals both within and across each category of verbal operant. However, further research is needed on the clinical utility of this assessment and on methods to assess verbal operants using a more efficient experimental arrangement. The assessments in this study required 1 to 2 weeks to complete. It may be possible to identify

functions more quickly by (a) designing a single control condition, (b) rapidly alternating among multiple test conditions in a multielement design, or (c) using brief experimental arrangements similar to those used to assess problem behavior in clinic settings (e.g., Northup et al., 1991). Nevertheless, this study extends the functional analysis literature by showing that its procedures can be used to classify language skills in accord with the functional taxonomy supplied by Skinner's theory of language.

One assumption in this study was that the identified verbal operants had been acquired prior to the assessment. However, it is possible that one or more of the functions were learned via exposure to the variables manipulated during the test conditions. For example, contact with the contingencies in the mand test condition (access to the item) could have increased and maintained the targeted vocal response as a mand if this consequence functioned as a reinforcer. An analogous type of false positive has been shown to occur during a functional analysis of problem behavior (Shirley, Iwata, & Kahng, 1999). Exposure to the contingencies provided in one test condition also could have influenced responding during a subsequent test condition (e.g., potential carryover from the mand test sessions to the intraverbal or tact test sessions for Jenny and Linda). As in functional analyses of problem behavior, the assessment focused on responses that were already in the participant's repertoire and highly pertinent conditions under which the responses may or may not have occurred. This methodology is valuable for revealing behavioral sensitivity to certain forms of reinforcement, including those that are currently unrelated to response maintenance in the natural environment. Thus, although the analysis may produce false positives, the outcomes will provide information about current and potential functional relations that should assist caregivers in developing effective language interventions. The degree of similarity between the variables related to vocal responses in the natural environment and those manipulated in the test conditions of the verbal assessment should be investigated via descriptive analysis in future research.

Another type of false positive may have occurred in the mand and tact test conditions as a result of the additional listener variables that were included in these sessions (i.e., the verbal statements "What do you want?" and "What is this?"). If the participants responded to these statements as mands for the vocal response, the

resulting increase in responding may have constituted compliance to the therapist's mand rather than engagement in the tested verbal operant. These statements also could have been discriminative for other types of consequences in the natural environment. Thus, it is possible that the vocal response was not controlled by the key variables manipulated in these conditions, such as deprivation. These additional variables, which were very similar to those described by Skinner (1957), were included to increase the likelihood of occasioning the verbal operant and to enhance discrimination. This problem might be circumvented in future research by reducing the frequency of these therapist statements (e.g., delivering the statement once at the beginning of each session), considering only those vocal responses that do not occur in close temporal proximity to the therapist statements, or by omitting these statements altogether.

It is also possible that some verbal operants were not identified because the consequence provided (i.e., praise) was not a functional reinforcer for the response. This interpretation is consistent with the results for Jenny's response "baby," which occurred at high levels in the first tact test session and then decreased to zero. Previously identified reinforcers (e.g., food, leisure materials) could have been provided for correct responses in the tact and intraverbal conditions. The purpose of the assessment, however, was to determine if the response was functionally related to the controlling variables described by Skinner (1957). The use of potent but arbitrary reinforcers would have obscured the effects of praise alone. Information about the conditions under which a response will not occur is important to both theory and clinical application.

Nevertheless, some previously acquired verbal operants may not have occurred because the relevant stimulus conditions were absent from the assessment. For example, the object delivered contingent on the vocal response (for the

mand) or continuously available (for the tact) may not have been functionally related to the vocal response or adequately resembled the controlling stimuli in the natural environment. Other stimuli that occasioned the response in the natural environment (e.g., certain statements made by caregivers or teachers) also may have been absent. We attempted to circumvent this problem by using relevant objects from the child's classroom or home and by including verbal statements that are commonly associated with reinforcement for specific verbal operants (e.g., "What do you want?" for the mand, and "What is it?" for the tact). This potential limitation may be especially relevant for the intraverbal test condition, which consisted of a fairly circumscribed antecedent (several fill-in-the-blank statements) that may or may not have been part of the participants' learning histories. Fill-in-the-blank statements were selected because they are frequently used as part of early intraverbal training (e.g., Sundberg & Partington, 1998). The statements consisted of words that seemed highly likely to be associated with the specific vocal response in the natural environment. Nevertheless, the possibility that the assessment failed to identify some verbal operants cannot be ruled out in the absence of additional data on the validity of the assessment outcomes (e.g., descriptive analysis).

Other important functions may not have been identified because the assessment was limited to a small set of putative antecedents and consequences. For example, some studies have shown that perseverative speech or vocalizations that are otherwise inappropriate can be maintained by escape from demands (Durand & Crimmons, 1987) or by attention in the form of verbal reprimands (e.g., Rehfeldt & Chambers, 2003). In fact, no clear functions were identified for one response in this study (Linda's response "baby"). Other potential reinforcing consequences (e.g., escape from demands) should have been evaluated for Linda

before concluding the assessment. It should be noted that during the evaluation none of the participants were reported or observed to engage in excessive levels of repetitive speech or echolalia, a behavior disorder that is commonly associated with autism.

Another potential limitation of the assessment was the exclusion of the echoic test condition for responses with an identified function. An echoic function was presumed to be a necessary prerequisite for the acquisition of the other verbal operants (Sundberg & Partington, 1998). However, the echoic test condition might have indicated whether the therapist's verbal response would immediately occasion the child's response (i.e., distinguish between an immediate versus delayed echoic). This information might indicate whether echoic prompts would be effective when teaching other verbal operants.

Further research is needed on the validity and clinical utility of this assessment methodology. The reliability of other assessment methods, such as caregiver report about function, also should be evaluated. Finally, studies that incorporate descriptive analyses of vocal speech and other topographies of verbal operants in naturalistic settings would help to expand knowledge about the acquisition and maintenance of language in children with autism and other developmental disabilities. Such information may lead to improved treatments that ultimately enhance the short-term and long-term efficacy of early intervention.

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Received July 21, 2004

Final acceptance April 18, 2005

Action Editor, Jennifer Asmus