

*INCREASING COMMUNICATIVE INTERACTIONS OF
YOUNG CHILDREN WITH AUTISM USING
A VOICE OUTPUT COMMUNICATION AID AND
NATURALISTIC TEACHING*

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We evaluated the effects of a voice output communication aid (VOCA) and naturalistic teaching procedures on the communicative interactions of young children with autism. A teacher and three assistants were taught to use naturalistic teaching strategies to provide opportunities for VOCA use in the context of regularly occurring classroom routines. Naturalistic teaching procedures and VOCA use were introduced in multiple probe fashion across 4 children and two classroom routines (snack and play). As the procedures were implemented, all children showed increases in communicative interactions using VOCAs. Also, there was no apparent reductive effect of VOCA use within the naturalistic teaching paradigm on other communicative behaviors. Teachers' ratings of children's VOCA communication, as well as ratings of a person unfamiliar with the children, supported the contextual appropriateness of the VOCA. Probes likewise indicated that the children used the VOCAs for a variety of different messages including requests, yes and no responses, statements, and social comments. Results are discussed in regard to the potential benefits of a VOCA when combined with naturalistic teaching procedures. Future research needs are also discussed, focusing on more precise identification of the attributes of VOCA use for children with autism, as well as for their support personnel.

DESCRIPTORS: voice output communication, autism, naturalistic teaching, augmentative and alternative communication

One of the most frequent needs among young children with autism is assistance in developing effective communication skills. Despite noted progress in assisting children

with disabilities in acquiring communication skills (see Mirenda, Iacono, & Williams, 1990, for a review), communication effec-

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tiveness continues to represent an area of serious concern in applied behavior analysis. One specific area that has received significant research attention in this regard is the use of naturalistic teaching procedures (Warren & Kaiser, 1988).

Naturalistic teaching procedures involve the use of naturally occurring opportunities to teach communication skills during the course of an individual's daily routine (Halle, 1982). Such procedures are designed to focus on communicative behaviors that are of immediate functional utility to an individual in terms of affecting the individual's surrounding social and physical environment (Halle, 1987). Naturalistic teaching procedures likewise attempt to use routinely available items and activities of reinforcing value to an individual as a consequence for the individual's communicative behaviors (R. L. Koegel, O'Dell, & Koegel, 1987). To date, a number of investigations have provided support for the potential of these types of teaching approaches for assisting individuals with autism to improve their communication effectiveness (see L. K. Koegel, 1995, for a summary).

Recently, another means of assisting children with autism to communicate has been developed, involving voice output communication aids (VOCAs) as a type of augmentative and alternative communication (Beukelman & Mirenda, 1992). Voice output communication aids involve activation of a device to provide recorded or synthesized speech. Individuals with severe mental retardation have acquired skills to use VOCAs to make specific requests (Schepis, Reid, & Behrmann, 1996; Soto, Belfiore, Schlosser, & Haynes, 1993) and to initiate communicative interactions (Dattilo & Camarata, 1991). In addition, VOCA use by an individual with multiple disabilities has been accompanied by increases in communicative interactions of support personnel (Schepis & Reid, 1995).

A number of advantages of VOCAs relative to other augmentative and alternative communication systems have been reported (Schepis *et al.*, 1996). In particular, relative to manual signing and graphic-based systems, VOCAs permit the programming of messages of varying length and content that are easily understood by individuals who are both familiar and unfamiliar with the VOCA user (Ronski & Sevcik, 1996). The speech output of a VOCA also provides a potentially efficient way to gain the attention of communication partners (Ronski & Sevcik, 1966), unlike graphic systems or manual sign language that require visual proximity of communication partners as well as specific knowledge of the augmentative system (e.g., how to interpret various manual signs). However, despite these purported benefits of VOCAs, there has been a relative lack of research demonstrating successful VOCA use by young children with autism and severe language delays.

In light of the encouraging results of naturalistic teaching procedures for assisting individuals with autism to communicate and the potential advantages of VOCAs, a seemingly logical area of research would be to evaluate the use of VOCAs within a naturalistic teaching paradigm. Applications of naturalistic teaching procedures involving VOCAs have been reported to result in considerable communication advances with some youths with mental retardation (Ronski & Sevcik, 1996). To date, however, investigators have not reported on the use of such devices in conjunction with naturalistic teaching procedures with young children with autism. The purpose of this study was to evaluate the effects of VOCA use combined with naturalistic teaching procedures for increasing the communicative interactions of young children with autism. Whereas previous research has focused on VOCA use by individuals with severe disabilities to make requests (Schepis *et al.*, 1996), in this

study VOCAs were evaluated in conjunction with naturalistic teaching procedures for assisting children to request items, answer yes and no questions, and make statements and social comments. Because of reported concerns regarding potentially detrimental effects of VOCAs in terms of decreasing use of other communication behaviors, examination of the children's use of gestures, vocalizations, and words was conducted in addition to evaluation of VOCA behavior (cf. Layton & Watson, 1995).

METHOD

Participants and Setting

Four children with autism participated. Independent ratings by an examiner using the Childhood Autism Rating Scale (Schopler, Reichler, & Renner, 1988) indicated that each child functioned in the severe range of autism. Scores on the Vineland Adaptive Behavior Scales indicated that each child's overall adaptive functioning ranged between the 18- and 24-month level. Two children used some words, although very infrequently, and all children imitated simple sounds. Each child also responded to one-step requests (e.g., "come here," "sit down") although compliance was inconsistent. Each child was ambulatory, and all children with the exception of Lynn displayed independent toileting skills. Participants were selected based on prebaseline observations indicating that these individuals infrequently engaged in communicative interactions with staff and rarely used vocalizations for communicative purposes (with the exception of cries or screams to indicate apparent discontent). In addition, previous evaluations had recommended training in formal communication systems.

Ben was 5 years old and vocalized infrequently using only a few words (e.g., "see you later") in an echoic manner. He rarely initiated interactions with others. During in-

dependent play, Ben showed a preference for three activities among those available in the classroom and typically chose these activities when given the opportunity. He required verbal and physical prompts from classroom staff to complete work-related tasks such as sorting items.

Cory was 5 years old and used brief sounds and gestures to communicate. Most of his vocalizations were in the form of a cry. Cory typically did not establish eye contact and rarely attempted to interact physically with others. During leisure time, he typically played with one or two items in a repetitive manner. Customarily, he worked on simple tasks with verbal and physical prompts from classroom staff. Cory engaged in head slapping and finger waving that sometimes interfered with his participation in activities.

Lynn was 3 years old and used sounds or gestures in an apparent attempt to communicate, although these behaviors occurred very infrequently. On occasion, Lynn would take an individual by the hand and lead him or her to a door or object. During independent play, Lynn frequently chose the same activity among those available in the classroom and infrequently explored other activities. Lynn did not engage in work-related tasks without physical prompts from classroom staff.

Ian was 3 years old and occasionally displayed vocalizations or gestures to communicate. At times, Ian would vocalize a single word such as "no" and at other times would lead a familiar adult by the hand to a desired object. During play time, Ian typically chose among three activities from those available in the classroom. He worked on teacher-directed tasks with verbal and physical prompts from classroom staff. Classroom staff reported that Ian frequently did not comply with teacher requests.

The study was conducted in a self-contained classroom for children with autism in

a regular elementary school. Classroom staff included one certified teacher with 3 years of teaching experience and three assistants with 12 years, 2 years, and 1 year of experience, respectively, in educational settings. During snack and play routines, there were 7 children present with a diagnosis of autism, along with the teacher and one or two assistants.

Selection of VOCAs

Selection of the specific VOCA to use with each child was based on several factors using guidelines described previously (Muselwhite & St. Louis, 1988). First, classroom staff were asked to provide descriptive information about each child's communicative and interaction skills, as well as each child's most preferred food, items, and activities. Second, classroom staff were shown different sizes and types of graphic representations (e.g., line drawings, photographs) and were asked their opinions regarding visual features as well as number and content of messages that would be most useful for teaching each child to use a VOCA during existing classroom routines. Third, a clinician trained in augmentative and alternative communication and assistive technologies (the first author) observed each child during daily routines including snack, play, and seat work to assess each child's current modes of communication (gestures, manual sign language, etc.). Fourth, an experimenter presented each child with three different VOCAs to determine his or her ability to activate (press) and visually scan each device. Each child was prompted to use each device. Individual recommendations for VOCAs were then made for each child based on their relative success in activating the different devices.

As a result of this process, a VOCA known as a Cheap Talk (available from Enabling Devices, 385 Warburton Avenue, Hastings-on-Hudson, NY 10706) was se-

lected for use in the study. Compared to other VOCAs, a Cheap Talk is relatively inexpensive (range, \$75 to \$150, depending on number of messages) and is easy to record, and each child was able to activate the device and scan the array of symbols. Black and white computer-generated symbols (4 cm by 4 cm) that included the printed words of the message were placed on an eight-choice or four-choice Cheap Talk, depending on the number of messages that had been determined to be appropriate for each child. The background color for each symbol coincided with a grammatical category represented by the critical word in the phrase or sentence that conveyed the communicative intent. To illustrate, for the sentence, "I want a snack, please," the critical word was "snack." Because snack is a noun in this context, the colored background for nouns was used (see Goosens, Crain, & Elder, 1994, for an in-depth description of this type of color coding). Classroom staff indicated that each child would be able to visually discriminate the symbols on the boards. During the last three observations in the snack routine, Ben used a VOCA called a Black Hawk (available from ADAMLAB, 33500 Van Born Road, Wayne, MI 48184) with only the printed words (2 cm by 2 cm) for each message rather than graphic representation. At that point the words had been paired with the symbols for 1 year, and staff believed that Ben could respond to the words alone (see Ronski & Sevcik, 1996, for similar results of pairing words with symbols on VOCAs for youths with significant mental retardation). The Black Hawk operates in the same manner as the Cheap Talk, but offers an option of including up to 64 messages.

Ben had eight messages on his VOCA during the snack routine: "I'd like a snack, please," "I'd like a drink, please," "thank you," "more," "I'm finished," "yes," "no," and "I need to use the bathroom." Cory's four messages during the snack routine were

“yes,” “no,” “I’d like a snack, please,” and “I’d like a drink, please.” Lynn’s and Ian’s messages for snack included “yes,” “no,” “I’d like a snack, please,” and “thank you.” During the play routine, Ben’s and Cory’s messages were “yes,” “no,” “more,” “please,” “thank you,” “I need help,” “I’d like some play dough,” and “let’s do something else.” Only Ben and Cory participated in the play routine with VOCAs, whereas all 4 children participated in the snack routine. Snack and drink items varied from day to day according to the ongoing classroom routine. Different play items and activities such as play dough, tape recorder, computer, and trucks were available and accessible to the children during the play routine.

Behavior Definitions

Definitions for child behaviors were as follows: *Child communication*: The child was within close physical and hearing proximity (i.e., a distance normally expected for communication purposes in a classroom) of another person and directed a communication response to that person. Separate communicative interactions were scored if at least 5 s occurred between communicative responses, a target child interacted with a new person, or the type of communication changed (such as from a gesture to a VOCA). Child communication was scored according to the following subcategories: *Child-to-child communication*: child communication that was directed to another child. *VOCA*: The child activated the VOCA by pressing the template. *Physically guided VOCA*: The teacher or aide touched some part of the target child’s hand or arm to guide the response of pressing the VOCA. To be recorded as physically guided VOCA, the touch prompt had to be specifically directed to using the VOCA in contrast to some other type of child communicative behavior. *Word vocalization*: an utterance that was recognizable as a word in the English language. *Nonword*

vocalization: an utterance that was not recognizable as a word in the English language, and intent was unclear, but was directed to another person, excluding crying, breathing sounds, and laughing. *Gesture*: The child extended his or her hand toward the teacher or aide or object in the presence of the teacher or aide or touched the hand or arm of the person.

Definitions for teacher or aide behaviors were as follows: *Communicative interaction*: any intelligible verbalization, other than verbal prompts to communicate, directed toward a target child (the individual is near the target child, eye contact is made with the child, or the child’s name is said). Communicative interactions included verbalizations directed to a child both prior to (i.e., antecedent) and after (i.e., consequence) child communicative behavior. Separate interactions were scored if at least 5 s occurred between communication responses or if a new person interacted with the target child. *Verbal prompt specifically to communicate*: The teacher or aide specifically asked the child to make a communicative response, such as requesting the target child to say a specific word, to sign a word, to press the VOCA, or to use the device. For example, a request or directive by a teacher for a child to “tell me what you want with your VOCA” or to “use the VOCA” would represent a verbal prompt to communicate. In contrast, a more general teacher question such as “Do you want a drink?” would be considered a communicative interaction but not a verbal prompt specifically to communicate.

Observation System and Interobserver Agreement

Observation sessions for snack time began when a child was seated at the snack table and were terminated when a child left the table or when the teacher indicated that snack time was over. The length of snack time averaged 11 min (range, 6 to 19 min).

Table 1
Mean and Range (in Parentheses) Reliability for Communicative Behaviors

Behavior	Child				Overall average
	Ben	Cory	Lynn	Ian	
Total communication	95% (88% to 100%)	84% (67% to 96%)	93% (85% to 100%)	88% (88% to 89%)	90%
VOCA	97% (89% to 100%)	89% (72% to 100%)	86% (24/28)	100%	93%
Guided VOCA	100%	93% (67% to 100%)	80% (4/5)	100%	93%
Gestures	100%	57% (0% to 100%)	100% (3/3)	89% (88% to 90%)	87%
Nonword	100% (4/4)	48% (0% to 100%)	100%	81% (76% to 85%)	82%
Word	75% (3/4)	—	—	—	75%

Note. Dashes for the mean level indicate that there was no occurrence during reliability checks. Fractions indicate that there was only one session with occurrence, with the number of agreements during that session presented over the number of agreements plus disagreements.

Play observations were conducted after a child had completed a series of classroom tasks and the teacher told the child that he or she had time to play. Play time observations averaged 9 min (range, 5 to 12 min). The beginning and end of both snack and play periods were signaled by the teacher independently of the experimenter.

Two experimenters gathered data on target behaviors with a Tandy 100 handheld computer. A software application programmed in BASIC was used to collect occurrence data on each of the target behaviors in real time. Use of real-time data collection permitted an analysis of rate changes for each category of communicative behavior as well as an analysis of child behaviors that were not prompted by classroom staff (i.e., child communicative behavior that was not preceded by a staff communicative behavior directed toward the child within the preceding 5 s). Reliability observations occurred during at least 17% of the sessions involving all conditions and participants. Agreement for target behaviors was scored if both observers (experimenters) entered the code for the same target behavior within 2 s of each other (Lalli, Casey, Goh, & Merlino, 1994).

Reliability was calculated by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100% for each of the dependent variables.

Reliability averages and ranges for each child communicative behavior and each child are presented in Table 1. Agreement for each behavior category when averaged across all children was at least 82%, with the exception of word vocalizations. Word vocalizations were observed during only one reliability session for 1 child, and observers agreed on three of the four recorded occurrences. The lower reliability for gestures and nonword vocalizations for Cory appeared to be related to a very low frequency such that a small number of disagreements deflated the average (see Results). Specifically, on over 80% of all reliability checks, there was no more than one disagreement on gestures or nonword vocalizations for Cory. Throughout all reliability checks, no observer recorded child-to-child communication.

Reliability for staff communicative behaviors averaged 93%. Reliability for staff communicative behavior with Ben averaged 90% (range, 50% to 100%) and with Cory av-

eraged 80% (range, 50% to 92%). Reliability for staff behavior was 100% with both Lynn and Ian. There were no occurrences of staff providing specific verbal prompts to communicate in any experimental condition for any of the participants during reliability observations.

Experimental Conditions

Baseline for snack routine. Prior to the study, classroom staff had received instructions on ways to promote the children's communicative responses from clinicians who were responsible for providing educational consultation to the classroom. These consultations were a regular part of the county school system and had been provided independent of this project. During baseline snack probes, a target child was typically sitting at one of two small tables with 3 to 4 children or at one large table with 6 classmates. Classroom staff occasionally sat with the children during snack but typically stood adjacent to the table while providing food and drink items. Data were collected on each dependent variable for a target child and classroom staff, with the exception of VOCA behavior (because the VOCA was not available). Baseline probes spanned 2, 4.5, 6, and 2 months, respectively, for Ben, Cory, Lynn, and Ian.

Baseline for play routine. Probes conducted during play activities were similar to those for the snack routine. Classroom staff were present in the room and a target child had access to play items, either provided by the teacher or selected by the child from the array of items available in the classroom. The teacher or one of the aides was available to interact and prompt material engagement with a child. Baseline probes for the play routine spanned 6 months and 5 months for Ben and Cory, respectively.

Naturalistic teaching and VOCA. After baseline observations were conducted for a target child in the snack or play routine, the

experimenter conducted a 30- to 45-min training session with classroom staff that focused on 1 target child and classroom routine selected for intervention. At the beginning of this session, staff were asked their opinion about the types of items or activities the target child preferred in relation to the classroom routine being discussed. The experimenter also provided information on child preferences based on observations of the items the child had selected in a free-choice situation and the amount of time a child had engaged with each item. Classroom staff and the experimenter discussed the types of communication messages that would provide the child with the most useful communicative responses in terms of frequency of use and function. The graphic representation for each message was also decided, with an attempt to ensure that each symbol was clearly distinguishable from other symbols. Classroom staff were instructed how to record messages and store the VOCA when not in use.

During the training session, the experimenter provided verbal and written presentations outlining the main components of naturalistic teaching procedures in relation to VOCA use and a target child and routine. The main features of the naturalistic instructional strategy included (a) using child-preferred stimuli available within the natural routine, (b) using child-initiated responses (i.e., child communicative behaviors not preceded by a staff interaction) as the point of intervention, and (c) providing verbal and gestural prompts with minimal use of physical guidance. Natural cues such as physical approach, expectant delay, or questioning looks and eye contact were described and modeled as ways to evoke a child's initiation of a communication response (Halle, 1982, 1987). Classroom staff were given multiple examples of interactions that could occur in a targeted routine, including types of questions to ask if a child did not respond to less

intrusive natural cues. For example, if a child raised his hand toward a cup, the teacher was instructed to provide an expectant look and wait for the child to use an appropriate VOCA message. If a child did not activate the VOCA, the teacher was shown how to ask the child, "Would you like a drink?" and, if necessary, gesture toward the VOCA. Classroom staff were instructed to use the least amount of physical guidance to evoke a VOCA response in the event a child did not respond to less intrusive prompting, such as gesturing or naturalistic question asking. If the latter prompts were unsuccessful in obtaining the desired response, staff were instructed to proceed with more intrusive prompts, with the final prompt being a physical prompt if necessary. Physical prompts were required infrequently.

Following this session, a target child was provided with the VOCA during the targeted classroom routine. At the beginning of the first experimental session for a target child in a routine, classroom staff modeled the use of the VOCA by pressing the keys on the device and directing the child's attention to the graphic representations of each message. The child was allowed to freely explore the VOCA for 1 min (e.g., pressing switches and listening to messages). Following the initial demonstration of the VOCA, the VOCA was provided with no further instructions to the target child at the beginning of subsequent sessions for that routine. Feedback regarding the performance of classroom staff was not provided after a session; however, on occasion they asked the experimenter's opinion of ways to facilitate child use of the VOCA during a specific routine or asked questions about the VOCA. In these instances, the experimenter responded to their questions by referring to the information provided at the training session.

Data were collected during the intervention condition as described in baseline, with the additional VOCA responses. Probes con-

ducted during the naturalistic teaching and VOCA snack condition spanned 13, 3, 2, and 3 months for Ben, Cory, Lynn, and Ian, respectively. The naturalistic teaching and VOCA play condition probes for Ben and Cory spanned 3 and 1 months, respectively. In this regard, although observational probes were conducted over time periods of several days and weeks in contrast to daily observations, the first observation during an intervention condition was always conducted within 1 week of the last baseline observation for each child, with the exception of Cory's intervention in the play setting. There were 3 weeks between Cory's last baseline observation and the first observation during intervention in the play setting. This delay was due to Cory missing several days of school because of illness, a school holiday, and several days of school closing because of inclement weather.

Contextual Appropriateness and Use of Different Messages

Intermittently during the naturalistic teaching and VOCA snack condition, classroom staff were asked to rate the contextual appropriateness of each child's VOCA responses after the session. The experimenter selected which sessions to ask for ratings prior to beginning any observations for a session. A 7-point rating scale was used, with 1 representing *extremely appropriate*, 4 representing *neither appropriate nor inappropriate*, and 7 representing *extremely inappropriate*. At least six ratings were obtained for each child ($M = 16.5$, range, 6 to 34 across individual children). Follow-up contextual rating probes were also conducted for the snack routine after termination of formal observation of target behaviors, spanning periods of 9 months, 4 months, 5 months, and 2 months for Ben, Cory, Lynn, and Ian, respectively. At least seven ratings were obtained for each child ($M = 13.5$, range, 7 to 28 across individual children). The teach-

er and two assistants completed ratings for Ben and Cory, whereas only the two assistants completed ratings for Lynn and Ian (one assistant completed 53% of the ratings and one completed 47%). The teacher and assistants completed ratings during and after the intervention. In addition, the director of a local preschool program who was unfamiliar with the students and classroom completed a rating for each child during the follow-up probes.

On five occasions for each child, probes were also conducted to determine how many different messages the children used at least once in the snack routine. These probes occurred 14 months, 12 months, 4 months, and 2 months after formal data collection had terminated for Ben, Cory, Lynn, and Ian, respectively. Days on which probes occurred for different message use were determined prior to conducting any observations for a given day.

Experimental Design

A multiple probe design (Horner & Baer, 1978) across time and across 2 participants in two routines and 2 participants in one routine was used to evaluate the effects of VOCA use within a naturalistic teaching paradigm on child communicative behavior.

RESULTS

Child Behavior

The number of communicative interactions per minute, including gestures, vocalizations, word vocalizations, and VOCA behaviors for Ben and Cory during the snack and play routines, is presented in Figure 1, and is presented for Lynn and Ian in the snack routine in Figure 2. All children displayed an increase in communicative interactions during the VOCA and naturalistic teaching condition, relative to baseline in each classroom routine. Ben, Cory, Lynn, and Ian showed an average number per min-

ute of communicative interactions of 0.05 (range, 0 to 0.13), 0.02 (range, 0 to 0.08), 0.16 (range, 0 to 0.80), and 0.07 (range, 0 to 0.33) in the baseline snack condition, respectively. Respective rates of communicative interactions during the naturalistic teaching and VOCA snack condition increased to 2.85 per minute (range, 1.54 to 4.18), 2.56 (range, 1.11 to 4.50), 3.94 (range, 2.10 to 6.50), and 3.29 (range, 2.00 to 5.23). Communicative interactions that were VOCA responses averaged 93% (range, 73% to 100%), 82% (range, 57% to 100%), 89% (range, 71% to 97%), and 36% (range, 23% to 40%) of all interactions for Ben, Cory, Lynn, and Ian, respectively. Most VOCA communicative behaviors were not physically guided for each child except Ian. Specifically, nonphysically guided VOCA behavior in the snack routine averaged 95% (range, 72% to 100%), 95% (range, 75% to 100%), 83% (range, 60% to 96%), and 41% (range, 16% to 100%) of all VOCA communicative behavior for Ben, Cory, Lynn, and Ian, respectively. Further analysis of VOCA use indicated that a number of VOCA activations that were not physically guided were initiated by each child without any apparent prompt from classroom staff (i.e., VOCA use without a staff interaction within the preceding 5 s): 52% (range, 25% to 90% across sessions) of Ben's VOCA use, 67% (range, 25% to 93%) of Cory's, 45% (range, 16% to 72%) of Lynn's, and 47% (range, 25% to 70%) of Ian's.

In the baseline play condition (Figure 1), the average number per minute of communicative interactions was 0.09 (range, 0 to 0.50) and 0.11 (range, 0 to 0.60) for Ben and Cory, respectively. During the naturalistic teaching and VOCA play condition, Ben's and Cory's number of communicative interactions per minute increased to 3.55 (range, 2.50 to 5.00) and 2.57 (range, 1.64 to 3.33), respectively. Communicative interactions that were VOCA responses averaged

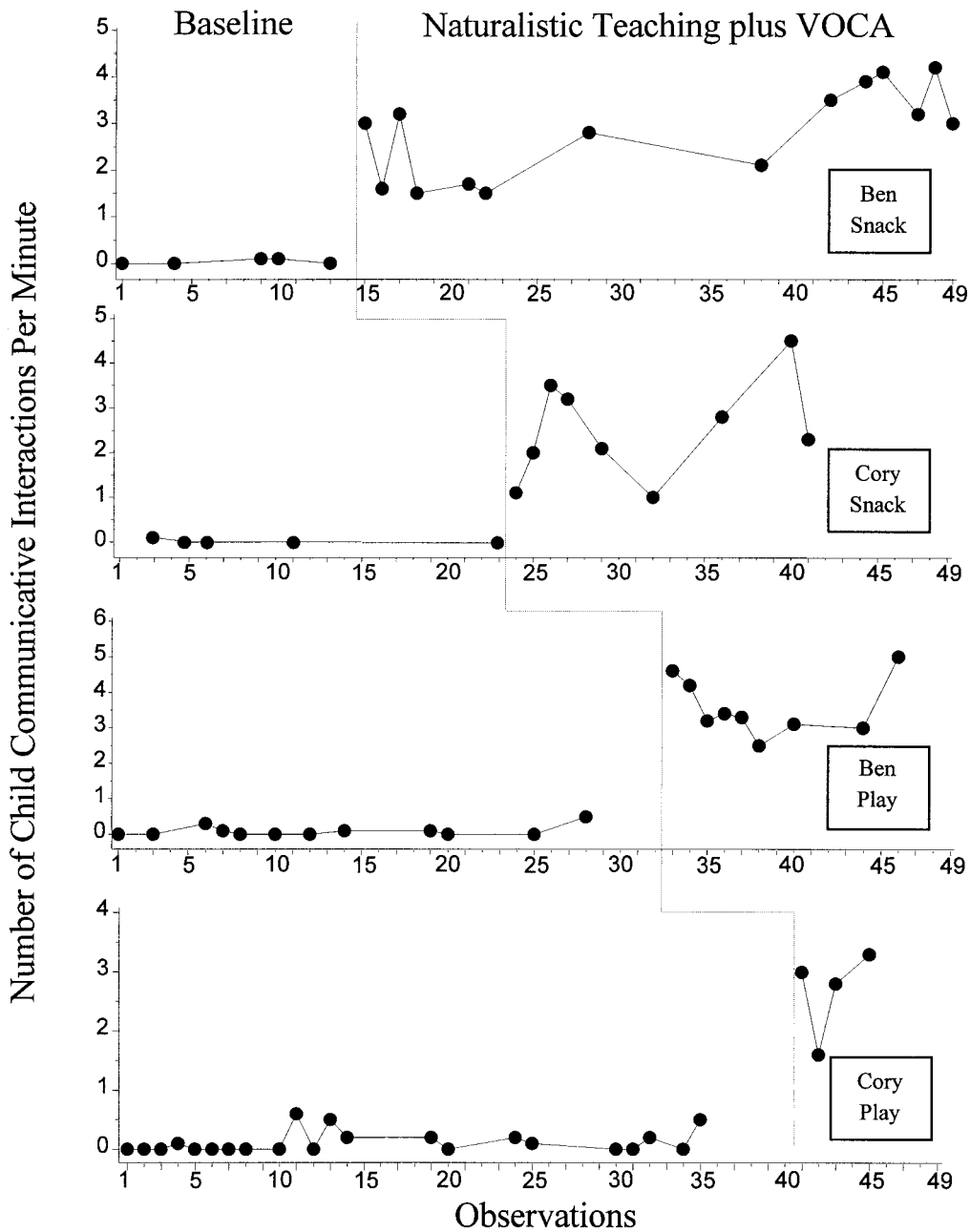


Figure 1. Number of communicative interactions per minute for Ben and Cory during both experimental conditions during the snack and play routines.

87% (range, 65% to 100%) and 86% (range, 78% to 93%) for Ben and Cory, respectively. Nonphysically guided VOCA responses for Ben and Cory in the play condition averaged 98% (range, 96% to 100%) and 90% (range, 76% to 100%), respective-

ly. Sixty-eight percent (range, 52% to 100%) of Ben's nonphysically guided VOCA activations and 59% (range, 35% to 92%) of Cory's activations appeared to be initiated by the students in that they were not preceded by an interaction by a teacher or assistant

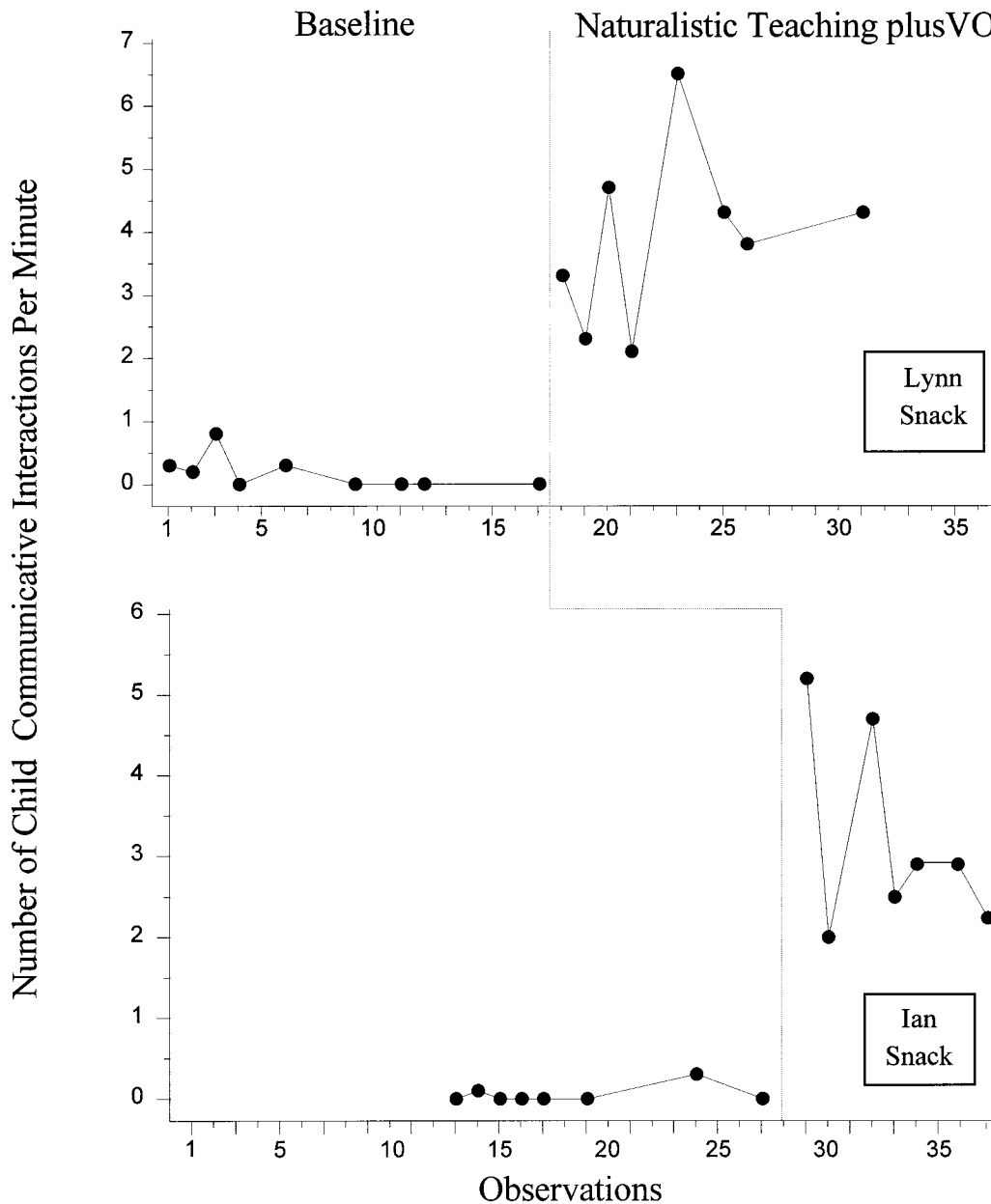


Figure 2. Number of communicative interactions per minute for Lynn and Ian during both experimental conditions during the snack routine.

within the preceding 5 s. There were no occurrences of child-to-child communicative interactions in either condition during snack and play routines for 3 of the children, and only seven such interactions occurred for Lynn (in the VOCA snack condition).

The number per minute of different types

of communicative interactions for each participant other than VOCA usage (i.e., gestures, nonword vocalizations, and words) is presented in Table 2. There was no indication that these non-VOCA communicative behaviors decreased in frequency for any child during the intervention. Specifically,

Table 2
Mean Number (with Ranges in Parentheses) of Non-VOCA Communicative Behaviors Per Minute

Child	Condition	Communicative behavior		
		Gestures	Nonword	Word
Ben	Snack BL	0.03 (0–0.13)	0.00	0.02 (0–0.06)
	Snack NT	0.08 (0–0.06)	0.06 (0–0.25)	0.07 (0–0.63)
	Play BL	0.05 (0–0.33)	0.04 (0–0.20)	0.00
	Play NT	0.05 (0–0.14)	0.24 (0–0.50)	0.18 (0–0.57)
Cory	Snack BL	0.02 (0–0.08)	0.00	0.00
	Snack NT	0.33 (0–0.54)	0.15 (0–0.50)	0.00
	Play BL	0.11 (0–0.60)	0.01 (0–0.20)	0.00
	Play NT	0.23 (0–0.44)	0.11 (0–0.33)	0.00
Lynn	Snack BL	0.11 (0–0.60)	0.05 (0–0.33)	0.00
	Snack NT	0.30 (0–1.20)	0.10 (0–0.55)	0.00
Ian	Snack BL	0.03 (0–0.17)	0.04 (0–0.17)	0.00
	Snack NT	1.10 (0.25–2.54)	1.01 (0.47–1.89)	0.00

Note. BL = baseline; NT = naturalistic teaching and VOCA condition.

the number per minute of gestures and nonword vocalizations increased in the VOCA snack condition relative to baseline levels for all the children, although the amount of increase was generally small and variable across children. Similarly, rate of gestures and nonword vocalizations for Ben and Cory in the naturalistic teaching and VOCA play condition increased at least somewhat, except for Ben’s gestures which were maintained at baseline level. No occurrences of word vocalizations were observed for Cory, Lynn, or Ian in any condition. There was some increase in word vocalizations for Ben during both the naturalistic teaching and the VOCA snack and play routines relative to baseline.

Classroom Staff Behavior

Teacher and aide communicative interactions during each of the routines for each participant are represented in Figures 3 (Ben and Cory) and 4 (Lynn and Ian). Number per minute of staff communicative interactions in the snack baseline averaged 0.51 (range, 0.33 to 0.81), 0.44 (range, 0.22 to 0.60), 0.49 (range, 0.10 to 0.89), and 0.36 (range, 0 to 0.58) for Ben, Cory, Lynn, and Ian, respectively. During the VOCA and naturalistic teaching conditions the number of staff communicative interactions increased to averages of 2.83 (range, 1.63 to 4.00), 2.11 (range, 1.22 to 3.00), 3.23 (range, 1.78 to 5.20), and 3.50 (range, 2.00 to 5.23), respectively. During the play baseline condition, the number per minute of staff communicative interactions averaged 0.67 (range, 0 to 2.67) and 0.82 (range, 0 to 1.80) for Ben and Cory, respectively, and increased to respective rates of 2.89 (range, 1.73 to 4.83) and 3.00 (range, 2.09 to 3.83) in the play naturalistic teaching and VOCA condition. There were no occurrences of staff providing specific verbal prompts to communicate in either condition during snack and play routines for any of the participants.

When the children initiated use of the VOCA (i.e., without an interaction from a staff person within the preceding 5 s), the VOCA activations were usually followed by a communicative interaction from staff (i.e., within 5 s). Of the apparent VOCA initiations, 74% were followed by an interaction from staff. The average percentages of apparent VOCA initiations followed by a staff interaction within 5 s for Ben, Cory, Lynn, and Ian were 74%, 69%, 58%, and 93%, respectively. Staff interactions following apparent VOCA initiations accounted for the majority of all staff interactions with the children during the intervention, representing 79% of staff members’ interactions with

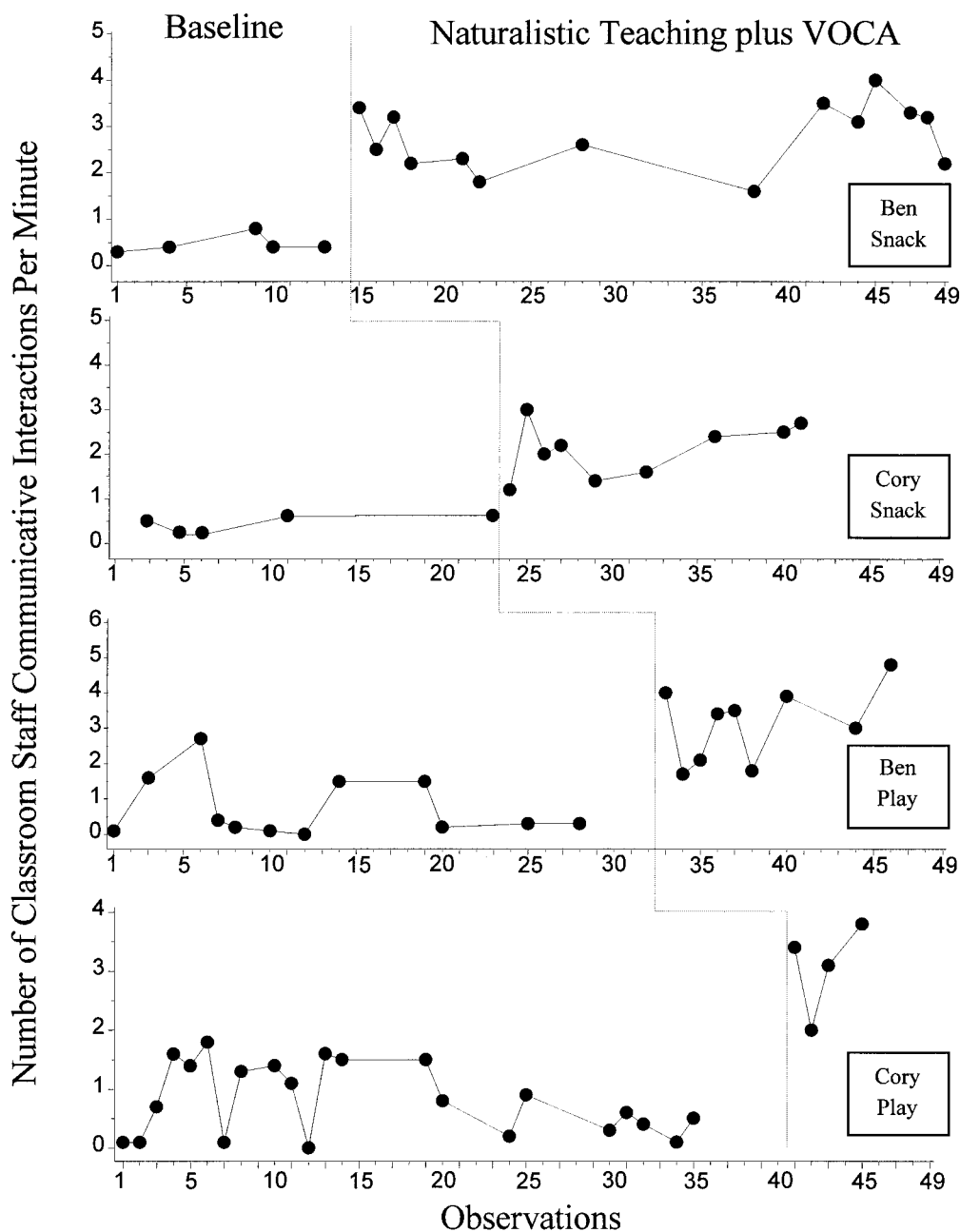


Figure 3. Number of staff communicative interactions per minute with Ben and Cory during both experimental conditions during the snack and play routines.

Ben, 62% with Cory, 61% with Lynn, and 63% with Ian.

Staff communicative interactions followed (i.e., within 5 s) 78% of all child communicative behavior that did not involve VOCA use, although as indicated previously,

non-VOCA communication by the children was infrequent. Staff interactions followed 71% of Ben's non-VOCA communicative behavior, 70% of Cory's, 86% of Lynn's, and 84% of Ian's.

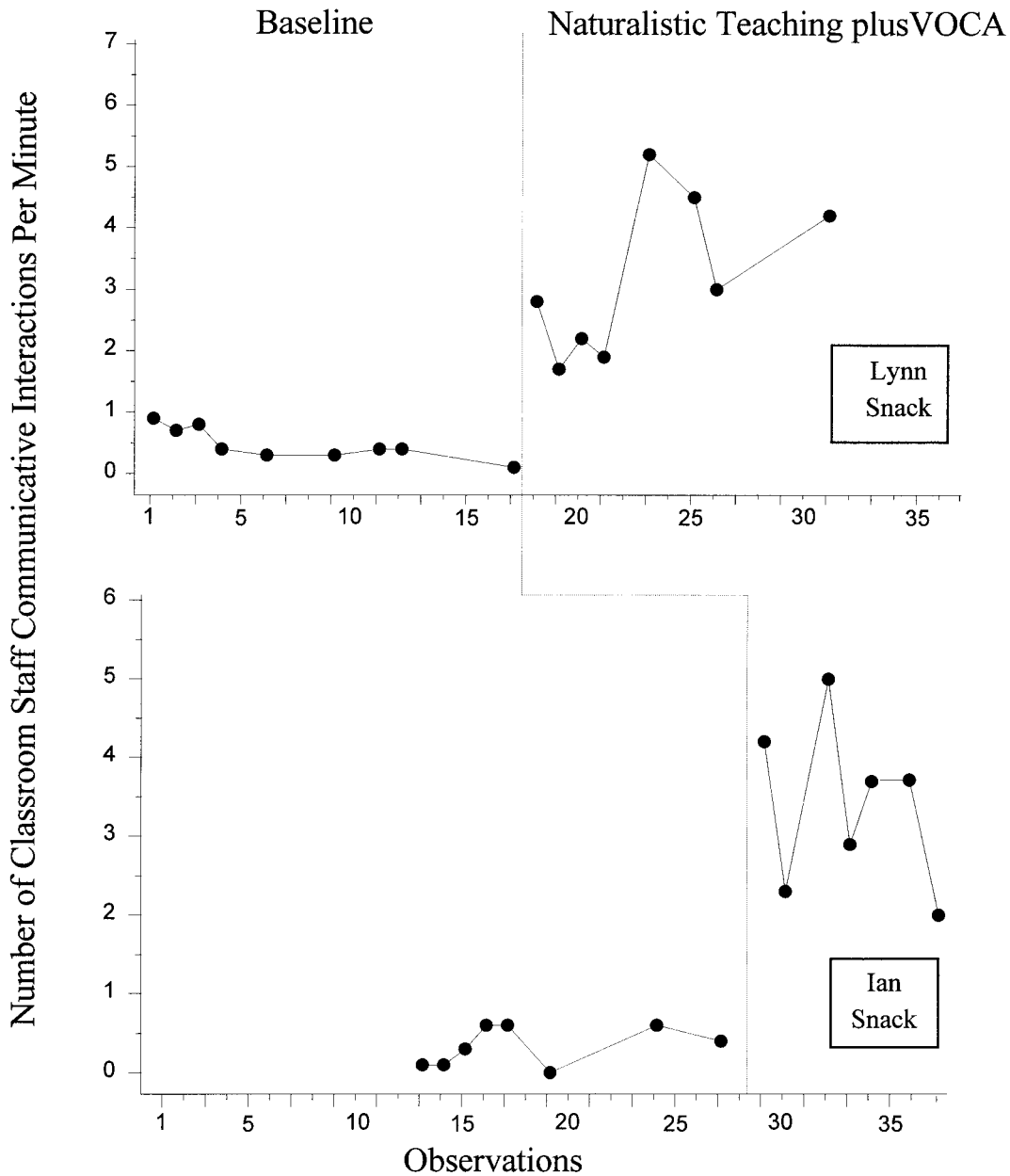


Figure 4. Number of staff communicative interactions per minute with Lynn and Ian during both experimental conditions during the snack routine.

Ratings of Contextual Appropriateness

During the interventions, average ratings of the contextual appropriateness of the children's VOCA communications by classroom staff indicated that they were on the *appropriate* end of the rating scale for each child. Ben's average rating was 1.8 (between *very*

and *extremely appropriate*), Cory's average was 2.8 (between *appropriate* and *very appropriate*), Lynn's average was 3.6 (between *neither appropriate nor inappropriate* and *appropriate*), and Ian's average was 2.8 (between *appropriate* and *very appropriate*). The follow-up ratings conducted after termina-

tion of formal experimental observations indicated that the average ratings essentially were maintained for Cory (average of 2.9) and Ian (3.1) and improved somewhat for Ben (1.0) and Lynn (2.5). The ratings by the person who was unfamiliar with the students were very similar to the ratings of the classroom staff: 2, 3, 1, and 2 for Cory, Ian, Ben, and Lynn, respectively. Again, all ratings by the classroom staff as well as the person unfamiliar with the students averaged on the *appropriate* end of the rating scale.

The observations for the number of different messages activated on the VOCA, spanning approximately the same time period as the follow-up contextual ratings, indicated that Ben and Cory used an average of 10 and six different VOCA messages per session, respectively (after formal observations were terminated, Ben had 10 messages and Cory had eight messages available), and Lynn and Ian used between two and four different messages each session. During follow-up probe observations for different messages, the children used messages that represented each specific type of communication response.

DISCUSSION

The results of this study with young children with autism support and extend the findings of previous research examining the use of VOCAs by persons with other types of severe disabilities. Results demonstrated the efficacy of using a VOCA in conjunction with naturalistic teaching procedures to increase the frequency of communicative behaviors by 4 children in one naturally occurring classroom routine and 2 children in an additional routine. All participants used a VOCA to request items, respond to questions, and make social comments during the natural routines of snack or play. The majority of VOCA communication responses for all children were not physically guided

by classroom staff, with the exception of Ian. Also, each child used the VOCA consistently without a specific verbal prompt to communicate, and used it relatively frequently without any preceding verbal behavior from a staff person.

There was no evidence of VOCA use being associated with a decrease in the frequency of other child communicative behaviors. In fact, increases, albeit generally rather limited, were seen for all children for at least some other communicative responses (e.g., gestures, words, or vocalizations) when they had access to a VOCA within the naturalistic teaching paradigm. These results might address concerns, noted earlier, that use of a VOCA may inhibit other functional communication forms. The lack of a decrease in use of other communicative behavior may have been due to staff members' frequent interactions with the children following such behavior. Throughout the intervention, staff interacted with the children following 78% of their communicative behaviors that did not involve VOCA use, which was very similar to the 74% of child-initiated VOCA behaviors that were followed by an interaction from staff. Hence, the children's other communicative behaviors may have been reinforced along with the VOCA use. However, an analysis of the specific type of interaction following each child communicative behavior was not conducted (e.g., whether other child communicative behaviors such as a gesture began an interactive chain that eventually included a VOCA activation), such that the controlling variables of non-VOCA communicative behavior cannot be determined. In light of the lack of a decrease in other child communicative behaviors, more refined analyses of the effects of VOCA use on such communicative behaviors as gestures, vocalizations, and word use are warranted. Such analyses would include specific data on staff members' use of nonvocal models and gestures to attempt to communicate,

in addition to vocal and physical guidance that were recorded as staff communicative behavior in the current investigation.

The contextual ratings of child communicative responses by classroom staff suggested that the vast majority of nonphysically guided VOCA responses were contextually appropriate. These ratings were supported by the ratings of the individual who was unfamiliar with the students and classroom routine. However, the contextual ratings should be interpreted cautiously because the majority of the ratings were conducted by classroom staff who were very familiar with the students, which may have positively biased their ratings.

Baseline rates of communicative interactions by staff were very low in contrast to the naturalistic teaching condition in which children had access to a VOCA. Following training on naturalistic teaching and introduction of the VOCA for each child, there was an increase in classroom staff members' communicative interactions with the children. These increases were probably due in part to the recency of the training at the beginning of the intervention, which focused on means of prompting child communicative behaviors. Although no formal data were collected, it appeared that the classroom staff were generally consistent in following the naturalistic prompting procedures that were presented in the initial training. However, it is also likely that the increases in staff communicative interactions were due to the ease in understanding the children's VOCA communication and subsequent staff responses to the VOCA activations. Several factors seem to support the suggestion that the increases in staff interactions with the children during the VOCA and naturalistic teaching condition were due to staff responses to VOCA use by the children and not just to increases in prompting interactions. First, based on a considerable amount of staff management research, it is

unlikely that one training session on VOCAs and naturalistic teaching strategies would be sufficient in itself to bring about such a dramatic and consistent change in staff communicative interactions (see Reid, Parsons, & Green, 1989, for a review). Second, the fact that the majority of staff interactions with the children were within 5 s of apparent child initiations of VOCA use (averaged across all children, 66% of all staff interactions followed apparent child VOCA initiations) suggests that staff members were responding to the children's VOCA use. The increases in classroom staff communicative interactions directed to the children during the naturalistic teaching and VOCA condition are similar to a previous research finding that VOCA use by a person with profound multiple disabilities facilitated communicative interactions of support personnel (Schepis & Reid, 1995). Nevertheless, the current investigation does not permit a conclusive determination as to the variables responsible for the increases in staff interactions with the children, and additional research is warranted to determine whether VOCA use by individuals who are nonvocal or minimally vocal functions to prompt or reinforce responses from support personnel.

The students' acquisition and functional use of VOCAs within the conditions of this investigation suggests that additional research on the use of VOCAs by children with autism is warranted. Formal data collection on VOCA use for 1 child in the study spanned 1 year, and follow-up contextual ratings by classroom staff continued for 1 year for each child. Classroom staff continued to provide the children with access to a VOCA, suggesting the absence of a novelty effect that sometimes exists when a relatively new technology is first employed. However, because this investigation focused on evaluating the combined effects of VOCA with naturalistic teaching procedures, independent effects of VOCA access cannot be de-

terminated. In light of the increases in interactions that were observed, results of this study seem to offer encouragement for continued investigation of VOCAs in a variety of contexts. Relatedly, this study was limited to an evaluation of two classroom routines, and more research is needed to examine issues related to the use of a VOCA for extended periods throughout a child's day. Research attention also could address potential logistical concerns that may arise with extended use of a VOCA, such as portability of a device across routines and settings and maintenance of the device (e.g., batteries).

A final note of concern relates to the absence of communicative exchanges among children in the classroom in either condition. Although the VOCA was used effectively by the children with classroom staff, the use of the device did not facilitate communicative interactions among children. It is important to note that communicatively competent peers were not available in the class and, therefore, more valid assessment of child-to-child interaction must await further research. Such research is needed to investigate the extent to which naturalistic teaching procedures and the use of a VOCA may enhance interactions among children with disabilities and their speaking peers as well as peers who also use VOCAs.

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STUDY QUESTIONS

1. The authors defined naturalistic teaching procedures as those involving the use of naturally occurring opportunities to teach communication skills during the course of an individual's daily routine. To what extent do these procedures resemble those described by Hart and Risley (*JABA*, 1975) as *incidental teaching*?
2. What is a VOCA? What are its purported advantages, and what is a potential disadvantage of VOCA-assisted communication?
3. Examine the lists of VOCA messages selected for each participant. What features of the daily snack and play routines might affect the rate of these VOCA responses?
4. Describe the main features of the naturalistic teaching strategy. What were the consequences for various communicative behaviors during baseline and training?
5. The data presented in Figures 1 and 2 show the total number of communicative responses per minute for each child. Additional information contained in the text provides a breakdown of communication responses into separate categories. Using this information, estimate Ian's rate of independent VOCA communication during naturalistic teaching.
6. What effect did VOCA use have on the children's other forms of communication?
7. Provide several possible reasons for the observed increases in child and adult communication during naturalistic teaching.
8. Approximately what percentage of participants' VOCA and non-VOCA communication responses were followed by staff interaction? Assuming that staff interaction might serve as reinforcement for communicative behavior, how might staff members have altered their interaction patterns to produce greater increases in participants' VOCA use?

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