J Autism Dev Disord (2007) 37:1505–1513
DOI 10.1007/s10803-006-0243-6

ORIGINAL PAPER

The Effects of Enhanced Milieu Teaching and a Voice Output Communication Aid on the Requesting of Three Children with Autism

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Published online: 25 October 2006

Abstract The purpose of this study was to evaluate the effects of enhanced milieu teaching when combined with a voice output communication aid on the requesting skills of three children with autism. The research design was a multiple probe across participants. All sessions were conducted during 5-min play sessions in the child's classroom. All three children learned to use the voice output communication aid to request items during play. Additionally, all three children increased their total requesting during play.

Keywords Enhanced milieu teaching · Voice output communication aid · Communication intervention · Naturalistic intervention

Introduction

Enhanced milieu teaching (EMT), a naturalistic communication intervention, has been described as a hybrid intervention model combining strategies from the interactive model (Girolametto & Weitzman, 2002; Kaiser & Hemmeter, 1996) and milieu teaching intervention approaches (Alpert & Kaiser, 1992; Hancock & Kaiser, 1996). EMT has been shown to increase communication skills in young children with language delays (Hemmeter & Kaiser, 1994; McCathren, 2000), including children with autism (Hancock & Kaiser, 2002; Kaiser, Hancock, & Nietfeld, 2000). Despite the effectiveness of EMT for children with autism, to our knowledge, no studies of EMT have been completed using any augmentative and alternative communication (AAC). Since many children with autism have been shown to lack formal expressive communication skills, they may not benefit from an intervention that focused solely on verbal expressive communication. Therefore, it seems important to study the effects of EMT when combined with AAC strategies.

Augmentative and alternative communication intervention strategies may consist of a variety of options including but not limited to sign, picture exchange, and voice output communication aids (VOCA[1]). In fact, research has demonstrated the effectiveness of using VOCAs to teach communication skills to individuals with limited expressive ability (Brady, 2000; Schepis, Reid, Behrmann, & Sutton, 1998; Sigafoos et al., 2004). However, the context for intervention with the VOCA has been studied very little. In fact, Schepis and colleagues noted that while a substantial research base showed support for naturalistic instruction such as EMT, no research on the use of naturalistic communication instruction paired with VOCAs existed.

Schepis et al. (1998) used the following naturalistic intervention *elements* during their study: (a) child-preferred stimuli available within the natural routine;

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[1] A VOCA consists of a switch device linked to a pre-recorded message or synthesized speech output. Each time the switch is pressed; the message is activated and heard by listeners.

(b) child-initiated responses as the point of intervention; (c) adult use of verbal and gestural prompts with minimal use of physical guidance; and (d) adult use of natural cues such as physical approach, expectant delay, or questioning looks and eye contact. Intervention was implemented during play and snack routines. Four children with autism under 5 years of age increased their use of VOCAs. Additionally, classroom staff increased their interactions with the target children (Schepis et al., 1998). One limitation of this study was that the VOCA was not available during baseline and therefore authors were not able to conclude that the intervention was the sole reason for increased VOCA use. A second limitation is that the exact intensity of the intervention was difficult to measure given the lack of information reported by the authors.

In a similar study, Brady (2000) taught two children to use a VOCA during joint activity routines such as playing audio tapes, gluing with glitter, and making snacks. The intervention consisted of adult use of physical prompting and natural reinforcement (e.g., the child received the item he/she requested). Children, one with autism and one with traumatic brain injury, learned to request target objects using the VOCA and both children showed increases in receptive comprehension of the target object labels. One limitation of Brady's study was that the children were limited to only four requesting trials per session which prevented the authors from assessing the development of spontaneous requesting. A second limitation was that the intervention was implemented during ''highly controlled contexts'' (p. 203). Finally, the exact intensity of the intervention could not be measured given the lack of information reported by authors.

This study sought to replicate and extend the work of Brady (2000) and Schepis et al. (1998) by examining the effects of a *more complex* naturalistic communication intervention. EMT has been similar to previous studies in that the play activities were preferred by the children, adult prompting occurred following child behavioral indications such as reaching or pointing. EMT was also similar in that adult prompting strategies and natural reinforcement were used. However, EMT has differed from the procedures used in the previous studies in several ways. First, during EMT, the adult has taken on a follower role by using responsive interaction strategies such as contingent motor and verbal imitation. For example, the adult repeated or expanded child vocalizations and the adult also imitated how the child played with the toys. Neither of the previous studies implemented these types of techniques. Second, during EMT, the adult has taken on a leader role by using shortened utterances to match the child's level of linguistic development. Neither of the studies reported the use of adult language input/adult modeling (Hancock & Kaiser, 2002; Hemmeter & Kaiser, 1994; Kaiser et al., 2000; McCathren, 2000). Since neither study reported the intervention intensity that each child received, this study was also designed to control for intervention intensity by implementing sessions that were exactly 5 min in length 4 days per week; a schedule that seemed feasible for most teachers to implement.

The purpose of this study was to evaluate the effects of EMT when combined with a VOCA on the communication skills of children with autism. The purpose was to examine the intervention effects on children's: (a) independent use of the VOCA, (b) independent use of gestures, and (c) independent use of vocalizations and verbalizations during play. It was anticipated that all three children would learn to use the VOCA independently and that increases would be observed in other communicative behaviors such as gestures, vocalizations, and verbalizations.

Method

Participants and Setting

Three children with autism and their teacher or teaching assistant participated in this study. None of the children demonstrated a pointing response which prevented the completion of any standardized measures of receptive or cognitive abilities prior to the start of the study.

Mickey

Mickey was a 45-month-old Caucasian boy who was diagnosed with PDD-NOS by a pediatrician independent of the researchers. Mickey scored a 48, severely autistic, on the *Childhood Autism Rating Scale* (*CARS*; Schopler, Reichler, & Renner, 1988) and a 71 Adaptive Behavior Composite on the Classroom Edition of the *Vineland Adaptive Behavior Scale* (*VABS*; Sparrow, Balla, Cicchetti, & Doll, 1985). Mickey had a history of seizures and had taken anti-convulsants prior to the start of the study. Mickey did not speak and he rarely made noises. At the start of the study, he was not capable of imitating vocalizations though he could imitate motor behaviors with prompting (e.g., clapping). He independently engaged in reaching, leading, and head banging as primary forms of communication to request and reject. Mickey attended a private preschool for children with communication disabilities

5 days per week for 4 h each day. There were three other children in his classroom. His lead teacher, a doctoral student in special education, implemented the intervention. Prior to the study, Mickey had attended the school for 10 months. Before enrolling in the school, Mickey had never participated in interventions of any kind.

Terrence

Terrence was a 66-month-old Caucasian male. An independent psychologist diagnosed him with autism. Terrence scored a 42, severely autistic, on the *CARS* and a 60 on the Adaptive Behavior Composite on the *VABS*. Terrence did not speak and he did not vocalize other than whining noises. Terrence verbally imitated the word ''more'' when prompted. Terrence also imitated motor behaviors such as signing ''help'' when prompted. Terrence independently used reaching and leading as primary modes of communication to request. Terrence's rejection responses included pushing items away with his hands and sitting passively. With regards to cognitive and receptive abilities, Terrence performed the following with the aid of tactile, visual, and auditory prompts: (a) stop an activity and look at the speaker in response to having his name called and (b) recognize the names of common objects. He was able to perform the following tasks with the help of visual and auditory prompts: (a) understand simple, one-part directions, (b) remember where toys were kept, and (c) match colors. Terrence attended the same school as Mickey but he was placed in a different classroom alongside five other children with autism. Terrence's assistant teacher, a master's student in special education, implemented the intervention. Prior to the study, Terrence had attended the school for 19 months. Before enrolling in the school, Terrence received speech and language therapy.

Rocky

Rocky was a 48-month-old Caucasian boy. An independent psychologist diagnosed him as having autism. Rocky scored a 58, severely autistic, on the *CARS* and a 59 Adaptive Behavior Composite on the Classroom Edition of the *VABS*. Rocky did not speak or vocalize though he often emitted stereotypical noises that appeared to lack communicative intent. He did not engage in gross or fine motor imitation. His primary form of communication consisted of physically directing an adult or peer to preferred objects. Other than running away, he did not engage in behaviors to communicate rejection. In the area of cognitive and receptive skills, Rocky was able to make a choice of a preferred activity from a field of four objects. He led adults by the hand to desired objects/food, etc. He clapped hands together to request ''more'' and pushed adult hands apart (when they held his hands together) to indicate finished. He stopped an activity following an adult demand to stop. Rocky attended a public integrated preschool within the local school district. He attended along with five other children with disabilities and six typically developing children. His assistant teacher, a master's student in special education, implemented intervention procedures. Prior to the study, Rocky had attended the school for 7 months. Rocky received no intervention prior to entering school.

The teachers[2] of participating children were enrolled in a graduate course called Communication Intervention. As part of the course, the students learned all intervention procedures. Additionally, all students in the course were required to submit three videos demonstrating proficiency at implementing the intervention. It should be noted that the target children in the study were not used for practice or competency demonstration.

Materials

Preferred items from each child's classroom were used throughout the study. Although these toys varied across participants, in general, they included items such as a garage with plastic cars, Oreo cookie® puzzle pieces, jigsaw puzzles, and figurines. Prior to each session, the teacher presented the child with a selection of three activities and asked the child, ''what do you want to play with today?''. The choices of toys were varied for each session. Children made selections by pointing, reaching, or initiating interaction with the item. If a child showed a desire to change toys, the teacher assisted the child in cleaning up the existing activity and three new toys were presented. The only exception to this rule occurred with Rocky, whose play skills were less developed than the other two boys. Rocky showed strong preferences for engaging in stereotypical behaviors such as finger flapping and gazing at the lines on the wall. When Rocky tried to escape the play activity, his teacher physically redirected him back to the play activity. If he left the play area twice during a session, the existing activity was cleaned up and three new activities were presented.

[2] From here forward, all adult implementers will be called teachers even though two were actually assistant teachers.

Additional research materials included the four-button VOCAs, a clipboard, pencil, and coding form. The VOCA used in this study was the Cheap Talk 4 In-Line Direct® by Enabling Devices. The Cheap Talk 4 has four buttons that could be labeled with pictures and messages recorded individually. Each button was labeled with a picture representing the request (e.g., cars, more, or help). Phrases were pre-recorded by a boy of about the same age as the participants (e.g., ''I want cars'').

Measures and Inter-Observer Agreement

A coding sheet and operational definitions for behaviors were created specifically for this study. Each behavior of interest was assigned a code and teachers marked these behaviors (codes) on the coding sheet as they occurred. This is commonly known as event recording (Alberto & Troutman, 2003). Table 1 shows the operational definition for each of the behaviors that were measured. At the end of each session, teachers summed the data for each code resulting in a total frequency of behavior per session. For the purposes of this paper, prompted and independent VOCA use were graphed. Gestures, vocalizations, and independent VOCA use were summed and graphed to portray independent requesting attempts.

Prior to the start of the study, teachers practiced the coding procedures for this study using videotapes from previous studies showing behaviors of interest for this study. Practice continued until agreement of 80% or higher was achieved at which time the study began. Beginning with the first baseline session and for every session thereafter, teachers continuously coded target behaviors during the entire 5-min play session with the child.

A second coder, the first author, independently observed 26, 25, and 25% of the sessions for Mickey, Terrence, and Rocky, respectively. These observations were spread evenly over baseline and intervention sessions. Agreements and disagreements were scored by comparing each code scored by the coders. The total number of agreements were added and divided by the total number of agreements plus disagreements and multiplied by 100 (Iwata & Page 1986).

Fidelity of treatment checks were also completed by the independent observer. Using the intervention competency checklist, the independent observer scored the percentage of intervention steps implemented correctly. Table 2 displays the inter-observer agreement data and ranges for each behavioral code for each child as well as the overall fidelity of implementation by the teacher.

Design, Analysis, and Procedure

A multiple probe design across participants was used (Horner & Baer, 1978). In this design, a variation of the multiple baseline design, all participants were observed during baseline conditions before intervention began. When the baseline data for participant 1 showed a stable pattern, intervention began while participants 2 and 3 remained in baseline with observations completed about once per week. Prior to intervention for participants 2 and 3, observations were conducted more frequently to demonstrate stability of the baseline data before intervention began. When participant 1 showed signs of intervention effect, intervention began for participant 2. This continued until all three participants received intervention. Visual analysis of mean, trend, and level was used to determine the intervention effects.

The main benefit of using this type of design is that it controlled for maturational development. Moreover, this design also controlled for intervention effects that may have been implemented without knowledge of the

Table 1 Operational definitions of child behaviors

Child behavior	Definition	Example
Correct VOCA	Child independently presses VOCA to request an object, action, or response	Child presses button that activates message, ''I want car''
Incorrect VOCA	Child independently presses VOCA to request. Child shows displeasure in outcome by screaming, shouting, or refusing object	Child presses button for ''more'' and cries when more cars are given
Prompted VOCA	Adult prompts child to press VOCA. Includes verbal, gestural, physical, and time delay prompts	Child reaches for car. Adult asks, ''what do you want?'' Child presses ''more'' button
Gestural communicative act	Child uses a sign or gesture for a communicative purpose	Child points to cars
Verbal/vocal communicative act	Child uses a word or word approximation	Child says ''mo'' or ''more'' for more

Table 2 Inter-observer agreement

Code	Mickey		Terrence		Rocky	
	%	Range	%	Range	%	Range
Correct VOCA	100	N/A	86.6	(83–100)	100	N/A
Incorrect VOCA	82.3	(80–100)	96.4	(90–100)	100	N/A
Prompted VOCA	90	(67–100)	88.8	(82–100)	100	N/A
Gestural communicative act	80	(67–100)	90	(80–100)	100	N/A
Vocal/verbal communicative act	100	N/A	88	(80–100)	100	N/A
Fidelity of implementation	93.3	(87–100)	96	(93–100)	100	N/A

VOCA voice output communication aid

researchers. Specifically, the children in this study were observed in baseline conditions for a period of time. Intervention was staggered across children. This demonstrated that children's communicative behaviors changed when and only when the intervention in this study was implemented (Alberto & Troutman, 2003).

All baseline and intervention sessions were conducted during 5-min play sessions between the child and his teacher or teaching assistant 4 days per week. Sessions were held in the child's classroom on the floor where free play usually occurred. It should be noted that the participants in this study did not receive the intervention at any other time during their school day. The participants continued receiving their regular educational programming throughout the study. Thus, the only new intervention, to our knowledge, throughout the course of this study was the EMT and VOCA procedures that were implemented in the 5-min play sessions.

Baseline

During baseline sessions, teachers played and talked with the children as they normally would. Adults did not implement any EMT components during baseline. The VOCA was present during all baseline sessions but the teachers did not show the children how to use the VOCA.

Intervention

The intervention play sessions were identical to those in baseline except the adult implemented EMT procedures. Specifically, the adult followed the child's lead during play. The adult imitated child motor and play behaviors, spoke in shortened sentences, and used environmental arrangement strategies such as in sight and out of reach to promote requesting. When the child made a request using an informal gesture, the adult used most-to-least prompts (e.g., physicals, verbal models, verbal mand-models, gestures, and time delays) to elicit a correct request with the VOCA. Specifically, children were taught to use the VOCA using incidental or naturalistic teaching following an informal gestural request. The children were taught only to press the button on the VOCA which activated the pre-recorded message (e.g., ''I want cars''). Children were not taught how to program messages or how to change pictures on the VOCA as this was done by teachers.

Following a VOCA request from the child, the adult provided the child with the desired outcome or object (i.e., reinforcement). The adult also paired reinforcement with an expansion of the VOCA recording such as ''you want more cars!''. Other than instruction the children were receiving in their day-to-day school day, no other instruction was given to the children.

Results

Prompted and Independent VOCA

Figure 1 displays the data for prompted and independent VOCA use. As can be seen, all three children showed an increase in VOCA use. None of the children used the VOCA in baseline. Mickey increased his independent use of the VOCA to an average of 10.5 instances. Terrence increased his independent VOCA use to an average 7.3 and Rocky increased to an average 12.8. While only anecdotal in nature, Mickey's teacher reported that he requested to use his VOCA during play one day outside of the study sessions.

Total Spontaneous Independent Requests

Total use of independent VOCA, gesture, and verbal communication was added to obtain a value for total spontaneous independent communication (see Fig. 2). All three children showed an increase. However, only one participant began vocalizing during the study. Mickey increased from an average of 0 in baseline to

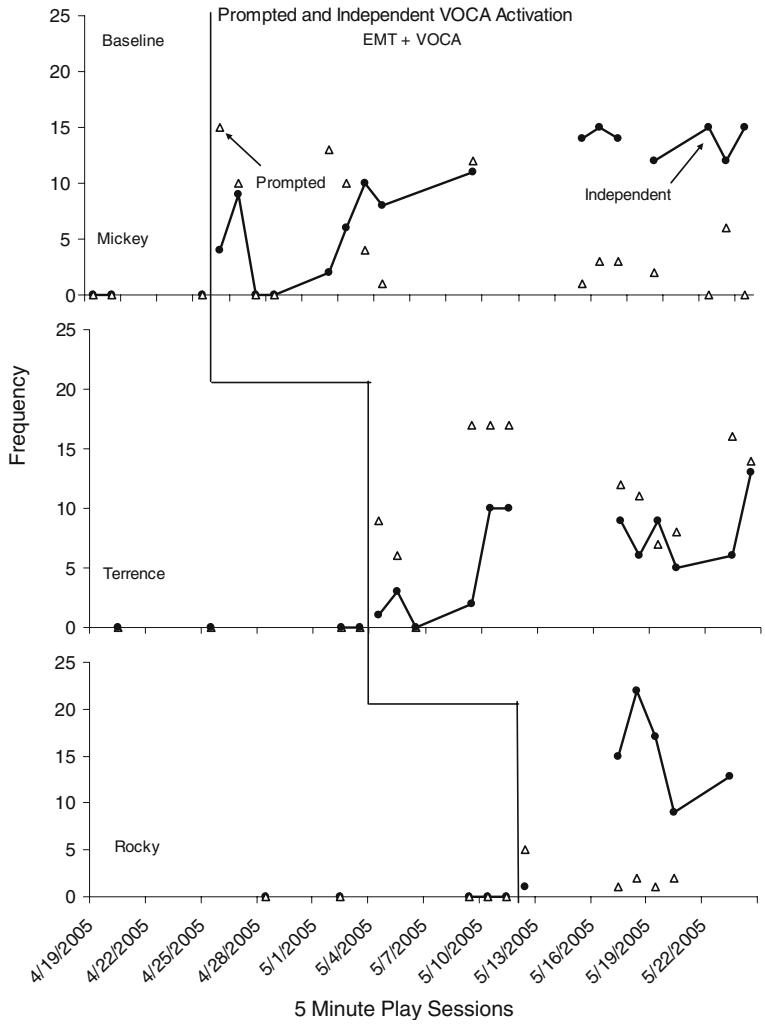

Fig. 1 Frequency of prompted and independent voice output communication aid use in 5-min sessions

11.9 during intervention. Terrence increased from an average of 0 in baseline to 32.7 during intervention. Rocky increased from an average of 1.8 in baseline to 15.4 during intervention. Terrence actually began using vocalizations during the course of this study. He increased from 0 vocalizations during baseline to an average of 8.8 during intervention. His parents and teachers provided anecdotal information to support this as well.

Discussion

This study demonstrated the effectiveness of using EMT paired with a VOCA to increase the communication skills of three children with autism. This study adds to the literature in several ways. First, this study is the first to demonstrate the use of any type of AAC intervention paired with EMT. Kaiser and colleagues have repeatedly demonstrated the effectiveness of EMT with young children (Hemmeter & Kaiser, 1994; Kaiser & Hester, 1994), including children with autism (Hancock & Kaiser, 2002; Kaiser et al., 2000). However, none of those studies used VOCAs. This combination of intervention strategies would seem particularly relevant to children with autism as approximately one third (Bryson, 1996) to one half (Lord & Paul, 1997) of this group do not develop functional speech.

Second, this study adds to the literature on the effectiveness of using VOCAs with young children with autism. Of most importance was the brevity of actual intervention. In this study, the children received intervention for only 5 min each day with a maximum of 19 intervention sessions. The entire study was completed in 1 month. While Schepis et al. (1998) also taught young children with autism to use their VOCAs during natural activities, it is unclear how much intervention was necessary to obtain intervention effects. Children in the Schepis study received intervention in both snack and play periods. The authors reported that intervention for snack lasted an average

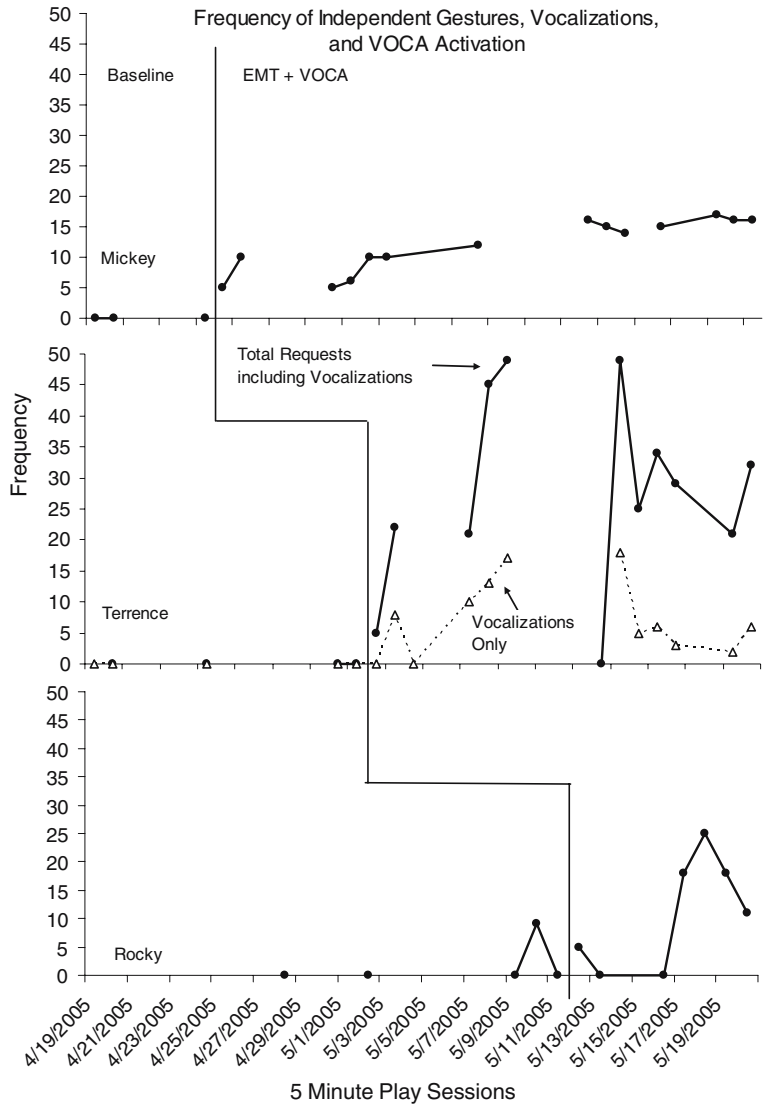

Fig. 2 Frequency of independent gestures, vocalizations, and voice output communication aid use in 5-min sessions

of 11 min while the length of play averaged 9 min. It is unclear why the children showed such steep learning curves in the current study. Perhaps this could be attributed to the age of children. The youngest child was Mickey, who was 3. Perhaps their fast acquisition was due to the intervention they received prior to beginning this study. Similar acquisition data might not be obtained with younger populations (e.g., under age 3) who lack the history of early intervention.

The fast acquisition obtained in this study may also be explained by the intervention itself. EMT, a naturalistic intervention combined with VOCA use, expands upon the studies by Schepis et al. (1998) and Brady (2000) because EMT consists of responsive interaction techniques (e.g., verbal and motor imitation) and shortened adult utterances in addition to naturalistic procedures used in previous studies (e.g., following the child's lead, natural reinforcers, and prompting). These results add support for the use of naturalistic interventions to support children's communicative development (e.g., Johnston, Nelson, Evans, & Palazolo, 2003; Schepis et al., 1998). Additionally, this study was conducted in the children's classrooms during regularly scheduled play periods.

Some of the results in this study require additional discussion. First, while the acquisition data are promising, the complexity of the EMT intervention should not be overlooked. All three teachers in this study were advanced graduate students with extensive experience in 1:1 intervention implementation. Additionally, the students had completed a course on communication intervention and had successfully demonstrated competency in the intervention prior to intervention implementation. Therefore, the participants in this study received intensive communication intervention from the first day of intervention.

Second, the results of these data portray children who were fairly passive in their interactions with adult communication partners. None of the children used the VOCA in baseline. Additionally, the children had little to no communicative interaction during baseline whatsoever. For example, before intervention, Terrence rarely requested and often just sat quietly doing nothing. When treatment began, however, Terrence began to interact more by requesting and looking at the therapist. His classroom teachers' reported that he was more social and engaged during activities both in the classroom and outside on the playground. While this is only anecdotal in nature, the data presented in this study suggest that the EMT intervention resulted in increased use of the VOCA as well as increased spontaneous communication.

Finally, while anecdotal in nature, Mickey's teacher reported that Mickey actually requested his VOCA during a play session when the VOCA had not been made available. While this study lacks formal social validity data, this anecdotal report would suggest that Mickey was comfortable with the VOCA system.

The results of this study should be viewed with caution given study limitations. First, the children were exposed to a variety of other interventions during the course of the study. However, the multiple probe design rules out the possibility for extraneous influences in the data. All three children failed to use the VOCA during baseline and all three children showed zero to minimal spontaneous communication in baseline. Second, some may believe that since the teachers served as data collectors for the study that the results may be biased. However, an independent coder was present for over 25% of observations for each child. Agreement was within acceptable levels on these observations which provides validity for the data collected. Finally, as previously noted, the children in this study received various types of intervention prior to participating in this study. Therefore, the results should not be generalized to all children with autism.

Nonetheless, the results of this study lead to implications for additional research. Specifically, the process for training teachers to implement this complex intervention should be documented. How much training and feedback are necessary? What types of support are needed to carry the intervention out during classroom activities? How do classroom teachers feel about this intervention?

A second area of future research relates to the issue of training very young children to use VOCAs early in the intervention process. Drager et al. (2004) reported that even typically developing 3-year olds had difficulty with dynamic displays upon initial exposure. Even after training, children performed better using a contextual scene format when compared to a traditional grid format. Clearly, additional work is necessary to determine what technologies are appropriate for young children with communication delays.

Finally, the maintenance and generalization of this intervention should be studied. This study lacked the ability to follow the children over time and across settings. Improved communication skills are only as important as the environments in which they are used.

Acknowledgments This research was supported in part by a UT-Austin Undergraduate Research Fellowship to Christie Layton and a UT Austin Summer Research Award to Melissa Olive. However, the opinions expressed herein do not necessarily reflect the position or policy of The University of Texas at Austin and no official endorsement by the University should be inferred. The authors would like to thank the Moore-Weis Children's Center of Austin, the Round Rock Independent School District, and the participants and their parents for participation in this study.

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