Published in final edited form as:

Res Pract Persons Severe Disabl. 2008 March ; 33(1-2): 59–70.

Increasing Communication in Children With Concurrent Vision and Hearing Loss

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Abstract

Nine children with complex communication needs and concurrent vision and hearing losses participated in an intervention program aimed at increasing intentional prelinguistic communication. The intervention constituted a pilot, descriptive study of an adapted version of prelinguistic milieu teaching, hence referred to as A-PMT. In A-PMT, natural gestures and vocalizations were targeted in child-focused, one-on-one activities conducted by a member of the project staff. Adaptations included using more physical prompts than in other forms of PMT and using means other than directed eye gaze to determine directionality of gestures. All nine participants increased their rates of initiated, intentional communication substantially during the course of intervention; in addition, each participant acquired new forms of natural gestures. Results were limited primarily to requests (as opposed to other communication functions). Discussion centers on how to promote more generalized communication developments in future implementations of the program.

DESCRIPTORS

unaided communication; gestures; children; presymbolic communication; intervention; intentional communication; vision loss; hearing impairment

Acquiring communication skills is typically one of the primary goals for young children who have complex communication needs associated with multiple disabilities, concurrent vision and hearing losses, and suspected cognitive delays. Children with these characteristics are often severely delayed in learning conventional forms of communication, such as speech or sign language, and may not develop these skills despite being exposed to early childhood education services and responsive environments. Family members and educators are often at a loss when it comes to identifying an appropriate communication focus for children with such complex needs. There is a critical need for research demonstrating effective communication strategies for children with severe and multiple disabilities, including concurrent hearing and vision losses.

Several studies have demonstrated the effective use of technology to increase early communication by children with complex communication needs, particularly those who have severe motor challenges. For example, Schweigert and Rowland (1992) presented

results of a comprehensive program that taught children with dual sensory impairments and severe orthopedic impairments to communicate using microswitches. Participants learned to use switches to call for attention and to indicate a choice. Mar and Sall (1994) describe a similar program that incorporated switch interfaces, voice output, and computer technology for children with dual sensory impairments who had varying communication needs. In a series of recent articles, Saunders et al. (2001, 2003, 2005) presented results demonstrating methods for assessing and teaching basic signaling and choice indications by individuals with profound multiple disabilities.

In addition to technology, however, early communication programs may be maximally effective when participants are taught to combine technology with unaided communication responses. For example, in the study of Schweigert and Rowland (1992), examples are provided of teaching meaningful vocalizations in combination with switch activation. Additional research on effective means for teaching unaided communication responses as part of a comprehensive early communication program is needed.

Unaided communication includes production of natural gestures (for those who have adequate motor skills) and nonspeech vocalizations. Information derived from studies of prelinguistic communication in typically developing infants may be particularly relevant for children with severely delayed communication. Although onset of first words or signs is often considered one of the most important early benchmarks of communication, typically developing children communicate with care providers through facial expressions, natural gestures, and vocalizations long before they utter their first word or sign (Bates, Benigni, Bretherton, Camaioni, & Volterra, 1979; Crais, Day-Douglas, & Cox-Campbell, 2004). By the time children learn to say/sign their first word, in fact, a complex and mutually rewarding system of communication has already been firmly established. Newly developed symbolic forms of communication are overlaid upon this existing foundational system (Bakeman & Adamson, 1986; Butterworth & Grover, 1988).

Children with severe and multiple disabilities also develop prelinguistic communication, but their communication may be difficult to interpret (Siegel-Causey & Guess, 1989; Snell, 2002). For example, idiosyncratic or contextually bound movements may be interpretable by familiar communication partners but not by others (Carter & Iacono, 2002). Thus, it may be particularly facilitative to teach children who experience significant support needs to produce interpretable natural gestures or to produce such gestures at higher rates. Natural gestures have a practical advantage over many other forms of early communication, in that they do not require access to equipment or other media. Hence, if a child has learned to use interpretable gestures, a means of communication is always available to him or her. In addition, communication partners are likely to respond to a child's communicative gestures by providing additional linguistic input (Tomasello, 1999; Tomasello & Todd, 1983). Such input can aid in comprehension and provide a model for symbolic communication and facilitate further communication development.

Few studies exist, however, that document effective teaching of communicative gestures to children with complex communication needs. Calculator (2002) conducted an intervention program aimed at teaching young children with Angelman's syndrome to use enhanced natural gestures. These enhanced gestures were derived from intentional gestures that already existed in the child's motor repertoire or could be taught based on the child's existing motor skills. Parents were taught to recognize, to encourage, and to teach these gestures during ongoing activities. Although data regarding the children's communication were not presented, parents indicated that the program was acceptable and feasible. Pinder and Olswang (1995) taught four children with cerebral palsy to use eye-gaze gestures and

reaches-toward-objects to request during play. All four children increased their use of these prelinguistic signals during intervention.

One approach to teaching children to communicate with gestures and vocalizations has been called prelinguistic milieu teaching (PMT; Fey et al., 2006; Warren et al., 2006; Yoder & Warren, 1998). This approach combines the strategies of delayed prompting, modeling, and environmental arrangement within teaching contexts that are child driven and highly motivating. Participants are taught to request and to comment within social and play-oriented routines, such as “give-me-five” or taking turns rolling a ball. Gestures such as giving, extending an open palm, and pointing are modeled and physically prompted, when necessary. Contingent natural consequences for the activities reinforce the child’s newly learned behaviors. Fey et al. (2006) demonstrated that children who participated in PMT increased their rates of communication significantly compared with children who did not receive this intervention. Participants in the Fey et al. study demonstrated developmental delays and limited or no verbalizations at the start of their interventions. However, none of the participants in the Fey et al. study had significant hearing or vision impairments.

In the current, adapted, version of PMT, we sought to extend the PMT intervention (PMT) to children with more significant communication and support needs. Our primary purpose is to describe the program, adapted version of prelinguistic milieu teaching (A-PMT), and to report preliminary responses to the program by a group of children with complex communication needs, including concurrent vision and hearing losses. This article includes information on the children’s overall communication frequencies and different types of communications observed over the course of intervention.

Methods

Participants

Participants were recruited from all local school districts within a 60-mile radius of the authors’ base, with the assistance of two state deaf-blind projects and rich media advertisement. Nine children participated in this program. At the outset of the study, the participants ranged in age from 3 years, 0 months to 7 years, 0 months; their average chronological age was 5 years, 1 month. Five children were White, two African American, one Asian American, and one Hispanic. All participants experienced concurrent vision and hearing losses, as documented by their educational records and/or teachers’ reports, and were included on the deaf-blind census in their respective states. In the case of two participants, for whom vision loss was not clearly indicated in their records, staff members associated with this project administered the Teller Acuity Cards screening (Teller, 1989). As a group, the participants in this study represented a full range of vision loss: total blindness; light perception only; partial sight, with fairly functional vision; field loss; and cortical vision impairment. Similarly, the children demonstrated a full range of hearing loss as well—from profound, bilateral sensorineural deafness to severe, moderate, and mild hearing loss. One participant, who experiences a moderate sensorineural loss, wore bilateral hearing aids. Five of the participants had a cochlear implant; none of these children wore hearing aids on their nonimplanted side. Hearing levels reported for the remaining three participants represent unaided hearing status. Diagnoses as well as vision and hearing information for each participant are presented in Table 1.

The children who participated in this study were representative of most the population of individuals who experience concurrent hearing and vision loss in the United States. The National Consortium on Deaf-Blindness’ 2005 national census (Killoran, 2007) reported that 91% of children and youth (birth through 22 years), who are diagnosed with deaf-blindness, also experience other disabilities. All participants in this study demonstrated multiple

disabilities. Due to the complex nature of the children's disabilities, which included cognitive disability in each case, scores from standardized cognitive assessments were neither available nor appropriate measures of their intellectual abilities. Staff from this project, therefore, completed the Wisconsin Behavior Rating Scale (WBRS; Song et al., 1980) with each participant. The WBRS is a criterion-referenced measure, based on developmental milestones that typically occur between birth and 3 years. Information for completing the WBRS is obtained through interviews and direct observations and summarized according to 11 subscales. A unique feature of this instrument is that it was developed and standardized with persons with developmental disabilities, including a subgroup of children who experienced deaf-blindness. Age-equivalent scores from the receptive language, expressive language, and socialization subscales from the WBRS as well as the total behavioral age-equivalent scores for each participant are presented in Table 1.

As mentioned previously, all of the study participants experienced disabilities in addition to their vision and hearing losses; each demonstrated cognitive disability and six of the nine children demonstrated moderate physical/motor challenges. All of the participants, however, did demonstrate adequate upper extremity mobility and control for independently performing gestures, such as reaching and giving.

Participants' Initial Communication Status

All participants were primarily prelinguistic communicators at the outset of the study. All were between 3 and 7 years, experienced concurrent vision and hearing losses, and exhibited a repertoire of fewer than three (total) symbolic communication acts. Parent report, teacher report, and classroom observations by project staff indicated that all participants' expressive communication consisted primarily of idiosyncratic communication forms that were interpreted as communicative by others. For example, several children moved away from nonpreferred objects and smiled and laughed during preferred events. Only two children used any conventional manual signs or spoken words during classroom observations. One child signed "more" and "finished," and a second child produced a vocal approximation of the word "hi." Children's use of communicative gestures, vocalizations, or symbolic forms (i.e., signs, speech, or symbols) during classroom observations were at very low rates, averaging below 0.01 per minute across all children.

Additional information about children's communication was obtained from videotapes of the children during the A-PMT sessions. Sessions were videotaped at least once per week throughout the intervention. These tapes were later coded using procedures described below to obtain information about rates of communication and forms of communication at various stages of the intervention. These data are described and presented below as an indication of communication change during intervention. However, it should be noted that we did not conduct true baseline or maintenance measures in the absence of intervention. Therefore, changes may have been associated with variables other than intervention.

We reviewed each child's educational records to document both the number of communication goals included and the number of educational program goals that might be, in some way, related to behaviors targeted in this study. We analyzed each participant's annual individualized education plan (IEP) or individualized family service plan (IFSP) that was in effect at the outset as well as throughout this pilot study. Only three participants' IEPs/IFSPs included three or more goals related, in any way, to prelinguistic communication (e.g., initiate communication exchange, engage in turn-taking game, seek adult for needed assistance); one child's plan included two such goals, three participants' programs included one such goal, and two children's annual educational plans included zero goals that, in any way, related to prelinguistic communication. It is interesting to note that all participants' IEPs/IFSPs for this same period included at least one goal that targeted symbolic

communication skills (e.g., use pictures to express wants/needs, associate manual signs with corresponding objects); four participants' individual educational programs included three or more symbolic communication goals.

Program Description

An A-PMT was provided to each participant 3 to 4 days per week for several months, depending on individual child response to intervention. PMT is designed to increase the frequency and complexity of intentional, nonverbal communication acts (Warren et al., 2006) and particularly to increase the frequency of communicative gestures and vocalizations of children who communicate at low rates. PMT is not prescriptive in the sense that sequential, exact steps can be delineated in advance or generalized across children. The demonstrated effectiveness of this strategy is attributable, at least in part, to the fact that specific activities are individually determined according to each child's interests. In PMT, an interventionist engages the child in preferred activities, arranges the environment to promote communication, and builds social routines in which the child and the adult play predictable roles. These routines often include a preferred object, toy, or food but may also revolve around social games such as "high five" or "tickle." The routines involve predictable turn taking and provide rich contexts and frequent opportunities for a child to communicate (Rollins, Wambacq, Dowell, Mathews, & Reese, 1998; Snyder-McLean, Solomonson, McLean, & Sack, 1984; Woods-Cripe & Venn, 1997). For example, the child and the communication partner may take turns placing a vibrating toy on their arms; the partner then might interrupt the turn-taking sequence by holding on to the toy for an extraordinarily long turn or by turning off the switch before returning the toy to the child. Such interruptions provide motivation for the child to initiate communication—in this case, a request to reactivate the toy. Once a communication response is observed, the turn-taking routine continues, and the child receives a contingent, natural, positive consequence (e.g., the vibrating toy). The forms of communication targeted by PMT include nonsymbolic gestures, such as an open hand extended toward an object or a give-for-help gesture and vocalizations.

Although most aspects of PMT appeared appropriate for children with complex communication needs associated with deafness and blindness, some adaptation were required. Adaptations were aimed at making the strategies appropriate for, and accessible to, children who experience concurrent vision and hearing losses. First and foremost, activities that required vision or hearing were minimized, and vestibular and tactile activities were emphasized with all participants. For example, several children participated in routines involving making a request to swing, to roll over a bolster, or to play in a barrel. All but one participant retained at least some residual vision and/or hearing; however, and routines that involved toys with flashing lights and/or loud sounds were also included in accordance with each individual participant's residual sensory abilities. All toys and the availability of vestibular events were kept in proximity to each child at all times, however, to ensure the child was aware of their accessibility.

A second area of significant adaptation was prompting. PMT includes verbal prompts for communication. In the current implementation, project staff relied primarily on physical prompts, such as hand-under-hand, and tactile prompts. Throughout a participant's intervention sessions, prompts were systematically faded using a most-to-least prompt fading procedure (Wolery & Gast, 1984).

A third area of adaptation was related to one of the key communication components targeted by PMT—eye gaze. One of the defining aspects of an intentional communication act (ICA; as opposed to preintentional acts) is that a behavior be clearly directed toward a communicative partner (Bates et al., 1979; Bruner, 1984; Warren & Yoder, 1998). A

common way to indicate that a behavior is directed toward someone is to look in her or his direction. For example, when an infant vocalizes, then looks at her or his caregiver, the behavior can readily be interpreted as intentional communication. Hence, early in PMT, participants are specifically taught to shift their eye gaze from the toy or the object on which their attention is focused to their communication partner (Fey et al., 2006; Warren et al., 2006). For this study, project staff adapted this component for children who were blind by teaching and by accepting body orientation and/or searching behaviors as indicative of attention shift. For example, if a participant reached her hand out to search and find her partner or turned her body toward the partner, it was interpreted to mean that the participant was directing her behavior toward the partner, even if direct eye gaze could not be detected. Descriptions of key components of A-PMT, along with examples of activities used in the intervention, are provided in Table 2.

All A-PMT intervention sessions were conducted at each participant's school (first choice) in a quiet location in or near the classroom or at the child's home in one-on-one sessions between a project staff member and the participant. Intervention sessions were similar, across participants, in structure and length, though particular routines and activities were individualized for each participant. Interventions were planned to last for a maximum of 60 minutes but minimum of 30 minutes per day and to be conducted 4 days each week. Minor variations to this schedule occurred, however, due to scheduling conflicts. The average number of minutes spent in intervention sessions each week, per participant, was 163—ranging from 147 to 218 minutes/week. Each participant continued to participate in intervention sessions until a substantial increase in communication rate was noted. On the basis of past research by Wetherby, Alexander, and Prizant (1997), a target rate of one initiated communication act per minute over three consecutive probe sessions was selected as an intervention goal. The length of time each child participated in intervention ranged between 2.5 and 8 months; the mean length of intervention participation was 5.5 months.

We attempted to measure the degree to which interventionists applied the procedures associated with A-PMT by asking two graduate students, who were not involved in implementing any of the sessions, to observe 20% of the intervention sessions that were videotaped (sessions were videotaped approximately once per week). The graduate students recorded how the A-PMT strategies were being implemented with each child. Data from these observations indicated that individualized examples of Goals 1–4, presented in Table 2, were observed with each participant at least once, during each session reviewed. Goal 5, acknowledging children's communication attempts, was not consistently observed on the tapes of sessions with several participants.

Coding of Communication Acts

One session with each participant, of the four intervention sessions conducted each week with each of the children, was videotaped throughout the implementation of this pilot study. These videotapes were later digitized and coded, using computer software (i.e., *The Observer*) developed for this purpose (Noldus Information Technology, 2002). Two coders, observing each videotape at different times, independently identified each ICA performed by the participant. Coders knew that participants were receiving intervention, but they did not know the specific goals or teaching procedures targeted for each child. ICAs were defined as gestures or vocalizations that cooccurred with evidence of coordinated attention between a communication partner and an object/event of interest and that appeared to have a communicative function. As described above, coordinated attention could be demonstrated through eye gaze shifts (for participants with sufficient residual vision), shifts in body orientation or posture, or searching behaviors (for participants who experienced total blindness).

Coders determined the conversational type of each communication act—an initiation, a response to a question, or a response to a prompt. Next, the coders recorded the form of each identified communication act. Coded forms included gestures, vocalizations, verbalizations, distal points, signs, and any combination of these forms. Gestures were then further categorized as one of the following: wave hand; raise hand in a “give-me-five” gesture; nod head; shake head; shrug shoulders; clap hands (as comment); make direct contact with the partner, such as lead by the hand or move the partner’s hand to item of interest; push partner’s hand away; tap partner to get her attention; give an object to the partner; show an object to a partner; tap item of interest, while oriented to partner; contact point; shift gaze; imitate vocalization; and extend hand with open palm. The coding scheme for this pilot investigation also included the use of spoken words, object symbols, and graphic symbols, but these symbolic communication behaviors were not observed to occur during the course of the videotaped sessions.

Next, the communicative function of each ICA was coded as behavior regulation, joint attention, or social interaction. Behavior regulation acts included requests and rejections (e.g., giving a toy to the interventionist to ask for help; pushing the interventionist’s hand away). Joint attention acts were communication behaviors used to direct another’s attention to a noteworthy object or event, as if to comment (e.g., vocalizing to show surprise when presented with an unusual toy; clapping when offered a favorite activity). Social interaction acts included greetings and requests for social games (e.g., giving a “high five,” taking the partner’s hand to continue a tickling game).

Thus, each communication act was coded for conversational type, form, and function. For example, a communication act could be coded as an initiated gesture, involving leading the communication partner by the hand, and communicating behavior regulation. A different communication act could be coded as a prompted vocalization that communicated joint attention. Frequencies of the participants’ ICAs were converted to rates (frequency of ICAs per minute) for the purposes of comparability due to variations in session lengths.

Reliability

Observers were initially trained to a minimum criterion of 80% agreement, across all dependent variables, on three randomly selected video files. Subsequently, all videotaped intervention sessions (one per week, per participant, throughout intervention) were independently coded by each of two observers, using the Noldus software package described earlier. The *Observer* software automatically time stamped each communication act recorded, and reliability determinations were calculated for time-matched events. Interrater reliability between the two independent coders was calculated by applying the consistency definition for the single rater intraclass correlation coefficient (ICC) to the scores yielded by each observer’s codes (Sven & Ary, 1989; Weunsch, 2003). An ICC reflects the proportion of variance in scores that is related to actual sample differences rather than to the raters, interactions between raters and samples, or other unknown factors. ICC is interpreted similarly to Kappa coefficients and approaches 1.0 when all raters score items the same way. The means of ICCs, across all participants, for type of communication (initiated vs. prompted vs. response) was .803, the mean ICC for communication function was .801, and the mean ICC for form of communication was .721. Discrepancies were discussed by the coders, then resolved by consensus. Data presented in this manuscript represent the results after consensus coding.

Participants' Communication Performance

Rates of Communication

Data pertaining to each child's initiated and prompted communication acts were obtained from the intervention sessions that were videotaped once per week (intervention was provided three to four times per week, but only videotaped once per week). Figure 1 shows each child's communication as coded from the videotaped sessions. Considerable variability can be seen in rates of initiated and prompted communication across time and across children. For most participants, the trends show increases in initiated communication and decreases in prompted responses over the course of intervention.

Rates of individual participants' initiated communication acts, measured at the beginning and the end of the A-PMT intervention, are reported in Table 3. These data are provided to facilitate comparison of the degree of change observed in each child from the beginning to end of intervention. Each participant's rate of communication initiation, for each of his or her first three sessions (i.e., beginning of intervention) and then for each of his or her last three sessions (i.e., end of intervention), were averaged; means are reported here for each of these time frames. All participants increased initiated communication over the course of this pilot intervention, although changes varied greatly across individual children. For example, Hank increased his communication initiations from an average of once every 2 minutes at the beginning of intervention to almost two per minute by the end of intervention. Thus, by the end of intervention, Hank was initiating communication nearly 80 times during a 40-minute session (the average length of individual intervention sessions across participants)—and it took 76 sessions for him to reach this criterion. In general, children with the lowest communication rates at the beginning of intervention showed the greatest increases in communication initiation by the intervention's end.

In addition, participants' rates of prompted communication acts are shown in Table 3. Again, rates are averaged for the first three sessions and the last three sessions conducted with each child. Seven participants' rates of prompted communication acts decreased over the course of intervention. Prompted ICAs decreased as participants became more independent in their communication.

Communication forms

Implementation of intervention activities varied to some degree across participants, dependent on each child's current communication abilities and the extent of his or her interests, functional hearing, functional vision, and other health conditions. For example, for the children who had very limited (or no) vision, communication targets focused on proximal gestures, such as giving and guiding the interventionist's hand to do something, instead of distal gesturing or pointing. For a participant who had a tracheotomy, vocalizing was not targeted as a communication act. Table 4 shows changes in the communication forms demonstrated by each participant, from the beginning of intervention to the end of the intervention phase. After participating in this pilot implementation of A-PMT, eight of the nine children showed increased diversity of communication forms to varying degrees.

During the first three observations, eight of nine participants used a "push away" (i.e., motion of rejection) form of communication. For one participant (Hank), this was his only recognizable communication form at the beginning of intervention. Two additional participants (Howard and Olive) used the "push away" form as one of only two communication forms, and a fourth child (Robert) used this form as one of his three forms of communication during their respective beginning sessions. The remaining five participants demonstrated between five and seven communication forms during initial observations.

Several forms were observed at the end of intervention that were not demonstrated by many participants at the beginning of implementation of A-PMT. These included “give to partner for help,” “tap partner’s hand,” “high five,” “point,” “imitate vocalization,” and “shift in gaze (or body orientation)” —which no child demonstrated at the beginning of the A-PMT intervention. Each of these forms was specifically targeted during this pilot implementation.

Communication functions

Most participants’ communication acts served the function of behavior regulation, as requests (e.g., for an object, for the partner to perform a particular action) or rejections. Table 5 shows the rates for each participant’s demonstration of each communicative function, both at the beginning and the end of his or her intervention. All participants demonstrated significant increases in the use of behavior regulation communicative acts. Six children did demonstrate some communication for social interaction by the end of their intervention, but only two participants (Howard and Mark) showed an increased use of social communication with any frequency. Only one participant (Carl) demonstrated an increase of communication for joint attention.

Discussion

Children with severely limited communication skills, who experience concurrent vision and hearing losses, were observed to communicate much more frequently after participating in an adapted PMT intervention. All nine children demonstrated an increase in communication initiations, to varying degrees, and seven of the nine participants’ rates of prompted communication acts decreased. In addition, eight of the nine participants showed increased diversity of communication forms after participating in A-PMT, and three of the nine participants demonstrated increased diversity of communication functions. Although this exploratory implementation of A-PMT did not control for maturation or other extraneous variables, results from this intervention program suggest the need for a more thorough, experimental evaluation of this intervention strategy.

One of the most appealing aspects of A-PMT is its focus on teaching natural gestures, such as giving (something to another person) and extending an open palm (to request something from another person). The advantage of these forms of communication, in comparison to manual signs or other abstract communication forms, is that natural gestures are readily understood by most communication partners within a child’s own cultural group. Improved understandability, when a child uses conventional, natural gestures, increases the child’s likelihood of success in communicating with multiple partners during the crucial, initial stages of learning to communicate. With natural gestures, the focus of initial communication instruction can be on the interpersonal aspects of communication, exemplified by gesturing toward a communication partner while referencing an object or an event. Learning to direct behaviors to a communication partner is a critical aspect of early communication development—one that is often overlooked in communication instruction. A-PMT appears to be an approach that can facilitate learning these very important, interpersonal aspects of communication.

As mentioned previously, every one of the nine participants’ IEPs or IFSPs included at least one goal that targeted some aspect of symbolic communication; four participants’ individualized programs included three or more such goals. In contrast, the participants’ IEPs or IFSPs included a relatively small number of goals that were even remotely related to prelinguistic (i.e., nonsymbolic) communication. Our results suggest that targeting prelinguistic behaviors may be a valuable addition to communication programs for children who have communication needs similar to the participants in this intervention. Research is needed to validate this suggestion, however.

Although all participants demonstrated more communication initiations after participating in A-PMT, their increased communication rates primarily reflected increases in behavior regulation communication acts or communication aimed at obtaining particular objects or activities. Few increases were seen in the more interpersonal aspects of communication—joint attention or social interaction. The limited range of functions demonstrated by the participants in this study is consistent with other observational reports that also reported a preponderance of behavior regulation communication acts (Brady, McLean, McLean, & Johnston, 1995; Carter, 2003; Houghton, Bronicki, & Guess, 1987; McLean, McLean, Brady, & Etter, 1991).

Future studies are needed to address interventions aimed at teaching a greater variety of communication functions. Although interventionists in the current study frequently provided opportunities for the children to comment, by introducing novel activities or surprise events, this exposure was not adequate to substantially increase joint attention communication. A systematic approach similar to that used by Kasari, Freeman, and Paparella (2006), to teach children with autism to initiate joint attention, may provide more positive outcomes. Natural consequences for the communication of joint attention include the acknowledgement by and attention from a communication partner. These social behaviors may not, however, be highly reinforcing for many beginning communicators. A comprehensive program aimed at enriching social interactions may be a necessary foundation for teaching children to initiate and to respond to joint attention. Research specifically targeting joint attention, with the population of children who have significant support needs, including concurrent vision and hearing losses, is warranted.

Our program provided A-PMT in fairly intensive, one-on-one teaching sessions. We felt it was important to use this approach to demonstrate that children could learn to communicate in structured play settings that presented multiple communication opportunities. However, future investigations should extend this teaching to more typical activities, including training within natural classroom contexts. We observed that many teachers and parents did not readily encourage children to communicate with natural gestures and vocalizations and therefore missed many opportunities to communicate with the children participating in this pilot study. Thus, a significant need exists to educate teachers, parents, and other communication partners about the value of communicating with natural gestures as well as ways to encourage gesture use in everyday interactions. Investigation of the role of natural gestures, as elements in a longitudinal communication program that also targets the emergence of symbolic communication forms, is another future research need.

In conclusion, results of this pilot program suggest that A-PMT is a teaching procedure that can be implemented with children who have complex communication needs. These results further suggest that communication intervention strategies, with demonstrated effectiveness with children who experience other disability conditions, may be appropriately adapted for implementation with learners who have concurrent vision and hearing losses. Children who participated in this program made observable changes in their communication skills, particularly rate of communication initiation, with the implementation of A-PMT. This pilot investigation did not, however, exercise experimental control over the timing of the A-PMT intervention. Next steps, for future study, would be the experimental investigation of A-PMT, with a design that includes controls for threats to internal and external validity. In such future studies, careful documentation of fidelity of treatment would also increase the ability to replicate interventions across individuals and other programs.

Acknowledgments

This pilot study was supported by USDE grant award H324D0003-05. The authors wish to acknowledge the assistance of James Sweeney, Joan Houghton, Kate Nielsen, Samantha Irick, and Gabe Holcombe in conducting this research and the families of the participants, cooperating schools, and teachers.

References

- Bakeman R, Adamson LB. Infants' conventionalized acts: Gestures and words with mothers and peers. *Infant Behavior & Development* 1986;9:215–230.
- Bates, E.; Benigni, L.; Bretherton, I.; Camaioni, L.; Volterra, V. The emergence of symbols: Cognition and communication in infancy. New York: Academic Press; 1979.
- Brady N, McLean J, McLean L, Johnston S. Initiation and repair of intentional communication acts by adults with severe to profound cognitive disabilities. *Journal of Speech and Hearing Research* 1995;38:1334–1348. [PubMed: 8747825]
- Bruner J. Interaction, communication, and self. *Journal of the American Academy of Child Psychiatry* 1984;23:1–7. [PubMed: 6693672]
- Butterworth, G.; Grover, L. The origins of referential communication in human infancy. In: Weiskrantz, L., editor. *Thought without language*. New York: Oxford University Press; 1988. p. 5-24.
- Calculator S. Use of enhanced natural gestures to foster interactions between children with Angelman syndrome and their parents. *American Journal of Speech-Language Pathology* 2002;11:340–355.
- Carter M. Communicative spontaneity of children with high support needs who use augmentative and alternative communication systems II: Antecedents and effectiveness of communication. *Augmentative and Alternative Communication* 2003;19:155–169.
- Carter M, Iacono T. Professional judgments of the intentionality of communicative acts. *Augmentative and Alternative Communication* 2002;18:177–191.
- Crais E, Day-Douglas D, Cox-Campbell C. The intersection of the development of gestures and intentionality. *Journal of Speech, Language and Hearing Research* 2004;47:678–694.
- Fey M, Warren S, Brady N, Finestack L, Bredin-Oja S, Fairchild M. Early effects of prelinguistic milieu teaching and responsivity education for children with developmental delays and their parents. *Journal of Speech, Language and Hearing Research* 2006;49:526–547.
- Houghton J, Bronicki GJB, Guess D. Opportunities to express preferences and make choices among students with severe disabilities in classroom settings. *Journal of the Association for Persons With Severe Handicaps* 1987;12:18–27.
- Kasari C, Freeman S, Paparella T. Joint attention and symbolic play in young children with autism: A randomized controlled intervention study. *Journal of Child Psychology and Psychiatry* 2006;47:611–620. [PubMed: 16712638]
- Killoran, J. The national deaf-blind child count: 1998–2005 in review. Paper presented at the State/Multi-State Deaf-Blind Project Directors' Meeting; Washington, DC. 2007.
- Mar HH, Sall N. Programmatic approach to use of technology in communication instruction for children with dual sensory impairments. *Augmentative and Alternative Communication* 1994;10:138–150.
- McLean J, McLean L, Brady N, Etter R. Communication profiles of two types of gesture using nonverbal persons with severe to profound mental retardation. *Journal of Speech and Hearing Research* 1991;34:294–308. [PubMed: 2046354]
- Noldus Information Technology. The Observer, version 4.1. Wageningen, The Netherlands: Noldus Information Technology; 2002.
- Pinder GL, Olswang L. Development of communicative intent in young children with cerebral palsy: A treatment efficacy study. *Infant-Toddler Intervention* 1995;5:51–70.
- Rollins PR, Wambacq I, Dowell D, Mathews L, Reese PB. An intervention technique for children with autistic spectrum disorder: Joint attentional routines. *Journal of Communication Disorders* 1998;31:181–189. [PubMed: 9549673]

- Saunders M, Questad K, Kedzierski T, Boase B, Patterson E, Cullinan T. Unprompted mechanical switch use in individuals with severe multiple disabilities: An evaluation of the effects of body position. *Journal of Developmental and Physical Disabilities* 2001;13:27–39.
- Saunders M, Saunders R, Mulugeta A, Henerson K, Kedzierski T, Hekker B, et al. A novel method for testing learning and preferences in people with minimal motor movement. *Research in Developmental Disabilities* 2005;26:255–266. [PubMed: 15668076]
- Saunders M, Timler G, Cullinan T, Plilkey S, Questad K, Saunders R. Evidence of contingency awareness in people with profound multiple impairments: Response duration versus response rate indicators. *Research in Developmental Disabilities* 2003;24:231–245. [PubMed: 12873657]
- Schweigert P, Rowland C. Early communication and microtechnology: Instructional sequence and case studies of children with severe multiple disabilities. *Augmentative and Alternative Communication* 1992;8:273–286.
- Shrout P, Fleiss J. Intraclass correlations: Uses in assessing rater reliability. *Psychological Bulletin* 1979;2:420–428. [PubMed: 18839484]
- Siegel-Causey, E.; Guess, D. Enhancing nonsymbolic communication interactions among learners with severe disabilities. Baltimore: Paul H. Brookes; 1989.
- Snell M. Using dynamic assessment with learners who communicate nonsymbolically. *Augmentative and Alternative Communication* 2002;18:163–176.
- Snyder-McLean LK, Solomonson B, McLean J, Sack S. Structuring joint action routines: A strategy for facilitating communication and language development in the classroom. *Seminars in Speech and Language* 1984;5:213–228.
- Song, A.; Jones, S.; Lippert, J.; Metzgen, K.; Miller, J.; Borreca, C. Wisconsin Behavior Rating Scale. Madison, WI: Wisconsin Center for the Developmentally Disabled; 1980.
- Sven, H.; Ary, D. Analyzing quantitative behavioral observational data. Hillsdale, NJ: Lawrence Erlbaum; 1989.
- Teller, D. Teller acuity cards and handbook. New York: Vistech Consultants; 1989.
- Tomasello, M. The cultural origins of human cognition. Cambridge, MA: Harvard University Press; 1999.
- Tomasello M, Todd J. Joint attention and lexical acquisition style. *First Language* 1983;4:197–211.
- Warren, S.; Bredin-Oja, S.; Fairchild-Escalante, M.; Finestack, L.; Fey, M.; Brady, N. Responsivity education/prelinguistic milieu teaching. In: McCauley, R.; Fey, M., editors. *Treatment of language disorders in children*. Baltimore: Paul H. Brookes; 2006. p. 47-77.
- Warren, SF.; Yoder, PJ. Facilitating the transition from preintentional to intentional communication. In: Wetherby, A.; Warren, S.; Reichle, J., editors. *Transitions in prelinguistic communication*. Vol. 7. Baltimore: Paul H. Brookes; 1998. p. 365-385.
- Weunsch KL. Inter-rater agreement. 2003 from <http://core.ecu.edu/psyc/wuenschk/docs30/InterRater.doc>.
- Wetherby, A.; Prizant, B. CSBS Manual: Communication and Symbolic Behavior Scales manual—Normed edition. Baltimore: Paul H. Brookes; 2003.
- Wetherby, AM.; Alexander, DG.; Prizant, BM. The ontogeny and role of repair strategies. In: Wetherby, A.; Warren, S.; Reichle, J., editors. *Transitions in prelinguistic communication*. Baltimore: Paul H. Brookes; 1997. p. 135-161.
- Wolery M, Gast DL. Effective and efficient procedures for the transfer of stimulus control. *Topics in Early Childhood Special Education* 1984;4:52–77.
- Woods-Cripe J, Venn M. Family-guided routines for early intervention services. *Young Exceptional Children* 1997;18–26.
- Yoder P, Warren S. Maternal responsivity predicts the prelinguistic communication intervention that facilitates generalized intentional communication. *Journal of Speech, Language and Hearing Research* 1998;41:1207–1219.

Figure 1.
Rates of initiated and prompted intentional communication recorded during videotapes collected once weekly, during intervention.

Table 1

Description of Participants

Participant	Age at onset (years)	Diagnosis	Vision loss	Hearing loss	Age Equivalent in months – from WBRs			
					Behavioral age	Receptive language	Expressive language	Socialization
Howard	5–4	Prematurity, ROP	Detached retinas; total blindness	Bilateral profound SN ^a	22.4	19	18	11
Michelle	5–9	Sclerocornea	Legally blind, light perception	Bilateral severe to profound SN ^a	15.8	10	11	11
Lucy	6–0	Robinow syndrome	Hyperopia amblyopia ^b	Bilateral moderate SN ^c	20.7	23	23	29
Robert	5–8	CHARGE syndrome	Legally blind, field loss, myopia, colobomas ^b	Bilateral severe to profound SN ^a	14.6	13	9	11
Hank	4–3	Cerebral palsy	20/84 acuity, exotropia ^d	Bilateral mild to moderate SN	9.6	6	8	11
Olive	3–0	CMV	Hyperopia esotropia ^b	Bilateral moderate to severe SN ^a	13.8	9	10	9
Mark	5–1	Cerebral palsy	20/250 acuity, staphyloma ^d	Severe to profound SN (L)	11.8	5	10	12
Bart	7–0	Pierre Robin syndrome	Legally blind, exotropia	Bilateral undetermined SN	12.6	7	13	11
Carl	3–6	Severe neurologic disorder	Esotropia, field loss, cortical vision impairment	Bilateral severe to profound SN ^a	13.5	7	13	7

Note. SN = sensorineural.

^aParticipant has one cochlear implant.

^bParticipant has corrective lenses.

^cParticipant has bilateral hearing aids.

^dParticipant's Snellen conversion resolution acuity as assessed with Teller Acuity Cards.

Table 2

Intervention Strategies That Comprised A-PMT

Goal	Examples of specific techniques	Examples showing accommodations for sensory impairments
1. Establish routines to serve as the context for communication	Imitate the child's motor acts	C stomps floor, then I stomps floor while placing C's hand on I's leg (if C is blind)
	Imitate the child's vocal acts	C vocalizes while playing, then I vocalizes while placing C's hand on I's throat or face area (so C can feel vibrations)
	Take turns playing with a preferred object	I gives a vibrating ball to C and allows C to play with it for about 20 seconds, then I takes the ball and plays with it for about 5 seconds then gives it back to C. Repeat.
	Perform an action the child finds funny or interesting, pause, then repeat to get more laughter	I introduces a funny puppet that "sings" old McDonald. I plays with the puppet, C laughs, and I pauses
2. Increase the frequency, spontaneity, and range of conventional and nonconventional gestures	Provide the child with the desired object or action contingent on the use of a gesture	During turn taking with the vibrating ball (example above), I pauses longer than usual and waits for child to extend open palm toward I. Once C extends palm, I provides C with the vibrating ball
	Pretend not to understand by looking and gesturing quizzically and saying "What?" or "What do you want?"	C is searching for a preferred toy that I possesses. I says "What?" while taking the child's hands and demonstrating a shrugging Gesture
	Provide choice making opportunities	I presents two preferred objects to C, placing C's hands on each object in turn (if C is blind). I then pulls the objects just out of reach but maintains contact with C and asks, "Which one do you want?"
	Physically prompt the child to produce a specific gesture	When C indicates a desire to obtain a particular object, I guides C's hand to produce an open palm request. I then places the object in C's extended hand.
3. Increase orientation to communication partner(s)	Model an appropriate gesture	When something unexpected happens, I models an exaggerated point and looks back and forth between unexpected event and C
	If the child gestures toward an object but does not orient his or her gesture or body toward I, I waits for such orientation	C reaches toward a desired object, I waits several seconds for child to turn toward, or search for, I
	Gain child's attention by tactually, verbally, and/or visually soliciting attention	I taps C's hand to gain C's attention
	Encourage orientation to partner by placing desired objects in proximity to I's face	Place toy right next to I's face, so that C is likely to accidentally look at I's face. Gradually increase the distance between the toy and I, so C will obviously shift gaze or body orientation between I and object
4. Provide appropriate consequences	Encourage searching behavior	Provide a toy that requires I's assistance to operate. I gradually increases distance from C, so that C must seek out I's assistance.
	When child produces target behavior (e.g., gesture, orientation, vocalization), immediately provide desired consequence	When C hands an object to I for assistance, I immediately provides assistance and access to object
	If C does not emit target behavior after I waits several seconds, or prompts, provide consequences	I waits for child to vocalize to request more of a tickling game. After waiting several (e.g., 7) seconds, I tickles C.
5. Acknowledge child's communication attempts	Acknowledge verbally, or tactually (e.g., "Yes, you told me you want it")	Child tries to activate a toy, then gives toy to I. I says, "Oh, you need help."

Note. I = interventionist; C = child.

Table 3
Rates of Initiated and Prompted Communication at the Beginning and End of Intervention

Participant	Sessions to criterion	Rate initiated at beginning of intervention ^a	Rate initiated at end of intervention ^b	Rate prompted at beginning of intervention ^a	Rate prompted at end of intervention ^b
Howard	95	0.44	1.15	0.69	0.26
Michelle	38	1.52	1.98	0.69	0.51
Lucy	40	1.42	1.50	0.09	0.20
Robert	80	0.27	1.66	0.14	0.08
Hank	76	0.50	1.98	1.10	0.14
Olive	53	0.52	1.75	0.22	0.64
Mark	67	1.26	1.59	0.47	0.26
Bart	77	0.66	1.89	0.67	0.33
Carl	53	1.18	1.74	0.96	0.25

^aRate presented is the mean across the first three intervention sessions.

^bRate presented is the mean across the last three intervention sessions.

Table 4

Communication Forms at Beginning and End of Intervention

Participant	Extend hand, open palm	Move partner hand to item	Tap partner hand	Give to partner for help	Give "high five"/wave	Clap (as comment)	Push away, reject	Shake head	Point—contact or distal	Tap item (for choice)	Shift gaze—item to partner	Make eye contact + reach	Imitate vocalization	Make sign or verbalize
Howard	E	E	E	E			B		(NA)		(NA)	(NA)	E	B + E
Michelle	E	B + E	B + E	E			B		(NA)	B + E	(NA)	(NA)	E	B + E
Lucy				B + E	B + E	B + E	B + E	B + E	B + E		E			B + E
Robert	B + E	B + E	E	E	E	E	B + E		E		E			
Hank	E		E	E		E	B + E		E		E		E	E
Olive	B + E	E	E	E	E		B + E							
Mark	B + E	B + E	E	E	E	B + E	E		E		E		B + E	B + E
Bart	E	B	B + E	E			B + E	B	B	B + E		B + E		
Carl	B + E	B	B + E	E		B	B + E				E		E	B + E

Note. B = form demonstrated during first three intervention sessions; B + E = form demonstrated during first three and last three intervention sessions; E = form demonstrated only during last three intervention sessions; NA = participant had no residual/functional vision.

Table 5

Rates of Communication Functions at Beginning and End of Intervention

Child	BR (beginning)	BR (end)	SI (beginning)	SI (end)	JA (beginning)	JA (end)
Howard	0.51	1.08	0.1	0.37	0	0.01
Michelle	0.33	2.07	0	0	0	0
Lucy	0.47	2.01	0.05	0.08	0	0.01
Robert	0.13	1.69	0	0.07	0	0
Hank	0.24	2.04	0	0.04	0	0
Olive	0.31	1.91	0	0.02	0	0
Mark	0.99	1.37	0.05	0.60	0	0
Bart	0.58	1.99	0	0	0	0
Carl	0.43	1.77	0	0	0	0.35

Note. Beginning of intervention rates represent the mean of each participant's first three intervention sessions; end of intervention rates represent the mean of each participant's final three intervention sessions. BR = behavior regulation, SI = social interaction, JA = joint attention.