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AUTHOR Mar, Harvey H.; Sall, Nancy
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ABSTRACT

This project developed and evaluated an intervention program involving applications of technology to enhance the communication skills and behaviors of children with deaf blindness and other severe disabilities. Of interest were specific applications designed to increase attention, use of symbols, reception, expression of choice, awareness of contingencies, and social interaction. Project objectives involved: identifying technological resources; developing a conceptual framework of communication technology applications; selecting and implementing interventions that can enhance early communication and that can be integrated into the educational curriculum; and evaluating the efficacy of technology applications in enhancing early communication skills, meeting individualized education program goals, and promoting the development of related functional skills. Participants included 26 children, ages 3 to 15. A team collaboration model was utilized, in which each child's communication goals were generated and intervention activities were then implemented, monitored, and revised. One case example illustrates the multistep process. Overall results supported the efficacy of integrating microcomputers and other technological resources into students' communication training, including students with severe to profound cognitive disabilities. Analysis of intervention goals and activities revealed that, for students with nonsymbolic, nonintentional forms of communication, increasing social attention and contingency awareness were of primary concern. In contrast, for students with higher levels of communicative competence, increasing the use of symbols was most frequently targeted. Appendixes contain profiles of expressive communication and social interaction and a copy of the first issue of the Center for Adaptive Technology newsletter. (Contains 21 references.) (Author/JDD)

Applications of Technology in the Communication Training of Children with Deaf-Blindness: A Programmatic Approach

TECHNICAL REPORT

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Harvey H. Mar, Ph.D.
Project Director

Nancy Sall, M.S.
Project Coordinator

Developmental Disabilities Center
St. Luke's-Roosevelt Hospital Center
428 West 59th St.
New York, NY, 10019
212 523 6230

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Abstract

Applications of Technology in the Communication Training of Children and Adolescents with Deaf-Blindness: A Programmatic Approach

The purpose of this project was to develop and evaluate an intervention program involving applications of technology to enhance the communication skills and behaviors of children with deaf-blindness. Of interest were specific applications designed to increase attention, use of symbols, reception, expression of choice, awareness of contingencies, and social interaction. The major objectives of this project were to: (1) identify technological resources that are currently in use, or potentially applicable, in communication training of children with deaf-blindness and severe disabilities; (2) develop a conceptual framework in which applications of technology in communication training can be appropriately considered and selected on the basis of a learner's level of communicative competence; (3) select or design or adapt, and implement, technological forms of intervention that can serve to enhance early communication, and that can be integrated into the educational curriculum, and (4) evaluate the efficacy of technology applications in enhancing early communication skills, in meeting short- and long-term IEP goals, and in promoting the development of related functional skills.

Participants included 26 children, ages 3 to 15 years, with dual sensory impairments and other severe disabilities. A team-collaboration model was utilized in which each child's Communication Goals were first generated, and intervention activities were then implemented, monitored, and revised. One case example is presented to illustrate the multi-step process. Overall results supported the efficacy of integrating microcomputers and other technological resources into the communication training of students with dual sensory impairment, including those with severe to profound cognitive disabilities. Analysis of intervention goals and activities revealed that, for students with

nonsymbolic, nonintentional forms of communication, increasing social attention and contingency awareness were of primary concern. In contrast, increasing the use of symbols was most frequently targeted for students with higher levels of communicative competence.

Dissemination activities included: (1) the development of a resource manual entitled "Technological Resources for Students with Deaf-Blindness and Severe Disabilities; (2) seminars, workshops, and presentations at local, statewide, and national levels designed for special and regular education teachers, speech and language pathologists, computer teachers, and parents; (3) establishment of a permanent technology resource center in New York City that provides information and services to individuals with disabilities and their families on educational applications of microcomputer and other forms of technology; and (4) development of an assessment protocol, entitled "Profiles of Expressive Communication and Social Interaction" to relate individual communication behaviors and skills of students with sensory impairments and severe disabilities to technology-based interventions supportive of communication goals.

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Applications of Technology in the Communication Training of Children with Deaf-Blindness: A Programmatic Approach

I. Theoretical and Conceptual Framework

A. Introduction

Over the past decade, a remarkable array of technology, from simple microswitches to speech-recognizing computer programs, has been used to facilitate communication of individuals with disabilities. Despite this rapid progress, relatively few applications have been designed for the education of children with deaf-blindness. This "lag" is evident from studies which have reported that augmentative communication devices and assistive technology, in general, are seldomly considered for children with deaf-blindness, especially those who may also have severe cognitive disabilities (Matas, Mathy-Laikko, Beukelman, & Legresley, 1985; Parker et al., 1990).

Although suggestions have been made that technology be better utilized to achieve educational and communication goals for these children (e.g., Fredericks & Baldwin, 1987; Warren, Horn, & Hill, 1987), there has been little discussion as to what specific objectives might be served by technology interventions or of what advantages they might have over non-technological approaches. In fact, there is continuing uncertainty about the appropriateness of technological interventions and skepticism about their pragmatic worth when an individual's educational needs pertain to the most basic life skills. Concerns are well voiced that technology not replace methods and techniques proven to be the simpler or more effective, supplant natural opportunities for social exchange, or be implemented only to yield costly and esoteric outcomes (e.g., Hofmeister & Friedman, 1986). Consequently, intervention strategies, especially for children with dual sensory impairments whose communication behaviors are nonintentional, nonsymbolic, or nonconventional (Rowland & Stremel-Campbell, 1987), have tended to emphasize increasing opportunities for social interaction (e.g., Siegel-Causey & Ernst, 1989) rather than augmenting expressive skills per se.

The dearth of empirical studies on the efficacy of applying technology to enhance social or communication skills of children with dual sensory impairments can be related to several factors. First, the diversity among these learners in their communication skills makes it difficult to comprise a sample of "subjects" for whom communication training can be approached unilaterally. Further, the absence of guidelines or frameworks to even consider who might benefit from educational technology or of what applications might be appropriately considered has made it difficult to develop systematic programs of intervention. Second, the cognitive requirements for effectively using technology are often

assumed to be too demanding for students who are deaf-blind and who have severe intellectual disabilities. Although the validity of this assumption has been seriously questioned (Reichle & Karlan, 1988), such children tend to be excluded from augmentative interventions or computer-assisted instruction (Mirenda & Iacono, 1990). Third, for persons who are deaf-blind, technological resources have been regarded less as teaching instruments than as assistive tools to meet specific adaptive or environmental needs. Development of computerized sensory and mobility aids, for example, has proliferated, but efforts to promote teacher-learner contact or the learning of basic concepts and skills with technology are, by comparison, quite limited (Warren, Horn, & Hill, 1987).

B. Roles of Technology in Communication Training

Yet, the potential value and roles of technology in the language and communication training of children with deaf-blindness, even those with severe to profound intellectual disabilities, have been exemplified by a growing number of case studies and demonstrations. Locke and Mirenda (1988) reported that an 11-year-old boy who was blind and had severe mental retardation successfully learned to request food items by touching tactile symbols of a computer's expanded keyboard that, in turn, provided feedback from a speech synthesizer. Mathy-Laikko et al. (1989) designed an intervention for an 8-year-old girl with severe motor impairment, profound mental retardation, and deaf-blindness to help her associate the press of a switch with interaction from a care provider. Thorley, Ward, Binepal, and Dolan (1991) developed a long-term intervention program in which the use of printed words combined with signs increased functional communication skills of a 13-year-old boy who was deaf-blind and had severe intellectual disabilities. Buckley (1992) recently described an innovative computer education program designed specifically for children with deaf-blindness and cognitive disabilities to support their acquisition of language and academic concepts.

The most extensive study thus far has been conducted by Schweigert and Rowland (1992). In their three-year project, microswitch technology was used with 11 children ranging in age from 10 months to 10 years, each having severe, multiple disabilities including dual sensory impairments, to increase their awareness of social contingencies. Schweigert and Rowland hypothesized that once social cause-and-effect had been established, microtechnology could be further utilized to teach rudimentary communication skills such as requesting attention or making choices. Hence, these investigators designed an instructional sequence, called the Early Communication Process (ECP), involving four increasingly sophisticated levels of communication-- gaining attention; making requests or expressing interests; making choices or expressing preferences; and using symbols to make choices or express preferences. Case studies were reviewed to illustrate how ECP

could be applied programmatically to achieve individualized goals while accommodating the communication needs of a diverse group of children. Each case study exemplified how decisions were systematically made to target appropriate communication skills and to modify interventions based upon the child's progress.

This project attempted to extend these efforts by developing and evaluating a model of intervention program in which broad applications of technology were integrated into the communication training of children with deaf-blindness. Specifically, the major purposes of this study were to: (1) identify a range of microcomputer applications that could facilitate the development of communication and social skills of preschool and school-age children with deaf-blindness; (2) consider differences in technology-supported intervention goals and activities as functions of communicative competence and age of these students; (3) develop a programmatic approach to intervention planning in which communication skills, competencies, and needs of individuals with dual sensory impairments could be related to the most appropriate communication training strategies involving the use of technology; (4) describe a process of collaborative "teaming" to integrate these technology-supported interventions into the student's educational program; and, (5) evaluate the effectiveness of technology interventions to achieve the desired outcomes for individual students.

C. Communication Behaviors of Children with Deaf-Blindness

Communicative competence can be understood as the efficiency of the exchange of messages between persons, and the awareness of the social structure or interactive process in the exchange. The achievement of competence is a gradual process, but there are notable qualitative changes and differences of behavior in this progression. These differences have been conceptualized in terms of levels or stages of communication development, and various frameworks have been formulated to describe these transitions and sequences in children with severe disabilities, including dual sensory impairments.

In a sequence of communicative competence described by Rowland and Stremel-Campbell (1987), individuals with most basic skills (Level I) "communicate" through reactive or reflexive behaviors. The meanings of these reactive behaviors (e.g., movements, crying, gurgling) are unintended and are, therefore, largely interpreted by communication partners. These behaviors are primarily involuntary, and the learner has little awareness or understanding of the social cues or context in which the behaviors are elicited. This level of communicative competence is not specifically tied to infancy or early childhood; the needs and interests of some persons with multiple disabilities, including profound mental retardation, are often interpreted on the basis of their reactive behaviors. In contrast, the highest level of communicative competence in the sequence (Level VII)

involves the use of a formal, symbolic language system. Within the rules of the language system (e.g., sign language, spoken English), the individual's messages can vary in length, complexity, content, and structure. Social aspects of language, such as awareness, attention, initiation, turn-taking, intonation, and expressive gestures are well established.

Between these extremes are several other levels of competence defined by different degrees of intentionality, conventionality, and symbol use in the learner's social exchanges. According to Rowland and Stremel-Campbell, at Level II, behaviors may be intentionally produced but not necessarily intentionally communicative. For instance, the learner may be aware that his or her behaviors (e.g., screaming) have direct outcomes (i.e., attention), but they are not initiated with the purposeful intent of affecting another person's behavior. When such intentional communication is established at Level III, the expressive forms (e.g., tugging, reaching) are often directly tied to needs or desires. However, they are nonconventional in the sense that they may be situation or individual specific. Level IV is marked by the use of more conventional means of communication (e.g., pointing, waving, nodding), and social interactions are more extensive and complex. Although an individual's forms of expression are not symbolic, they are more readily interpreted across contexts. At the next levels, the learner uses universal symbols, which is prerequisite to the use of a formal, symbolic language system. The ability to associate concrete symbols (e.g., pictures, objects, gestures) and their referents is a hallmark of Level V. The use of abstract symbols such as words, letters, signs, or codes, characterizes communication at Level VI.

Research has indicated that most children who are deaf-blind experience severe communication difficulties (Matas et al., 1985) and do not make the transition from "early" behaviors (Levels I to III) to the more symbolic, conventional, or formal systems of communication (Stremel-Campbell & Matthews, 1988). The communication behaviors of many students who have both dual sensory and cognitive impairments are often described as nonsymbolic and nonconventional (Siegel-Causey & Downing, 1987). Intervention efforts have, therefore, generally focused on facilitating the acquisition of intentional social behaviors that are functional across environments. Such interventions have been designed to enhance a learner's awareness and recognition of environmental changes, personal desires and needs, familiar persons, turn-taking opportunities, and dyadic exchanges. Attention has also been given to augmenting communication of these students through the use of tangible objects, pictures, signs or gestures, consistent reactions and responses, communication devices, and co-active movement.

D. Communication Goals

A review of the extant literature on intervention strategies (e.g., Siegel-Causey & Ernst, 1989; Schweigert & Rowland, 1992) suggests that communication goals for most children with deaf-blindness and severe disabilities can be grouped under six broad categories designed to increase or enhance the following skills: (1) attention, which involves orienting to, or directing and sustaining interest toward, a person, object, or activity. Many students with deaf-blindness and severe cognitive disabilities can sustain only brief interest in their environment. Educational priorities are, thus, often directed toward increasing an individual's awareness of oneself, recognition of familiar people, and ability to attend to social or functional activities (Siegel-Causey & Downing, 1987); (2) awareness of contingencies, which refers to the knowledge that certain actions and behaviors can directly lead to specific outcomes, including social outcomes. Understanding of this concept of "cause-and-effect" is often associated with one's ability to communicate intentionally, a major accomplishment for many individuals with deaf-blindness and cognitive disabilities; (3) social interaction, which involves initiation, turn taking, and participation in social events such as peer-group activities. Dual sensory impairments can reduce a student's awareness of social events that occur beyond the immediate proximity, and so limit one's ability to respond to social cues and signals. Interventions are often designed to help the student signify social interest or engage in give-and-take exchanges; (4) use of symbols, defined as the ability to associate objects, people, and events to specific codes or representations in visual, auditory, or tactile forms. Many individuals with dual sensory impairments have extreme difficulty acquiring symbolic communication modes such as speech or sign language (Siegel-Causey & Downing, 1987), and goals are often specified to help the individual use symbol forms that are meaningful, conventional, and readily understood by others; (5) expression of choice, which refers to the ability to acknowledge options and indicate preferences. Making choices about activities, preferred objects, partners, and time is regarded as a critical component of communication training for students with severe cognitive disabilities, since it promotes increased independence and self-determination; and, (6) reception or responsiveness to others, which involves understanding the words or actions of other persons. The primary receptive mode (e.g., receiving tangible object cues) for an individual with deaf-blindness often differs from the primary expressive mode (e.g., using signs or gestures). Thus, a student's intervention plan may focus on learning to interpret others' cues, symbols, signals, and behaviors in the context of meaningful activities.

Within each of these six broad categories, many exemplars of the targeted skill can be identified to meet individual goals. For example, enhancing the use of symbols may

mean increasing the use of functional signs, learning to associate tangible objects to referents, using two-dimensional picture cues, acquiring more vocabulary, or using gestures more consistently.

In the present project, the specific communication goals for each student were first identified through an extended process involving school-based observations, reviews of educational records and plans, and team meetings with school personnel including teachers, speech-language pathologists, and other related-service providers. Once the goals were established, plans were developed stipulating the forms, contexts, and frequency of interventions. As part of this planning process, the team considered applications of technology-related interventions, and devised various high-tech and/or low-tech activities to complement and be integrated within the overall intervention plan. Data collection and recordkeeping procedures were also established as a means to monitor and evaluate the effectiveness technology-based interventions. Each classroom teacher of each student was also interviewed to obtain feedback about the student's attainment of goals and generalization of communication skills.

II. Methods and Participants

A. Participants

A total of 26 children and adolescents with dual sensory impairments from one preschool, one private school, and one public school in New York City participated in this study. Altogether, 14 different teachers were represented by these students. The students ranged in age from 2 years, 11 months to 15 years, 10 months (mean of 7 years, 4 months). There were 8 girls and 18 boys. Most students had other disabilities in addition to dual sensory impairments (e.g., physical disability, seizure disorder, mental retardation). In this sample, 20 students were assessed to have either severe or profound cognitive disabilities, and 6 had either mild or moderate cognitive disabilities. The students were from diverse ethnic, cultural, and socioeconomic backgrounds.

Extensive information about each student's communication and social interaction behaviors was also obtained in the intervention planning phase, as described below. Based upon this information, each student's level of communicative competence as described by Rowland and Stremel-Campbell (1987) was independently determined by two persons who rated the student's communication behaviors. The interrater reliability coefficient was .98. Within this sample, the expressive communication skills of 16 students could be described as nonsymbolic and nonconventional communication, corresponding to Levels II and III, at the onset of their participation in this project. The communication skills of the remaining

10 students were rated as Level IV through Level VII. A summary of individual student characteristics is presented in Table 1.

B. Equipment and Technology Resources

Each school was equipped with several computers, peripherals, and software. Most students whose interventions involved microcomputers used the Macintosh LC with a 12" color monitor, Apple IIe emulation card with 5.25" disk drive, Echo LC Speech Synthesizer, and several adaptive keyboards and input devices (e.g., Unicorn Expanded Keyboard, PowerPad, Touch Window, Intellikeys, Ke:nx). In addition, each site had one or more Apple II computers, each equipped with an Adaptive Firmware Card and Echo Speech Synthesizer. Also available were various types of microswitches that could be used with the computers and/or adapted battery-operated devices and toys. Each site acquired a library of 40 to 50 public domain and commercial software programs, including several programs designed to promote communication and social skills. In addition, at one school, a teacher created individualized programs to address the interests of particular students.

C. Intervention Planning Procedures

For each participant in this project, an extensive process involving a sequence of information-gathering activities was implemented to determine appropriate intervention goals and activities. The process began with organizing a team who would be responsible for developing, supporting, providing, and/or monitoring technology-based activities for the given student. Team members could include the student's teacher, speech and language pathologist, computer resource teacher, parent, teacher assistant, member of the technology research project, and/or other related-service providers. Once a team was established for the student, records were reviewed and initial data-collection procedures began.

Record review. Each student's educational records were first reviewed to obtain information on: individual characteristics (e.g., age, medical diagnosis, sensory impairments, degree of mental retardation); communication behaviors (e.g., expressive and receptive modes, history of augmentation, symbol use, language spoken in the home); psychosocial issues (e.g., behavioral concerns, functional skill levels, preferred activities); cognitive and learning skills (e.g., concept knowledge, academic skills, sensorimotor functioning); educational programs (e.g., IEP goals, related services, schedule of activities); and physical characteristics (e.g., physical impairments, gross and fine motor coordination and control, mobility). A computerized database was established for each student in which this information was kept. New information was entered into the database to keep the records current. This was especially important for the purpose of reviewing, monitoring, and revising technology-supported intervention goals and activities throughout the course of the student's involvement in the project.

Table 1, continued. Student Characteristics

Age	Sex	Degree MR	Visual Impairment	Hearing Impairment	Diagnosis	Comm. Level
9-9	M	Mild	light perception	mild	traumatic injury	IV
10-3	M	Moderate	cataracts	bilateral profound	congenital rubella	VI
10-5	M	Mild	retinal colobomas	bilateral moderate	CHARGE syndrome	VI
10-11	F	Severe	cataracts	bilateral profound	congenital rubella	IV
15-10	M	Severe	light perception	degree unknown	Peter's Anamoly	VII

Note. n=26. [a] student described in Case Example.

Table 1, continued. Student Characteristics

Age	Sex	Degree MR	Visual Impairment	Hearing Impairment	Diagnosis	Comm. Level
11-3	M	Profound	light perception	mild-moderate	cerebral palsy	III
11-6	M	Profound	bilateral optic atrophy	bilateral profound	cerebral atrophy	III
13-0	M	Profound	light perception	mild	cerebral palsy	II
13-6	M	Profound	cataracts	bilateral severe	congenital rubella	III
13-8	M	Profound	severe optic atrophy	degree unknown	cerebral palsy	II
			Students with Communication Levels IV-VII (n=10)			
3-4 [a]	M	Severe	cortical blindness	bilateral moderate	cerebral palsy	IV
4-5	F	Severe	cataracts, glaucoma	profound	congenital rubella	IV
5-5	M	Mild	anophthalmia	deaf	Bell's Palsy	VII
7-1	M	Severe	cortical blindness	degree unknown	cerebral palsy	IV
8-7	M	Profound	cortical blindness	degree unknown	seizure disorder	IV

Table 1

Student Characteristics

Age	Sex	Degree MR	Visual Impairment	Hearing Impairment	Diagnosis	Comm. Level
			Students with Communication Levels II-III (n=16)			
2-8	M	Severe	degree unknown	degree unknown	cerebral palsy	II
2-11	F	Profound	cortical atrophy	degree unknown	cerebral palsy	II
2-11	M	Moderate	degree unknown	bilateral	congenital rubella	III
3-2	F	Profound	cortical blindness	bilateral severe	cerebral palsy	II
3-2	F	Severe	light perception	degree unknown	prematurity	II
3-3	F	Moderate	degree unknown	severe-profound	cytomegalovirus	III
3-10	M	Severe	blind	bilateral severe	CNS dysfunction	II
3-11	F	Severe	legally blind	severe-profound	prematurity (ROP)	III
6-0	M	Profound	blind	mild	cerebral palsy	III
6-2	F	Profound	legally blind	profound	CHARGE syndrome	II
9-5	M	Profound	cataracts	degree unknown	congenital rubella	II

Observations and structured interactions. After a student's records were reviewed, the student was observed in school and classroom settings. Observations were made of the student during an activity that provided natural opportunities for social interaction with the teacher or peers (e.g., group activity, music time, lunch). Sequences of behaviors, language, responses, and interactions were recorded verbatim by a member of the research staff for subsequent analysis. Observations ranged from periods of 30 to 60 minutes, and at least one observation was conducted per student during this initial planning phase. In addition to observations, each student was also engaged in a more formal 30-minute period of structured one-to-one interaction with a research team member. The purpose of this interaction was to obtain additional first-hand information about a student's social and communication skills, such as give-and-take responding, requesting behavior, initiation, and turn-taking. Simple games and activities that were age appropriate were presented in these sessions (e.g., ball playing, puzzles, switch-activated toys and activities, drawing, using a tape player). A student's behaviors and responses during this period were recorded on a rating scale that was specially devised for this project to describe specific aspects of the individual's communication behaviors (e.g., use of symbols, intentionality, complexity, reciprocity, consistency, etc.). Taken together, the observational and interaction data provided information that could be used to help the student's team generate appropriate communication and technology-supported goals and activities.

Interviews. The next step of the sequence was to conduct interviews of a student's teacher, assistant teacher, speech and language pathologist, and other related-service providers. Specific questionnaires were developed by this project to review: the student's current breadth of communication behaviors; nature and degree of the student's progress; primary concerns regarding communication and social skills; effective strategies, activities, and approaches for communicating with the student across natural contexts and events; and, future goals and expectations.

Identification of goals and activities. Once the above stages were completed, a student's team met to review all of the information. The purpose of this meeting was to generate Communication Goals that would promote communication and social interaction skills of the student, and to consider appropriate technology-supported activities that would relate to each Communication Goal. Team members ensured that the goals they formulated were consistent with the student's IEP. Furthermore, Communication Goals were developed so as not to duplicate or substitute for speech-and-language or communication therapy, but to support the general goals of the therapist. Each student had three to five major Communication Goals. Several activities for each goal involving the use of available technological resources within the school (e.g., computer, alternate input devices,

software, augmentative communication devices) were then specified. Examples of Communication Goals and activities pertinent to each goal are presented in Table 2.

D. Implementation and Monitoring Procedures

Once the Communication Goals and activities were established for a given student, an implementation plan was developed to determine: who would conduct the activities, the contexts in which the activities would be conducted, how frequently intervention would occur, what specific activities would be selected for a particular session, how long a session would last, etc. These concerns were addressed in an initial meeting involving a student's team, and in informal meetings among team members during the project period.

Coordination of activities. Depending on particular circumstances, schedules, and available personnel, a student's teacher, teacher assistant, research project staff member, or computer teacher assumed the primary responsibility for conducting the intervention activities. Schedules for technology-supported communication training were established by each student's team. Interventions were provided from one to five times per week, 20 to 40 minutes per session, as specified in the intervention plans. There were no significant differences among the three schools in the average number of sessions per student per week. Neither were there differences in the average number of sessions per week between students with nonsymbolic, nonconventional versus those with symbolic, more formal modes of communication. All participants were enrolled in 12-month school programs. The average number of months between participants' first and last sessions was 11.8 (range of 3 to 17 months).

In the preschool, intervention activities were conducted in an area of the student's classroom. In the private school and the public school, students were brought to a separate computer room within the building. Activities for a given participant could occur in small-group format if the student's intervention plan targeted social interaction as an area of concern (e.g., turn taking, initiation, orienting or responding to others). The group would generally include other students from the same classroom who were not necessarily project participants, but whose teachers felt would benefit from technology activities.

Teacher support. During the project period, project staff members or the computer resource teacher provided inservice training and support to students' teachers and aides within each school to enable them to assume greater roles in technology activities. This support was deemed critical to promote continuity of the intervention programs, consistency in communication training, and monitoring of students' responses and progress. Some of the training was conducted in formal sessions in which teachers learned to use specific equipment or software, troubleshoot common problems, or design intervention activities. However, most training was provided informally as needed.

Table 2

Examples of Specific Communication Goals and Intervention Activities

Goal Category: Use of Symbols
Specific Goal: To promote student's ability to combine two symbols in expression.
1. Using language software, student combines subject and verb to describe picture on screen.
2. During a highly motivating computer activity, student signs (e.g., "want more") in response to teacher's questions.
3. Using tactile cues on an alternative keyboard, student combines cues in succession to form a sentence (e.g., "Music finished.").
Goal Category: Social Interaction
Specific Goal: To help student learn turn-taking and imitation skills in peer-group tasks.
1. In imitation, student vocalizes "my turn" during group computer activity.
2. With teacher prompts, student passes switch to peer upon finishing her own turn.
3. With suggestions from peers, student creates pictures on screen with drawing program.
Goal Category: Awareness of Contingencies
Specific Goal: To help student learn relationship between behavioral responses and social or functional outcomes.
1. In response to the word "more," student presses switch to continue activity (e.g., listening to music on a tapeplayer).
2. Using a modified keyboard, student learns that certain keys are associated with different outcomes (e.g., continuing musical program or changing programs).
3. Using a software program with high-contrast images on the computer monitor, student increases visual attention to images by sustaining gaze.

Monitoring interventions/Data collection. Each student's communication training activities involving technology was monitored closely throughout the project period. Project staff members were responsible for ensuring that the schedules of intervention activities were maintained. Individualized rating scales were created to evaluate each learner's performance on intervention activities (e.g., degree to which student indicated choice of music from a software program). The student's performance and behaviors pertaining to each of his or her Communication Goals (e.g., intentionally initiating choice and preference in daily routines) were rated on a 5-point basis in each intervention session. In addition to these rating scales, general observations of attention span, motivation, skill learning, and other behaviors were recorded. Several times during the course of a student's involvement in the project, the team members met to review the student's progress. The purpose of these informal and formal meetings was to re-assess the appropriateness of intervention goals and activities, and to make modifications or additions as was deemed necessary. Finally, all teachers were interviewed at the end of their students' involvement in the project to obtain information about their perceptions of student changes, relevance of technology activities, and integration of computers into students' curricula.

III. Case Example

A. Description of Implementation

The following case example describes the communication training program of a student who was involved in this project over a three-year period. The purpose of this case example is to illustrate the planning, implementation, and monitoring procedures, and to provide examples of technology-based goals for a child with dual sensory impairments. Characteristics of the student, whose name is William, are in Table 1.

William was 3 years, 4 months old when he began to participate in this project. He was in a class with five other children of the same age, each of whom had multiple disabilities. William was identified as having dual sensory impairments, as well as physical and severe cognitive impairments. Medical reports indicated that William was born prematurely, and was diagnosed as having spastic quadriplegia and hydrocephalus. He had cortical visual impairment that was manifested by a short visual attention span and inconsistent regard of visually-presented materials. He had a moderate bilateral hearing impairment. His functional hearing was noted to be better on the right side, but the extent of hearing loss was unknown. At the time of the record review and initial classroom observations, William's primary forms of expressive communication consisted of vocalizations, such as vowel or consonant sounds (e.g., ah, ba, ma, geh), other guttural

and "raspberry" sounds, yelling, and laughing. William's gestures included clapping, reaching toward and grasping objects, and shaking and banging objects. He often combined specific gestures, such as touching and patting, with vocalizations during interactions with classmates.

Receptively, William could comply with simple requests (e.g., "Give me", "Clap your hands") and was also noted to respond appropriately to a familiar adult's tone or gesture. During the observations and one-to-one interactions, William expressed interest and "choice" by reaching for and manipulating preferred items. Otherwise, he would push away or drop objects, yawn, or close his eyes. He imitated simple sounds and gestures (e.g., pushing a toy car back and forth, shaking his head "no"). He displayed an understanding of contingency awareness by occasionally using adaptive switches to activate novel toys. William's communication skills could be characterized as Level IV in the sequence proposed by Rowland and Stremel-Campbell (1987). Although his communication behaviors, such as waving his arm, pushing an object, or vocalizing "ah" were clearly intentional, they were not symbolic, as his behaviors consisted mostly of actions closely or directly associated with an activity or need.

William's educational records indicated that he could respond to sounds presented on his right side, use his right hand purposefully to manipulate objects or to activate mechanical toys, and locate noise-making objects. He was noted to specifically enjoy activities involving music, noisy toys, and imitative games. Several goals on William's IEP focused on promoting expressive communication and basic social interaction skills (e.g., increasing vocal exchanges; imitating vocalizations; responding to peer's greeting).

B. Generation of Individual Communication Goals

Information obtained from William's IEP, the observations, one-to-one interactions, and interviews, was reviewed by a team comprised of William's teacher, a teacher aide, a speech and language pathologist, and a project member. The team generated a list of five major Communication Goals that were consistent with the IEP, and which expanded the objectives on communication and social skills. These goals related to promoting William's attention, use of symbols, expression of choice, awareness of contingencies, and reception.

Under "Attention", the primary objective was to increase visual interest (e.g., sustain gaze, visually orient toward communication partners, respond when visual stimuli are presented or changed). Intervention activities included having images momentarily appear on a computer monitor or making a picture move around the screen by pressing a switch. When these events occurred, William was prompted to visually regard the monitor, which appeared to provoke his interest for brief periods at a time. William was

also directed to visually orient toward others in his group during turn-taking sequences or when his name was called. For this objective, three public domain software programs which provided brightly colored and animated pictures (Happy Face, Music and Boxes, The Dancer) were used which proved to be especially motivating for William.

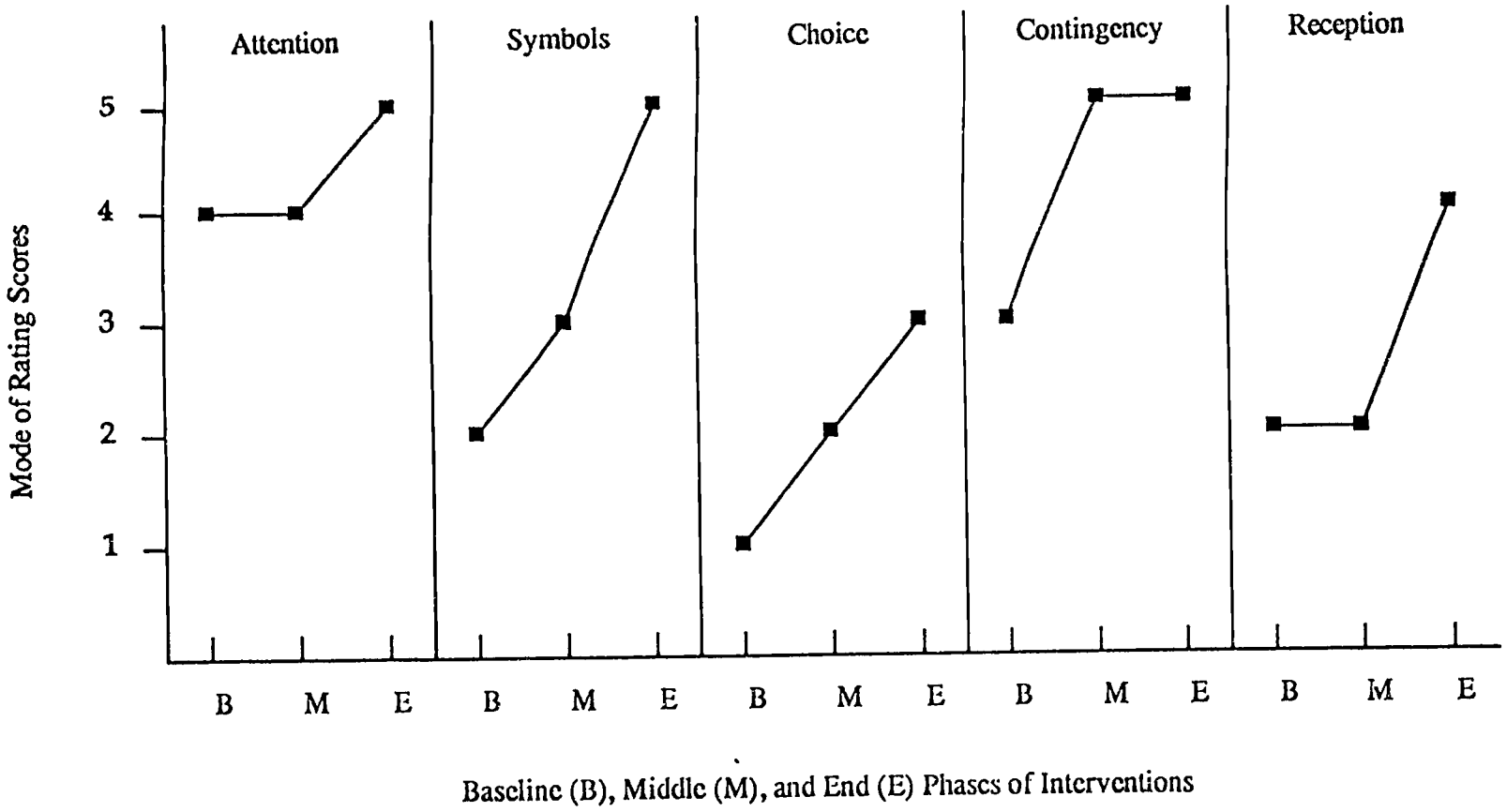
General objectives to promote William's use of symbols focused on increasing his intentional use of sign approximations (e.g., "more", "my turn", "finished"). During various computer activities, William would be prompted to respond to simple questions (e.g., "Do you want more?", "Whose turn is it?") with specific gestures (e.g., patting the teacher's hand or tapping his own hands together). Over the course of intervention, the general sequence of activities and the teacher's questions were consistent to promote increased spontaneity and independence in William's use of symbols. A third general goal was to promote William's ability to express a preference when given a choice between two alternatives. Several activities were designed to teach William to point to or sustain his eye gaze to one of two presented pictures or objects. For example, William would be encouraged to point to a picture of a computer (versus book) to indicate his desire to play on the computer. For the fourth goal, which focused on promoting William's awareness of contingencies or causal relations, William was prompted to press a switch to make images appear on the monitor. A simple sequence to cue William to press the switch, then visually regard the monitor, and receive reinforcement from the teacher was initially developed to promote this skill. The final goal was to increase William's receptive responses to simple directions regarding computer activities. A range of natural and spontaneous interactions with the teacher and peers in the context of computer activities provided William with opportunities to respond to simple commands (e.g., "Wait.", "Look at the computer.", "Tell Mike to take his turn.")

When the activities were first introduced, William and a classmate were paired to work in a small group. A Macintosh LC computer was set up with specific adaptations. Ke:nx emulation was used to connect switches and adaptive keyboards, as well as to design specific customized setups for use with the Unicorn Expanded Keyboard. Initially, a 6" X 10" orange plate switch was connected to the computer. This switch was later replaced with a smaller 5-inch round switch. The selected software programs were simple to operate, and were activated by either a single or sustained press of the switch. Altogether, William received 35 communication training sessions over a 13-month period in which these technological resources were used.

C. Individual Performance

Figure 1 below presents baseline, middle, and end scores for William's achievement within each goal category. Ratings could range from 1 to 5, corresponding to

Figure 1. Changes in William's achievement of each Communication Goal across intervention phases.



increasingly higher levels of performance. For example, in activities designed to increase William's awareness of contingencies, his performance in each session was rated according to the degree of assistance he required to press the switch appropriately. A rating of 1 corresponded to his need for total assistance. A rating of 3 indicated his need for prompting or assistance 50% of the time, and a rating of 5 reflected William's ability to independently manipulate the switch during the entire session. "Baseline" scores represent the modes of the ratings for the initial one-third of the sessions. "Middle" scores reflect the modes for the next one-third of intervention sessions. "End" scores reflect the modes of the final one-third of the sessions.

William's performance across the 35 sessions reflect increased skill acquisition in all categories. As can be seen, although William had been able to maintain visual interest for 15 minutes (rating of 4) when interventions first began, by the final sessions he was able to consistently attend for 30 to 35 minutes (rating of 5). In fact, William was noted to become increasingly impatient when he had to wait for the program to boot up, and began to communicate his impatience by directly vocalizing to others during intervention. Marked change in William's use of symbols over sessions was also noted. During baseline, he would request "more" less than 50% of the time, given initial physical prompts (rating of 2). However, by the end of the intervention period, he was noted to spontaneously, independently, and consistently sign "more" when given verbal cues (rating of 5). Comparable changes toward the achievement of goals to promote William's expression of choice, awareness of contingencies, and reception can also be seen in Figure 1. Thus, overall, the data reflect that William was able to successfully use computers and adaptive technology to increase specific skills and achieve Communication Goals related to his IEP.

IV. General Results

A. Types of Communication Goals

Group data were also analyzed to evaluate the effects of the technology program as a whole, and to determine: (1) the types of technology-supported Communication Goals and activities as functions of students' communication levels and age; (2) the extent to which students achieved Communication Goals through technology-supported interventions; and, (3) teachers' perceptions about, and applications of, technology in communication training as a result of their involvement in the program.

Figures 2 and 3 show distributions of the types of Communication Goals that were generated for all 26 students during the team meetings. Each goal for each student was categorized as relating to Attention, Use of Symbols, Expression of Choice, Awareness of Contingency, Reception, or Social Interaction, as defined above. Figure 2 shows the

distribution of the six types of Communication Goals for the 16 students with nonconventional, nonsymbolic levels of communicative competence (Levels II and III) versus the 10 students whose communication modes are more symbolic and conventional (Levels IV to VII). Several results are of note. As can be seen, increasing the use of symbols was the primary concern for the students with higher levels of communicative competence, more so than for students with communication Levels II and III. For these latter students, increasing attention and contingency awareness were targeted as frequently as symbol usage, and to greater degrees than students with communication Levels IV to VII. Goals pertaining to receptive communication were seldomly generated for students with communication Levels II and III, and for all students, increasing social interaction skills were, somewhat surprisingly, infrequent objectives.

In Figure 3, the distribution of students' Communication Goals are presented for two age groups. The 13 younger students in this project ranged in age from 2 years, 11 months to 6 years, 2 months. The 13 older students ranged in age from 7 years, 1 month to 15 years, 10 months. Of interest in this analysis was to determine whether a student's age, independent of communication level, was a factor in considering what Communication Goals were appropriate. Overall, the relative distributions of Communication Goals were similar between the two age groups. For both age groups, increase in the use of symbols was the predominant goal, followed by increase in attention and contingency awareness. For both age groups, increasing receptive skills and social interaction skills were least targeted as goals. The relatively small differences between groups indicate that, independent of communication level, the variable of age was not relevant in the consideration of appropriate Communication Goals for these students.

B. Effectiveness of Interventions

Analyses were conducted to determine the effectiveness of technology-supported interventions in the students' achievement of targeted Communication Goals. Data for one analysis were provided by the individualized rating scales kept for each intervention session. For each student, a 1- to 5-point scale item had been generated to correspond to each Communication Goal. For example, one goal for a student focused on increasing social interaction and turn-taking skills with a peer during intervention. For this goal, the student's social interaction during each intervention session was rated from 1 (minimal interaction and acknowledgment of peer) to 5 (consistent response to peer, initiation of social interaction). Another goal for the same student was to increase contingency awareness by using a switch to activate or change a computer program. The student's performance relative to this goal was also rated from 1 (requires total assistance, does not purposefully manipulate switch) to 5 (consistently uses switch to intentionally activate

Figure 2. Relative percentages of Communication Goals by category as a function of students' communication levels (Levels II-III versus Levels IV-VII).

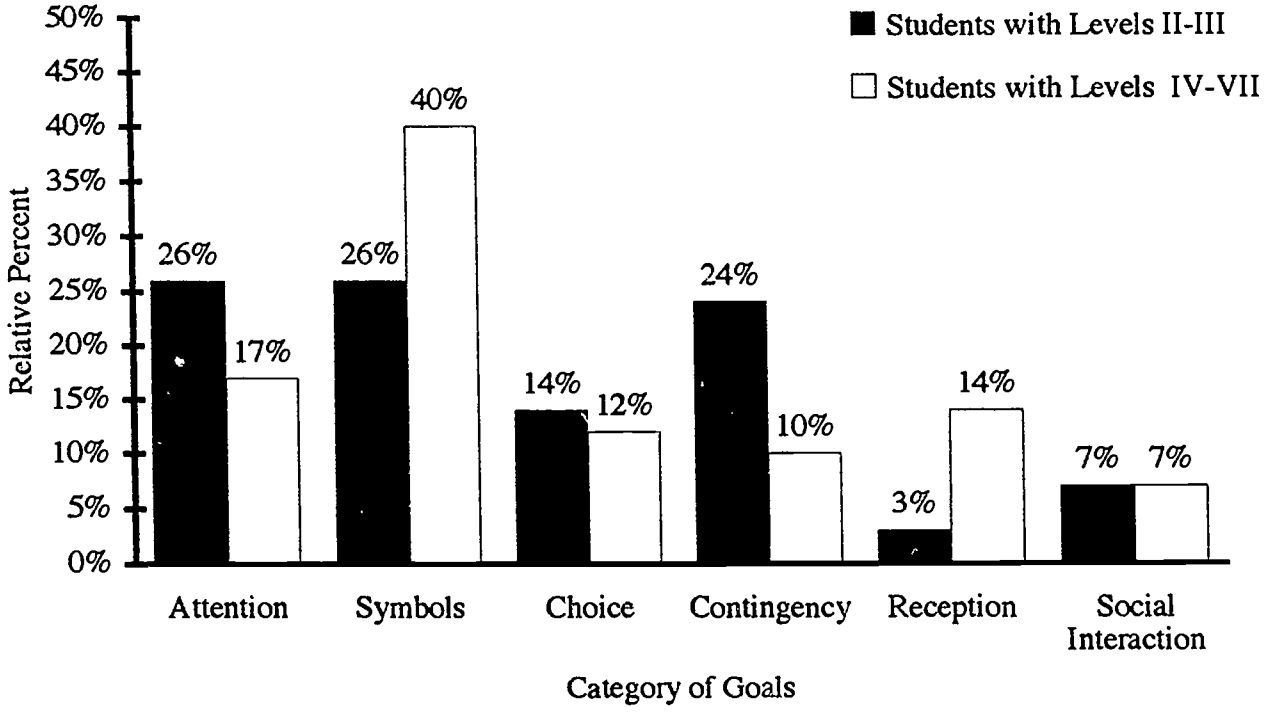
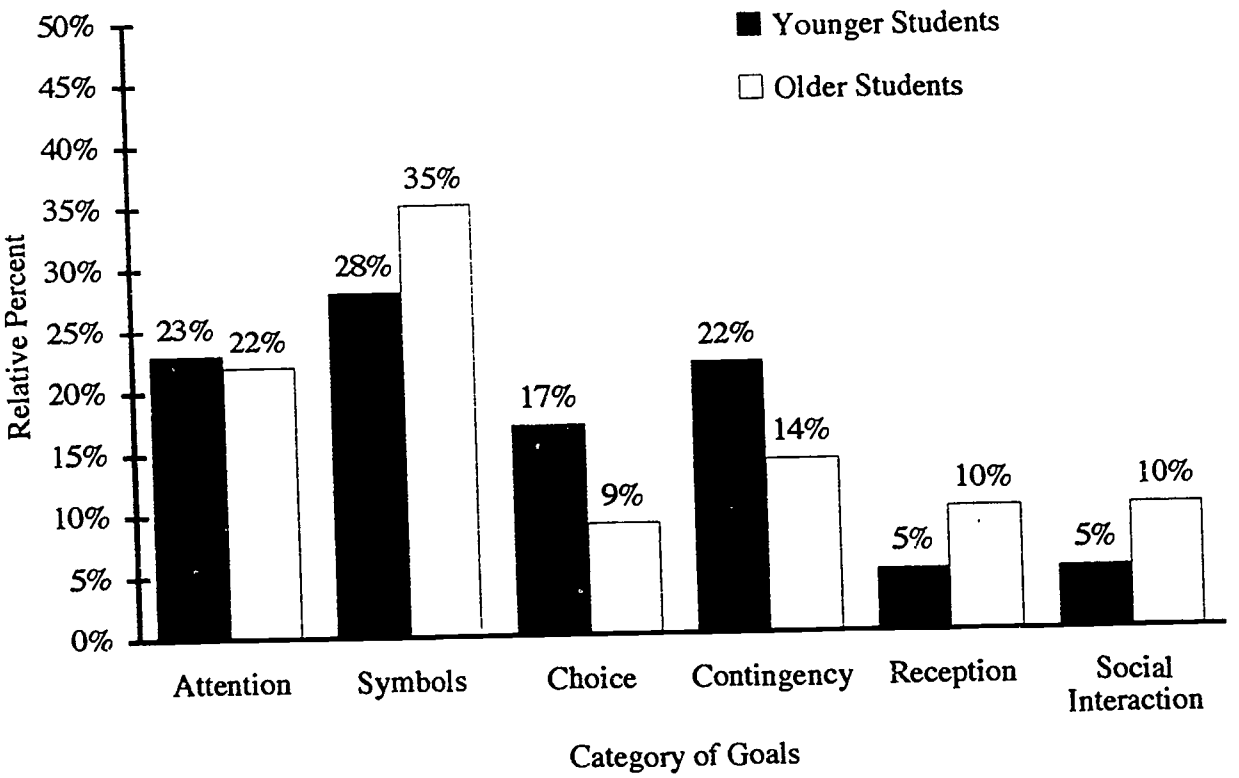


Figure 3. Relative percentages of Communication Goals by category as a function of students' chronological ages (younger versus older).



computer program). Ratings had been made by the person who was primarily responsible for conducting the interventions.

The individualized rating scales for each student were separated into two groups, corresponding to the first versus second half (e.g., first 15 sessions vs. last 15 sessions) of the student's involvement in the project. Each scale item was then examined to determine whether, overall, there was positive change, no change, or negative change in the ratings from the first half to the second half of the sessions. Change, either positive or negative, was indicated only if the mode of the ratings of the first half differed from that of the second half. Across all students, positive change occurred with respect to 44% of all Communication Goals. No change was evident according to these ratings on 42% of Communication Goals. For a small proportion of Communication Goals, 14%, there was negative change, or generally poorer performance between the first and second halves of the intervention period.

A second analysis was performed on information provided by the teachers of the participants. After the student's last intervention session, his or her teacher was asked to review each of the Communication Goals, to indicate (yes or no) whether the student had made specific positive changes in the communication behavior or skill that had been targeted, and to describe the changes. Figures 4 and 5 summarize the teachers' responses for students with communication Levels II to III versus Levels IV to VII, and younger versus older students, respectively. In contrast to the data obtained from the rating scales, teachers reported that their students made positive changes toward a much greater proportion (67%) of the Communication Goals. As can be seen in the figures, gains were reported most frequently for goals to increase contingency awareness (86% overall) and attention (77% overall). Figure 4 shows that when students are divided by level of communicative competence, there are some differences in patterns of reported goal acquisition. Overall, students with communication Levels II and III are perceived to reach their Communication Goals more frequently than students with communication Levels IV to VII attain their Communication Goals. (Note that the specific goals within these categories varied from student to student.) This is especially the case in regard to increasing attention, the expression of choice, and social interaction. When the younger and older students of this project were compared, as shown in Figure 5, more pronounced differences can be seen. Individualized Communication Goals to enhance the use of symbolic communication and the expression of choice were reached more frequently by younger students relative to older students. Conversely, teachers reported that older students achieved goals in social interaction and receptive communication more often than

Figure 4. Percentages of Communication Goals successfully achieved per category for students with different communication levels (Levels II-III versus Levels IV-VII).

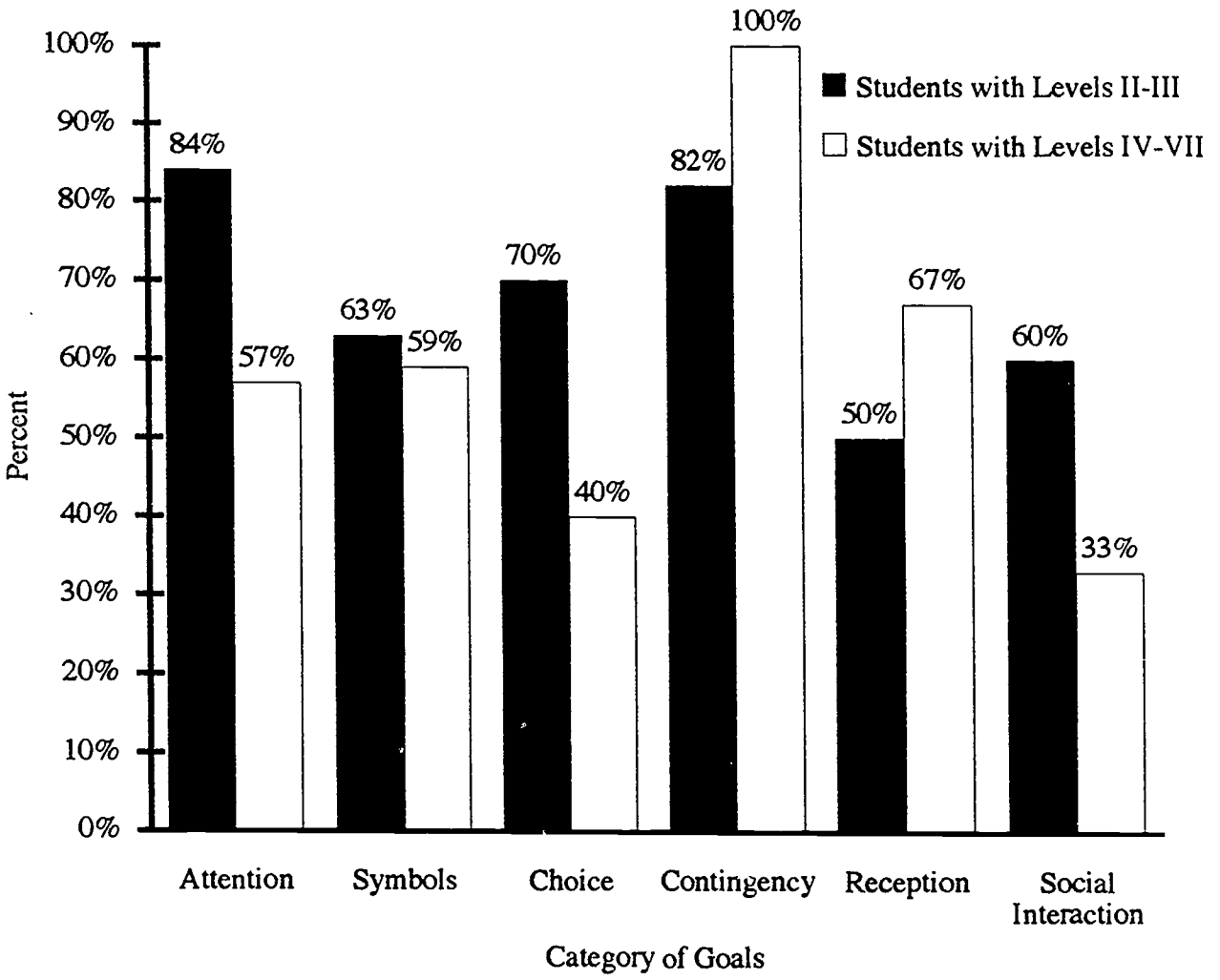
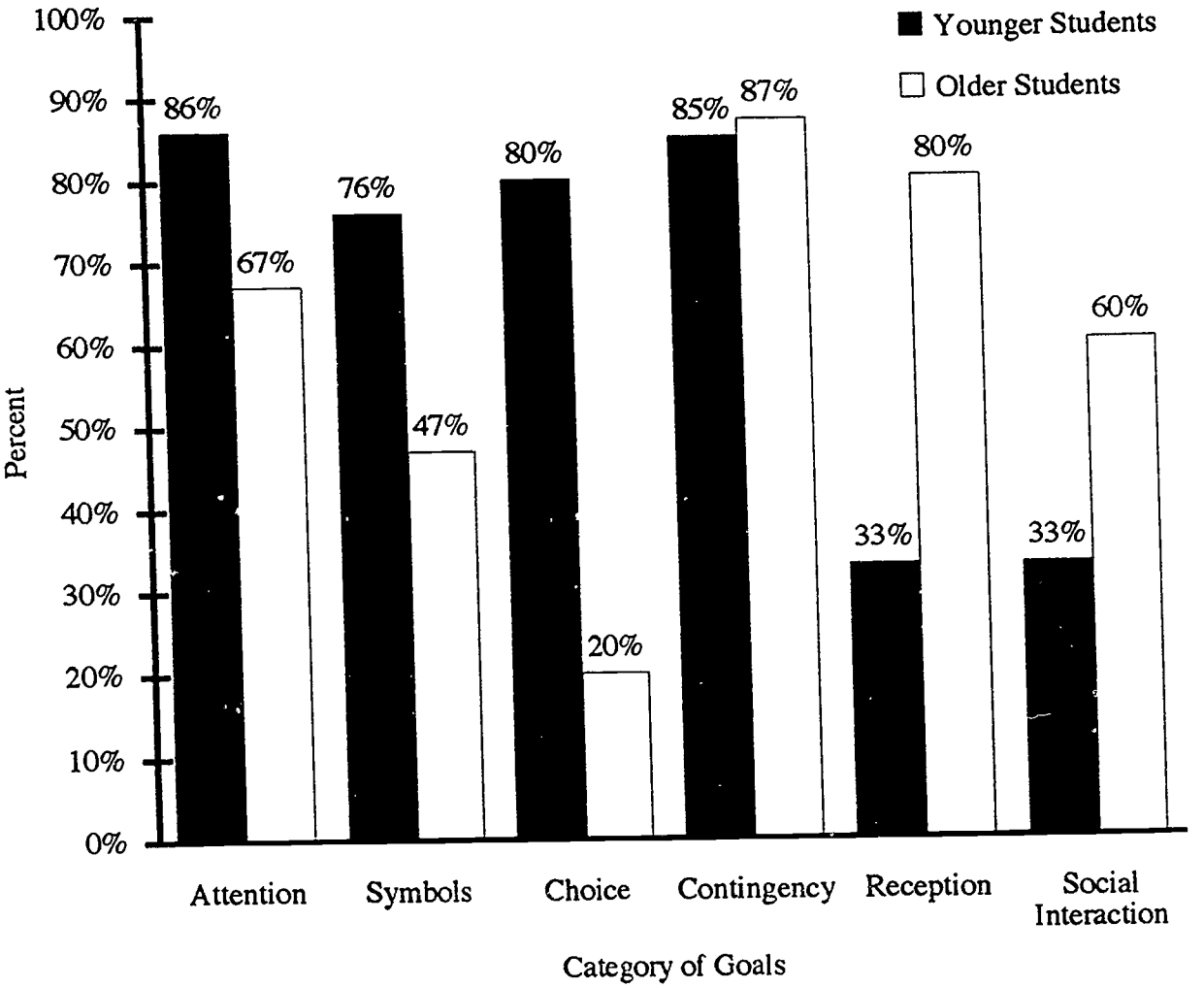


Figure 5. Percentages of Communication Goals successfully achieved per category for students with different chronological ages (younger versus older).



younger students reached their goals in these areas, both of which emphasize social aspects of communication.

C. Teacher Interview Data

Teachers' perceptions about various other aspects of their students' participation in this project were also obtained through interviews. Across the 26 students there was general agreement that applications of technology-supported interventions in communication training: (1) were relevant and appropriate in meeting the individual student's needs in the area of communication (85%); (2) were worth the amount of time the individual in question devoted to activities (96%); (3) did not take away from any gains that student might have made through other activities (100%); (4) did not interfere with the teaching of critical functional skills to that student (92%); and, (5) had clear impact upon the student's communication and social interaction skills (77%). As to whether the student made concomitant gains in other areas, teachers perceived that skills acquired in technology-supported interventions helped to increase the individual's general attention (77%), motivation (81%), and understanding of cause-and-effect relations (83%). However, generalized gains in turn-taking behaviors (52%), choice making (50%), and use of symbols (30%) were not perceived to have been made to the same extents.

Finally, the 14 teachers were asked questions about how they would be affected by their direct involvement in the project's activities. All respondents (100%) reported that they would continue to use technology-supported activities to promote social and communication skills of the participants. Teachers also reported that computers and adaptive devices were increasingly integrated into classroom activities (79%). Indeed, six-month follow-up visits revealed that the programs were still in effect with students who had participated in the project with the exceptions of students who had moved or transferred to different schools.

V. Project Impact

A. Implications of Findings

This project addressed several issues about applications of technology in the communication training of students with deaf-blindness and other severe disabilities. The basic concern was to evaluate the efficacy of using technological approaches to support the communication training of these individuals, whose communication development have been identified consistently as educational priorities (e.g., Siegel-Causey & Downing, 1987). The present results support and extend in several ways those of Schweigert and Rowland (1992), who had demonstrated that switch technology, utilized in the context of an

instructional sequence or curriculum, could enhance the attentional, choice-making, and symbolic communication skills of students with dual sensory impairments.

First, microcomputer technology can be effectively applied to address a wide range of communication needs and goals of students who vary considerably by age, extent of deaf-blindness, and degree of communicative and cognitive ability. In this project, students with very basic levels of communicative competence were at least as likely to achieve their individualized Communication Goals using technological supports, as were students who had more formal, intentional, and symbolic communication modes. Further, the majority of individuals in this study had been formally assessed to have severe or profound mental retardation in addition to dual sensory impairments. Many studies have shown that individuals with such cognitive disabilities can learn to manipulate switches in purposeful activities (e.g., Wacker, Wiggins, Fowler, & Berg, 1988). However, beyond these "low-tech" interventions, there has been little documentation thus far that other technological or augmentative approaches can or should be used to facilitate the acquisition of critical communication skills and behaviors by persons with severe or profound mental retardation (Iacono & Miller, 1989). The positive outcomes of this project, though modest, generally support the view that, indeed, such applications can be used to address educational needs of these students, and that the presence or absence of "cognitive prerequisites" (e.g., symbolic representation, cause-and-effect, object permanence) may be irrelevant in decisions to apply technological or augmentative interventions in communication training (cf. Reichle & Karlan, 1988). The results further suggest that technology-supported interventions for students with dual sensory impairments and severe mental retardation may be particularly effective in promoting attention and contingency awareness, which represent foundations of communicative intent.

Second, applications of microcomputer technology unique to the communication needs of individuals with dual sensory impairments were developed, expanded, and compiled in this project (Sall & Mar, 1992). Some specific examples of these goals include learning to: associate tactile impressions, cues, and symbols with words, persons, or objects; make choices or match objects to symbols through auditory scanning; take turns and initiate interaction in small-group computer activities with the assistance of vibratory or tactile cues; use signs to label exemplars of a concept or category; maintain alertness and orientation to visual and/or auditory events; and, receive tactile signs in anticipation of changes or transitions in educational activities. The range of technology interventions that are applicable to this low-incidence population may be extensive. Although goals to promote attention, contingency awareness, use of symbols, and expression of choice were most frequently targeted by technology-supported activities in this study, as in the study by

Schweigert and Rowland (1992), interventions in this project were also designed to promote receptive language and social aspects of communication (e.g., initiation, response to others, turn-taking, cooperative learning). In particular, those applications of technology which focused on improving spontaneous peer interaction exemplified how students with diverse abilities and functional sensory skills could be included together in group or cooperative learning activities.

Third, this project utilized a specific model of intervention planning, implementation, and monitoring in which team collaboration was essential. Notwithstanding extreme individual differences among students with deaf-blindness, communication training involving the use of technological resources can be approached programmatically to ensure that interventions are appropriate, relevant, and integrated into the educational plan for each student. Like the Early Communication Process instructional sequence described by Schweigert and Rowland (1992), such a model is flexible enough to accommodate individuals with very different communication behaviors and needs by providing a systematic method to critically evaluate what communication goals might be best achieved using technological supports, in addition to other teaching resources.

Just as significant, the training and technical assistance provided to teachers as part of this model were critical to familiarize them with microcomputers and other assistive devices, reduce fear or anxiety about using these resources as teaching instruments, and change misconceptions about potential benefits of technology-supported interventions, each of which is a critical barrier to the use of technology in both education and research involving students with severe disabilities (Parker et al., 1990). The vast majority of teachers in this project agreed that technology-supported intervention activities neither interfered with teaching of functional skills nor supplanted more "traditional" approaches to communication training of their own students. In addition, nearly all teachers continued to use technology interventions as part of communication training well after the project ended. These are important outcomes in light of concerns that microcomputer technology may not be well applied to the education of students with the most severe disabilities (e.g., Hughes & Smith, 1982).

There remain numerous issues about the efficacy of using technology to enhance communication and social skills of students with severe disabilities that neither this study nor educational research in general has addressed. In and of itself, the demonstration that communication training objectives can be achieved through applications of technology is of limited usefulness. What ultimately must be included as part of the demonstration are three other essential criteria: (1) There must be clear evidence that educational applications of technology result in outcomes that favor their use over other non-technological

communication training approaches, or in some combination with other approaches. That is, the direct advantages must be unequivocally shown in order to justify their use; (2) The process of intervention planning in which technological resources are appropriately considered must be specifiable and validated. York, Nietupski, and Hamre-Nietupski (1985) have cautioned that practitioners may be compelled to embrace the use of technology indiscriminately, especially if the applications have been successfully used in other situations. Although in this project, a programmatic approach was described to review students' educational needs prior to intervention, more explicit guidelines, similar to those proposed by York et al. (1985) with respect to the use of microswitches, are also needed to help make decisions as to whether and for what exact purposes microcomputer activities should be integrated into an individual's educational plan; and, (3) Applications of technology in communication training must be guided by objectives to promote functional, real-life skills. A constant concern in this project was to monitor the students' intervention sessions to ensure that content was related to educational goals, and that the focus of the sessions was on social interaction and communication, not the use of technology per se.

Future research efforts might be directed toward expanding the foundation of knowledge about the uses, roles, potential, limitations, and advantages of technology tools and resources in the education of students with dual sensory impairments and severe disabilities. A critical next step will be to evaluate the maintenance and generalization of those gains in communication skills achieved through technology-supported interventions.

B. Dissemination Activities

The major dissemination products and activities are presented in Tables 3 and 4 on the following pages. Table 3 summarizes the products, which include a resource manual on applications of technology for children and adolescents with deaf-blindness, an article recently submitted to the journal Augmentative and Alternative Communication which summarizes the information presented in this final report, assessment protocols utilized to establish communication profiles of students who participated in this project, a videotape in which technology applications with deaf-blind students are demonstrated, and a comprehensive, compiled bibliography on technology for students with deaf-blindness and severe disabilities. The assessment protocol can be seen in the Appendix to this report. The Resource Manual, which contains abstracts of the written resources compiled in the bibiliography, is a separately bound document. Table 4 describes the papers, workshops, and seminars on technology applications for students with deaf-blindness and severe disabilities that have been presented over the course of the project period. Target audiences are also described.

Table 3

Products for Dissemination

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1. Resource Manual--

   Technological Resources for Students with Deaf-Blindness and Severe Disabilities

   Target Audience: Administrators, Teachers, Assistant Teachers, Speech/Language Pathologists, Parents, Educational Technology Specialists, Teacher Trainers

   (Disseminated through SpecialNet Deaf-Blind Bulletin Board, NARIC, NICHCY, California Deaf-Blind Services, TRACES, TAM, National TASH Conference, and the various schools and educational programs in New York City.)

2. Annotated Bibliographies--

   Selected Literature on the Applications of Technology for Students with Severe Disabilities

   Target Audience: Administrators, Teachers, Speech/Language Pathologists, Educational Technology Specialists, Teacher Trainers

   (Disseminated through Department of Special Education at Teachers College, Columbia University, and schools and educational programs in the New York City area.)

3. Videotape--

   Applications of Technology in the Communication and Social Interaction Training of Students with Deaf-Blindness and Severe Disabilities

   Target Audience: Students with disabilities, Administrators, Teachers, Assistant Teachers, Speech/Language Pathologists, Educational Technology Specialists, Parents, Teacher Trainers

(Disseminated at Final Meeting and copies given to parents of children participating in project.)

4. Assessment Instrument--

Profiles of Expressive Communication and Social Interaction

Target Audience: Students with disabilities, Administrators, Teachers, Speech/Language Pathologists, Parents, Teacher Trainers

(Disseminated at National TASH Conferences, Hilton-Perkins National Conference on Deaf-Blindness, and other workshops and conferences.)

5. Assessment Instrument--

Cognition from a Social/Communication Perspective

Target Audience: Students with disabilities, Administrators, Teachers, Speech/Language Pathologists, Parents, Teacher Trainers

(Disseminated at various workshops and conferences in the New York City area.)

6. Article--

Applications of Technology in the Communication Training of Children with Deaf-Blindness: A Programmatic Approach

Target Audience: Administrators, Teachers, Speech/Language Pathologists, Parents, Educational Technology Specialists, Teacher Trainers

(Paper submitted to AAC January, 1993.)

7. Establishment of the Center for Adaptive Technology, Inc.--

Target Audience: Individuals with severe disabilities and their families, educators, and professionals who work with them.

(Non-profit organization incorporated in June, 1990 in New York State.)

Table 4

Papers, Presentations, and Inservice Training Workshops

Papers presented at National Conferences

1. Mar, H.H., & Sall, N. (January, 1993). Applications of Technology in the Communication Training of Children with Deaf-Blindness: A Programmatic Approach. Paper submitted for publication.

   This research paper was submitted to Augmentative and Alternative Communication for consideration for publication. This paper focuses on the students involved in the project and presents a case study describing specific interventions, as well as data regarding interventions for the 26 students.

2. Applications of Technology in the Communication Training of Students with Dual Sensory Impairments and Severe Disabilities. (November 19, 1992). Poster presented at the Association for Persons with Severe Disabilities 19th Annual Conference, San Francisco, CA.

   This poster session served as a final presentation for the technology project. Items presented during the session included the "Profiles of Expressive Communication and Social Interaction," "Augmentative and Alternative Communication Interventions and Individuals with Severe Cognitive Disabilities," and the "Technological Resources for Students with Deaf-Blindness and Severe Disabilities". Approximately 80-90 people attended.

3. Mar, H.H., & Sall, N. (March, 1992). Communication and Social Interaction in Students with Dual-Sensory Impairments. Paper presented at the Hilton-Perkins National Conference on Deaf-Blindness, Washington DC.

   This paper focused on the "Profiles of Communication and Social Interaction," developed as an assessment tool. This tool aims to provide a description of

communicative behaviors of children with deaf-blindness and severe disabilities, and identify potential goals or activities to increase specific behaviors. The target audience included both professionals and parents; approximately 30 persons attended.

4. Applications of Technology in the Communication Training of Students with Severe Disabilities. (November 19, 1991). Poster presented at the Project Director Meeting, Washington, DC.

   This poster session provided information on the uses of technology and adaptive devices in promoting communication and social interaction. The "Profiles of Expressive Communication" were distributed during the session. Approximately 75 persons attended the display.

5. Mar, H.H., & Sall, N. (November, 1991). Leaving School with Something to Say: The Roles of Technology in Communication Training. Paper presented at the Association for Persons with Severe Disabilities 18th Annual Conference, Washington DC.

   This paper addressed the communicative intent of the range of behaviors and skills observed among children with deaf-blindness and severe disabilities. Of specific interest was the role of technology and adaptive devices in the development of social interaction and communication. Audience members, approximately 40, included both professionals and parents.

6. Mar, H.H., & Sall, N. (December, 1990). Profiles of Expressive Communication and Social Interaction. Paper presented at the Association for Persons with Severe Disabilities 17th Annual Conference, Chicago IL.

   This paper presented the initial stages of the assessment tool developed to help professionals understand the range of communicative behaviors used, in natural settings, by students with dual sensory impairments and severe disabilities. The audience of approximately 45 people included both professionals and parents.

Regional Inservice Training Programs and Workshops

1. Technology-Based Interventions to Promote Communication and Social Interaction. (January 12, 1993). New York Mothers and Others, New York, NY.

   This parent meeting included a session on the applications and roles of technology in promoting communication in children with various types of disabilities. Specific examples of technology-based interventions were presented. Approximately 30 people attended this meeting.

2. Cognitive Communicative Development and the Applications of Technology for Children with Deaf-Blindness and Severe Disabilities. (November 5, 1992). St. Luke's/Roosevelt Hospital, New York, NY.

   This was the final meeting of educators, therapists, administrators, parents and project staff. The material presented covered the project from beginning to end. Fifteen individuals participated in this meeting.

3. Technology for Young Children with Disabilities: A Workshop for Headstart Teachers. (September 23, 1992). Center for Adaptive Technology, New York, NY.

   This half-day workshop focused on applications of technology for young children with various disabilities. Eight Headstart teachers were involved.

4. The New IDEA in Assistive Technology Conference. (May 15, 1992). Center for Adaptive Technology and Teachers College, Columbia University, New York, NY.

   The focus of this one-day conference was on the changes in adaptive technology specifically with regard to the Individuals with Disabilities Education Act. In addition, the conference also included "hands-on" opportunities to explore and learn about specific devices and new advancements. There were 52 attendees to this conference.

5. Adapting Technology to Promote Independence. (April 16, 1992). Mental Retardation Institute, Westchester County Medical Center, Valhalla, NY.

   This workshop served to introduce a group of multidisciplinary professionals to the various types of adaptive devices and the roles of technology in promoting independence for persons with severe disabilities. Participants received course credit for attending this workshop; thirteen persons attended.

6. Augmentative Communication and Environmental Control Through Technology: Parent Workshop. (November 26, 1991). Public School 53, Brooklyn, NY.

   This workshop aimed to introduce parents to adaptive technology used to promote communication and independence for students with severe disabilities. This was one school involved in the research study. Ten parents were involved.

7. The Roles of Technology in Communication Training. (November 18, 1991). Consortium for Medical Education in Developmental Disabilities (C-MEDD), New York, NY.

   The C-MEDD conference is an annual conference for physicians, nurses, psychologists, and other medical personnel involved with persons who have developmental disabilities. This presentation focused on the social and communicative aspects of individual behaviors and introduced the participants to adaptive technology as one tool to promote communication. Approximately 50 professionals attended this conference.

8. The Roles of Technology in the Assessment Process. (November 13, 1991). Technical Assistance Center, New York City Board of Education, Bronx, NY.

   This workshop was conducted for educators, psychologists, and caseworkers involved with children in the New York City Public Schools. The "hands-on" session introduced participants to the power of using computers for assessment and individualized interventions. Thirty participants were involved.

9. Assessment and Enhancement of Communication Skills in Students with Disabilities. (June 11, 1991). Center for Adaptive Technology, New York, NY.

   This one-day workshop was aimed at speech-language pathologists from the New York City Board of Education, working with students who have severe disabilities. The focus of the workshop was on augmentative communication. Approximately 20 therapists participated.

10. Using Computers with Students Who Have Disabilities: Adapting Software to Meet Individual Needs. (May 15, 1991). Center for Adaptive Technology, New York, NY.

    This one-day workshop was geared towards computer teachers in the New York City Board of Education. The focus of the workshop was on adaptive technology and software. There were 21 participants.

11. Enhancing Communication of Students with Severe Disabilities: Implementing Technology Intervention Plans. (March 25, 1991). Center for Adaptive Technology, New York, NY.

    This workshop, for special education teachers and speech-language pathologists, was the third in a series of three. The overall focus of the series was on the applications of technology in promoting specific skills. This particular workshop addressed identification and implementation of technology-based activities. There were 17 participants in this workshop.

12. Enhancing Communication of Students with Severe Disabilities: Integrating Technology into the Curriculum. (November 29, 1990). Center for Adaptive Technology, New York, NY.

    This was the second in a series of three workshops for special education teachers and speech-language pathologists. This particular workshop addressed the issues of integrating technology into the classroom and existing curriculum. There were 17 participants in this workshop.

13. Enhancing Communication of Students with Severe Disabilities: Applications of Technology. (November 8, 1990). Center for Adaptive Technology, New York, NY.

This was the first in a series of three workshops for special education teachers and speech-language pathologists. This one-day session focused on adaptive devices, software, and available resources. In addition, the identification of communicative behaviors and the role of technology in promoting certain skills was addressed. There were 13 participants attending this session.

14. Introduction to Adaptive Technology: A Workshop for Parents. (May 8, 1990). Public School 53, Brooklyn, NY.

This workshop introduced parents to adaptive technology. Specific attention focused on communication and independence for students with severe disabilities. This was one school site involved in the research study. Approximately 15 parents were involved.

15. Adaptive Technology for Communication and Social Interaction. (December 14, 1989). Jewish Guild for the Blind: The Guild School, New York, NY.

This was the second of a two-part series of inservice programs for teachers and classroom aides. Nine people were involved.

16. Introduction to Adaptive Technology: A Workshop for Teachers. (December 12, 1989). Jewish Guild for the Blind: The Guild School, New York, NY.

This was the first in a two-part series of inservice programs. This session served to introduce personnel to adaptive technology in general. This was one school involved in the study. Approximately 15 staff were involved.

Copies of this final report are also available for review through the following centers and agencies: the Regional and Federal Resource Centers, the HEATH Resource Center, the National Clearinghouse for Professions in Special Education, the National Information Center for Children and Youth with Disabilities, the Technical Assistance for Parents Programs project, the National Diffusion Network, the ERIC Clearinghouse, the National Clearinghouse for Children with Deaf-Blindness, and the Child and Adolescent Service Systems Program.

C. Center for Adaptive Technology

During the first year, this project formally established a program to assist individuals with disabilities, family members, and educators to identify, learn to use, and review technological resources and equipment (software, peripheral devices, computer systems, technical information) that could support educational goals. Starting as a school-based site to conduct this project's research activities, the Center for Adaptive Technology was developed primarily to address technological needs of children and adolescents with severe disabilities, including deaf-blindness. The Center is now housed in two connected offices at the Jewish Guild for the Blind, 15 West 65th Street, New York, NY.

The Center is "staffed" largely by volunteers, but specific services requested by agencies have been contracted to meet particular needs. Most of the Center's activities have involved staff development and training, and many workshops on communication behaviors and technology interventions for students with deaf-blindness and other severe disabilities have been conducted. The Center was established because of the lack of such a resource within the New York City area. It is now informally associated to the TRAID (Technology Related Assistance to Individuals with Disabilities) project of New York State, and its downstate branch, Manhattan United Cerebral Palsy. Project personnel are officers of the Center, which was designed to continue to provide resources, assistance, information, and services to individuals with severe disabilities beyond the project period. Consultants to the Center include physicians, educators, engineers, related-service providers, and parents. A newsletter describing this program is also included in the Appendix.

More detailed information pertaining to this project, its activities, and the materials can also be obtained by directly contacting personnel of this project, Harvey H. Mar, Ph.D. (Project Director) or Nancy Sall, M.S. (Project Coordinator) at the Developmental Disabilities Center, St. Luke's-Roosevelt Hospital Center, 428 West 59th Street, New York, NY, 10019.

APPENDIX

A. **References**

B. **Profiles of Expressive Communication and Social Interaction**

C. **Center for Adaptive Technology's newsletter, directions in adaptive technology**

D. **Technological Resources for Students with Deaf-Blindness and Severe Disabilities**
(separately bound as Appendix Part D)

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ST. LUKE'S\ROOSEVELT
Hospital Center

428 West 59th Street, New York, New York 10019

Developmental Disabilities Center
212-523-6230

The Roosevelt Hospital
St. Luke's Hospital
Woman's Hospital

Profiles of Expressive Communication and Social Interaction

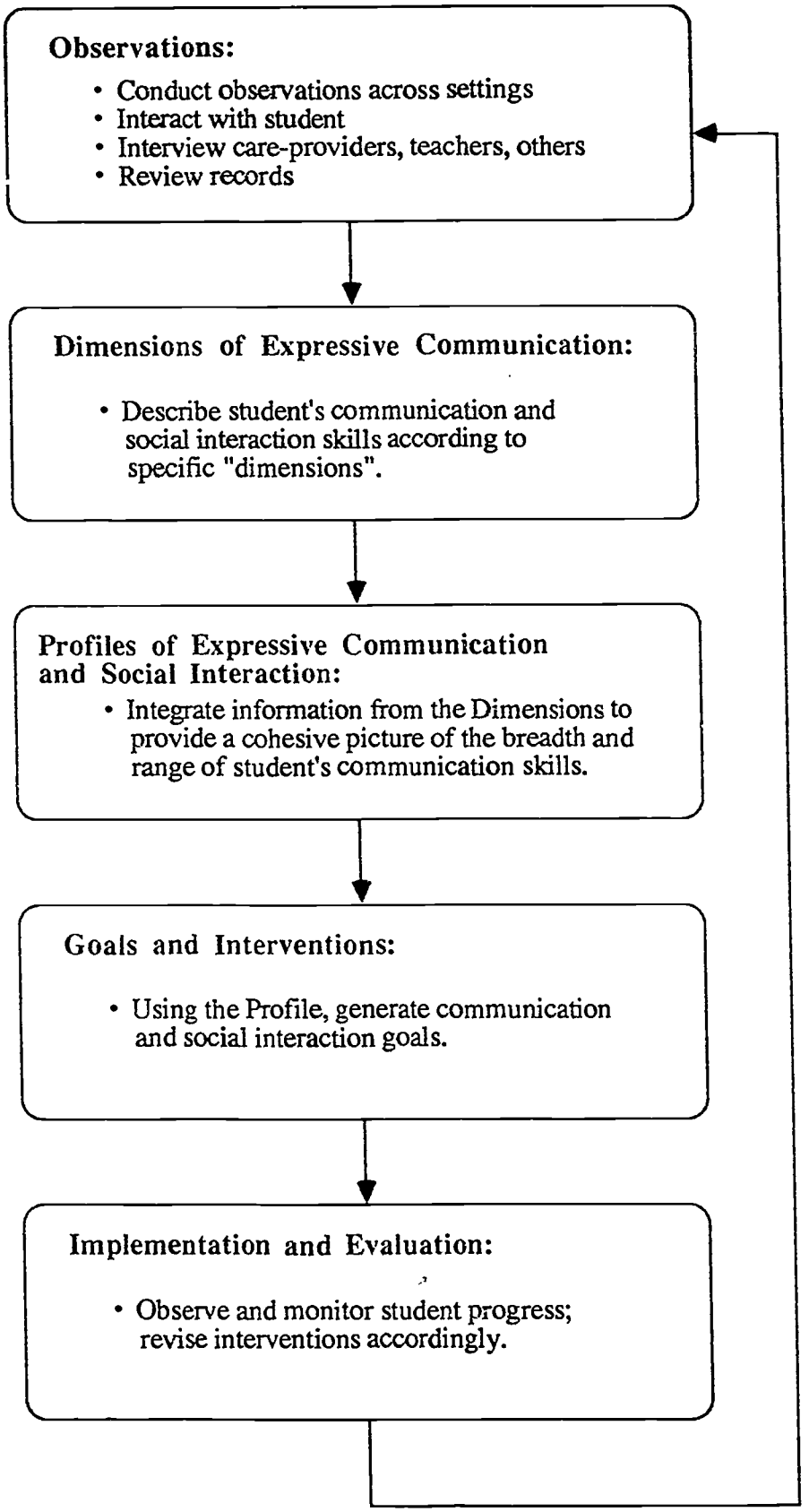
Harvey H. Mar, Ph.D.

Nancy Sall, M.S.

Developmental Disabilities Center

A University Hospital of
Columbia University College of Physicians & Surgeons

ASSESSING COMMUNICATION PROFILES: FLOWCHART



Harvey H. Mar, Ph.D. and Nancy Sall, M.S.
St. Luke's/Roosevelt Hospital Center

ST. LUKE'S\ROOSEVELT

Hospital Center

428 West 59th Street, New York, New York 10019

The Roosevelt Hospital
St. Luke's Hospital
Woman's Hospital

DIMENSIONS OF EXPRESSIVE COMMUNICATION

Harvey H. Mar, Ph.D. and Nancy Sall, M.S.
Developmental Disabilities Center

These seven dimensions of expressive communication represent characteristics or qualities of individuals' social and communicative behaviors. The communication behaviors of any individual, regardless of the form or sophistication of those behaviors, can be viewed in terms of the degree to which these qualities exist or are observed. Often, however, one must know an individual very well to accurately describe his or her competence along each dimension. Dimensions are not "parts" of communication per se, but ways to more specifically analyze the functionality of one's communicative behaviors relative to their social needs, environments, and partners.

Dimensions of Student's Behavior *degree of:* *description:*	Scale
Intention	1 2 3 4 5 6 7
Contextuality	1 2 3 4 5 6 7
Consistency/Generalization	1 2 3 4 5 6 7
Use of Symbols	1 2 3 4 5 6 7
Initiation	1 2 3 4 5 6 7
Social Sequencing	1 2 3 4 5 6 7
Complexity	1 2 3 4 5 6 7

For description of behaviors, refer to attached sheets.

Intention.

Intentionality refers to an individual's ability to deliberately convey a message. It can be expressed as the degree to which an individual signals (or directs his or her behavior toward) another person for the purpose of gaining attention, commenting, or expressing a need, desire, or reaction. Intentionality thus implies social awareness, and involves the performance of acts for the primary purpose of communicating. Communicative intent can be expressed through a variety of verbal and nonverbal modalities (e.g., eye contact, gesturing, tugging, calling out), and its degree can range from reflexive behaviors that must be largely interpreted by others (nonintentional) to behaviors that are deliberately produced to engage the attention of others. In this regard, intentionality reflects the understanding of social cause-and-effect.

Examples of Range of Behaviors:

1. Has startle reflex when initially touched; grimaces when undesired food is presented; smiles when music is turned on.
2. Reaches toward desired object when it is placed in front of her; pushes away unwanted person or object.
3. Reaches for desired object on request; vocalizes and bangs on radio when music stops.
4. Points to one of two pictures on communication board to make choice; vocalizes to get teacher's attention, then points to desired object.
5. Spontaneously makes sign for "cracker" to request more; greets peer who enters room.
6. Calls a friend on the telephone; asks directions to complete a required task.
7. Gives speech or report.

Consistency/Generalization.

This aspect of communication refers to the degree to which an individual uses specific communication behaviors consistently across time, settings, and persons. Consistency implies that the individual has learned to recognize the association between a particular communicative behavior or expression (gesture, vocalization) and its referent (object, person, event, need, desire, situation). Thus, whether the form of communication is a gesture, spoken word, physical movement, or sign, the individual uses the same behavior or expression (e.g., uttering "zah") to signify or represent the same idea (e.g., desire for pizza) in relevant situations and from one day to the next. Generalization is an extension of this ability, and refers to the degree to which the individual can appropriately apply the same communicative form in new or different contexts and situations, and in interaction with different persons. Generalization implies that the individual recognizes that the mechanism for expressing a need, desire, interest, or reaction is basically constant across social and physical environments.

Examples of Range of Behaviors:

1. Increased or decreased general activity when presented with stimuli, yet, the behavior is associated with several sources of stimuli.
2. When shown spoon with food on it, student leans forward, opens mouth, and vocalizes.
3. Approximates sign for "toilet" to tell teachers, parents, and therapists when she needs to use the bathroom.
4. Uses object cues to represent "eat", "drink", "finished", etc.
5. Uses a picture communication board to indicate to peers, as well as to group leader, desire for specific after-school activity.
6. Student points to pictures in communication book to give her lunch order in restaurant and school cafeteria; uses augmentative communication device to answer questions during social studies and science lessons.
7. In a new and unfamiliar setting, student asks for directions and if still in need of help, turns to another person to ask again; when upset with a peer, student uses facial expressions and gestures, which connote anger, to emphasize a statement.

Contextuality.

Contextuality refers to the correspondence between an individual's communicative behavior and the situation (context) in which the behavior occurs. It refers to how specific and appropriate the expressive behavior is to the situation, and how precise the behavior is in conveying the individual's communicative intent. Contextuality reflects how well differentiated one's "vocabulary" or repertoire of communicative responses is, and how able an individual is to apply or select the responses from his or her repertoire which best fit the object, person, event, need, desire, or situation. Thus, contextuality also relates to how easy or difficult it is to interpret the communicative intent of an individual in the situation in which the behavior occurs. Asking for a specific item is better differentiated than making a general request; identifying a person by name is better differentiated than a general vocalization to request attention.

Examples of Range of Behaviors:

1. Cries when uncomfortable; activity level increases when familiar person appears.
2. Vocalizes differently when angry versus tired; retreats from or rejects undesired object.
3. Uses category name (e.g., dog) to represent several exemplars (e.g., horse, dog, bear); signs "yes" in response to different types of questions.
4. Uses multi-syllabic vocalizations to indicate need for particular item; same symbol used most often in regard to that or a very similar item.
5. Points to picture on communication board to indicate desired item; verbally approximates words or signs in regard to specific activity.
6. Yelling "I need help" in a dangerous situation versus saying the same sentence when confused about completing a task.
7. Changing the complexity of a sentence for two different listeners (e.g., for a young child and an older adult), yet conveying the same meaning.

Use of Symbols.

Use of symbols refers to an individual's ability to communicate with representations, and thus implies the ability to associate objects, persons, and events to unique codes. Symbols can be words, signs, gestures, utterances, pictures, and other codes in any modality (speech, print, tactile impression, sound, etc.). Individuals may differ in the degrees to which they use symbolic communication (e.g., signing to request a desired object, naming things) as opposed to more direct behaviors (searching for the desired object, pointing to things). This dimension of communication also refers to the degree of concreteness or abstractness of the symbols used, and the conventionality of the symbols. Concrete symbols (e.g., picture of an apple) are more closely tied to the perceptual attributes of their referents than are abstract symbols (e.g., the printed or spoken word "apple"). Symbols that are conventional (e.g., words, signs, Morse code, braille) are more universal than nonconventional symbols (gestures, specific behaviors, vocalizations) and are, therefore, more readily interpreted.

Examples of Range of Behaviors:

1. Reactive or reflexive smile when pleasant sensation is felt.
2. Moves hand in specific gesture (e.g., to indicate "want") when seeing desired object, but uses same gesture when not wanting item as well.
3. Gestures and extends empty cup towards teacher to indicate wanting more; vocalizes and raises arms to indicate need to move.
4. When presented with two object cues on communication board and asked whether student wants to eat (spoon) or drink (cup), student alternates glance and points to desired item; student sees bus on street and approximates sign by moving hands as if on a steering wheel.
5. Walks into office with mail, spontaneously waves hello and says "ma" for mail; to get peer's attention, student calls out "Da Da" for Denard.
6. Student combines three or four symbols to form a sentence in class; signs "Work finished. Play ball."
7. Uses elaborate symbols precisely.

Initiation.

This dimension reflects the ability of an individual to appropriately initiate communication when the opportunity arises. An individual may initiate a communicative behavior in response to a need, a social situation, or an event. Initiating communication might not only serve specific functions (e.g., to make needs known), but may also contribute to the quality or degree of social interaction by "inviting" others to respond (e.g., by addressing or greeting them). The form of the initiating behavior may vary. For example, conventional greetings, as well as gestures, tantrums, head turning, signs, and smiles may be used to initiate communication. The salient quality of initiation is that these behaviors represent ways to begin sequences of interaction, and that they are directed toward the goal of getting a social reaction or response.

Examples of Range of Behaviors:

1. Momentarily orients to person talking; smiles when person enters the room.
2. Holds up arms to indicate wanting to stand or be picked up; touches teacher's arm to get attention; smiles and vocalizes when familiar person talks.
3. Pulls teacher's hand toward desired out-of-reach object to indicate wanting object; waves hello and goodbye when prompted.
4. Uses single words or signs to label objects and indicate needs; becomes excited when it is her turn in group activity.
5. Waves hello/goodbye appropriately and independently; shows object to another person to instigate an interaction; engages in and initiates short conversations or interactions with others.
6. Approaches peers who are playing a game and asks to play with them.
7. Begins and sustains a conversation; requests clarification or indicates lack of understanding.

Social Sequencing.

Social sequencing refers to the extent to which an individual actively engages in interactive events, and understands the give-and-take nature of social exchange. In its simplest form, a social sequence can be thought of as a response (e.g., smile, vocalization, headturning, eyegaze, gesture) to a social stimulus (e.g., greeting, approach by another). A social sequence represents the structure or flow of an interaction between two (or more) persons, where a participant's communicative response follows some precipitating event and may serve to continue the sequence. Conversation is a primary example of social sequencing; there is implicit understanding of turn-taking, temporal sequence, progression, and of the beginning and end. Other forms of social sequencing include game playing (e.g., knowing when to take a turn) and performing steps of social routines (e.g., shaking hands with others in a room). Sequences can be extended, as in conversation, or relatively brief, as in following a simple command.

Examples of Range of Behaviors:

1. Activity level changes in response to another person beginning or stopping an interaction (e.g., pauses, quiets, vocalizes, smiles, moves body, etc.)
2. Has simple response when a routine is initiated, such as extending arms when being lifted or moving hands when music is turned on.
3. Takes turn when teacher prompts; approaches or signals partner to continue event, such as by calling out his name or touching him.
4. Participates in simple reciprocal activity with peer; knows when it is her turn in a familiar activity.
5. Sits next to peer at work station, and engages in parallel work or play; waits for turn, impatiently, when playing a video game with 2 other students.
6. Knows familiar conventions of social interaction (e.g., not interrupting, waiting for turn); waits for partner to finish talking before communicating further.
7. Joins in a conversation appropriately; involves a third person in an on-going social activity.

Complexity.

Complexity refers to the degree of sophistication in the form of the communicative expression or behavior. This dimension is reflected by such aspects of communication as length of "utterance", syntactic structure, combination of symbols to represent complex ideas, and mixture of symbol systems or modalities (e.g., using sign along with voice). Complex communication behaviors may represent abstract or concrete ideas; the structure of the "output" defines the degree of complexity. Thus, for example, a complete sentence is more complex than a phrase or a single-word utterance. A combination of several signs to convey an idea is more complex than stringing two signs together. Gestures used in combination with pictures may represent a more complex form of communication than using gestures alone.

Examples of Range of Behaviors:

1. Student fusses while sitting at lunch table and then quiets when food is given to him.
2. Teacher approaches student with bowl of food and student reaches into bowl with hand; vocalizes and smiles to indicate desire to continue activity.
3. Reaches for desired object/picture when given a choice of two; some single symbol use such as 1-word or 1-sign language approximation.
4. Uses 1-word utterances to identify favorite book; approximates sign for "lunch" when it is time to eat.
5. Uses either 1-word or simple combinations to label objects, events, persons, and make needs known , such as pointing to desired object and signing "more".
6. Teacher asks student what she needs and she responds, "I need help."; when given communication board, student orders lunch at fast food restaurant.
7. Student calls out to peer, "Hey, Ruben, sing a Spanish song.", peer hums, and student says, "Is that a Spanish song?"; using electronic augmentative communication device with picture symbols, student points to pictures that represent "I am going to a restaurant tonight" in response to question from peer.

Harvey H. Mar, Ph.D., and Nancy Sall, M.S.
St. Luke's/Roosevelt Hospital Center

ST. LUKE'S\ROOSEVELT
Hospital Center

428 West 59th Street, New York, New York 10019

The Roosevelt Hospital
St. Luke's Hospital
Woman's Hospital

PROFILES OF EXPRESSIVE COMMUNICATION AND SOCIAL INTERACTION

Harvey H. Mar, Ph.D. and Nancy Sall, M.S.
Developmental Disabilities Center

I. Individual orients to or responds to the source of stimulation with reactive or reflexive behaviors (e.g., eyeblinks in response to certain visual stimuli; smile in response to pleasant sensation). These behaviors are generally nondifferentiated and nonintentional and, therefore, must be interpreted by the care provider as expressing certain internal states or needs. However, the individual may have a few behaviors in response to specific events or needs which may be differentiated (e.g., a separate and distinct cry for hunger versus cold; greater activity level in response to different persons). Responses and behaviors are specific to the immediate situation or the student's immediate needs, and the care provider must interpret the student's likes, dislikes, and wants.

Behaviors may include: physical or physiological responses such as twitches, goosebumps, pupil dilation, eye blinks, startle reflex, changes in respiratory patterns, reactive facial expressions (e.g., grimace), and gross-motor movements (e.g., flail arms, drop head, kick legs). Certain differentiated responses may include: eye gaze or gaze aversion; smile; frown; grunt/groan; cry; fuss; quieting; pleasure sounds (e.g., coo, gurgle), and head turning toward the source of the event.

[e.g., student may have increased or decreased general activity when presented with stimuli, such as startle and shift in body position when approached and touched by teacher, or increased eye blinks/movements and facial grimace when clothes are changed; before lunchtime, while sitting at table and waiting for food, student fusses, is given food, and then student quiets and gazes in direction of food]

II Individual produces specific and direct behaviors in response to events, interactions, or states. In general, a given behavior may be consistent from one day to the next and across similar situations. These behaviors may have communicative intent, and their meanings can often be interpreted by the care provider in the context of the situations. The individual may not communicate in deliberate turn-taking fashion or wait for a response but, rather,

may gratify his or her needs and interests at an "object level", i.e., by acting directly upon objects or persons that are physically present.

Behaviors may include: reach toward/lean toward; turn away; throw; kick; eye contact; laugh; scream/yell; differential vocalizations; alternate gaze; touching self (e.g., rubbing eye, pulling ear).

[e.g., teacher approaches student with bowl of food and student reaches into bowl with hand; when shown spoon, student opens mouth, leans forward, and vocalizes; individual vocalizes and smiles to indicate desire to continue action or activity; teacher shuts off and takes away radio which student was engaged with, and student vocalizes and folllows teachers movements with eye gaze; when presented with two objects, student alternates glance and then fixates on desired object to indicate preference]

III Individual communicates mostly through behaviors and actions, such as simple gestures, body movements, facial expressions, and vocalizations. The individual is able to communicate intentionally and understands that his or her actions will affect the behavior of another individual. Communicative behaviors are often closely or directly associated with the immediate activity or need. The action or behavior, itself, is often the message and, therefore, it may not be a true symbolic representation. However, there may be fragmented use of a few conventional (but perhaps imprecise) symbols (e.g., single signs, single-word approximations). Communication behaviors may be generalized across similar situations and settings, and are used with consistency. In this regard, meanings of these behaviors may be readily deciphered by familiar persons. The individual may exhibit simple turn-taking skills in interactions.

Behaviors may include: manipulating person; push; pull; grab; reach; vocalizations; repeated body movements (e.g., clap); pointing; extending object; touching; nod head; hold out hands; shrug; wave; kiss/hug; raise hand; point to objects; intonated sound patterns; and self-injurious behaviors.

[e.g., teacher presents student with two objects, asks which one student wants, and student reaches for desired object; student pulls teacher's hand toward desired out-of-reach object to express wanting to obtain object; when listening to tape-recorder and it stops, student vocalizes and bangs hand on tape recorder; teacher approaches student sitting on floor, and student makes eye contact and raises hands up towards teacher; students extends empty cup towards teacher to indicate wanting more]

IV The individual may use a mix of behaviors as well as conventional expressive forms to communicate, often singly or in isolation, as opposed to in combinations (e.g., single gestures, one-word utterances, using single pictures). Occasionally, the individual may use very simple combinations of these behaviors (e.g., pointing to object and vocalizing), although not necessarily in a true grammatical sense. Communication is largely intentional such that needs, wants, and comments can be directly expressed to others, rather than

directly acted upon. Some conventional symbols used for labeling particular needs, objects, events, or persons may be consistently used, and many other gestures, utterances, or signals approach symbolic representations. Through imitation, the student increases his or her expressive repertoire. The individual may initiate interaction and participate in brief turn-taking exchanges with others.

Behaviors may include: activating switch; pantomime; depictive gestures approximating signs; word approximations; multi-syllabic vocalizations; pointing to objects; and pointing to line drawings.

[e.g., student brings toy to teacher to hold so that he can pull the string to manipulate it; when teacher presents two object cues on communication board and asks whether student wants to eat (spoon) or drink (cup), student alternates glance and then points to one of the object cues; student sees bus on street and makes arm and hand movements as if moving a steering wheel to indicate word for "bus" or "car"]

V The individual uses symbols as the primary means of communicating wants, needs, and ideas about objects and events. These symbols (e.g., object cues; picture cues; drawings; codes; words/word approximations; signs/sign approximations) are conventional and, therefore, readily interpreted by others. He or she may use a particular form of language (e.g., sign language, speech, picture board) the majority of time, and acquire new vocabulary primarily through this system. The individual may sometimes combine symbols with other behaviors (e.g., pointing to object and signing "more") or combine symbols together (e.g., saying "mama up", signing "drawing finished") to connect ideas. The communication behaviors are expressed with intent and may be generalized across a variety of settings with familiar and unfamiliar people. Additionally, the student initiates interaction and can imitate sounds or gestures in the social environment.

Behaviors may include: single or, occasionally, simple combinations of words/word approximations or sign/sign approximations; pointing to or touching single or, occasionally, simple combinations of symbols, e.g., photographs, line drawings, icons, words.

[e.g., when presented with activity booklet, student points to line drawing symbolizing cooking activity to indicate next sequence in schedule; student accesses activity box, picks out miniture 3-dimensional object cue of toilet, and brings to teacher to tell teacher that she needs to go to the bathroom; student walks into office with mail, holds out letters, waves hello and says "ma" for "mail"; to get peer's attention, student calls out "Da Da" when peer's name is "Denard"; student waves to get teacher's attention, then signs "cracker" at lunchtime.]

VI The individual communicates by using a formal symbol system or systems (e.g., sign language, picture book) to represent objects, events, people, feelings, and environmental stimuli. Thoughts can be expressed by combining symbols; although such strings may be

short or supplemented by other expressive forms or behaviors, they do follow syntactical rules. The individual can communicate about objects and events beyond the immediate context, and may use some symbols to connote abstract concepts and ideas (e.g., "many", "fast", "before", "tomorrow"). The individual uses language for a variety of reasons, such as to facilitate interaction, comment on past, present, and future situations, ask questions, make declarations, and participate in short conversations.

Behaviors may include: combining spoken words or manual signs; pointing to printed pictures or words in sequence (e.g., bliss symbols, Mayer-Johnson symbols) to create sentences.

[e.g., teacher asks student what she needs and student says, "I need help."; after practicing numbers in class, student sees poster with large numbers on it, points to each number and signs "8,7,2,5,9" while looking at poster; presented with communication board and asked question "Where is your coat?", student points to picture-symbols in succession, representing "Coat closet"; student signs "Work finished. Play ball.", and puts away materials, and gets the ball.]

VII Individual uses a language system with fluency or near fluency to communicate and interact within his or her environment. Language constructions may be elaborate, symbols (e.g., words, signs) are used precisely, and grammatical and syntactical structures may be complex. The individual is able to convey the same message in different ways within the language system. Other natural nonverbal behaviors (e.g., body language, facial expressions) are used to emphasize statements, connote certain meanings, or convey affect. Conversations are on par with other competent language users such that, even when the language systems are different (e.g., spoken language vs. sign language), communication between partners occurs readily via a translator or interpreter.

Behaviors may include: spoken language, sign language, printed forms of expressive language, or other augmentative, symbolic language forms in which nouns, verbs, adjectives, pronouns, etc., can be expressed in sentence form.

[e.g., sitting at lunch table with classmates and teacher, student signs"When is Mr. Rose coming?", teacher answers, "In a few weeks.", and student signs, "Oh I see."; student calls out to peer, "Hey Ruben, sing a Spanish song.", peer hums, and student says, "Is that a Spanish song?"; using electronic device and picture-symbols, student points to pictures that represent, "I am going to a restaurant tonight." in response to a question asked by peer.]

ST. LUKE'S\ROOSEVELT
Hospital Center

428 West 59th Street, New York, New York 10019

The Roosevelt Hospital
St. Luke's Hospital
Woman's Hospital

EXAMPLES OF GOALS AND TECHNOLOGY INTERVENTIONS FOR EACH COMMUNICATION PROFILE

Harvey H. Mar, Ph.D. and Nancy Sall, M.S.
Developmental Disabilities Center

Profile	Goal
I.	A. Help individual develop an orienting response directed to social or sensorimotor stimulation.
	B. Promote different reactions to different events, routines, and/or persons.
	C. Provide stimuli which encourage differentiated and natural responses in social and daily living routines.
	D. Help individual learn to repeat differentiated behaviors when same stimuli is presented.
	E. Help develop an individual's anticipatory behaviors to or within familiar events, routines, and activities.

Technology Interventions

1. Use multisensory stimuli with auditory-tactile-visual feedback to promote interest and to maximize the individual's ability to sustain the response. Bright, noise-making objects that produce tactile sensation may be used during leisure time.

2. Provide immediate feedback to individual's orientation response so as to promote initial associations between those responses and some social event. Continuing with an activity in response to the individual's reaction (e.g., using taperecorder to play song each time person alerts or smiles).

Profile II.

Goal

A. Help individual associate specific reactions or behaviors with specific events or needs.

B. Help individual learn to express choices in daily routines.

Technology Interventions

1. Using switch-activated devices and toys, student engages in functional activities involving cause-effect, environmental control, etc.

2. Using PowerPad with photographs, student selects one of two choices for desired classroom activity.

Profile III.

Goal

A. Promote individual's use of conventional gestures, body movements, and other expressive means.

B. Reinforce the association of individual's direct behaviors with symbolic representations.

C. Help student to increase his/her verbal or gestural imitation skills to acquire new vocabulary.

Technology Interventions

1. Using a TouchWindow and appropriate software programs, student points to objects that are named.

2. Using software program with new vocabulary words, teacher engages student in imitation games, using Unicorn Keyboard with overlays that match pictures on the monitor.

Profile	Goal
IV.	A. Increase individual's single-word vocabulary in primary conventional form (e.g., sign, vocalization, picture board).
	B. Promote individual's combining of conventional expressive behaviors.
	C. Help individual translate non-symbolic behaviors to symbolic forms.
	D. Help student learn turn-taking and other social skills in peer interaction.

Technology Interventions

1. Student uses IntroTalker in learning to correctly associate spoken words to pictures (with voice feedback).
2. Student uses 8-item talking word board for key words, and gradually adds new words to increase vocabulary.
3. Using switch-operated games for two or more players, student plays game with peers and participates in turn-taking and social "rules".

Profile	Goal
V.	A. Promote individual's combining of symbols to produce more complex syntactical utterances.
	B. Expand individual's vocabulary in primary expressive form.
	C. Help student increase length of conversational or turn-taking sequences.

Technology Interventions

1. Using a talking word board for specific daily activity, with picture symbols, student points to combinations of symbols to make complete sentences.
2. Student incorporates new vocabulary words, added to communication board, into existing "phrases" (e.g., I want to listen to the [tape recorder] [music] [radio].)
3. Student participates in computer-assisted learning activities which focus on increasing vocabulary e.g., First Verbs; First Categories).
4. Using PowerPad and picture symbols, student will create simple sentences.

Profile	Goal
VI.	A. Facilitate student's ability to communicate needs or ideas in different ways. B. Help individual be more descriptive in utterances. C. Promote student's ability to initiate interaction.

Technology Interventions

1. Student uses computer with speech synthesizer, as a talking word board, to initiate social interaction (e.g., calling out a peer's name).

2. Using an electronic augmentative communication device, student touches picture symbols representing specific words, including descriptive words, to make complex sentences. If a particular symbol is not available, student has strategies for substituting another symbol to convey the same message.

Profile	Goal
VII.	A. Facilitate expression of complex, abstract, and creative ideas through different media. B. For users of nonspeech forms of communication, promote fluency in using alternative or augmentative communication systems and devices.

Technology Interventions

1. After appropriate augmentative or alternative communication system is identified (e.g., sign language, braille, electronic device with speech synthesizer, picture system), train for mastery through adaptive computer devices and peripherals (e.g., keyboard training, screen enlarging programs for written activities, speech feedback systems for improving sound production or discrimination).

2. Teach student to use multimedia programs which can support the expression of thoughts with sound, graphics, print, etc.

directions in adaptive technology

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10023

(212) 873-1409

Preschool student learns to activate toy by pressing a switch.

Welcome... to the first issue of *directions in adaptive technology*!

We hope that this issue and future newsletters will serve as a forum to describe current affairs in adaptive technology, especially in the New York Metropolitan region, as well as to share information about new technology tools, applications, and resources. In this issue, we also report on some of the recent activities of the Center for Adaptive Technology.

Last year, the Center for Adaptive Technology was founded as a nonprofit organization to serve the needs of people with disabilities. Its general objective is to expand opportunities for individuals of all ages through the use of microcomputers, assistive devices, and communication products. The Center is comprised of many service providers who have joined together to share their collective knowledge about how individuals' specific needs can be supported by the use of technology. Through evaluation, training, consultation, and support, the Center aims to assist individuals to learn functional skills to promote their achievement and independence in school, the workplace, the community, or at home.

In this first year, the Center has been very active in "connecting" with numerous other organizations and individuals in the metropolitan area. We look forward to hearing from each of you! Please contact us to suggest topics for future newsletters that are of interest to you, as well as to obtain additional information about the Center and its activities.

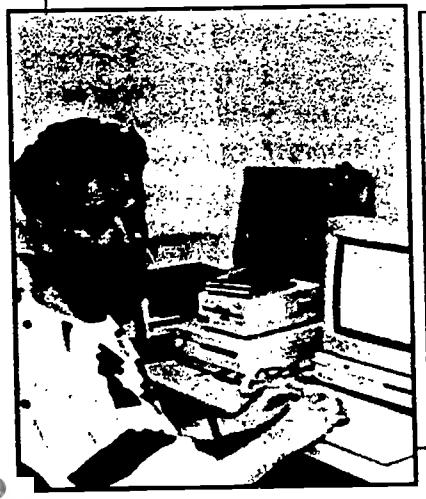
In This Issue...

CenterFolds...

Jeannette E. Fleischner, Ed.D., recently took part in a seminar on applications of technology for people with moderate disabilities. The *Tech Use Guide*, a reference for special educators, was developed during these meetings. This guide is available from the Center for Special Education Technology, Council for Exceptional Children, 1-800-873-8255.

Howard C. Shane, Ph.D., has been involved in the development of a new DecTalk Speech Synthesizer, to be available soon. This product was initiated in a joint venture between the Communication Enhancement Center of Children's Hospital, Boston and Digital Corporation. In addition, Dr. Shane will speak about augmentative communication at the 12th Annual Braintree Hospital Traumatic Head Injury Conference (October 2-4).

Joel E. Mittler, Ed.D., outgoing President of the Technology and Media Division of the Council for Exceptional Children, recently addressed the National Council on Disabilities, a federal agency whose members were appointed by President Bush. This agency invited leading professionals in the field to report on issues concerning the financing of assistive technology.



Fran Schuster, Principal at P.S. 396K, spends a summer internship studying at the Center.

Special Project

Involving Children with Dual Sensory Impairments

Center staff members Harvey Mar, Nancy Sall, and Jolynn-Marie Wagner are conducting a three-year project on communication development of children and adolescents with dual-sensory impairments. Funded by the federal Department of Education, this project is based at the Developmental Disabilities Center, St.Luke's/Roosevelt Hospital Center. The students involved in this project are enrolled in school programs throughout the New York City area. The focus of the project is to identify the range of students' communication behaviors and to enhance their expressive abilities through applications of technology. For example, Anna, who is six years old, has learned to activate a switch to control toys and appliances in her environment. Eric, age 11, uses tactile cues on a Unicorn Keyboard to play a game with adapted software programs.

The ultimate goal of this project is to explore how technology can be adapted and used to support educational objectives for students with deaf-blindness. The third year of this study will begin this Fall. The research conducted during this project will be disseminated at professional conferences and in journals during the coming year. Further information about this project is available by contacting Nancy Sall, Research Coordinator, 212-523-6230.

Current Inservice Topics...

The Center for Adaptive Technology is planning to organize and conduct a one day conference on "New Tools for Preschools" during the winter 1991/92. If your organization is interested in this workshop please contact us for details. In addition, the center provides hands-on training workshops on the following topics:

- The Macintosh LC, Ke:nx, and the Apple IIe Emulation Card
- Apple II computers and adaptive peripheral equipment
- Computer access for persons with physical disabilities
- Adapting computers for persons with visual impairments
- Augmentative Communication Devices
- Software for students with special educational needs
- Technology for environmental control

Featured Technology...

Macintosh LC with Ke:nx and IIe emulation:

Apple, Inc. recently introduced the Macintosh LC computer which, with an RGB color monitor and peripheral equipment, is a very powerful tool. It comes with 2MB of RAM. A 40MB hard disk drive is optional. Combined with the "Apple IIe Emulation Card," the Mac LC is able to run Apple IIe software, including commercial academic, recreational, and public domain programs. The IIe emulation card is easily snapped into the LC's motherboard. Through a port in the back of the computer, a 5.25" disk drive, which is necessary, can be connected. Once the software is installed, the IIe icon appears on the LC's desktop. From this point on, all one must do to run IIe software is double click the icon. The IIe card is designed specifically for the Mac LC and uses only IIe software. A TouchWindow can also be connected to the IIe emulator card. Although some software with sound can be heard through the Mac's speaker, an Echo LC Speech Synthesizer will soon be available from Street Electronics for complete auditory feedback.

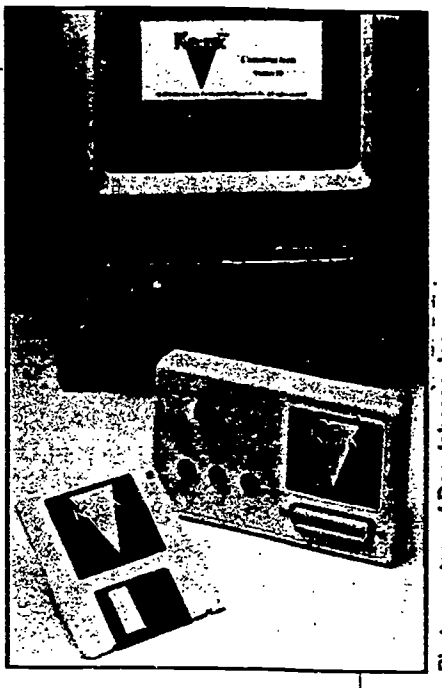


Photo courtesy of Don Johnson, Inc.

Just released from Don Johnston, Ke:nx™ (pronounced "connects") is a new tool which facilitates access to the Macintosh computer for users with special needs. Ke:nx (requiring minimum 1 MB Ram and a hard disk drive) allows alternative keyboards, such as the Unicorn Expanded Keyboard, to be used with the Macintosh. Ke:nx also "adapts" so that persons with physical disabilities can scan and select any key or combinations of keys by pressing a single switch. The Ke:nx software is installed on the hard drive and the hardware box plugs into the regular keyboard. Ke:nx truly increases the potential of the LC for educational, recreational, therapeutic, and vocational purposes. This, paired with the IIe card, transforms the Mac LC into a state-of-the-art tool for individuals with disabilities in school or at work.

Center for Adaptive Technology • Officers and Consultants

Officers

Jeannette E. Fleischner, Ed.D., Teachers College, Columbia University
Harvey H. Mar, Ph.D., St. Luke's/Roosevelt Hospital Center
Joel E. Mittler, Ed.D., C.W. Post College, Long Island University
Nancy Sall, M.S., St. Luke's/Roosevelt Hospital Center
Howard C. Shane, Ph.D., Children's Hospital of Boston

Consultants

Marjory Ackerman, M.A., OTR, Occupational Therapist, Private Practice
Alan Berger, M.S., Educational Training Associate, MRI/Institute for Human Development
Lucy M. Bernard, M.A., Special Educator, Nassau County BOCES
Catherine A. Canary, M.D., Developmental Pediatrician, St. Luke's/Roosevelt Hospital
Eddy Ehrlich, B.E.M.E., OTS, Rehabilitation Engineering Consultant, Private Practice
Patt Fay, M.A., RPT, Physical Therapist, St. Luke's/Roosevelt Hospital Center
Dan Fechtner, M.D., Rehabilitation Medicine Specialist, Columbia-Presbyterian Hospital
Linette E. Fisher, M.S., CCC, Speech-Language Therapist, Private Practice
Iris Fishman, M.S., CCC, Speech-Language Therapist, Jewish Guild for the Blind
Mary Giordano, M.S., CCC, Speech-Language Therapist, NY League for the Hard of Hearing
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Margaret Kaplan, M.A., OTR/L, Assistant Professor of O.T., SUNY-Brooklyn
Michele B. Mills, M.A., OTR/L, Assistant Professor of O.T., SUNY-Brooklyn
Joyce Sibari, M.A., OTR, Clinical Assistant Professor of O.T., SUNY-Brooklyn
Jolynn-Marie Wagner, M.A., Research Psychologist, St. Luke's/Roosevelt Hospital
Stanley Wainapel, M.D., MPH, Rehabilitation Medicine Specialist, St. Lukes/Roosevelt Hospital
Roberta M. Weiner, Ed.D., Technology Specialist, Center for Evaluation & Applied Technology
Rusty Zausmer, M.A., Technology Specialist, New York City Board of Education

Center for Adaptive Technology
15 W. 65th Street
New York, NY 10023

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