DOCUMENT RESUME

ED 328 007 EC 233 219

AUTHOR	Bullis, Michael, Ed.
TITLE	Research on the Communication Development of Young Children with Deaf-Blindness.
INSTITUTION	Oregon State System of Higher Education, Monmouth. Teaching Research Div.
SPONS AGENCY	Office of Special Education and Rehabilitative Services (ED), Washington, DC.
PUB DATE	Jan 89
CONTRACT	300-83-0237
NOTE	175p.
PUB TYPE	Collected Works - General (020) -- Reports - Descriptive (141)
EDRS PRICE	MF01/PC07 Plus Postage.
DESCRIPTORS	Classroom Environment; Communication Aids (for Disabled); *Communication Skills; *Deaf Blind; Early Childhood Education; Early Intervention; Interaction; *Interpersonal Communication; Interpersonal Competence; *Intervention; Multiple Disabilities; *Nonverbal Communication; Play; Sensory Aids; Skill Development; Vision Tests; Young Children
IDENTIFIERS	*Augmentative Communication Systems

ABSTRACT

This booklet collects seven papers drawing on research performed through the Communication Skills Center for Young Children with Deaf Blindness of the Oregon State System of Higher Education and its affiliated sites. Papers include: "Research on Vision Assessment" (Pamela Cress); "Use of Microswitch Technology To Facilitate Social Contingency Awareness as a Basis for Early Communication Skills: A Case Study" (Philip Schweigert); "Communication Opportunities for Children with Dual Sensory Impairments in Classroom Settings" (Charity Rowland); "Comparison of Intervention Strategies for Facilitating Nonsymbolic Communication among Young Children with Multiple Disabilities" (Ellin Siegel-Causey); "Training a Child with Multihandicaps To Use a Tactile Augmentative Communication Device" (Pamela Mathy-Laikko and others); "Play as an Intervention Strategy with Young Children with Deaf-Blindness" (Rebecca Fewell and Patricia Vadasy); and "Evaluation of a Training Program To Enhance Social Interactions between Children with Severe/Profound Multihandicaps and Deaf-Blindness and Their Caregivers" (Pamela Mathy-Laikko and others). References accompany each paper. (PB)

RESEARCH ON THE COMMUNICATION DEVELOPMENT OF YOUNG CHILDREN WITH DEAF-BLINDNESS

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Edited by Michael Bullis

January, 1989

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This manuscript was provided under contract #300-83-0237 from the Office of Special Education and Rehabilitative Services, United States Department of Education. The information presented herein does not necessarily reflect the policy of that office and no official endorsement should be inferred.

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PREFACE

Perhaps no handicapping condition is as debilitating as the dual sensory impairment of deaf-blindness. All too often, young children with this type of condition have difficulty developing even rudimentary communication skills. This situation is further exacerbated by a relative absence of systematic research, assessment tools, and curricula expressly designed for persons with deaf-blindness. Fortunately, in recent years, the professional community has directed more attention to this population, and various research endeavors have been initiated to develop appropriate and useful materials.

One such effort was the Communication Skills Center for Young Children with Deaf-Blindness (CSC). This project was funded through a 5-year contract that was awarded in 1983 to the Teaching Research Division of the Oregon State System of Higher Education by the United States Office of Special Education and Rehabilitation. The overall goals of CSC were to develop, implement, evaluate, and disseminate communication interventions to increase the early communication and language competencies of young children (0 to 5 years) with deaf-blindness. Toward this end a multisite, consortium model was adopted. The CSC was administered through the Teaching Research Division and included as members the Portland, Oregon, Public Schools; University of Wisconsin-Madison, Waisman Center; St. Luke's Hospital, New York; and Utah State University, Exceptional Child Center. At each of these sites specific topics related to communication development in children with deaf-blindness were investigated.

This manuscript is only one of the products generated from the project. It is our hope that the document will be both interesting and helpful to the reader; and that, in some way, it will aid children with deaf-blindness.

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This product was developed under contract #300-83-0237, Office of Special Education and Rehabilitative Services, U.S. Department of Education. The statements and materials contained herein do not necessarily reflect the position or policy of that office.

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I. Research on Vision Assessment

by
Pamela Cress

The staff at the Parsons site of the Communication Skills Center for Young Children with Deaf-Blindness have conducted a series of four studies to investigate the feasibility of using the preferential looking technique for assessing visual acuity in children with dual sensory impairments or in children at risk for such impairments. These children have historically been untestable for visual acuity due either to their age or to the severity of accompanying mental or physical impairments. Thus, the potential benefits of using this technique with the group seemed to warrant further investigation.

Visual acuity tests are intended to measure the clarity of one's vision under standardized testing conditions. Visual acuity tests can be used to detect vision problems as well as to determine the extent of reduced vision and to monitor change in visual status. Targets such as letters or pictures are typically presented, and the person being tested must name the targets or indicate in some other fashion, such as pointing or signing, that he or she can discriminate between several test targets. These tests measure what is termed "recognition acuity" and are widely used in vision-screening programs and by eye specialists. A major limitation of these tests is that they require relatively sophisticated responses that preclude the testing of most children under age 3 and of many older children with mental or physical handicaps.

In recent years a number of researchers have investigated the feasibility of measuring the resolution acuity (i.e., the capacity of the visual system to resolve a visual pattern) of infants through the use of a preferential looking paradigm (Baraldi, Ferrari, Fonda, & Penne, 1981; Birch, 1985; Birch & Stager, 1985; Dobson & Teller, 1978; Dubowitz, Mushin, Morante, & Placzek, 1983; Duckman & Selenow, 1983; Lennerstrand, Axelsson, & Andersson, 1983; Mayer & Fulton, 1985; Mayer, Fulton, & Rodier, 1984; Mayer, Fulton, & Sossen, 1983, 1983; Mohn & Van Hof-Van Duin, 1983; Teller, 1983, 1985). This work has been based on that of Fantz (1963) and others in the study of infant visual preferences; it was found that infants consistently prefer to look at patterned, rather than a plain or homogeneous, viewing target.

Visual acuity testing, using the preferential looking paradigm, generally has involved the presentation of a black and white grating, or striped target, of various dimensions paired with a plain grey target of equal luminance. An observer judges whether the child fixates the grating pattern. Preferential looking techniques were initially employed for acuity testing using lengthy presentations of a minute or more, but were soon adapted to a procedure known as forced preferential looking (Teller, 1979). This procedure utilized much shorter trials of a few seconds, thus facilitating the completion of a threshold test in a single sitting for many infants. The forced preferential looking technique was found to be useful with children from birth to 6 months of age. Beyond that age, however, subjects proved difficult to test due to a failure to maintain their interest in the task for a sufficient number of trials to reach a statistically defined threshold. To allow testing of children after 6 months, Mayer and Dobson (1980, 1982) introduced a variation of the forced preferential looking techniques, which they called operant preferential looking. The major difference between the two procedures is that operant preferential looking pairs a presumably reinforcing consequence (a multisensory display with lights and battery-operated toys) with the desired response of fixating the grating pattern. The arrangement, modeled after that described by Moore, Wilson, and Thompson (1977) for auditory testing, presented the reinforcing display on either the left or right side of the subject depending on the location of the striped target. While this variation allowed for testing of more children, the success rate was limited by the number of trials required, indicating a more difficult testing process.

Due to the limited attention spans of young subjects, several infant vision researchers have attempted to minimize the number of trials per test while retaining statistical accuracy. Dobson (1983) proposed the use of a shortened procedure for screening purposes. Her approach, referred to as the "diagnostic grating" procedure, is based on normative preferential looking data for infants of various ages and involves the repeated presentation of a stripe width known to be seen by most infants of the same age as the subject. Thus, infants whose acuities are normal for their age pass this screening while those who fail may receive more extensive testing and/or referral to an ophthalmologist or other specialist. Another attempt to shorten the procedure was made by Mayer, Fulton, and Hansen (1982) who described a "staircase procedure" in which decreasingly smaller stripes were presented following two correct responses at each target size. Errors resulted in the presentation of a trial of very wide, suprathreshold stripes, followed by the presentation of a stripe width one size larger than that presented in the error trial. This procedure has yielded thresholds in 20 to 25 trials, not including the suprathreshold trials, and seems to have statistical validity.

Recently, a rapid preferential looking test for infants was developed (McDonald et al., 1985; Dobson et al., 1986; Mahon, 1987; McDonald, Ankrum, Preston, Sebris, & Dobson, 1986; McDonald, Sebris, Mohn, Teller, & Dobson, 1986; Moskowitz, Sokol, & Hansen, 1987; Sebris, Dobson, McDonald, & Teller, 1987; Sebris, Teller, Dobson, & McDonald, 1984; Teller, McDonald, Preston, Sebris, & Dobson, 1986) that yields acuities in an average time of less than 5 minutes per threshold test. This procedure, initially called the acuity card procedure and currently referred to as the Teller Acuity Card procedure, was evaluated through clinical trials prior to its commercial distribution (Sebris et al., 1987). (Study 1, below, represents this author's contribution to the clinical trial.) Although the Teller Acuity Card procedure was developed and normed for use with the general population of 0 to 3-year-olds, some research has involved children who experience developmental delays or are at risk for such delays (Hertz, 1987; Mohn & Van Hof-Van Duin, 1986; Teller et al., 1986).

In an effort to add to this body of knowledge, four studies were conducted by this author. The first study provided information regarding the use of the Teller Acuity Cards in a clinical setting and was part of the previously cited multisite field test coordinated by the University of Washington Department of Psychology Infant Vision Laboratory. The third study compared the Teller Acuity Cards to the operant preferential looking procedure, which had previously been considered the most successful preferential looking paradigm with children who experience developmental delays. This study was conducted to determine whether either procedure was superior for use with the target group. Since early identification of visual impairment is one of the potential applications of the Teller Acuity Cards, the second study investigated the feasibility of using the procedure as part of a mass-screening program to identify preschoolers with developmental delays, including visual impairments. The fourth study compared the Teller Acuity Card results with those obtained with the HOTV test (Lippman, 1971), an accepted recognition acuity test, which can be administered using a nonverbal match-to-sample response, when testing school-aged children with moderate to severe mental handicaps and other disabilities. This study was conducted in order to assess the validity of using the Teller Acuity Cards with developmentally disabled children who are older than the 0- to 3-year-olds for whom the test was developed. These studies are described in the following sections.

Study 1

Study 1 was undertaken as part of the clinical trials of the Teller Acuity Card procedure conducted by numerous investigators and coordinated by the University of Washington's Infant Vision Laboratory (Sebris et al, 1987). Among the questions addressed in this study were the reliability and replicability of the procedure and the testability of the target population.

Subjects

Fifty-nine subjects took part in this study. All were untestable for recognition acuity. Their ages ranged from 19 days to 5 years, 8 months. Sixteen subjects were 2 months old or less; 25 subjects ranged from 2 to 12 months old, and 18 subjects were over 1 year old. Nineteen of the subjects were considered to have significant developmental delays and four were at high risk for handicapping conditions including visual impairment. The majority of these children (14) were over age 1. The remaining 35 subjects were apparently normally developing children, all but four of whom were less than 1 year old.

Procedures

Testing was done in exact accordance with the Protocol for Investigators: Clinical Trials for Acuity Cards provided by the University of Washington collaborators (Sebris et al., 1984). Briefly, this procedure involved the presentation of traditional preferential looking stimuli displayed on the front surface of 27.5 x 58.5 cm cards. A sample of the grating targets used can be seen in Figure 1. Cards were displayed through a cut out section in a 170 x 144 cm grey screen of the same color and luminance as the background grey on the cards. One of two test distances (36 cm or 54 cm) was used depending on the subject's age. At least two trials with a suprathreshold (0.20 cy/deg) card were conducted to familiarize the tester with the characteristics of each subject's fixation response, followed by presentation of a descending threshold sequence, counterbalanced for left-right position, until the tester judged that the subjects could no longer detect the grating stimulus. Procedural variations were used as needed to clarify ambiguous responses and included the presentation of suprathreshold or blank cards, representation of a previously detected stimulus, and representation of a card after changing the left-right position of the stimulus.

Results

All but one (98%) of the subjects were successfully tested for binocular acuity. Average length of the sessions was approximately 12 minutes. The

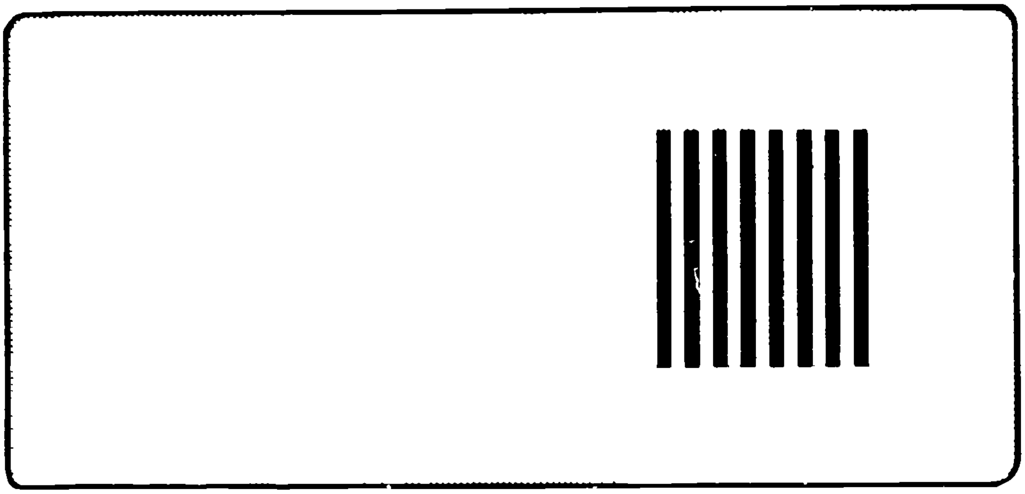

Figure 1. Sample of Teller Acuity Card Stimulus

untestable subject, a 19-day-old, could not be awakened. Fifty-two of the 58 remaining subjects (88% of total subject population) were also successfully tested for at least one monocular acuity, and 49 (83%) yielded all three acuities (both, right and left). This compares to 94 percent binocular and 83 percent monocular for the overall study, which included data from 977 subjects at the eight other sites (Sebris et al., 1987). Of the nine subjects who did not cooperate for all three threshold tests, six refused occlusion, two fell asleep, and one became fussy and inattentive. Six of these nine subjects were in the high risk/developmentally disabled group.

Of the 35 normally developing subjects of whom scores were obtained, 32 yielded acuities within the normal range for their ages. Of the three exceptions, none of the scores was more than one grating size larger than the norms of these subjects. Of the 23 subjects considered high risk or developmentally disabled, all were t sted for at least binocular acuity. Eleven (48%) scored outside the normal range on one or more thresholds. Three of the 11 high risk/developmentally disabled subjects scoring outside the normal range were tested wearing corrective lenses (Subjects #20, 26, and 30) and four had known or suspected vision defects (Subjects #5, 24, 31, and 53). Results from this high risk/developmentally disabled group are summarized in Table 1.

Six subjects were tested on a second occasion, either because monocular testing had not been completed (four normally developing infants, ages 4 to 8 weeks), or because of low confidence ratings by the tester regarding scores outside the norms of two subjects, one of whom was considered "normal" and the other, Subject #27, who was considered to be developmentally delayed. Three of the four subjects who failed to complete the three thresholds during the first session did complete them during the second session. Neither of the two subjects with scores outside the normal range changed their status during retesting.

Discussion

The Teller Acuity Cards were demonstrated to have a high rate of success in testing children whose visual acuity had previously been untestable. The high test rate, ease of administration, and consistency of results suggested that the procedure had utility for screening young children to detect early signs of abnormal visual development.

Study 2

Preschool vision screening is an integral part of many existing programs such as the Medicaid-sponsored Early and Periodic Screening and Diagnostic Testing Program, programs to determine eligibility for preschool special education services, high-risk-infant follow-up programs and mass vision-screening programs sponsored by volunteer organizations. Since visual acuity is considered the single most effective indicator of visual impairment (Blum, Peters, & Bettman, 1959), the effectiveness of these programs has been limited by the inability of the majority of children under age 4 to perform on recognition acuity tests. The field has long recognized the need for a rapid, reliable procedure for assessing visual acuity in young children and others whose disabilities prevent them from being tested. Study 2 was conducted to investigate the usefulness of the Teller Acuity Cards in a mass-screening program within the context of a multidisciplinary screening for developmental delays.

Table 1

Teller Acuity Card Results from High Risk and Developmentally Disabled Subjects

Subject	Age	Acuities: Both	Right	Left	Type of Developmental Disability
5	13 mo	20/400*	20/400	20/800*	esotropic, left eye
7	10 mo	20/100	20/100	20/100	Down syndrome
11	31 mo	20/800*	20/800*	--	Down syndrome
20	51 mo	20/50	20/100*	20/50	severe communication deficit
21	12 mo	20/400*	20/400	20/800*	high risk, health impaired
24	3 mo	20/400	20/800*	20/800*	ptosis, left eye
25	54 mo	20/25	20/25	20/25	severe communication deficit
26	62 mo	20/50	20/100*	20/100*	severe motor and communication deficits
27	36 mo	20/100*	20/400*	20/800*	severe communication deficit
29	6 mo	20/200	20/200	20/200	Down syndrome
30	68 mo	20/100*	20/100*	20/200*	visually impaired, severe motor and communication deficits
31	22 mo	20/200*	20/200	20/200	visually impaired, premature
37	9 mo	20/100	--	--	high risk, seizures
40	24 mo	20/50	--	--	severe motor and communication deficits
45	18 mo	20/50	--	--	hydrocephaly, motor & communication deficits
47	18 mo	20/100	--	--	overall developmentally disabled, health impaired
49	24 mo	20/800*	20/400*	20/800*	overall developmentally disabled, health impaired
51	10 mo	20/100	20/100	20/100	Down syndrome
52	9 mo	20/100	20/200	20/200	high risk, health impaired
53	18 mo	20/200	--	20/400*	visually impaired, premature
54	12 mo	20/100	20/100	20/100	Down syndrome
57	12 mo	20/200	20/200	20/200	Down syndrome
58	2-1/2 mo	20/800	20/800	20/800	high risk, premature

*outside norms for age

Subjects

Subjects were 44 apparently normally developing children at the following ages: 3 months (N=6), 9 months (N=8), 15 months (N=4), 24 months (N=7), 36 months (N=9), 48 months (N=4), and 60 months (N=6).

Procedures

Procedures for administering the Teller Acuity Cards were exactly as described in the first study; however, only a binocular acuity score was obtained for each subject.

Results

Results were obtained in less than 5 minutes for all subjects. Of the 44 subjects, 41 (93%) scored within the normal range for their ages. The three subjects (7%) who yielded scores poorer than expected, all at 36 months of age, scored one grating size outside the normal range for that age. Subsequent professional eye examinations showed refractive errors that warranted treatment with prescriptive lenses in two or the three subjects whose scores were atypical.

Discussion

The study demonstrated the viability of using the Teller Acuity Cards to quickly screen for vision deficits within the context of a general preschool screening for developmental delays. Children in these settings receive a number of tests from different examiners and even those who can meet the response requirements of recognition acuity tests often become uncooperative when traditional vision screening is attempted. The Teller Acuity Cards would appear to be ideally suited to this setting since results were rapidly obtained on all subjects across a wide age range (3 months to 6 years). The 7-percent rate of preschoolers failing the screening in this study is consistent with previous research in this area, from which an estimate of 5 to 8 percent prevalence of vision problems in preschoolers has been obtained (National Society to Prevent Blindness, 1980).

Best practice would suggest that a more thorough screening, including monocular visual acuity testing, would be preferable if sufficient time is available. Vision problems such as amblyopia may not be detected when using only a binocular test. Nonetheless, the constraints of time and subject cooperation may preclude monocular testing in some cases.

Study 3

Since previous research had indicated that the operant preferential looking procedure developed by Mayer and Dobson (1980, 1982) was useful in testing young children with developmental disabilities (Lennerstrand et al., 1983; Mayer et al., 1983), a study was conducted to compare the operant preferential looking procedure to the Teller Acuity Card procedure in a clinical setting.

Subjects

Subjects for this study were seven children attending a handicapped preschool program. Their ages ranged from 26 months to 52 months. None of the subjects could be tested for acuity with other known methods.

Procedures

The standard Teller Acuity Card procedure was used. The operant preferential looking procedure replicated that described by Mayer and Dobson (1982) with the following exceptions. Stimuli were located on a 27 x 458 cm paper tape, the ends of which were wound around two spools located on either side of the central viewing portion of the screen. A computer-driven step motor rotated the spools between trials to change the stimulus display in accordance with the staircase procedure as described by Mayer, Fulton, and Hansen (1982). An Apple IIe computer was programmed to rearrange the stimuli according to previous subject responses using the staircase procedure just mentioned. The program controlled for left-right position according to the Gellerman (1933) sequence for randomizing two choices. The experimenter could interrupt the staircase sequence to present the largest stimulus (.32 cy/cm), usually to re-establish subject responding, then resume the descending threshold sequence at the point of interruption.

The observer viewed the subject's eye movement through a centrally located aperture and operated a toggle switch to indicate left or right fixation. When the observer's response accuratel matched the true location of the grating stimulus, the computer activated a motor-driven drawer slide containing a 35 x 25 cm Plexiglas box, inside of which was an animated toy/musical bear. The box emerged from behind a hinged door on either the right or left side of the subject depending on the location of the grating during the trial just completed. The toy was activated for 5 seconds and then was withdrawn behind the screen with the door closing behind it. The observer then waited until the subject was oriented toward the front before operating the toggle switch, in this case to raise the shield concealing the stimulus array for the upcoming trial.

Data from the entire session were immediately available via a computer print-out and were also stored in the computer for future analyses. The order of the test administrations was counterbalanced across subjects.

Results

Table 2 provides individual results for the seven subjects. As can be seen, there were differences between the two procedures with this group of subjects. Out of the 13 opportunities to compare scores, the two procedures agreed 54 percent of the time and were within $\pm$ one octave of each other on 92 percent of these scores. (Differences in grating targets representing specific spatial frequencies are measured in octaves. A one-octave difference is equivalent to the doubling or halving of the denominator in Snellen notation, that is, 20/20 vs. 20/40 is a one-octave difference, as is 20/40 vs. 20/80, 20/200 vs. 20/400, etc.). On every occasion when the scores differed but were within one octave, the operant preferential looking score was the higher estimate (i.e., showed poorer acuity). On the one occasion when a difference between test scores greater than one octave occurred, the operant preferential looking procedure again contributed the higher estimate.

The two procedures also differed regarding the number of trials needed to determine subjects' visual acuity thresholds. This result was predictable since the operant preferential looking procedure utilized a more rigorous criterion

Table 2

Comparison of Operant Preferential Looking (OPL) and Teller Acuity Cards

Subject	Descriptors	VA Scores (OPL/Teller)	Minutes per Thresholds (OPL/Teller)	# Sessions (OPL/TELLER)
CB	31 months old	OU-100/100	9/4 min.	2/2
	language delay	OD-200/100	10/3 min.	
	retardation	OS-200/100	10/3 min.	
JS	36 months old	OU-inc/100	8/4 min.	inc/2
	William's synd.	OD-no test/100	-/2 min.	(2 OU OPL sessions)
	retardation	OS-no test/100	-/2 min.	
	visual impairment			
JB	37 months old	OU-200/50	6/2 min.	inc/inc
	orthopedic hand.	OD-no tests	-/-	(1 session each)
	retardation	OS-no tests	-/-	
BF	36 months old	OU-50/50	10/2 min.	inc/2
	orthopedic hand.	OD-no test/50	-/1 min.	(2 sessions
	language delay	OS-100/50	10/2 min.	OPL)
	retardation			
RC	26 months old	OU-100/100	8/1 min.	inc/inc
	language delay	OS-no tests	-/-	(1 session each)
		OD-no tests	-/-	
		(with glasses)		
NN	52 months old	OU-100/50	9/2 min.	3/1
	retardation	OD-100/50	8/2 min.	
	visual impairment	OS-50/50	8/1 min.	
	strabismus			
		(with glasses)		
SM	49 months old	OU-100/100	9/3 min.	3/2
	Down syndrome	OD-100/100	8/2 min.	
	retardation	OS-100/100	8/2 min.	
	visual impairment			
	strabismus			

for threshold determination; this also affected the mean times for completing threshold tests (8.6 minutes for operant preferential looking and 2.2 for Teller Acuity Cards) and the number of sessions required to complete (or attempt) three threshold tests. Of the seven subjects, five were tested for all three thresholds using the Teller Acuity Cards while only three subjects cooperated for all three tests using the operant preferential looking procedure, even when additional sessions were run.

Discussion

The results of this study suggest that the Teller Acuity Card procedure has a number of advantages over the operant preferential looking procedure when testing preschool children with moderate to severe developmental disabilities. The automated operant preferential looking procedure used in the study required a much longer period of time due to two factors: (a) Intertrial intervals were greater due to the 5-second activation of the toy and the additional seconds required for the apparatus to rearrange the stimulus array, and (b) the statistical properties of the staircase threshold sequence necessitated conducting two to three times the number of trials used in the Teller Acuity Card procedure. Subjects lost interest in the operant preferential looking procedure and many failed to cooperate long enough for thresholds to be determined.

The loss of subject cooperation during testing with the operant preferential looking procedure may also account for some of the discrepancy between the scores for the two procedures. For example, Subject JB showed a two-octave difference in binocular acuities (operant preferential looking 20/200, Teller Acuity Cards 20/50); trial-by-trial analysis of the operant preferential looking data showed that JB had correctly detected the first four presentations of the 20/50 grating before his performance deteriorated. He was eventually assigned the score of 20/200 using the staircase threshold criterion.

In a related study, Hertz (1987) tested 18 out of 19 children with severe retardation and cerebral palsy (ages 22 months to 7 years) for binocular acuity using the Teller Acuity Cards. She speculated that the higher success rate with this procedure, as compared to operant preferential looking, was influenced by the short administration time, flexibility of stimulus positioning, and increased interaction between the tester and child.

The Teller Acuity Card procedure has other obvious advantages over the operant preferential looking procedure in regard to cost, commercial availability, and portability. These data from Study 3 suggest that reliability need not be compromised by use of a less elaborate procedure such as this one.

Study 4

Since the results of the preceding studies indicated that the Teller Acuity Card procedure was useful in assessing the visual acuity of previously untestable young children, the procedures were subjected to field trials with over 50 children and youth with severe multiple handicaps, including dual sensory impairments. Experience confirmed the utility of the procedure in a variety of settings with children who experience a broad range of handicapping conditions, including those with the most severe handicaps. However, some questions remain about the validity of the procedure with persons beyond their preschool years, since the Teller Acuity Card procedure was developed and normed for use with infants and toddlers. Three studies have reported on the relationship between resolution, or grating, acuity (e.g., the Teller Acuity Card procedure) and recognition acuity as represented by Snellen-type acuity measures (e.g., letters, Illiterate E, Landolt C, picture tests). Mayer et al., (1984) found a correlation of $r = .789$ between the two measures and Moskowitz et al. (1987) reported agreement between Snellen and Teller Acuity Card procedure acuities on 7? percent of their subjects with known visual disorders. Hertz (1987), tested 14 youth with Down syndrome using the Teller Acuity Card procedure and a distance recognition test and found that 90 percent of the binocular scores were within one octave of each other and that 81 percent of the monocular scores met this criterion.

To further evaluate the use of Teller Acuity Card procedures with older handicapped children, a fourth study was conducted in which the Teller Acuity Card procedure was compared to an accepted recognition acuity test, the "matching" version of the HOTV test (Lippman, 1971).

Subjects

Complete data were obtained on 23 subjects who are students at the Special Purpose School in Parsons, KS. These students ranged from 15 to 21 years old and met the prerequisites of previously demonstrated performance on the HOTV test and the availability of recent optometric test results. Most were considered to have moderate to severe retardation; several had accompanying physical or sensory impairments.

An initial group of 55 subjects had been chosen for inclusion in the study because they represented a "normative" distribution of refractive errors among persons with mental handicaps (Woodruff, Cleary, & Bader, 1980). These "norms" differ slightly from the distribution of refractive errors in the general population. (Unfortunately, the subjects for whom parental permission to participate was obtained did not reflect either distribution.) Subjects were categorized as myopes if they had a refractive error equal to or greater than-.50 diopters (D); hyperopes were those who had refractive errors of +1.50D or greater. Nonreferrals were subjects whose refractive errors were at or around zero. Of the 23 subjects who participated, 3 were categorized as myopes (ranging from -1.25 percent D to -2.25D), 8 as hyperopes (ranging from +1.50 to +5D), and 12 as nonreferrals.

Procedures

Procedures used for Teller Acuity Card testing were exactly as described previously. Procedures for the HOTV test are standard for wall-chart distance-acuity testing with two exceptions: the test was designed for use at 10 feet rather than 20 feet, and the subjects could either name or match-to-sample (via a pointing response) the letters used as test targets (H, O, T, and V). The order in which the two tests were administered were counterbalanced across subjects. Binocular and monocular scores were obtained using each test. Both tests were administered within a single session.

Two types of reliability data were collected. Six subjects were retested by a different tester immediately following the first set of tests to investigate test-retest reliability. Interobserver reliability was evaluated with five additional subjects who were tested while a second observer independently scored the subjects' responses.

Results

The scores from the two tests were within 1 octave for 22 of the 23 subjects. For one subject (1 -2.25D myope), the Teller Acuity Cards yielded scores approximately 2-1/2 octaves better than the HOTV (20/10 vs. 20/70).

The Teller Acuity Card and HOTV scores were also analyzed as to their accuracy at detecting the presence of significant refractive errors that would warrant referral to a vision specialist. A score of 20/40 or worse on either binocular or monocular tests was considered for referral. As can be seen in Table 3, the HOTV correctly identified two of the three subjects with myopia while the Teller Acuity Card procedure identified only one of the three. Agreement between the two acuity tests occurred with two of the three subjects, once when the two tests correctly agreed to refer and once when they incorrectly agreed not to refer (false negative). Results from the group of eight subjects with hyperopia showed that the Teller Acuity Card procedure correctly referred six of the eight (75%) while the HOTV correctly identified only two subjects (25%). Within the hyperopic group the two acuity tests agreed with each other on four of the eight subjects (50%); in two cases the tests correctly agreed to refer and in two cases both tests yielded false negative scores.

Of the 12 subjects who were judged by optometric results to have no refractive errors, the Teller Acuity Card procedure correctly did not refer 10 (83%), while the HOTV correctly did not refer seven subjects (58%). Conversely, these data also show the rates of over-referral (false positives) for the Teller Acuity Cards as 17 percent, as compared to 42 percent for the HOTV. Of the total group of 23 subjects, the Teller Acuity Card results agreed with optometric findings for 17 subjects (74%) while the HOTV scores did so for 11 subjects, or 48 percent.

The six subjects who were retested by a second tester yielded a total of 18 threshold scores (3 scores per subject, i.e., binocular, right, and left) upon which to compare the tests. The test-retest scores obtained with the Teller Acuity Card procedure were identical for nine thresholds while eight of the remaining sets of scores were within one octave of each other and one set showed a two-octave difference. Thus, 94 percent of the test-retest scores were within one octave of each other. Test-retest results with the HOTV showed high levels of agreement; 13 of the 18 scores were identical and the remaining 5 were within a half-octave of one another (e.g., 20/20 vs. 20/30). This represents 100 percent agreement within a one-octave range. Interobserver agreement of both of the tests was measured at 100 percent for five other subjects.

Discussion

It is important to note at this point that the results of this study should be viewed with extreme caution due to the regrettably smaller number of myopes who participated. The relative effectiveness of the two acuity tests in detecting myopes and hyperopes would be predicted due to the discrepancy in test distances used by the two procedures. The HOTV test viewed at 10 feet would be predicted to be better at detecting myopes than the Teller Acuity Card procedure at 84 cm (33 inches), while the opposite would be predicted for hyperopes. The results of this study conformed to these predictions.

Table 3

Comparison of Teller Acuity Cards and HOTV Results

Optometric Status	Teller Acuity Card Procedure	HOTV
Nonreferrals N=12	10 correct nonreferrals 2 false positives	7 correct nonreferrals 5 false positives
Hyperopes N=8	6 correct referrals 2 false negatives	2 correct referrals 6 false negatives
Myopes N=3	1 correct referral 2 false negatives	2 correct referrals 1 false negative

The low rate of accuracy of the HOTV test in this study casts some doubt on the validity of its use in screening adolescents with mental handicaps, and should be further investigated. However, standard practice in school screening programs is to retest acuity on a different day prior to making a referral decision, and it may be that the accuracy of the HOTV, using a retest criterion, is greater than was found in this study. While these data do not indicate a relationship between the response mode (verbal labeling vs. match-to-sample pointing) and the accuracy of the HOTV, this variable should also be explored further.

Conclusions

The results of this series of four studies suggest that the Teller Acuity Card procedure has significant implications for the early identification and treatment of visual impairments. The procedure was found to have a high rate of success in testing children who had previously been untestable for visual acuity; success in obtaining binocular acuity estimates ranged from 98 percent to 100 percent across the four studies. Factors that further support the use of this procedure in applied settings include test times ranging from 5 to 15 minutes per child and the commercial availability of portable, high-quality test materials.

The Teller Acuity Card procedure seems feasible as a vision-screening tool for use with previously untestable children representing a broad range of ages and experiencing various degrees of handicapping conditions. However, the limitations of the Teller Acuity Card procedure as a screening tool must be better understood. The results from the fourth study suggest that the Teller Acuity Card procedure was only partially effective in identifying significant refractive errors in adolescents with mental handicaps. Research conducted by Mayer and Fulton (1985) and by Hertz (1987), suggests that the grating stimuli used in the Teller Acuity Card procedure also may not allow for detection of certain forms of amblyopia.

The Teller Acuity Card procedure has the potential to do more than provide early identification of young children with sensory impairments. As with traditional acuity tests, the procedure can be used to estimate the amount of residual vision possessed by a child with an impairment. It can also be used by eye specialists or other service providers as a repeated measure to evaluate the effects of a treatment (e.g., prescription lenses or surgery) or to monitor change in a child's visual acuity status across time. Accurate information about a person's visual acuity enhances the ability of medical and habilitation specialists to provide appropriate treatments and programs. Thus, the Teller Acuity Card procedure represents a major contribution to these fields.

To illustrate, a major investigation sponsored by the National Institutes of Health is currently being conducted at 27 sites around the country to longitudinally study changes in visual status, including visual acuity (as measured by the Teller Acuity Cards), among children with retinopathy or prematurity, a common visual impairment among high risk infants (V. Dobson, personal communication, July 25, 1988). Thus, the Teller Acuity Card procedure not only has immediate applications in educational and public health settings, but also may allow medical researchers to enhance their understanding of childhood visual impairments and discover new and better treatment approaches.

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5.5

II. Use of Microswitch Technology to Facilitate Social Contingency Awareness as a Basis for Early Communication Skills: A Case Study

by
Philip Schweigert

Microswitch and microcomputer technology offer educators important tools for training children with severe multiple handicaps. Specifically, such technology has been used to increase opportunities for children to participate actively in the environment. One common application of the technology is in training contingency awareness, or providing an understanding of the relationship between a behavior and its contingent results is especially useful because it can perceive very subtle or unrefined movements.

Acknowledgement of the importance of opportunities to exert control over the environment has grown out of a changing perception of the young infant. The normally developing infant is not a passive agent in the environment (Brinker & Lewis, 1982; Hulsebus, 1973; Lewis, 1984), but is instead an "...active information processing organism, initiating transactions with the environment and in turn being influenced by these transactions" (Yarrow, Rubenstein, Pederson & Jankowski, 1972, p. 217). Infants are constantly interacting with their surroundings and are capable of perceiving the relationship between their actions and corresponding environmental events. It is the realization of the association between behavior and environmental outcomes (contingency awareness) that is essential for future learning.

Watson (1966) hypothesized that from birth infants have the capacity for contingency awareness. That is, in addition to being able to produce rewards in their environment, they are also capable of detecting and <u>understanding</u> the contingent relationships that exist between their behavior and environmental outcomes. However, Watson suggested that during the first 3 months of life this avenue for learning is hampered by two factors: (a) the short term memory limitations of the infant, and (b) the infant's limited ability to make responses with a sufficiently short recovery time that would enable reinforcement to be elicited repeatedly directly from the environment. As an example, consider the infant who causes a mobile to move by hitting the crib with one arm. Under natural conditions, the contingent relationship between the arm movement and the movement of the mobile is undetectable; by the time the child can repeat that movement, the relationship has been forgotten.

Watson termed these first 3 months of life "a period of natural deprivation" (p. 123). He proposed, however, that even during the period of natural deprivation one might be able to provide contingent conditions artificially that are within the parameters of the infant's memory and motor limitations, enabling the infant to discern the contingent relationship between response and reinforcement. Watson proved this contention in a study (1966) involving his 2-month-old son. Similar demonstrations of contingency awareness under artificial conditions are found in studies by Siqueland (1965), Stern and Jeffrey (1965), and Watson and Ramey (1972).

Other studies (Finklestein and Ramey, 1977) demonstrated not only that the young child could perform contingency learning tasks, but also that these experiences better enabled the child to demonstrate learning in subsequent exposures to response-contingent reinforcement. They proposed that these opportunities might facilitate the infant's understanding of the environment and the development of techniques for interacting effectively with the world. These studies demonstrated that contingency awareness can be artificially induced in the very young normally developing infant who might otherwise be incapable of perceiving contingencies in the natural environment. These studies also raised the possibility that children with severe handicaps, who might not detect naturally occurring contingent relationships, might benefit from similar interventions.

The literature abounds now with evidence that microswitch technology can be successfully applied to facilitate contingency awareness in individuals with severe/multiple impairments. Watson (1972) described an 8-month-old child functioning at approximately the 1.5-month-old level who increased leg kicking with artificially mediated response-contingent reinforcement. Haskett and Hollar (1978) utilized music or lights as reinforcing stimuli for four youths, with profound retardation and physical impairments. Aged 9-17 years, these youths demonstrated their ability to discriminate between response-dependent and response-independent reinforcement. Research by Zuromski, Smith, and Brown (1977), Accrino and Zuromski (1978), Brinker and Lewis (1982), and Hanson and Hanline (1985) with infants and children with moderate to severe handicaps also demonstrated successful attempts to increase a targeted response and facilitate an awareness of control in the presence of contingent sensory stimuli controlled by the child's activation of different microswitch manipulanda.

In support of the position that contingency awareness is essential for to the child's future learning, many of the studies cited above have included references to Seligman's theory of "learned helplessness" (Seligman, 1975). Seligman proposed that a child who experiences a profound lack of control over his or her environment may fail to develop the motivation to attempt to effect environmental changes. This sense of helplessness can impede future learning and ultimately result in depression. While many questions still remain as to the exact process of contingency perception (Suomi, 1981) and its full effect on development (Thurman, 1979), it is evident that a contingently responsive environment can have a significant positive impact on a child's development. Curricula have been developed in response to the research described above, utilizing microswitches to allow the child with severe orthopaedic impairments to gain some control over the environment, thus interrupting the cycle of learned helplessness (Brinker & Lewis, 1982; Contingency Software, Inc. 1985; Zuromski et al., 1977, & Zuromski, 1981). Such applications are designed to ensure that children with severe handicaps can employ even subtle and infrequent movements within their voluntary motor repertoire and temporal limitations to act reliably upon their environment.

For the most part, the efforts described above have targeted increasing the child's awareness of the nonsocial (inanimate) world. Yet social contingency awareness is also crucial to infant development (Dunst, 1981; Goldberg, 1977; Lewis & Coates, 1980; Lewis & Goldberg, 1969). Furthermore, the infant's understanding of his or her role in relationship to the social and nonsocial environment differs (Golinkoff, 1983: Golinkoff, Harding, Carlson, & Sexton, 1984; Sexton, 1983). This is due, in part, to the fact that, under natural conditions, social contingencies are generally less predictable than are nonsocial contingencies (Brinker & Lewis, 1982; Goldberg, 1977; Suomi, 1981;

Watson, 1979). For instance, when the infant cries, the caregiver(s) may not respond in exactly the same amount of time or in precisely the same way each time, if at all. In contrast, in the inanimate world, a bell will always clang when shaken. The awareness of social contingencies is a vital part of the development of communication skills (Yarrow, et al., 1972, Simeonssen & Wiegerink, 1974). Intentional communication requires the awareness of contingent relationships between the expressive behaviors of the communicator and responsive outcomes in the social environment. Clearly, contingency learning tasks that are restricted to nonsocial outcomes are insufficient for the development of social-communicative competence. The study reported in this paper was designed to address the gap between the establishment of contingency awareness and the development of intentional communication.

The subject of the study was a child with dual sensory impairments as well as severe orthopaedic and cognitive impairments. Individuals with this combination of profound impairments are very likely to lack any sort of contingency awareness, whether social or nonsocial. Unaware of any relationships between their own limited responses and environmental outcomes, they may be delayed in demonstrating, or may never demonstrate, the social signals of vocalization, eyegaze, and smiling (Seigel-Causey, Ernst, & Guess, 1987). The caregiver, confronted with signals from the child that may be very difficult to interpret, may produce fewer and fewer responses to the child's behaviors. The prospect of developing effective communicative exchanges under these conditions is bleak.

The purpose of this study was to investigate the use of microswitch technology with the goal of developing an awareness of social contingencies in a child with severe vision, hearing, and orthopaedic impairments. The assumption was that the establishment of social contingency awareness might provide a foundation for the development of intentional communication.

Method

Subject

At the time of the investigation Shannon was 7 years old, with a diagnosis of cortical blindness, a severe to profound hearing loss, and extensive multiple handicaps. These handicapping conditions included hydrocephalus, spastic quadriplegia, an uncontrolled seizure disorder, mental retardation, and a congenital absence of the radius on the right forearm. Her previous medical history included 24 surgeries for shunting revisions. According to the most recent administration of the Wisconsin Behavior Rating Scale-Revised Version (Song, Jones, Lippert, Matzgen, Miller, & Boweca, 1980), Shannon's overall developmental functioning was placed at 3 months.

Previous interventions with the subject had focused primarily on the elicitation of responses to a variety of visual and auditory stimuli. Analysis of videotaped sessions revealed, at best, extremely inconsistent manifestations of awareness of or responsiveness to these visual and auditory stimuli. Shannon was similarly unresponsive to social stimulation, and no purposeful attempts to evoke attention from caregivers had been detected. The severity of her motor and sensory involvement radically reduced her ability to interact with her environment.

Procedures

The primary purpose of this single-subject study was to compare the effectiveness of social and nonsocial stimuli in a contingency learning task. Microswitch technology was necessary to provide perfect contingent relationships and to enhance a subtle motor response so that it served as a clear signal.

A microswitch was placed on the upper left hand corner of Shannon's wheel chair tray. The microswitch manipulandum was a light touch-sensitive pad 6-1/2 inches by 1/2 inch thick. The surface of the pad was tactually differentiated from the tray surface by adding a sheepskin pad to it. Contact to any portion of the switch would cause its closure. This manipulandum was held stationary on Shannon's tray with double-faced tape. Movement of the left arm to contact the switch was the motor response targeted in both social and nonsocial contingency conditions. Choice of this specific behavior was based on opinions of Shannon's teacher, parent, physical therapist, and occupational therapist. (At the time of this study, it was the single most reliable voluntary behavior in Shannon's repertoire.) The frequency of switch activations was recorded automatically by a control unit that counted switch closures. Mechanical items that provided nonsocial reinforcement were plugged directly into the control instrument. All equipment was checked daily, prior to its use, to ensure accurate performance and reliability of measurement.

The selection of nonsocial sensory reinforcers for use with this child was based on staff completion of the Sensory Assessment for the Active Stimulation Program (Zuromski, 1981). This sensory stimulus inventory was designed to examine responsiveness to and preference for different modes of sensory input (i.e., tactile, visual, auditory). This assessment resulted in a ranking of tactile and auditory modalities as the first and second strongest sensory channels, respectively, for the subject. Therefore, nonsocial contingency sessions involved delivery of either auditory or tactile stimulation. Auditory feedback consisted of a tape recording of children's music, caregiver's voice, and excerpts from a movie soundtrack randomly arranged on a single cassette tape. Tactile feedback consisted of cool air directed at the child's left arm and hand, from a distance of 36 inches by a hairdryer adjusted to the cool setting. Half of the nonsocial contingency sessions involved auditory feedback, and half involved tactile feedback. The delivery of the two feedback modes was systematically varied from session to session.

Social contingency sessions involved social feedback delivered by a caregiver who stood directly in front of and at eye level with Shannon. Activation of the microswitch by Shannon activated a vibrator device affixed to the underside of her wheelchair tray. The resulting vibration on the tray provided an auditory signal to the caregiver to deliver social reinforcement and also provided a means for Shannon to sense that a signal had been emitted[1]. Social reinforcement involved stroking Shannon's head and left arm while verbally praising her.

Social and nonsocial contingency conditions were investigated in separate sessions on a daily basis in the classroom. The morning schedule allowed for a 10-minute block of sessions while the afternoon schedule allowed for a 20-minute block of time or two 10-minute sessions. Social and nonsocial sessions were systematically altered between morning and afternoon time slots

In order to study the impact of the nonsocial stimuli on the dependent variable, an ABA design was selected. Baseline data were collected for eight 10-minute sessions. The control unit recorded switch closures caused by Shannon's arm movement under conditions when no contingent reinforcement occurred. Intervention was then begun. Under this phase of the experiment, switch closures would cause 5 to 8 seconds of auditory or tactile reinforcement. This phase continued for 13 sessions. The extinction phase was then carried out following the same procedures as in the initial baseline. Extinction continued for 13 sessions.

The initial design for the social contingency sessions was also an ABA design, although a fourth phase was added reinstating the social contingency after the initial baseline, intervention, and extinction phases were run. In social contingency sessions, the baseline phase lasted for 9 sessions; the intervention, extinction, and reinstated intervention phases lasted for 13 sessions each.

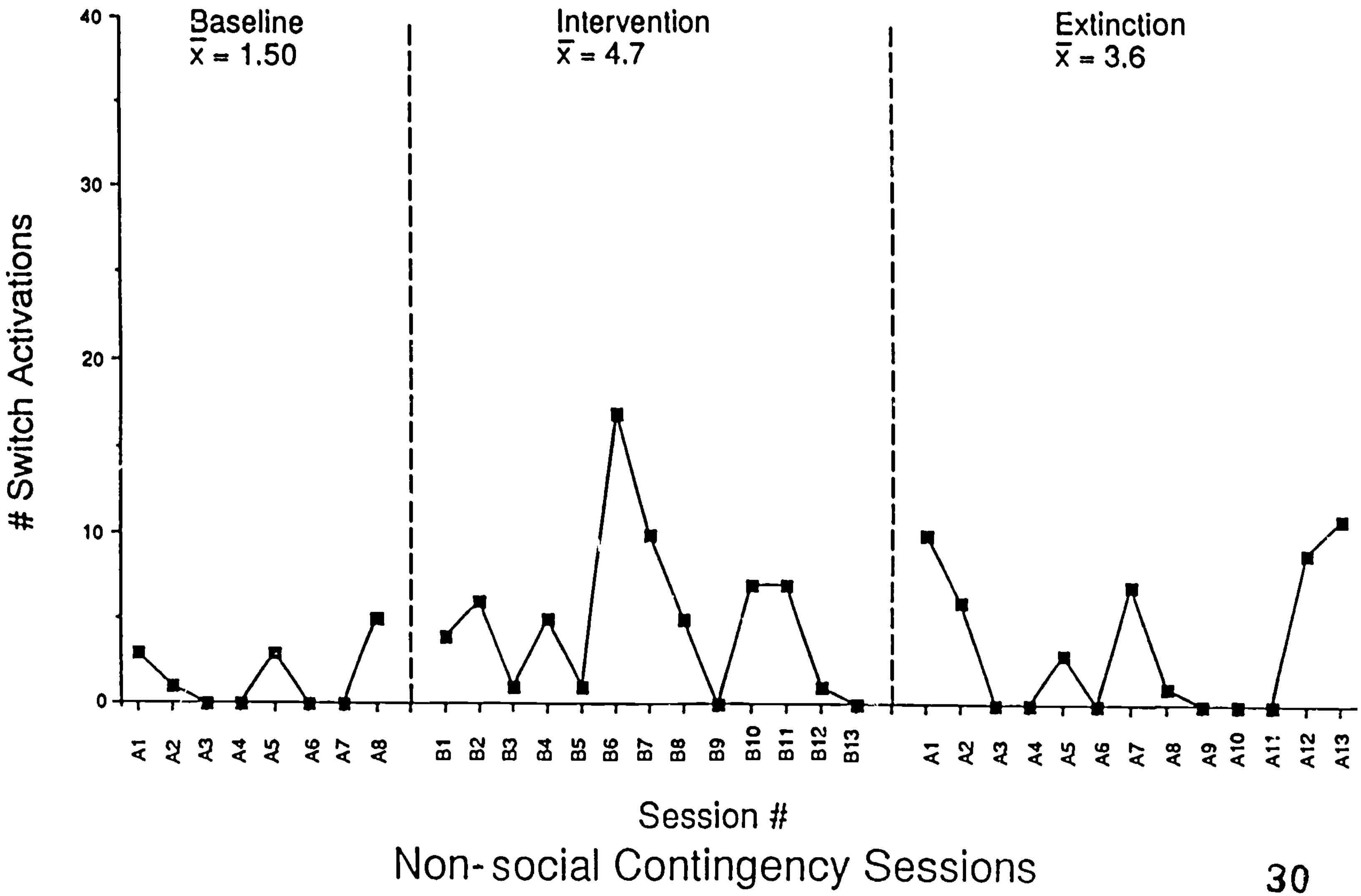
Results

Figure 1 shows the number of switch activations per 10-minute session for each of the three phases of the nonsocial contingency study, as well as the mean number of switch activations per phase. While the targeted behavior increased during the intervention phase, the extinction phase showed essentially no change, suggesting that the sensory stimulation was not effective in increasing purposeful behavior. These data suggest that either the nonsocial stimuli were not reinforcing to Shannon, or possibly that they were not even perceived by her.

Figure 2 shows the number of switch activations per 10-minute session for each of the four phases of the social contingency study, as well as mean number of switch activations per phase. The distinction between the two non-reinforced conditions (baseline and extinction) and the two response-dependent reinforcement conditions (interventions 1 and 2) are very clear, despite the variability of the data points th is typical of research with this population. The mean number of switch activations per session were 1.70 and 0.92, respectively, for baseline and extinction phases. The comparable means for the two intervention phases were 8.30 and 7.20. These data suggest that Shannon understood the difference between the presence and absence of social reinforcement and was able to vary her rate of behavior accordingly. The significance of this intervention for Shannon was underscored by reports from the attending caregivers who recorded that, in 30 percent of all sessions under social conditions, smiling occurred, as compared to only 10 percent under nonsocial reinforcement procedures.

Discussion

Upon completion of the study, both home and school personnel made decisions to use the microswitch manipulanda as a functional means for Shannon to gain attention. After employing the microswitch as a "calling device" for several months in the home and school settings, refinements of the system were made. Most recently the vibrator has been replaced with a small tape recorder that plays a tape loop of a young girl's voice, saying, "This is Shannon. Please come see me." The added features of volume control and a timing device allow the complete message to be heard from greater distances throughout her classroom as well as home. Activation of this portable system continues to require the same movement by the left hand to contact a light touch-sensitive microswitch device.



29 30

Figure 1. Number of switch activations for non-social contingency sessions

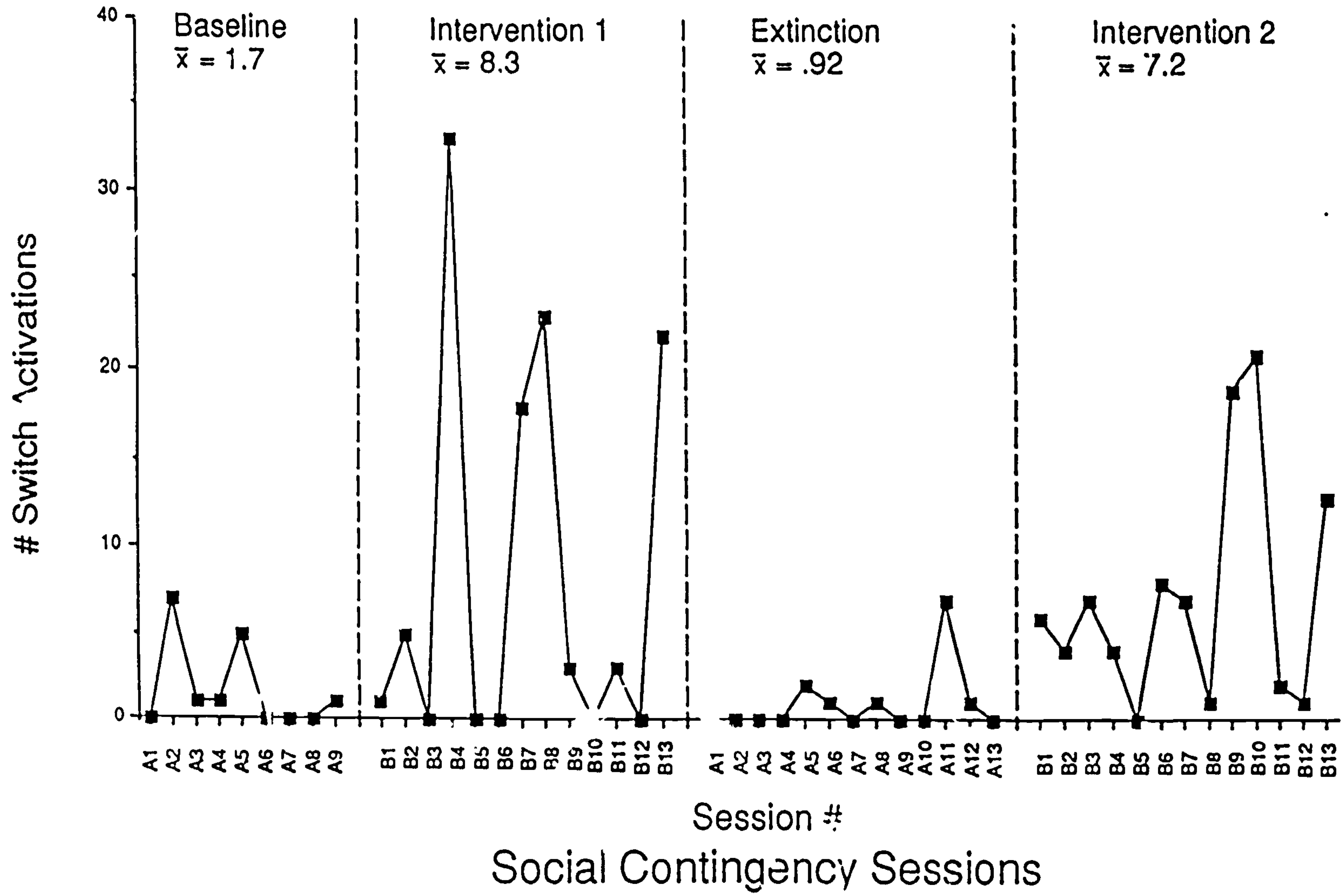


Figure 2. Number of switch activations for social contingency sessions

Shannon now has a reliable, effective, and socially acceptable means for requesting attention.

Conclusions

This investigation demonstrated the effectiveness of social feedback as compared to nonsocial feedback to condition a motor response in a contingency learning task. The subject appeared to acquire the targeted motor response only under conditions that resulted in social feedback. For Shannon, this first demonstration of an emerging awareness that she possesses the ability to make things happen provides an important key to her future development. She has, for the first time in her life, clearly shown an ability to learn. No less important for Shannon is the newly shared perception by her parents and teachers, that she has demonstrated learning and is indeed responsive to her environment. The application of microswitch technology thus enabled Shannon to (a) develop contingency awareness of a social nature and (b) acquire an <u>expressive</u> communication behavior (calling for attention).

Further research is presently underway to investigate more fully the role of microswitch technology as a means of promoting rudimentary intentional communication in the individual who has developed an awareness of social contingencies.

Footnotes

[1] Previous interventions utilizing vibrotactile reinforcement had failed to condition the targeted response; therefore, the vibratory component was not considered a reinforcing stimulus. Additionally, the vibration was triggered by switch activation in all phases of this study, so that any discrepancies in the rate of switch activation between phases could be attributed to manipulation of the social reinforcement.

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III. Communication Opportunities for Children with Dual Sensory Impairments in Classroom Settings

by
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Over the past 20 years, our concept of communication and how to enhance is has changed radical. We now know that many kinds of behaviors may be considered communicative. The current perspective dictates that language is the culmination of a communicative competence that begins early in a child's life. Communication, therefore, includes many presymbolic behaviors such as gross vocalizations and gestures that are used intentionally to affect the behavior of another person. This perspective is the result of a wealth of research revealing communicative intent in the behavior of infants long before they learn to speak (Bates, 1976; Bates, Benigni, Bretherton, Camaioni, & Volterra, 1977; Bateson, 1975; Condon & Sander, 1974; Lewis & Rosenblum, 1977; Schaffer, 1977; & Sugarman-Bell, 1978). This liberal interpretation of what constitute communicative behaviors has optimistic implications for the correction of severe communication impairments. It is now possible to examine and potentially remediate the development of generic communication skills that may be demonstrated through either presymbolic or symbolic means. State-of-the-art intervention programs have reflected this new perspective, and procedures have been developed to train individuals with severe sensory, cognitive, or motor impairments to communicate using gross body movements and vocalizations (Siegel-Causey & Guess, in press); gestures (McLean, Snyder-McLean, Jacobs & Rowland, 1981; Stremel-Campbell, Johnson-Dorn, Clark-Guida, & Udell, 1984 "tangible symbols," such as objects and pictures (Rowland & Schweigert, in press) and various electronic assistive devices (Mathy-Laikko, Ratcliff, Villarruel, & Yoder, 1987).

A second major change in communication training is related to the contexts in which intervention occurs. "Best practice" in communication intervention today generally involves "milieu training" (Hart & Rogers-Warren, 1978). Milieu training requires that communication training be couched within the envelope of the natural, functional activities of the learner's day, in contrast to isolated therapy sessions. However, when skill training occurs across the entire menu of daily activities, rather than in isolated programs, it becomes difficult to evaluate the level of implementation of communication training for individual students. Furthermore, the ongoing interactive style of the teacher greatly affects the quality of communication training. Halle (1984, 1987) has outlined methods for enhancing opportunities to communicate in functional contexts for students with severe disabilities. However, even these manipulations may be lost on the student who does not have the sensory abilities to perceive changes in the environment. Two further difficulties associated with the problems of learners with multiple and/or sensory disabilities compound the problem. First, many of these learners do not spontaneously initiate communication; they place the burden of interaction squarely on the teacher. Secondly, the use of highly artificial, often bulky and laborious, communication systems places further demands on the communication partner (most often the teacher). These greater demands also tend to inhibit spontaneous communication.

This paper summarizes a large body of data collected over the course of 3 years of study of the communicative behavior of children with dual sensory impairments. The subjects were all involved in training programs delivered by project and/or classroom staff. These were designed to remedy communication deficits that were unique to each child. As in any sample of individuals labelled "deaf-blind," the children in this study varied widely in terms of communication skills. Individual intervention programs tailored to the needs of each subject necessarily varied so widely that group data on these programs are not meaningful. Efforts in two specific areas of skill training endeavor have been reported in Rowland and Schweigert (in press) and Schweigert (in press).

Initial efforts to track communication skills in this population were restricted to observations of the subjects' communicative behaviors. It rapidly became apparent, however, that communication by subjects with dual sensory impairments is so heavily dependent upon the teacher's behavior that it was necessary to examine the number of opportunities the teacher offered the student to communicate, in addition to the student's behavior. A brief preliminary study (Study I) was conducted in January 1985 to ascertain the rate of communication and opportunities for communication currently occurring in project classrooms. In Study II, similar data were gathered on a continuous basis during the following 2 school years. The two studies afford an assessment of the children's communicative behaviors, the contexts in which communication is most likely to occur, and various relationships between the probability of cues to communicate and the probability of communicative behavior by the child with dual sensory impairments. Both studies also involved attempts to change teachers' behavior.

Study I

Subjects

Subjects were six children, 3 to 6 years of age, who were on the state deaf-blind registry, indicating that they had both vision and hearing impairments. All were students in self-contained classrooms in a public school setting. As mentioned earlier, they also demonstrated, as a group, a wide range of concomitant motor and cognitive impairments. Some children had a small vocabulary of manual sign language and even used some approximations of spoken words, while other children communicated only through rudimentary gestures such as tugging and fussing. Their sensory abilities ranged from total deafness coupled with total blindness to a combination of moderate vision and hearing impairments. Most of the children were ambulatory, but their orthopaedic skills ranged widely. Some children also had seizure disorders.

Data System

The observational coding system was developed specifically for this study. The data system tracked the following variables:

Cues to Communicate (CC) from teachers, instructional assistants, or peers. These were deliberate attempts to elicit a specific communicative behavior from the subjects. CCs were further categorized as visual (e.g., manual signs, gestures); auditory (e.g., speech, tapping something on a table); or tactile (e.g., touch cues), depending on the sensory system which the cues addressed.

Presymbolic Communication (by the subject). Deliberate attempts by the subject to communicate to teacher or peer through gestures or nonspeech vocalizations.

Symbolic Communication (by the subject). Deliberate attempts by the subject to communicate to teacher or peer through symbolic systems such as manual sign language, speech, or the use of picture of object symbols.

Data were recorded on a modified frequency basis at 30-second intervals that were signalled by an electronic device attached to the observer's clipboard. A small earphone was used by the observer to receive the signal so that classroom staff and subjects were not aware of the signal.

Procedures

The purpose of this study was to acquire a picture of each subject's entire school day in terms of the incidence of cues to communicate (CC) on the part of teachers and the incidence of communicative behavior (CB) on the part of the subjects across all classroom contexts. Therefore, each subject was observed for the entire school day, which amounted to approximately 3 hours for the two preschool subjects and approximately 6 hours for the other four subjects. One day-long observation session was conducted on each subject during each of two consecutive weeks (Observations 1 and 2). Two weeks later, an inservice training session was conducted for the teachers and instructional assistants who had been observed working with the subjects. During the 2 1/2-hour inservice training session, the first 2 weeks' of data were presented and strategies for increasing the number of CCs were discussed and demonstrated. During the week following this training session, a third full day of observations was made on each subject (Observation 3). One of the subjects was absent during the week of Observation 2, reducing the sample size to five for this set of data.

Reliability

Interobserver reliability was computed on 25 percent of the observation intervals for each subject, yielding a total of 17 hours of reliability sessions out of 69 hours of data. During reliability checks, both observers wore earphones connected to the same timing device, so that identical 30-second intervals were coded. Since most behaviors of interest occurred at very low rates, traditional reliability statistics were inappropriate. Accordingly, agreement was calculated on both occurrences and nonoccurrences, using the following formula: # agreements/# agreements + disagreements x 100 = percentage of agreement. Occurrence and nonoccurrence agreements were calculated for each subject and for each behavior category for each of the three observation sessions. Mean occurrence and nonoccurrence agreement scores, averaged across subjects, appear in Table 1.

Results

Results are presented in terms of the observed probability for each behavior category; that is, the probability that during any given 30-second interval, a given behavior was observed to occur at least once.

Probability of CCs. Table 2 reveals the observed probability of CCs for Observations 1 and 2 (averaged) versus Observation 3. The number of 30-second

Table 1

Occurrence and Nonoccurrence Agreement Scores for Each Behavior Category and Each Observation Across Subjects (Study I)

		Cues to Communicate			Communicative Behavior		
		Visual	Auditory	Tactile	Pre-symbolic	Symbolic	X
Observation 1 (n=6)	Occurrence	91%	92%	88%	88%	96%	91%
	Nonoccurrence	99%	99%	100%	99%	100%	99%
Observation 2 (n=5)	Occurrence	82%	85%	74%	86%	96%	85%
	Nonoccurrence	98%	98%	99%	98%	96%	98%
Observation 3 (n=6)	Occurrence	91%	93%	66%	94%	98%	88%
	Nonoccurrence	99%	100%	99%	98%	100%	99%

Table 2

Probability of Cues to Communicate and Number of Observation Intervals (in Parentheses) for Each Subject (Study I)

	Mean Across Observations 1 + 2		Observation 3	
S_1	.13	(640)	.14	(346)
S_2	.22	(644)	.23	(328)
S_3	.10	(1256)	.09	(586)
S_4	.13	(1164)	.10	(558)
S_5	.03	(984)	.11	(582)
S_6	.13	(600)	.10	(584)
$\bar{x}$	.12	(5286)	.13	(2984)

intervals observed appears in parentheses. For Observations 1 and 2, the probability of CCs ranged from .03 to .22, with a mean of .12. For Observation 3 (conducted immediately following the inservice) the range was from .09 to .23, with a mean of .13. The probability of CCs increased by .01 for Subjects 1 and 2, by .08 for Subject 3, and decreased by .01 for Subject 2 and by .03 for Subjects 4 and 6 after the inservice. Thus, no consistent pattern of immediate improvement appeared to be associated with the inservice training.

Modality of CCs. The CCs were categorized according to the sensory modality that they addressed. Visual cues included manual sign language, gestures, and holding up objects for the subject to see. Auditory cues included speech and nonvocal sounds that were designed to elicit communication. Tactual cues were CCs that involved touching the subject, including specific "touch cues" as well as physically assisting the subject to execute a communicative behavior. Table 3 shows the distribution of CCs for each subject across the three sensory modalities. The figures represent the percent of each type of CC out of the total number of CCs for each subject. The percent of visual cues was very consistent across subjects, averaging 44%. Subjects 2, 4 and 6, who received the highest percent of auditory cues (mostly speech) and the lowest percent of tactual cues demonstrated higher levels of cognitive and communicative competence and experienced less severe visual impairments than the other subjects.

Probability of Communicative Behavior. Table 4 reveals the observed probability of CB by subjects for Observations 1 and 2 (averaged) versus Observation 3. The probability of CB (presymbolic or symbolic) ranged from .02 to .33 across the first two observations, averaging .16. The range for the third observation was .09 to .29, also averaging .16. The probability of CB at Observation 3 increased by .06 for Subject 3 and by .07 for Subject 5. In the case of Subject 5, the increase was associated with a .08 increase in CCs, noted previously. In all other cases, the probability of CB decreased at Observation 3. Comparison of Tables 2 and 4 reveals that for Subjects 2, 3 and 4, p(CB) was routinely higher than p(CC). This discrepancy suggests that these subjects were producing some communicative behavior that was not elicited by cues from the teacher; in other words they were initiating communication.

Type of Communicative Behavior. In Table 5, the subject's CBs are categorized as presymbolic (gross vocalizations and primitive or conventional gestures) or symbolic (manual signs, spoken words, and two- or three-dimensional symbols). Subjects 1 and 5 communicated almost exclusively presymbolically. For the higher functioning subjects (2, 4, and 6), communication included roughly equivalent proportions of presymbolic and symbolic behaviors. For all subjects, presymbolic behavior played a significant role in their communication.

Contexts Facilitating Communication. The final analysis of the Study I data involved an examination of the activity contexts observed in the classrooms and the conditional probability of CCs for each context. As the observations were made, observers noted the activities in which the subjects were engaged. These activities were grouped on a post-hoc basis into eight major contexts: food-related activities (breakfast, lunch, snack); "language" programs (although teachers were encouraged to embed communication training into all functional routines, a few "language" programs remained, some of which were conducted by speech therapists); group activities at table (groups of two or more children interacting around a set of materials at a table); gross motor; toileting (none of the subjects were toilet trained and many had mobility problems that made the

Table 3

Distribution of Cues to Communicate Across Sensory Modalities for Each Subject (Study I)

	Visual Cues	Auditory Cues	Tactual Cues
S_1	41%	33%	25%
S_2	42%	48%	10%
S_3	47%	33%	20%
S_4	45%	44%	11%
S_5	48%	27%	25%
S_6	42%	43%	14%
$\bar{x}$	44%	38%	18%

Table 4

Probability of Communicative Behavior (Presymbolic and/or Symbolic) for Each Subject (Study I)

	Mean Across Observations 1 + 2	Observation 3
S_1	.10	.10
S_2	.33	.29
S_3	.13	.19
S_4	.17	.16
S_5	.02	.09
S_6	.18	.10
$\bar{x}$	.16	.16

Table 5

Distribution of Communicative Behaviors Across Presymbolic and Symbolic Categories for Each Subject (Study I)

	Presymbolic	Symbolic
S_1	94%	6%
S_2	54%	46%
S_3	64%	36%
S_4	41%	59%
S_5	100%	0%
S_6	48%	52%

trip to and from the toilet somewhat lengthy); departure (activities at the end of the day related to going home); transitions between activities (moving from one activity to another or waiting for the next activity); and solitary free play. The first column of Table 6 shows the percent of total intervals (across all three observations and all six subjects) that was spent in each of these eight major activities. The second column indicates the conditional probability of CCs in each activity across all subjects. This figure was derived by dividing the number of intervals during which a CC was observed in each activity context by the total number of observation intervals for that context. These data reveal great discrepancies between activities in terms of the conditional probability of CCs. The data also show that for this sample of subjects toileting and transitioning occupied a large percentage of the school day.

Table 7 is a derivation of the data presented in Table 6. The percent of time spent in each major activity and the conditional probability of CCs were divided into low, medium and high categories. The resulting matrix suggests activities that are likely to be the better contexts for communication training, based upon the percent of time devoted to the activity and the probability of CCs. Both group table and toileting activities, for instance, occupy a high percentage of classroom time and are already associated with a medium probability of CCs. Perhaps these are contexts in which the probability of CCs could be relatively easily increased to a high level. Gross motor and transition activities also occupy a significant part of the school day, but are associated with very low rates of CC. These are clearly contexts where an increase in CC should be targeted.

STUDY II

Subjects

Subjects during the first year of Study II were 14 children, 3 to 16 years of age who were on the state deaf-blind registry. This study spanned 2 school years and included four of the subjects from Study I. During the second year of Study II, only 12 subjects were involved, including one new subject. Changes in the subject sample were the result of subjects moving in and out of the public school classrooms with which the project was involved. As in Study I, all of the subjects were ambulatory. Some communicated at best through primitive gestures such as guiding by hand or pushing away; others used conventional gestures such as pointing; some used pictures or objects as symbols and two subjects used some manual sign language to communicate.

Data System

The observational data system used in Study I was refined somewhat for this study. All communicative behaviors by the subject (whether presymbolic or symbolic) were categorized as responses (elicited by a CC), physically assisted behaviors, or initiations. Furthermore, symbolic communicative behaviors were categorized as manual signs, speech, or tangible symbols (two-or three-dimensional symbols). Otherwise, the codes and coding procedures were identical to those used in Study I.

Table 6

Distribution of Observation Intervals and Conditional Probability of Cues to Communicate for Each Major Classroom Activity Across All Observations and All Subjects (Study I)

	% of Total Intervals	Conditional Probability of Cues to Communicate
Food-Related	15	.24
"Language" Program	3	.24
Group Activity at Table	24	.11
Gross Motor	15	.07
Toileting	22	.10
Departure	4	.25
Transition Between Activities	13	.03
Solitary Free Play	4	.00

Table 7

Analysis of Major Activity Contexts According to Time Spent in Activity and Probability of Cues to Communicate (Study I)

Percent of Time Spent in Activity	Conditional Probability of Cues to Communicate: Low	Medium	High
Low	Solitary Free Play	- -	Language Program Departure
Medium	Gross Motor Transition	- -	Food-Related
High	- -	Group Table Activity Toileting	- -

Procedures

The purpose of Study II was to track the generalization of communication skills trained either by project or classroom staff. Therefore, data were taken only in regular activities, conducted by regular classroom staff (not by outside therapists) and observations were not made of any programs designed exclusively to train communication skills. Subjects were observed for 60-minute sessions three times a month. Data sessions were systematically varied for each subject between morning and afternoon periods (except for preschool subjects who were only present for morning sessions). Observations were suspended during toileting, when the subject slept, when non-classroom staff worked with the subject, and during "language" programs. Generally, it took two hours to complete 60 minutes of allowable observation intervals. The number of sessions per subject varied (from 4 to 45), due to school absences by subjects or due to the subject moving in or out of a project classroom during the school year. For subjects who were present for the entire 2 years, the mean number of sessions was 43. Observers conducte a total of 509 sessions.

An intervention component was introduced halfway through the second year of Study II aimed at providing a more sustained effort to affect the rate of CCs from teachers. Thus, from January through April of Year 2, teachers were provided with regular feedback from the observation sessions. Graphs of the data were provided to teachers as they were generated (within a week after the observation was made) and the data were discussed with teachers in our monthly meetings with them. Thus, for each subject, eight observations were made before the feedback condition was instituted, and eight observations were made that were followed up by regular feedback to the teachers.

Reliability

Reliability statistics were computed on 22 percent of the sessions for each subject (for a total of 113 out of the 509 sessions). Since all coded behaviors occurred at very low rates, traditional reliability calculations were inappropriate. Accordingly, two reliability figures were computed on each behavior category for each student. These were Occurrence Reliability (Hopkins & Hermann, 1977; McReynolds & Kearns, 1983), which is computed only on occurrence data and is compared to Chance Occurrence Agreement; and the Kappa Coefficient (Cohen, 1960; 1969), which is computed on occurrences and nonoccurrences, adjusting for both chance occurrence and chance nonoccurrence probabilities. On any given reliability session, reliability statistics were calculated only for behavior categories for which both observers recorded occurrences in at least 5 percent of the intervals, since figures on behaviors that occur at lower rates are not meaningful. Reliability statistics for each behavior category appear in Table 8. The mean Occurrence Reliability across behaviors and subjects was .69 (the mean Chance Occurrence Agreement was .01); while the mean Kappa Coefficient was .76. Gelfand and Hartman (1975) suggest that an acceptable Kappa is .60.

Results

Probability of CC and CB. The first and simplest piece of information derived from the data was the overall probability of CCs in these more restrictive, but more frequent samples of classroom activities. Table 9 presents the probability of CCs, CB initiations and responses and physically assisted CBs

Table 8

Kappa and Occurrence Reliability for Each Behavior Category Across All Subjects and All Sessions (Study II)

	Kappa	Occurrence Reliability
Visual CC	.87	.81
Auditory CC	.83	.76
Tactual CC	.75	.64
Presymbolic Response	.78	.68
Presymbolic Physical Assist	.87	.79
Presymbolic Interaction	.74	.62
Manual Sign Response	.81	.72
Manual Sign Physical Assist	.71	.65
Manual Sign Initiation	.68	.56
Speech Response	.77	.66
Speech Physical Assist	NA	NA
Speech Initiation	.60	.48
Tangible Symbol Response	.89	.82
Tangible Symbol Assist	NA	NA
Tangible Symbol Initiation	.75	.61
X	.76	.69

NA = Occurrence not frequent enough to enable calculation of reliability statistics

Table 9

Probability of CC and CB for Each Subject for Each School Year (Study II)

	Cues to Communicate		CB Responses and Initiations		Physically Assist CBs	
	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2
S_1	.14	.15	.17	.21	.05	.03
S_2	.10	.22	.09	.17	.02	.04
S_3*	.12	.07	.04	.06	.05	.05
S_4*	.04	.13	.08	.17	.01	.01
S_5*	.03	.11	.04	.10	.01	.06
S_6*	.04	.10	.02	.10	.04	.02
S_7	.09	.06	.06	.08	.09	.11
S_8	.05	.07	.06	.07	.02	.03
S_9	.06	.06	.06	.07	.03	.02
S_{10}	.07	.06	.06	.07	.02	.02
S_{11}	.10	.11	.14	.12	.05	.03
S_{12}	.24		.33		.03	
S_{13}	.05		.09		.02	
S_{14}	.18		.25		.01	
S_{15}		.06		.05		.02
X	.09	.11	.11	.11	.03	.04

*Subject had different teachers in Years 1 and 2.

for each student and for each of the 2 school years. Four subjects had different teachers in Years 1 and 2, which may have profoundly affected their data: these subjects are noted by an asterisk in Table 9. Across all subjects and both school years, the mean probability of CCs was .10. In other words, the probability of observing a CC in any given interval of the school day that was not devoted specifically to communication training was .10. This figure would translate into one CC every 6 minutes, if CCs were evenly distributed across the time sample, although, as Study I had shown, this is clearly not the case. In reality, subjects experienced periods with high numbers of CCs and periods with no CCs at all. The probability of CCs varied widely from teacher to teacher and from subject to subject, ranging from .00 to .46 for any given hour-long session. (Factors contributing to this variation are discussed in later sections.) The lower overall rate of CCs found in this study as opposed to Study II reflects at least two factors. First, two of the highest functioning subjects of Study I (Subjects 12 and 14), who received a large number of CCs and in turn contributed a large number of CBs, were only involved in the first year of Study II. Second, the samples taken in Study II, which were designed as generalization probes, excluded some of the activities observed in Study I in which communication skills were most likely to be demonstrated. Furthermore, in Study I, a physical assist was coded as a tactual CC, thus increasing the probability of CCs, whereas in Study II physically assisted CBs were coded separately and did not contribute to the CC tally.

Modality of CCs. Cues to communicate were coded as addressing the subject's visual, auditory, or tactual senses. Since the degree of sensory impairments experienced by individuals labelled deaf-blind varies widely, it is essential that teachers use CCs of the appropriate modality. This may be difficult when children with widely varying sensory abilities are found in the same classroom. The most extreme differences between subjects were in the area of vision impairments; some subjects in Study II were totally blind while the others had varying degrees of functional vision. Figure 1 shows the percentages of visual, auditory, and tactual CCs out of all CCs directed toward totally blind versus partially sighted subjects during the first year of Study II. Totally blind subjects received an appropriately minimal percentage of visual cues--3 percent as opposed to 38 percent for the partially sighted group--but received many more tactual cues--50 percent as opposed to 17 percent for the partially sighted group. The two groups received an equivalent percentage of auditory cues. It appears that the teachers were adapting their techniques to accommodate the sensory abilities of individual students by providing appropriately more tactual cues to those who were totally blind. Although all of the subjects had hearing impairments, the high proportion of auditory cues for both groups is not surprising. (We generally advise teachers to use their normal speech patterns in addition to other cue modalities. Using normal speech patterns gives their interactions a natural cadence and gives the students the benefits of the paralinguistic and extralinguistic features associated with speech that might help them to interpret their teacher's message.

Relationship Between CB and CC. A bivariate regression analysis was conducted to assess the relationship between CCs (independent variable) and CB responses and initiations (dependent variable) for the second school year. As expected, a strong relationship ($R2 = 0.65$) between the variables was demonstrated, yielding $F = 432$ ($p = 0.0000$). Further analyses were conducted to tease out relationships between the probability of CCs and the communicative abilities of the subjects. The first variable to be examined was the rate of

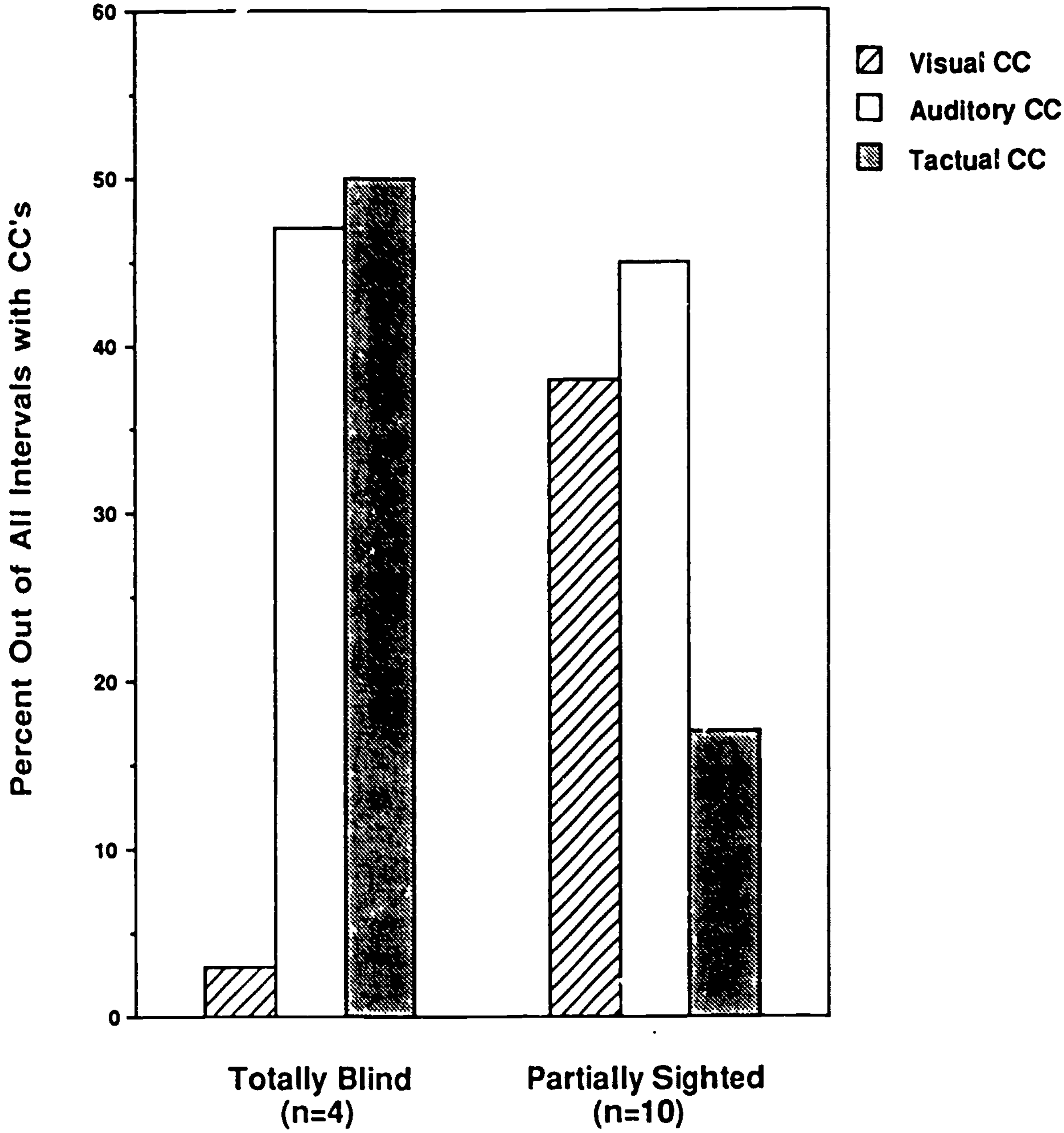

Figure 1

Percentage of Visual, Auditory, and Tactual Cues to Communicate for Subjects who are Totally Blind and Partially Sighted

CBs that were initiated by subjects (in contrast to those that were responses to CCs). Logically, one would expect that the subjects who initiated communication less often would receive more CCs from their teachers. An overall probability of CB initiations for each subject was derived from the data and subjects were categorized as high-, medium- or low-rate initiators. A comparison of the mean probability of CCs for these three groups of subjects revealed that the probability of CCs varied directly with the probability of CB initiations. In other words, subjects who were less likely to initiate communication were also less likely to receive cues to communicate, as shown in Table 10.

In a second analysis, the relationship between CCs and the subject's mode of communication was examined. Subjects were grouped into two categories: those who used primarily presymbolic communication, and those who used a symbol system (either manual signs or tangible symbols) generally in combination with presymbolic behaviors. Table 11 shows the probability of CCs for these two groups of subjects. Surprisingly, the subjects who used primarily presymbolic gestures (such as hand guiding, pointing, extending objects), which are quite generic and should be usable under many more circumstances than are specific signs or symbols, received approximately half the CCs that subjects who used some means of symbolic communication received. The influence of symbolic communication is heightened when one considers the data on three subjects who switched from using presymbolic CB during Year 1 to symbolic CB (tangible symbols) during Year 2. These three subjects were among the group who received the lowest rate of CCs in Year 1, but in Year 2, when they began using a symbolic system, they received the highest rate of CCs. These data suggest that the ability to use symbols had a profound effect on the teachers' behavior, independent of any personal characteristics of the subjects. The higher probability of CCs for subjects who use symbolic modes of communication is somewhat surprising, given that the symbol-using subjects had very small symbolic vocabularies. Perhaps it is easier to remember to provide cues for specific vocabulary items than for the more ubiquitous gestures.

Effect of Feedback on Probability of CCs and CBs

In January of Year 2, project staff began providing teachers with graphs of the data from the observation sessions on a weekly basis, and discussing the data at regular monthly meetings with them. It was anticipated that continuous feedback regarding their own behavior might help the teachers to pay more attention to the rate of CCs. Figure 2 shows the mean probability of CCs for each subject averaged across prefeedback sessions (1-8) and sessions with feedback (9-16). Eight out of the eleven widely disparate subjects showed increases in the probability of CCs. Two of the subjects who did not (Subjects 9 and 10) were in a classroom that experienced a dramatic decrease in the staff:student ratio when two new subjects who required 1:1 training were enrolled midway through the year. The third (Subject 2) was the student who received the highest probability of CCs and may illustrate a ceiling effect. Across all subjects and teachers, the probability of CCs was .10 prior to the feedback condition. This figure increased to .13 during the feedback condition. A comparison of these means yields a two-tailed $t = -2.57$ ($p = 0.028$).

The increase in the probability of CCs was mirrored by an increase in CB responses and initiations on the part of six of the subjects, as illustrated by Figure 3. The probability of CBs increased from a mean of .11 to a mean of .13 during the feedback condition (two-tailed $t = -2.15$, $p = .058$). Subjects 1, 2,

Table 10

Probability of CCs for Low-, Medium- and High-Rate Initiators (Study II)

	(CC)	
	Year 1	Year 2
Low-Rate Initiators (Initiation=.00-.03)	.06 (n=6)	.07 (n=5)
Medium-Rate Initiators (Initiation=.04-.07)	.07 (n=4)	.13 (n=4)
High-Rate Initiators (Initiation=.08-.29)	.16 (n=4)	.15 (n=3)

Table 11

Probability of CCs for Subjects Using Three Different Methods of Communication (Study II)

Primary Method of Communication	(CC) Year 1	Year 2
Presymbolic	.07 (n=10)	[illegible]
Manual Signs	.16 (n=4)	n=1)
Tangible Symbols	---	.17 (n=3)

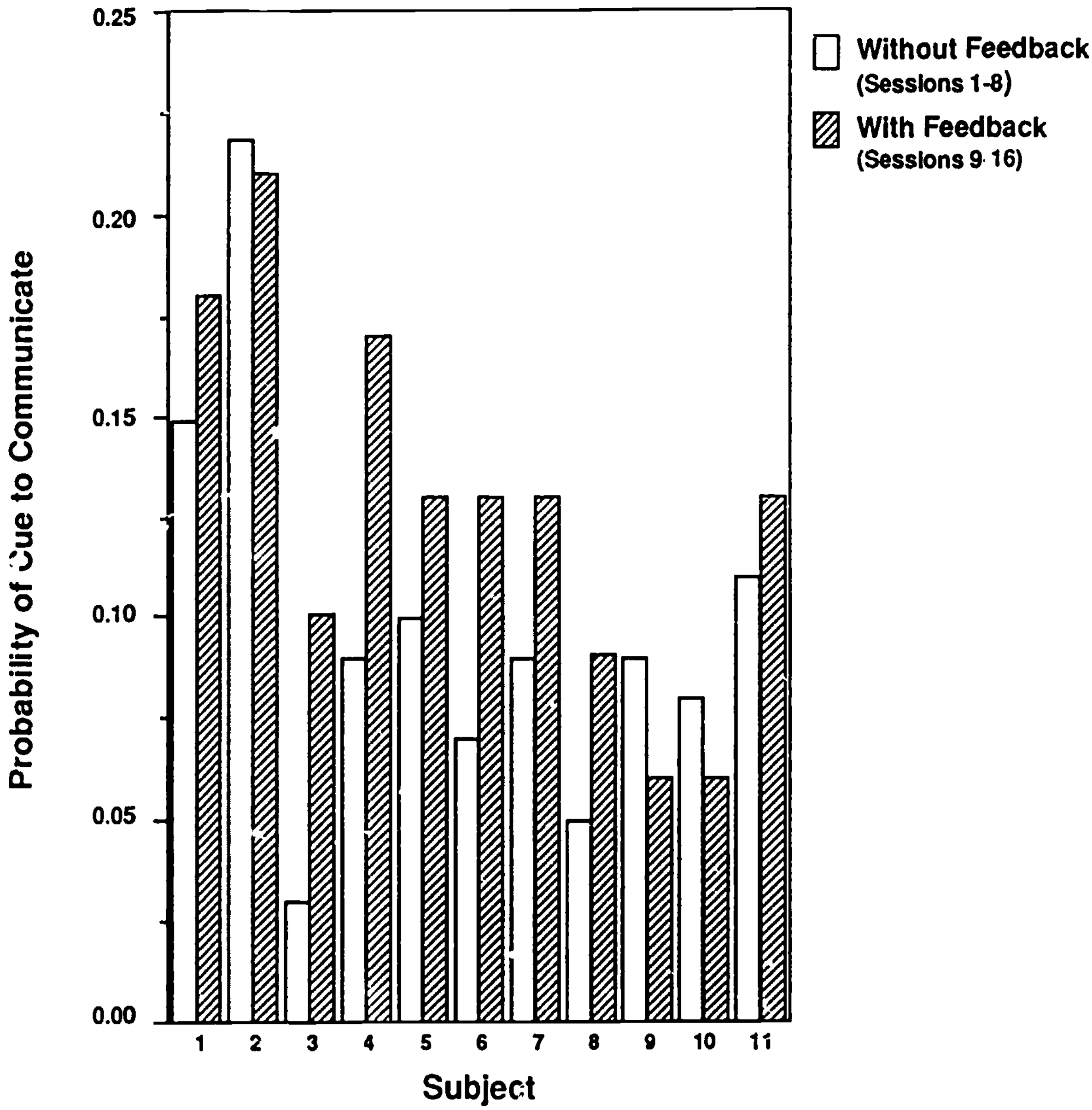

Figure 2

Probability of Cues to Communicate for Each Subject
Before and During Feedback Conditions

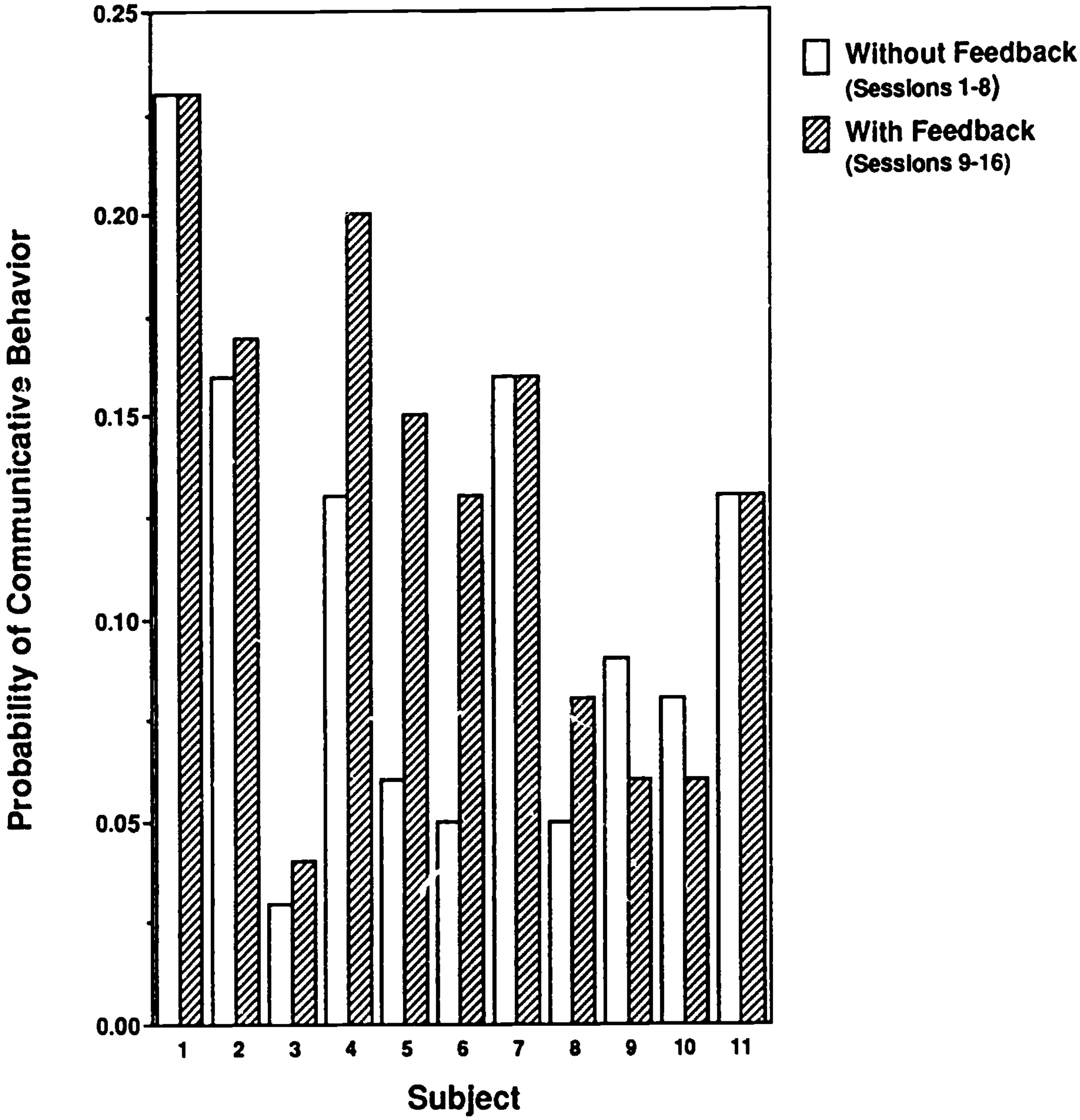

Figure 3

Probability of Communication Behavior by Each Subject
Before and During Feedback Condition

and 7, who showed no change or only a .01 increase in p(CB), began the study with the highest probability of CBs. The two subjects who show decreases in communicative behavior (Subjects 9 and 10) were both in the classroom that experienced a dramatic decrease in the staff:student ratio.

These results must be interpreted with caution. In one sense, the apparent change in probability of CCs is heartening, given the relative weakness of the intervention. The feedback that constituted the intervention was directed entirely at the teachers, while observations were made on both teachers and their instructional assistants. It was up to the teachers to communicate the feedback to their assistants, and project staff had no control over this aspect of the feedback. Given the fact that a significant portion of the programs observed were conducted by instructional assistants, and given the indirect nature of the feedback that they received, the degree of improvement is encouraging. On the other hand, it is impossible to separate the effect of the feedback intervention from improvement caused by other effects over the course of the school year.

Effect of Intervention on Initiation of Communication. One of the deficits commonly found in individuals with dual sensory impairments is a failure to initiate communication behavior. An examination of the data, breaking down communication into responses versus initiations, revealed a disconcerting trend. Although the probability of initiations did not change significantly over the course of the year during which the feedback condition was instituted, the proportion of initiations out of initiations-plus-responses declined over the course of the school year. The mean proportion of initiations was .48 for the first eight sessions, as compared to .34 for the final eight sessions, yielding a two-tailed $t = 4.52$ ($p = 0.001$). The subject-by-subject data plotted in Figure 4 show that for 10 out of the 11 subjects the proportion of initiated CBs decreased. Apparently, the increase in the subjects' rate of communication was restricted to increases in responses to the CCs--and did not reflect any increase in spontaneous communication.

Discussion and Conclusions

In Study I, the entire school day of a sample of subjects with dual sensory impairments was analyzed in terms of the time spent in eight major activities and the probability of CCs and CBs within these activities. The analysis of activity contexts reveals contrasts between the "typical" day of the teacher of students with multisensory impairments and that of a teacher of less severely disabled or nondisabled students. Carta, Sainato, and Greenwood (1988) studied nine handicapped and three nonhandicapped students in four different preschool classrooms, making day-long observations between 5 and 10 times per subject. Five activity areas from that study appear to coincide with those extrapolated from Study I: transition, snack, gross motor, self-care (presumably including toileting), and language. Of these, roughly equivalent percentages of time were spent in snack activities (15% versus 16%) and in language activities (3% versus 1%). However, students in project classrooms spent only 13 percent of their time in transition activities as compared to 21 percent for the Carta study, while much more time was spent by project students in gross motor (15% versus 2%) and self-care activities (22% versus 2%). In classrooms of students with multiple and sensory disabilities, toileting requires an extremely high level of effort as compared to other classrooms where the amount of time devoted to such activities is negligible. The amount of time spent in transition in project classrooms reflects the fact that most subjects were not able to transition from

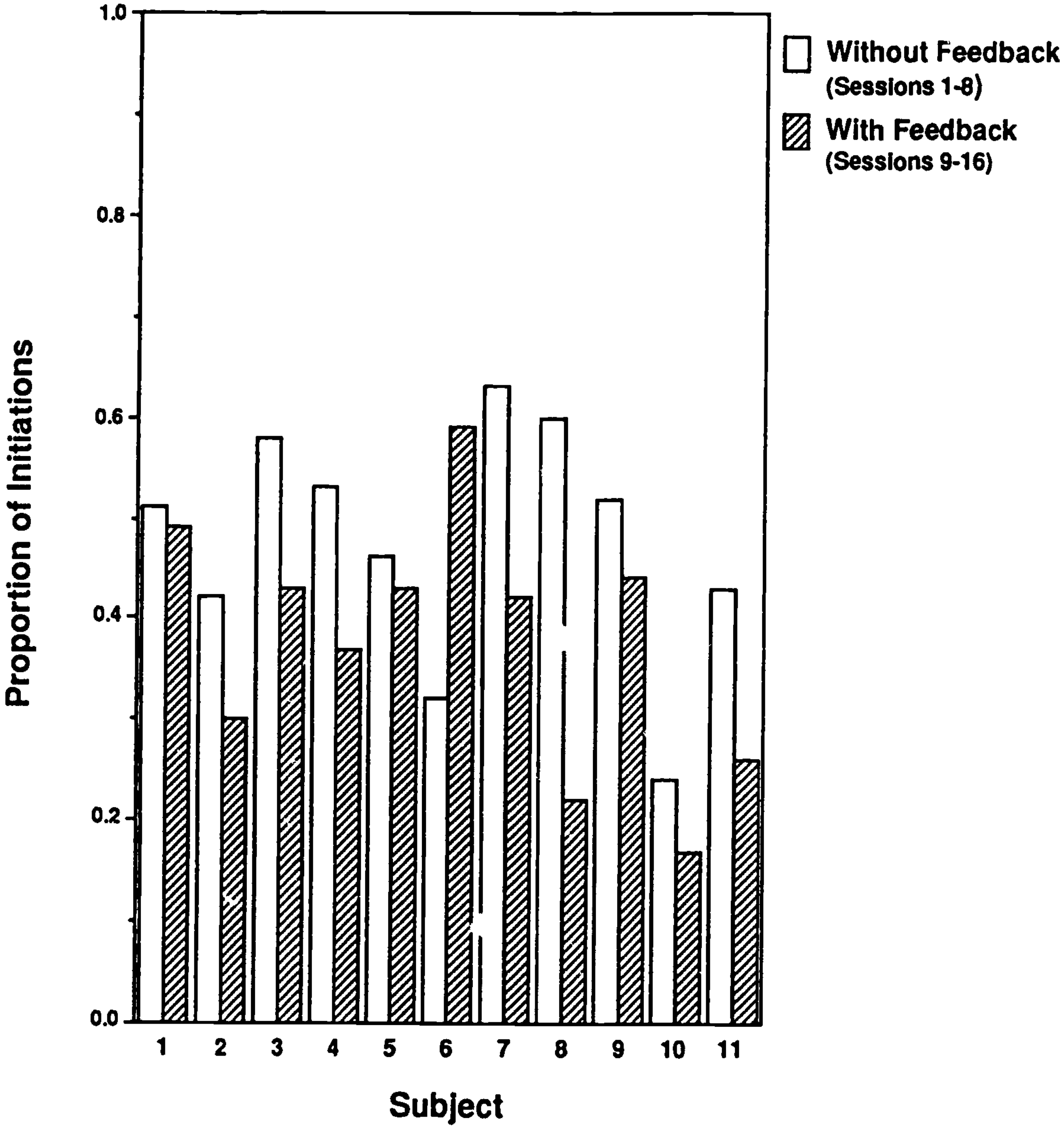

Figure 4

Proportion of Initiated CB out of Initiations Plus Responses for Each Subject Before and During Feedback Condition one activity to another independently and that, even once the students were in place, the teachers spent a great deal of time preparing to run programs. Compared to the Carta data, however, the amount of time spent in transition appears to have been kept to a minimum.

The analysis of the conditional probability of CCs for each activity suggests contexts in which communication skills are most easily targeted and activities in which greater efforts could be made to incorporate CCs. The overall probability of CCs across the schoolday (.13) affords some sort of standard against which similar data from other educational contexts might be judged in the future. If this overall rate appears low, one must remember that most of the subjects were incapable of perceiving cues to communicate unless the cues were directed specifically to them. Teachers in these classrooms were not able to communicate to the whole class or even to a small group at once, but had to direct communication to each student individually.
For some subjects the teacher had to communicate tactually to make a message understood. The data showed that all teachers were using a combination of visual, auditory, and tactual CCs and that the distribution of these cue modalities differed from subject to subject. Finally, Study I allowed the generation of a mean probability of communicative behavior (.16) for young children with dual sensory impairments in classroom settings. Analysis of the subjects' behavior showed that presymbolic communication constituted a minimum of 41 percent of their CBs, even for subjects who used some symbolic communication.

In Study II, the focus shifted to a longitudinal study of contexts to which communication skills might generalize from more concentrated skill-training sessions. In this study, a lower overall rate of CCs (.10) was established, although the rate varied widely from subject to subject. Further analyses revealed that subjects who initiated communication more frequently and subjects who were able to use some sort of symbol system to communicate received higher rates of CCs. This study included a number of subjects who were totally blind, and an analysis of the modality of CCs showed that teachers delivered a high percentage of tactual cues and correspondingly low percentage of visual cues to these subjects as compared to partially sighted subjects.

Both studies incorporated an intervention component designed to increase the rate of CCs on the part of the teachers and their assistants. Study I involved a "one-shot" inservice training session during which the preliminary data were discussed, and techniques for delivering CCs were described and demonstrated. This intervention was associated with no clear effect on the data derived from observations conducted during the following week. Study II involved a prolonged intervention during which the observational data were fed back (in graphic form) to teachers within a week after the observations were made, and the data and techniques for increasing CCs were discussed at monthly meetings with teachers. The data do show a significant increase in the probability of CCs during these feedback sessions in comparison to prefeedback sessions, an increase that was reflected by an increase in CBs for some of the subjects. This result must be interpreted guardedly, however, since other factors may have contributed to improvement over the course of the intervention. Whatever the cause of the increase in the probability of CCs, however, one effect is clear. The proportion of initiated CBs out of total CBs for ten of the eleven subjects dropped significantly during the feedback condition when the rate of CCs was elevated. This effect shows that merely increasing the rate of CBs by increasing the rate of CCs to the degree that the rate was elevated in this study does not serendipitously lead to a higher rate of spontaneous communication. It is possible that if the overall rate of CCs and CBs had been elevated more dramatically, the increased practice in communicative behaviors might have lead to increased initiations.

The equivocal results of the two intervention attempts reflect an unavoidable truth. It is very difficult to provide opportunities to communicate for the student with dual sensory impairments in the classroom setting in accordance with a "milieu" training approach. Although we as researchers or inservice trainers may see the potential for multiple opportunities to communicate in any given context, the teacher or instructional assistant must concentrate on any number of other variables in addition to communication. A need exists for training materials that provide concrete demonstrations of teachers providing CCs across many different contexts and for students using a variety of levels of communication. Furthermore, research must be attempted on means to encourage children with dual sensory impairments to initiate communication. The adult service environments to which these individuals will eventually move are not likely to provide a large number of cues to communicate.

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IV. Comparison of Intervention Strategies for Facilitating Nonsymbolic Communication Among Young Children with Multiple Disabilities

by
Ellin Siegel-Causey

All children begin communication at a nonsymbolic level as they convey their needs and desires through such behaviors as smiling, crying, fussing, and gesturing. Some individuals with severe, multiple disabilities, who are unable to speak or use another conventional symbol system, also communicate by using nonsymbolic modes similar to those of the normally functioning infant (e.g., facial expression, body movement, and gestures). Recognizing these nonsymbolic modes and responding sensitively to them present a major challenge to service providers who are involved in intervention programs with these individuals.

Many authors who have examined communication skills training emphasize the importance of developing an adequate early foundation to enhance later language development (Bates, 1979; Rogow, 1984; Schiefelbusch & Bricker, 1981; Sugarman, 1984). The contribution of early infant nonsymbolic behaviors in the normal course of communication development is well documented (Carlson & Bricker, 1982; Kagan, Kearsley, & Zelazo, 1978; Newson, 1977; Trevarthen, 1977; Ziajka, 1981), and some researchers have stressed the importance of recognizing nonsymbolic communication in individuals displaying severe disabilities (Houghton Bronicki, & Guess, 1987; Mirenda, Donnellan, & Yoder, 1983; Peck, 1985). There are a few procedures that integrate the communicative repertoires of nonsymbolic individuals into intervention programs (Gaylord-Ross, Stremel-Campbell & Storey, 1986; Klein et al., 1981; Musselwhite, 1986; Kaiser, Alpert, & Warren, 1987), and a limited number of procedures for identifying nonsymbolic behaviors (Otos, 1983; Sternberg & Adams, 1982; Stillman & Battle, 1985). Yet for the most part, this orientation has not been sufficiently integrated into personnel preparation or therapeutic and educational programs. As a results, the training of communication skills for individuals with severe disabilities, including deaf-blindness, is an area of great interest to educators and researchers (Bullis, 1985, 1986, 1987, in press; Kaiser et al., Reichle & Keogh, 1986; Schiefelbusch & Pikar, 1984).

The impaired development of young children with severe, multiple disabilities may create sensory isolation. It may also reduce significantly their social interactions and environmental exploration. Moreover, poor integration of sensory modalities and deficiencies in motor control may prevent any regular progress in language acquisition since cognition and social interaction appear to be closely related in the development of language (Bates, 1976; Bricker & Carlson, 1981; Bruner, 1975; Schaffer, 1977; Schlesinger, 1977; Snow, 1984; Vygotsky, 1962).

Children with severe, multiple disabilities or dual sensory impairments may appear to exist in a world of their own, focused on inward sensations. They have limited opportunity to learn from the environment through exploration or to learn from people through social interactions. The limited explorative and communicative behavior of children who have dual sensory impairments was observed by Jan van Dijk and led him to develop a theoretical approach that encourages the development of early communication through movement (van Dijk 1965a & b;

1966; 1967; 1968; 1969; 1986). His approach emphasizes the important role of nonsymbolic communication in the dynamic relationship between children with severe disabilities or dual sensory impairments and their caregivers. Van Dijk recognized that through motor activity, infants and children learn about themselves and their world. His theory includes development principles and extensive incorporation of Werner and Kaplan's (1963) work pertaining to the symbolic and representational skills underlying language. It also emphasizes concern with the total child in his or her life. The van Dijk approach uses the child's own repertoire to form movement dialogues. These dialogues are a natural extension of warm, nurturing relationships and provide the basis for communication intervention. His approach is theoretical and does not include specific procedures or methods. Two recent articles (Stillman & Battle, 1984; Writer, 1987) provide excellent synthesis and application of the van Dijk approach.

Purpose

Many individuals with severe, multiple disabilities use nonsymbolic modes such as gestures, vocal sounds, eye contact, body movements, and facial expressions to communicate in the absence of speech or other conventual symbol systems. Promotion of nonsymbolic communication presents a challenge to educators and researchers and, despite implementation of the van Dijk movement-based theory, little research has addressed his theoretical assumptions, especially with persons displaying severe disabilities. The present study, which tested propositions derived from van Dijk's theory, was guided by two assumptions. The first assumption is that communication is facilitated by primary caregivers who are nurturing (have a positive, trusting relationship that fosters development), and the second assumption is that there should be direct physical contact between the adult and child during early intervention. The van Dijk assumption that was studied was concerned with the role of movement intervention in the promotion of communication. This study examined the effects of movement intervention and passive intervention during social interaction. Both kinds of intervention for this study took place as the adult participant (paraprofessional) sat on the floor and held the child participant in her lap. The child faced the adult, as they rhythmically moved together (side to side, forward and back, or up and down) during movement intervention or viewed one of three battery-operated toys during passive intervention. The purpose of this study was to ascertain whether there are differences between the effects of movement intervention and passive intervention in promoting nonsymbolic communication behaviors in young children with severe disabilities.

Method

The independent variable of movement stimulation consisted of the child and adult moving rhythmically in a predetermined manner followed by cessation of the movement to provide the child an opportunity to exhibit an identified behavior (dependent variable) that would signal the adult to provide the rhythmic movement again. Passive stimulation consisted of the visual and auditory display of a battery-operated toy animal presented to the child for the same amount of time as required to implement the movement stimulation procedures. The display of the toy was then discontinued to provide the child an opportunity to exhibit an identified behavior (dependent variable) that would signal the adult to provide the battery-operated toy animal again. In accordance with the van Dijk guidelines, an adult who had a nurturing relationship and a caregiver role (teaching assistant) delivered the intervention procedures. The experimenter trained the teaching assistants to deliver both kinds of intervention.

Child Participants

Participants in this study were six students between 3 and 5 years of age who were identified as severely multiply handicapped and/or deaf-blind. All children were enrolled in local preschool classes for students with severe, multiple handicaps. Table 1 provides a description of the child participants. In addition, participant selection was based on two levels of communication, described by Stremel-Campbell (1982) as nonintentional behavior-Level I or intentional behavior-Level II (purposeful behaviors but not intentionally communicative). Secondly, the child's nonsymbolic communication skills as measured by the Callier-Azusa Scale (Stillman, 1978) needed to be in the range of 0 to 12 months on Cognition, Receptive Language, and Expressive Language areas. On the Wisconsin Behavior Rating Scale (Song & Jones, 1980) scores needed to be in the range of 0 to 11 months in Expressive Language, Receptive Language, and Social areas. A summary of Child Participant Communication Characteristics is presented in Table 2.

Adult Participants

In keeping with the van Dijk principles, an adult who had a nurturant relationship and caregiver role with the child (teaching assistant) delivered all the procedures. For this study nurturant described one who had at least 3 months experience with young children with handicapping conditions and who had worked as a paraprofessional in the classroom of the identified child participants for at least 3 months prior to the study. Adult participation were between 22 and 32 years of age and had between 7 to 23 months of experience as a paraprofessional with children with a variety of disabilities.

Settings

The study was conducted as two University-sponsored preschool sites for children with severe, multiple handicaps. Experimental sessions were conducted for Participant 1 (Sam) and Participant 2 (Paul) within a small area, approximately 10 x 8 feet (3 x 2.5m) in an unoccupied classroom across the hall from their classroom. Experimental sessions for the other four participants were conducted in a small, partitioned area, approximately 10 x 9 feet (3 x 3m), in an unoccupied corner of their preschool classroom.

Equipment

Typical preschool classroom equipment (small tables and chairs, toys, and positioning equipment) were situated outside the designated experimental areas. The partitioned experimental area used for movement and passive interventions were carpeted, well lit, and included two partitions of approximately 3 1/3 x 4 1/2 feet (1 x 1.5m) that separated the experimental area from the classroom. On one partition, grid measurements were posted on white poster board, approximately 3 x 3 ft (1 x 1m), with 2-inch tape strips of red, black, blue and green that guided the adult to move the child to a precise distance within each movement pattern (side to side, forward and back, and up and down). Passive stimulation equipment included a holder for displaying the toys, a box containing the battery-operated toys, and a timer-switch that regulated the operation of the toys.

Table 1

Child Participant Description

Participants:	1(Sam)	2(Paul)	3(Andrea)	4(Roger)	5(John)	6(Vivian)
Age at beginning of Study	4 yr 8 mo	4 yr 8 mo	4 yr	4 yr 4 mo	4 yr 10 mo	4 yr 8 mo
Sex	M	M	F	M	M	F
Vision	cortical blindness	legally blind	cortical blindness	normal exam, functional disability	normal exam, functional disability	Optic nerve atrophy; no functional vision
Audition	mild loss low to mid-frequencies	mod. to severe hearing loss	borderline normal low to mid-frequencies, normal high frequencies	normal exam, functional disability	normal exam, functional disability	near normal hearing, bilaterally
Deaf/Blind Registry	Yes	Yes	No	No	No	Yes
Retardation	Severe	Severe	Severe	Profound	Severe	Profound
Cerebral Palsy	Severe	Severe	Severe	Mild	Severe	Severe
Seizure Activity	Moderate	Moderate	Mild	Moderate	Controlled	Minor Motor Seizures
Length of time in educational placement	3 yr	2 yr	3 yr	2 yr	6 mo	3 yr

Note. Definitions from Demographic Form Definitions of the Communication Skills Center for Young Children with Deaf-Blindness and is available upon request from the Author.

Table 2

Child Participant Communication Characteristics Expressed in Developmental Months

				THE CALLIER-AZUSA SCALE (G) (Stillman, R., Ed., 1978)		WISCONSIN BEHAVIOR RATING SCALE (Song & Jones, Eds., 1980)				
Participant	Communication Level (Stremel-Campbell, 1984)	Date	Cognition	Receptive Communi--cation	Expressive Communi--cation	Date	Social	Receptive Language	Expressive Language	Behavioral Age
1 (Sam)	Level I: Nonintentional Behavior	5/85	6 (5)	6-12 (7)	6-12 (6)	11/84	11	6	6	5.2
2 (Paul)	Level II: Intentional behavior, but not intentionally communicative	5/85	0-6 (4)	0-6 (3)	6-12 (6)	11/84	6	2	5	2.5
3 (Andrea)	Level II: Intentional behavior, but not intentionally communicative	6/85	C-6 (2)	0-6 (3)	0-6 (5)	7/84	3	5	5	3.6
4 (Roger)	Level II: Intentional behavior, but not intentionally communicative	6/85	0-6 (3)	0-6 (4)	0-6 (5)	6/84	2	3	4	4.4
5 (John)	Level II: Intentional behavior, but not intentionally communicative	9/85	0-6 (2)	0-6 (3)	0-6 (3)	9/85	8	1	2	7.2
6 (Vivian)	Level I: Nonintentional Behavior	9/85	0-6 (2)	0-6 (3)	0-2 (2)	5/84	2	2	1	2.0

Note. All scores reported on the Callier-Azusa depict corresponding developmental month level ranges. The actual base step achieved (expressed in month level) is presented in parentheses.

Procedures

Assessment. Prior to implementing the study, a Nonsymbolic Assessment Code (NAC) (Siegel-Causey, 1984) was developed to assess the repertoires of young children with deaf-blindness or severe, multiple handicaps. The code provides an assessment device that describes motor and vocal behaviors of children with (a) limited behavioral repertoires and (b) low rates of behavior. The NAC provides a profile and description of the child's behaviors without judgment as to whether they are communicative acts.

Prior to implementation of intervention procedures, the NAC (Siegel-Causey, 1984) was used for assessing each participant. This observational assessment was used to record the participant's (child) behavior during interactions with the designated adult participant. The NAC was designed to assess the child's repertoire of head, eye, arm, and leg movements, facial expression, and vocalizations. Participants were observed, utilizing a time sampling format. After the assessment code was completed a behavior profile was drawn up for each child. Behaviors of the highest frequency were selected as identified dependent variables are listed for each child participant in Table 3. A complete description and directions for the assessment process are available (Siegel-Causey, 1986).

Adult participant training. The adult participants were taught the movement and passive stimulation procedures by the experimenter. Training occurred over a period of 3 days in which procedures were first demonstrated by the experimenter and then imitated by the adult participant (teaching assistant). Completion of training was determined by a criterion of 100 percent accuracy on each of the procedural steps as demonstrated with a doll, and later with a child (student with severe handicaps who was not in the study), for two consecutive sessions. (An outline of the training procedures and the Trainer Performance Checklist are available from the author.)

Intervention. Presentations of movement stimulation and passive stimulation were procedurally identical. One type of stimulation (movement or passive) was delivered within each treatment block and during a 10- to 15-minute session. The adult participant sat on the floor and held the child on her lap. The child faced the adult and was supported at the shoulders. Each position was predetermined and varied slightly depending upon the type of stimulation being delivered and child needs. (Exact descriptions of Passive Procedures and Movement Procedures are available from the author; Siegel-Causey, 1986.)

Movement stimulation involved three types of rhythmic patterns during each session: side to side, forward and back, up and down. One series of the movement consisted of the motion performed in each direction three times using a consistent, rhythmic pattern. For example, side-to-side series was right to left to midline, right to left to midline, right to left, and stopping at midline. The adult participant paused for 12 seconds while gazing toward the child's face. This pause provided an opportunity for the child to exhibit one of the identified motor behaviors (dependent variable). Passive stimulation consisted of separate presentations of three battery-operated toys. The position of the adult and child remained the same as in the movement procedures. Each toy was presented three times for 12 seconds, which was equal to the amount of time it took to deliver a series of movement stimulation.

Table 3

Child Participant Behaviors

Participant	Dependent Variables
1 (Sam)	Mouth Head movement-right Head movement-left Arms-upwards Vocalization
2 (Paul)	Smile Vocalization Head movement-right Arm-right Arm-left Head movement-left
3 (Andrea)	Arms Head/Mouth Smile Vocalization Open Mouth
4 (Roger)	Smile Head-left/right Silence-cessation of crying Head up Vocalization Natural gesture
5 (John)	Head Smile Vocalization Silence-cessation of crying Natural gesture
6 (Vivian)	Mouth/Smile Head Vocalization Arm movement Leg movement

Data collection: movement. The experimenter operated a tape recorder that provided an auditory signal every second. This allowed the adult participant (trainer) to regulate her timing of the specified series when the experimenter said, "stop." The trainer and child remained in their seated position at midline as the experimenter used an electronic timer for 12-second latency period. During this latency period the experimenter observed the child for any occurrence of identified behaviors (dependent variable). The movement series was presented three times. Since each series consisted of three presentations, there were nine opportunities for data collection.

Data collection: passive. The experimenter activated the specified toy using an electronic timer set for 12-second duration. After the toy was activated for 12 seconds, it was turned off by the experimenter using a remote switch, and the toy was removed from the child's view. The trainer and the child remained in their seated position at midline as the experimenter used an electronic timer for 12-second latency period. During this latency period the experimenter observed the child for any occurrences of identified behaviors (dependent variable). The passive series was presented three times. Since each of these series also consisted of three presentations, there were nine opportunities for data collection.

Data collection: child occurrence. A specific data sheet listed the participant's identified behaviors from the Nonsymbolic Assessment Code. During each 12-second latency period, the experimenter observed the child participant. If any of the identified behaviors occurred within the latency period, the experimenter recorded the observed child behavior (dependent variable), and the next cycle of stimulation was delivered immediately. This sequence of stimulation and latency was repeated for the three series of the specified trio. This provided nine opportunities to record occurrences of child behavior. If the child did not exhibit any of the identified behaviors, an auditory signal was emitted from the electronic timer signaling to the experimenter that 12 seconds had elapsed. The experimenter then signalled the trainer to initiate the next stimulation series. Data were also collected on the amount of time elapsed between the end of the stimulation and the child's response (latency), but for the sake of brevity these are not reported. These data are available from the author.

Experimental Design

A modified, alternating treatments design (Barlow & Hayes, 1979) counterbalanced across subjects was employed to compare the differences in effects of movement stimulation and passive stimulation on identified child behaviors. The design was modified to provide intervention blocks (successive sessions of the same stimulation) rather than rapid alternation of intervention. The components of the stimulation procedures were counterbalanced for order effects by the use of six trios. Movement stimulation involved three types of rhythmic patterns: (a) side to side, (b) forward to back, and (c) up and down. The passive stimulation included three different battery-operated toy animals (Toy A, Toy B, and Toy C). An arbitrary order for assigning the first condition of treatment (movement or passive) was used to control for sequential confounding effects. A random number table was used to assign the order of trio presentation for each child. Table 4 depicts the experimental design format with the trio sequences for each child participant.

Table 4

Alternating Treatment Block Format

Sam	MOVEMENT Trio 4 5 2 2 2 6	PASSIVE Trio 2 5 4 6 1 2	MOVEMENT Trio 2 3 1 6 5 6	PASSIVE Trio 1 2 6 3 4 4
Paul	PASSIVE Trio 3 5 4 3 6 6	MOVEMENT Trio 2 3 4 5 3 4	PASSIVE Trio 2 2 1 5 5 2	MOVEMENT Trio 5 4 3 2 2 4
Sessions:	1 2 3 4 5 6	7 8 9 10 11 12	13 14 15 16 17 18	19 20 21 22 23 24

Andrea	MOVEMENT Trio 3 2 6 4 1 3	PASSIVE Trio 4 1 6 5 2 6	MOVEMENT Trio 1 4 3 3 5 5	PASSIVE Trio 2 4 6 6 4 3
Roger	PASSIVE Trio 3 5 4 3 6 6	MOVEMENT Trio 2 3 4 5 3 4	PASSIVE Trio 2 2 1 5 5 2	MOVEMENT Trio 5 4 3 2 2 4
Sessions:	1 2 3 4 5 6	7 8 9 10 11 12	13 14 15 16 17 18	19 20 21 22 23 24

John	MOVEMENT Trio 5 5 1 2 1 2	PASSIVE Trio 6 1 2 [illegible] 3 3	MOVEMENT Trio 2 3 4 1 3 3	PASSIVE Trio 3 6 5 5 3 6
Sessions:	1 2 3 4 5 6	7 8 9 10 11 12	13 14 15 16 17 18	19 20 21 22 23 24

Vivian	PASSIVE Trio 3 2 5 3 2 2	MOVEMENT Trio 4 3 5 3 3 6	PASSIVE Trio 5 1 3 2	MOVEMENT Trio 5 4 2 6
Sessions:	1 2 3 4 5 6	7 8 9 10 11 12	13 14 15 16	17 18 19 20

Reliability

Occurrence. During reliability sessions the trained observer followed the same procedures for collecting data as delineated under "Data collection: child occurrence," in the section above. During these reliability sessions, the observer sat behind the trainer on the left and the experimenter sat to the right. The observer and trainer used separate data sheets to collect reliability recordings. There were nine opportunities per session to record reliability occurrence data.

Due to low occurrence of the identified behaviors (dependent variable), calculations were taken on occurrence data only, to control for the inflationary effect of nonoccurrence components. Reliability for occurrence was computed by dividing the number of agreements (when both observers agreed on an occurrence) by the total number of agreements plus disagreements. The result was then multiplied by 100. For each participant, reliability was calculated at least two times per intervention block (33 1/3% of the sessions) for a total of 8 of the 24 sessions per child. Interobserver agreement was calculated on occurrences of behavior (dependent variables) and the latency of those responses.

Results

Reliability

Across children, mean occurrence reliability ranged from 69 to 100 percent and mean nonoccurrence reliability ranged from 89 to 100 percent. Table 5 displays mean occurrence and nonoccurrence reliability scores across intervention conditions for each participant.

Comparison of Nonsymbolic Behaviors Across Movement and Passive Intervention Blocks

A visual analysis of the data is presented first for each child participant (see Figures 1 through 6). All graphs depict the four alternating treatment blocks of passive and movement stimulation. For occurrence data, graphs of the total number of behaviors per session are displayed. Treatment blocks were compared with reference to level and trend of data. Descriptive statistics were used to aid in the analysis. Table 6 displays total number of behaviors across conditions for all participants.

Sam. Graphs of Sam's total number of behaviors that occurred for each session are shown in Figure 1. Scores are plotted by the session number in which they were obtained, reflecting the distribution of the two interventions (movement and passive) across sessions.

Sam received the movement stimulation block first. The graphs show that across all sessions the most behaviors (4) occurred during the first experimental session. Also, we see little difference in number of behaviors across movement or passive stimulation conditions. Variability was greater for the first blocks (σ = 1.52 and 1.17, respectively) with a leveling of variability at σ = .84 for both of the last two conditions. There were zero responses across 50 percent of the sessions (12 of 24) which were equally distributed across movement and passive stimulation blocks. Comparison of Movement Block 1 and Passive Block 1 reveal very similar mean levels (1.5 and 1.1), and identical mean scores occur

Table 5

Mean Occurrence Reliability Scores and Mean Nonoccurrence Reliability Scores Across Stimulation Training Blocks for Each Child Participant

Participant	Occurrence $\bar{x}$ Movement	Nonoccurrence $\bar{x}$ Movement	Occurrence $\bar{x}$ Passive	Nonoccurrence $\bar{x}$ Passive
1 (Sam)	86.6	100	100	100
2 (Paul)	79	100	92.8	100
3 (Andrea)	70	100	100	100
4 (Roger)	74	89	50	90
5 (John)	85.5	87.5	93.75	95.7
6 (Vivian)	100	100	91.6	90

Table 6

Total Number of Child Participant Behaviors and Mean of Behaviors Across Intervention Blocks

Participant	Total Number of Behaviors				$\bar{x}$ Number of Behaviors	
	Passive	Total	Movement	Total	Passive	Movement
1 (Sam)	7[a]		9[b]		1.2[a]	1.5[b]
	3[c]		3[d]		.5[c]	.5[d]
		10		12		
2 (Paul)	23[a]		42[b]		3.8[a]	7[b]
	33[c]		40[d]		5.5[c]	6.6[d]
		56		82		
3 (Andrea)	23[a]		41[b]		3.8[a]	6.8[b]
	45[c]		19[d]		7 5[c]	3.2[d]
		68		60		
4 (Roger)	12[a]		33[b]		2[a]	5.5[b]
	19[c]		52[d]		3.2[c]	8.7[d]
		31		85		
5 (John)	35[a]		31[b]		5.8[a]	5.1[b]
	37[c]		43[d]		6.1[c]	7.1[d]
		72		74		
6 (Vivian)	22[a]		20[b]		3.6[a]	3.3[b]
	19[c]		18[d]		4.7[c]	4.5[d]
		41		38		

Note.

[a]First passive block
[b]First movement block
[c]Second passive block
[d]Second passive block

PARTICIPANT Sam

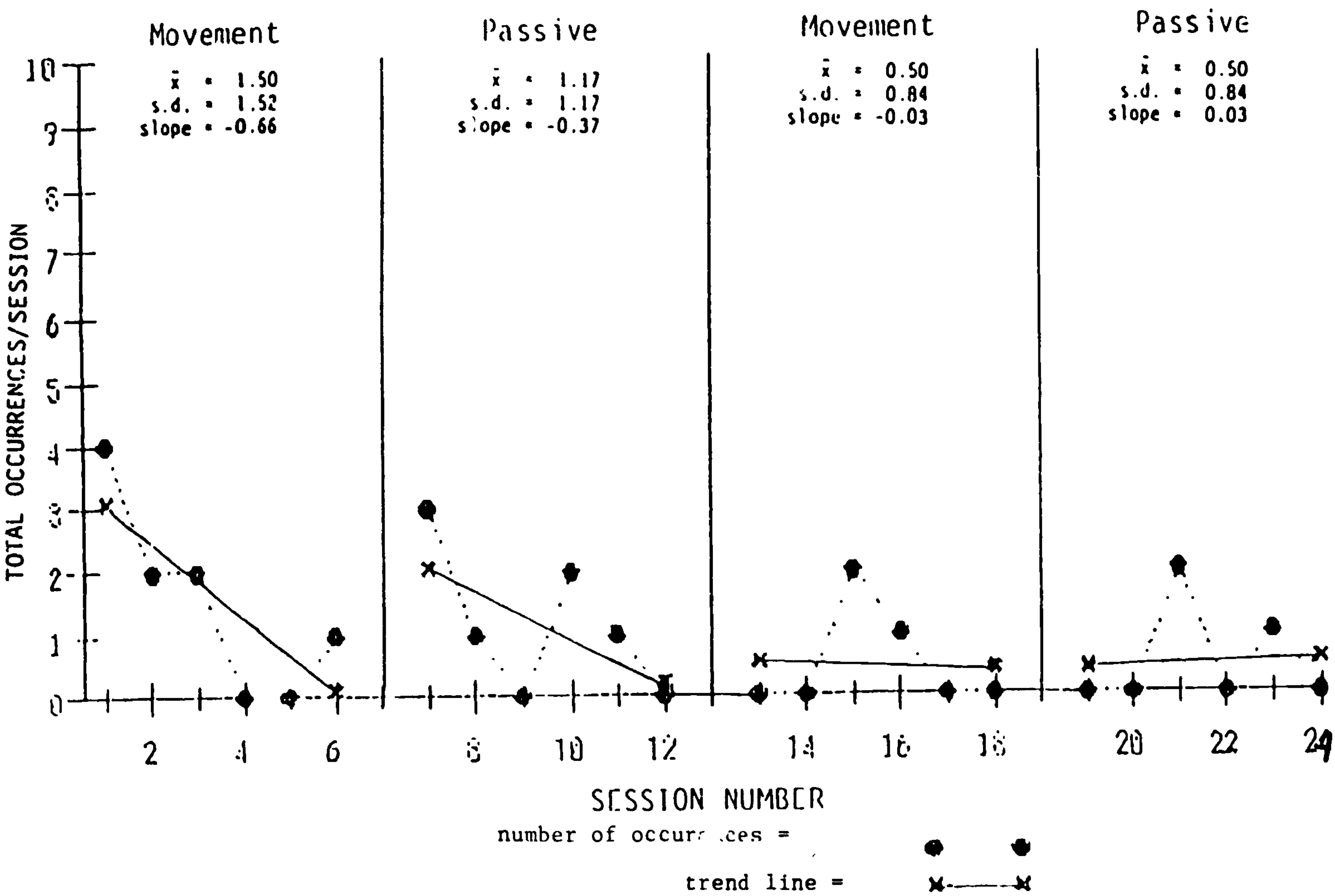

Figure 1

Sam, total number of behaviors

for Movement Block 2 and Passive Block 2. The slope of the data indicates downward trends for the first three stimulation blocks with an almost level slope during the last block.

Paul. Paul's occurrence graphs (Figure 2) display slight differences in the two conditions with more behaviors occurring during movement stimulation blocks. In addition, variability decreased across the blocks with highest levels during passive stimulation as displayed in standard deviation scores (σ = 1.9 and 2.7 for passive; σ = 2.5 and 1.5 for movement). Mean number of behavior occurrences revealed higher levels of movement blocks ($\bar{x}$ = 7 and 6.6) than for passive blocks ($\bar{x}$ = 3.8 and 5.5). The trend of the regression line fit to the data reflects accelerating slopes across all intervention conditions.

Andrea. Andrea's occurrence graphs (Figure 3) display little difference between movement and passive stimulation conditions. Total number of behaviors was 68 for the passive condition and 60 for the movement condition. Variability levels remained at similar moderate levels across conditions as displayed by standard deviation scores (σ = 2.7 and 2.8 for movement; σ = 3.3 and 3.2 for passive). Mean scores of occurrences revealed the highest level for the last treatment block (passive) at $\bar{x}$ = 7.5. The first block revealed the second highest mean ($\bar{x}$ - 6.8) of total occurrences of behaviors with the second and third condition having almost equal mean levels ($\bar{x}$ = 3.8 and 3.2 respectively). The trend of the regression line fit to the data reflects a decreasing slope for Movement Block 1 (-0.48). The next block, Passive Block 2, reveals a slight acceleration in trend (0.2) compared to the first block. Blocks 3 and 4 reveals steeper trends than condition 2 (0.4 and 0.6).

Roger. Roger's occurrence data (Figure 4) display differences between the two conditions with more behaviors occurring across movement stimulation blocks. Roger emitted a total of 31 behaviors across passive blocks and 85 behaviors across movement blocks. This analysis is substantiated when the mean number of behavior occurrences across treatments are compared (movement, $\bar{x}$ = 5.5 and 8.6; passive, $\bar{x}$ = 2 and 3.2). In addition, variability decreased across movement stimulation (σ = 2.4 and 1.8) with the least variability displayed during the movement stimulation block. Variability increased slightly across passive stimulation blocks (σ = 2.09 and 3.58). During data collection for occurrences of child behavior, co-occurrences of behavior (one or more target behaviors exhibited simultaneously) were recorded. Roger exhibited his highest rate of responding during the last stimulation block (movement) with two sessions revealing co-occurrences of behaviors.

Roger also demonstrated changes in the types of nonsymbolic behaviors displayed. Natural gestures were not originally observed during the assessment procedures that delineated his nonsymbolic behaviors (dependent variable). During the study, however, Roger demonstrated natural gestures during movement intervention. These were recorded on his data sheet when observed during any latency phase. His natural gesture during the latency phases was a movement that imitated the direction of the forward stimulation pattern (he leaned forward, toward the adult). No natural gestures were exhibited during passive intervention. His number of natural gestures steadily increased across movement intervention sessions.

John. John's occurrence graphs (Figure 5) display little difference between movement and passive stimulation conditions. Total number of behaviors was 74

PARTICIPANT Paul

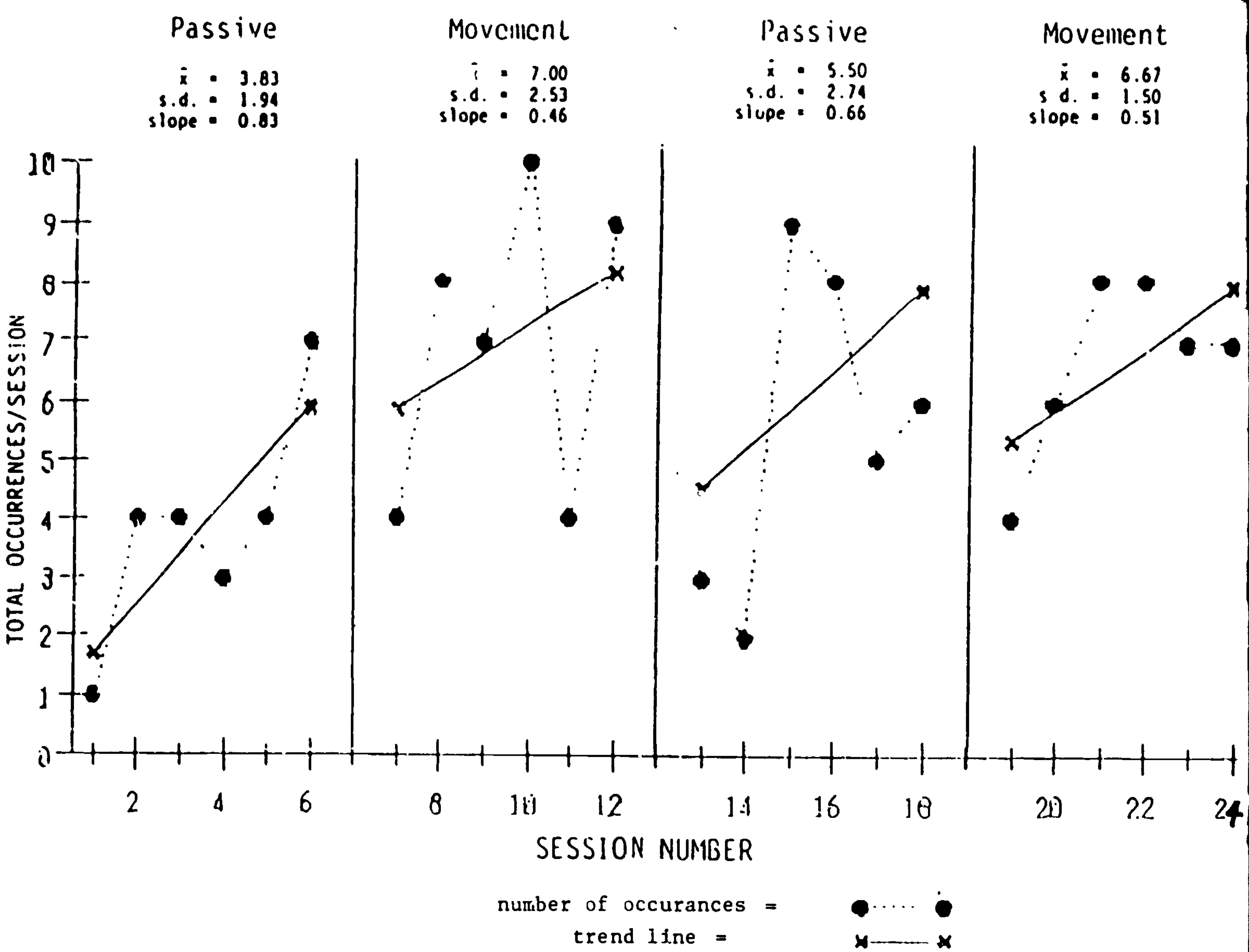

Figure 2

Paul, total number of behaviors

PARTICIPANT Andrea

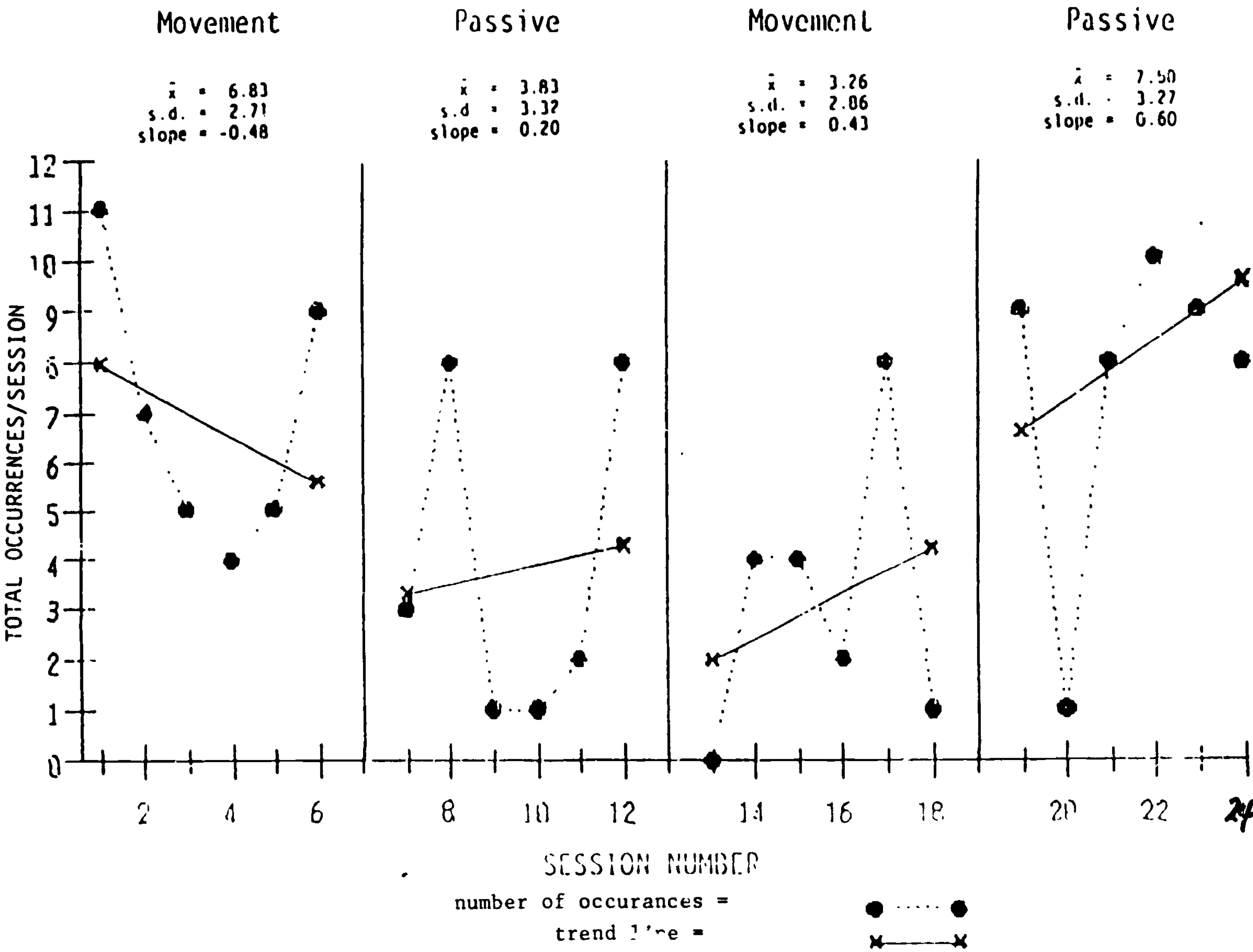

Figure 3

Andrea, total number of behaviors

PARTICIPANT Roger

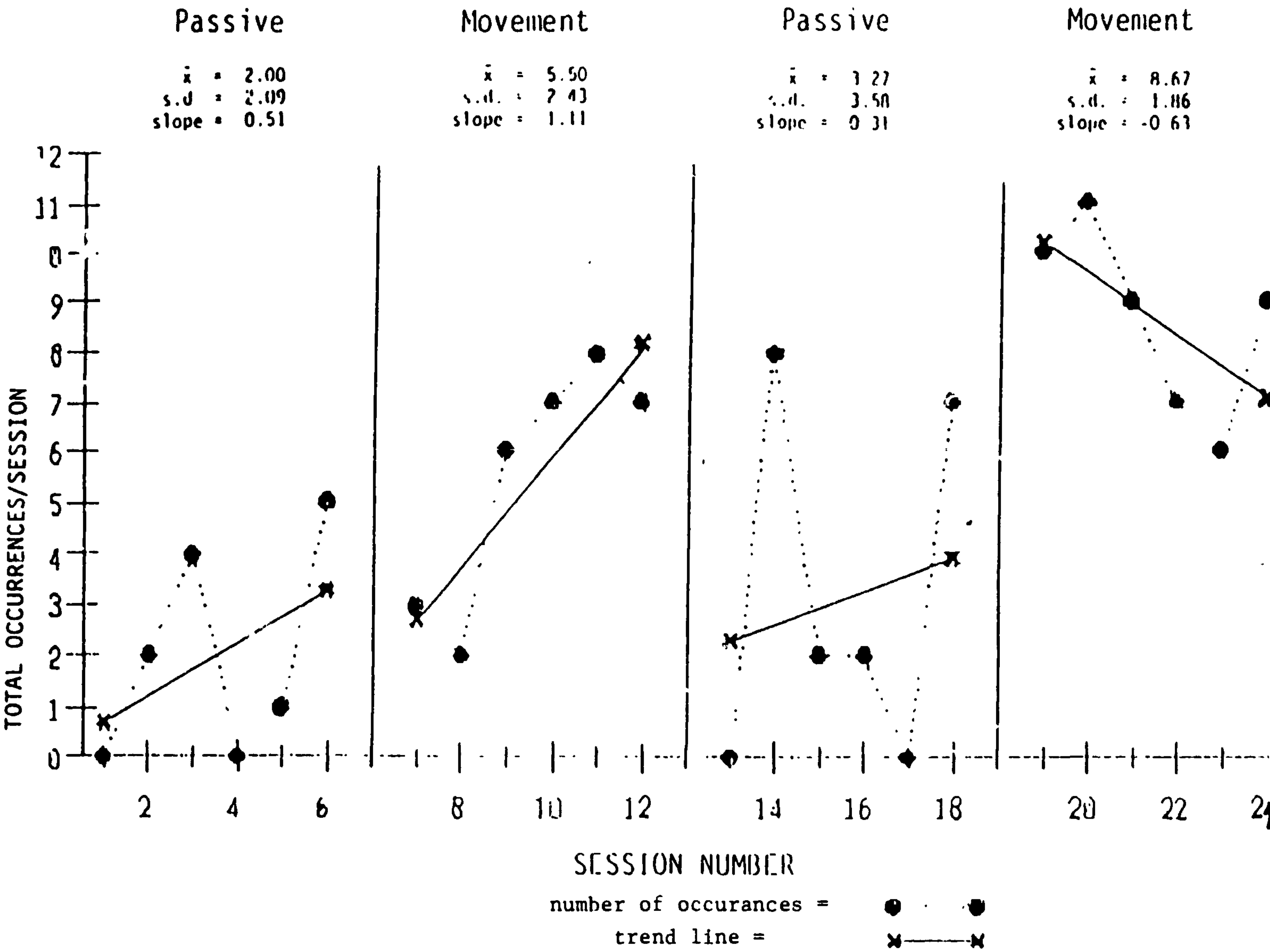

Figure 4

Roger, total number of behaviors

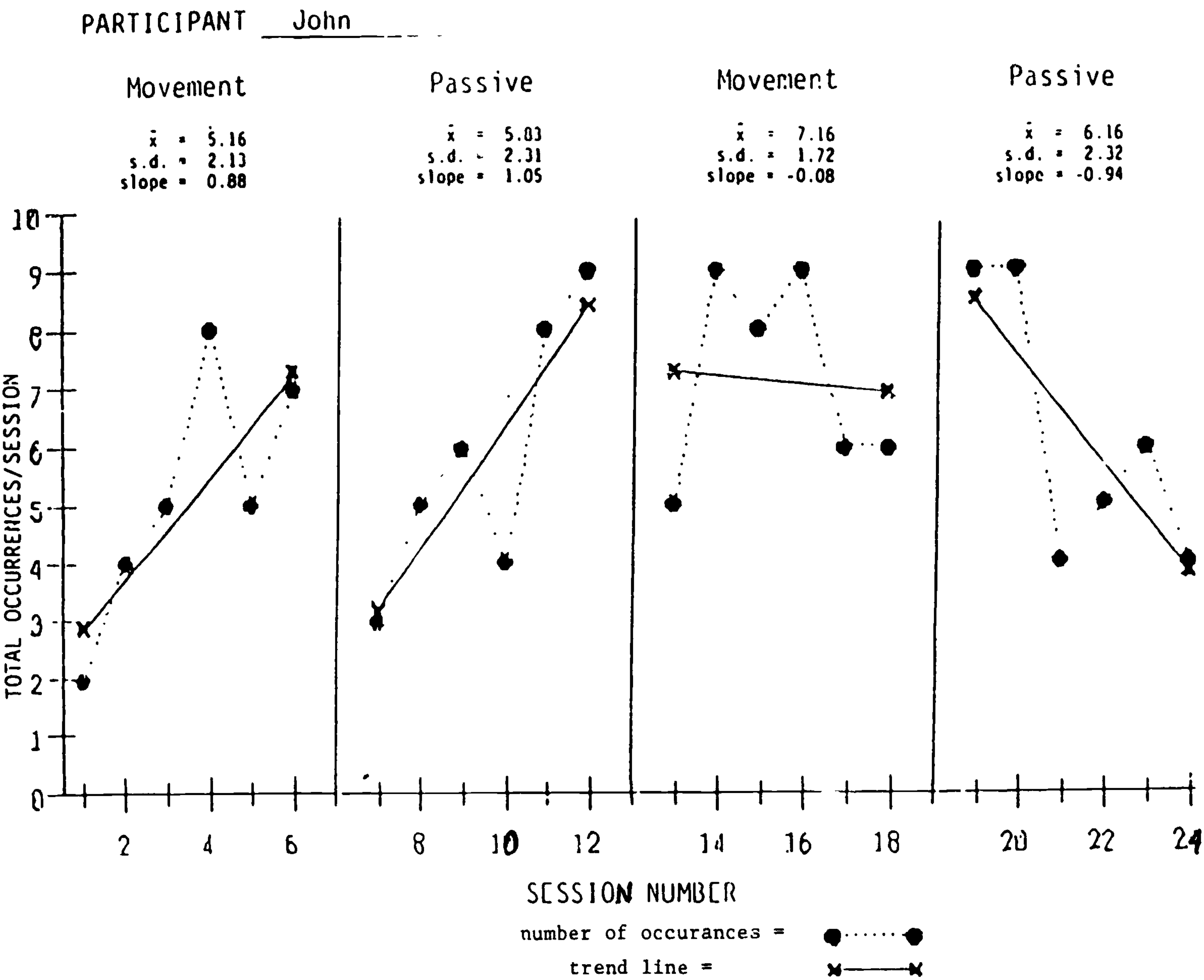

Figure 5

John, total number of behaviors

for movement and 72 for passive. Variability for movement stimulation decreased (σ = 2.1 and 1.7) but remained the same for passive stimulation (σ = 2.3). Comparisons in terms of mean numbers of behavior occurrences revealed the highest level of Movement Block 2 ($\bar{x}$ = 7.1). A best fit line revealed accelerating trends for Movement Block 1 (slope = .88) with slight deceleration in Movement Block 2 (slope = -.08). An acceleration of slope occurred for Passive Block 1 (slope = 1.0) and a steeper deceleration occurred for Passive Block 2 (-.94).

John also demonstrated changes in types of nonsymbolic behaviors. Although not originally observed during the assessment procedures that delineated his nonsymbolic behaviors (dependent variable), during the study he demonstrated natural gestures during the first passive block and during each of the sessions in the last movement block. His natural gestures during the latency phases consisted of leaning forward toward the adult, or tapping the adult's leg. These gestures were recorded on the data sheet when they were observed during the latency phase.

Vivian. Vivian received two stimulation blocks of 6 consecutive sessions and then a decrease to two stimulation blocks of 4 consecutive sessions to accommodate a hospitalization and surgery that conflicted with the study. Vivian was the only participant to receive 20 sessions rather than 24 sessions. No other changes in experimental procedures or format occurred. Vivian's occurrence data (Figure 6) reveal few differences between movement and passive conditions. Total number of behaviors for the passive condition was 41. Total number of behaviors for the movement condition was 38. Comparisons of variability levels across conditions reveal decreasing variability from Movement Block 1 to Movement Block 2 (σ = 2.2 and 1.2) and similar variability for both passive blocks (σ = 2.8 and 2.6). The trends of the regression lines fit to the data reflect a level trend for Passive Block 1 (slope = .06 and decelerating trend for Passive Block 2 (slope = .-.13). Trends for Movement Block 1 reveal deceleration (slope = -0.8) and the only acceleration in trend for Movement Block 2 (slope = .8).

Discussion

Outcomes

Visual inspection of the data reveals that, for two participants (Paul and Roger), increased nonsymbolic behaviors were demonstrated during movement intervention. Although slight increases in the number of nonsymbolic behaviors during passive intervention were demonstrated for two participants (Andrea and Vivian), the practical difference was insignificant when the overall mean level of responding was taken into consideration. Two participants (Roger and John) demonstrated changes in their types of nonsymbolic behaviors, that is, in their display of natural gestures (leaning forward, touching the adult). According to the van Dijk theory natural gestures correspond to and depict actions of an activity. During movement interactions sequences, the child is encouraged to communicate by using unique body movements (natural gestures) to represent actions (van Dijk, 1965a, 1965b, 1967, 1969; Werner & Kaplan, 1963).

One of the participants (Roger) whose nonsymbolic behaviors increased during movement intervention also demonstrated changes in the type of nonsymbolic behaviors displayed. During movement intervention Roger exhibited natural gestures that imitated the direction of the forward stimulation pattern. No natural gestures were exhibited by Roger during passive intervention and there

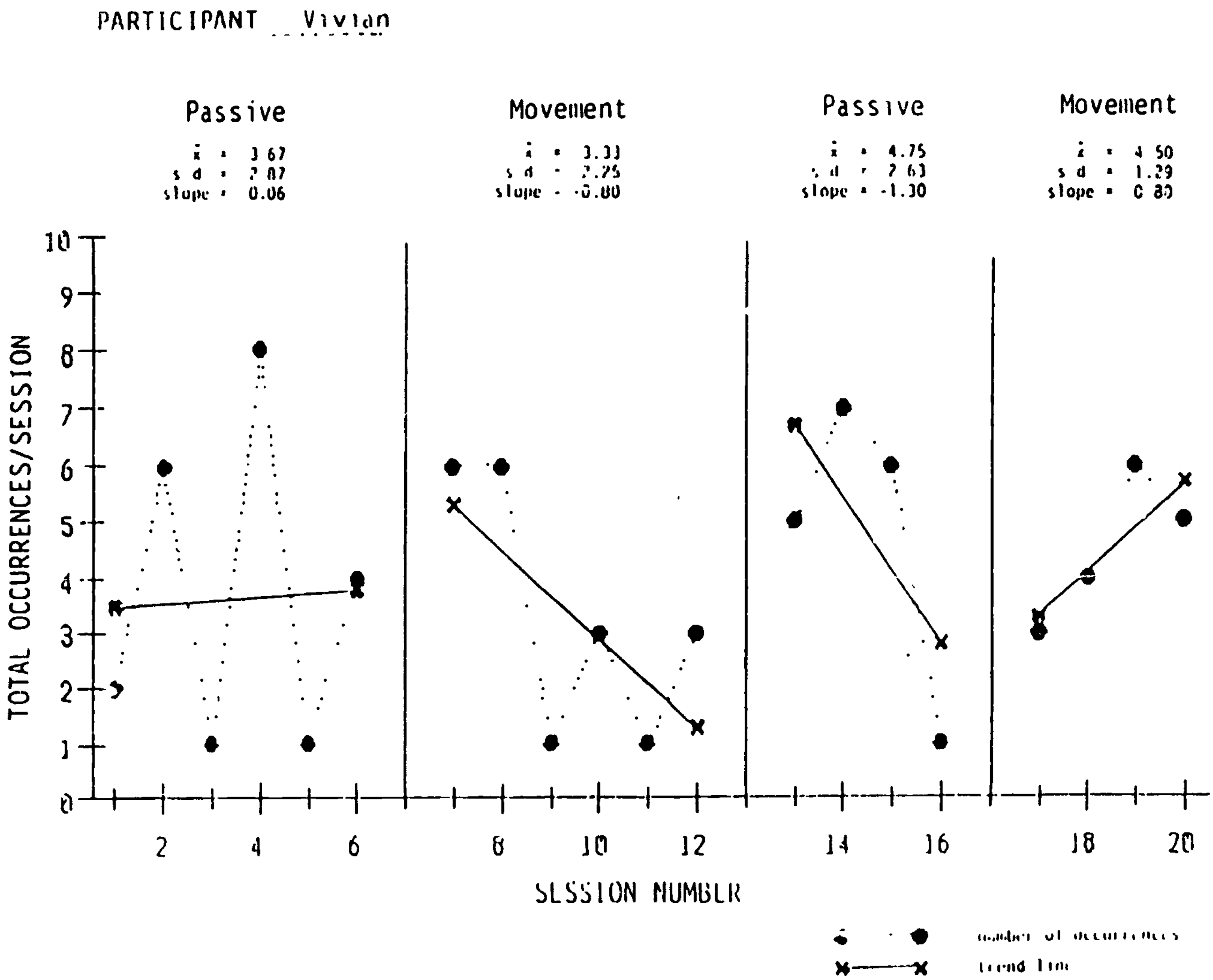

Figure 6

Vivian, total number of behaviors

was a steady increase in the number of natural gestures exhibited across movement intervention. One participant (John) also showed a change in type of nonsymbolic behaviors by exhibiting natural gestures (tapping the adult's leg or leaning toward the adult) during the first passive block and during each of the last movement block sessions. No differences overall were seen in the number of behaviors John exhibited across passive or movement intervention.

The Nonsymbolic Assessment Code (NAC) (Siegel-Causey, 1984) does not formally assess natural gestures. Movements that were used in a manner unique to the child and that depicted actions (natural gestures) were noted in the comments section of the assessment data sheets. No natural gestures were observed for any child participants during the assessment process. The observers agreed to be aware of such nonsymbolic behaviors during the study and to discuss incorporation of any behaviors that had been noticed by both observers during a session. This allowed the experimenter to incorporate modifications in topography of a child behavior and to add natural gestures during the study. It is notable that, during movement intervention, communication of both John and Roger expanded beyond their display of intentional behaviors to using natural gestures to <u>intentionally communicate</u>.

The use of natural gestures by two participants shows that natural gestures may be an important component in the ontogeny of nonsymbolic communication. The results indicate that natural gestures are unique to each child and can be reliably measured. It is interesting to note that two participants exhibiting natural gestures also had the most motor control and physical repertoires. In addition, both exhibited self-stimulatory behaviors (not counted as target behaviors). Thus, these two participants appeared most similar to the children observed by van Dijk when he developed his theory.

The provision of contingent experiences is important in the development of communicative competence (Carlson & Bricker, 1982; Reichle & Yoder, 1979). During this study, child behavior elicited the delivery of more stimulation. Contingency of experiences may have contributed to the study outcomes with those participants who displayed increased nonsymbolic behaviors (Paul and Roger); higher natural gestures that depicted action as a signal for more (Roger and John); and the decrease in latency of responses (Andrea, Roger, and John). It is plausible that these behaviors demonstrated the child participant's anticipation that their actions might affect the delivery of stimulation. The hypothesis that contingent responding of caregivers affects cognitive, attentional, and motivational development (Brinker & Lewis, 1982; Carlson & Bricker, 1982; Odom, 1983) was not tested during this study.

<u>Limitations</u>

This study used an alternating treatment format with the modification of intervention blocks rather than the rapid alternation of intervention conditions randomly sequenced across sessions. Alternating treatments designs, which include the randomization and counterbalancing strategies used in this study, provide a viable method to compare treatments in single-subject research. The use of rapidly alternating treatment designs, however, does not necessarily allow for cumulative effects. That is, it effects are likely to accrue only after extended experience under a treatment, then this accrual is less likely to occur with research designs than alternate the treatment conditions. The added modification of treatment blocks may have reduced this disadvantage. It may be, however, that for children so severely disabled, six sessions of training for approximately 15 minutes, 2 to 4 days a week represented insignificant intervention (i.e., the treatment blocks might have been too short to allow for cumulative intervention effects).

The emphasis placed on the demonstration of target behaviors during latency phases might have prevented inquiry about the equally important dimensions of the child's nonsymbolic behaviors during actual intervention. Perhaps the children exhibited target behaviors as they received a particular rhythmic movement or viewed one of the toy animals. The cessation of stimulation (latency) may have subdued the child's responses until stimulation occurred again. In addition, the study of the affect and biobehavioral state both during intervention and during latency phases might have provided insight about the children who displayed low rates of behaviors.

Future Research

The present study used an assessment procedure that allowed the experimenter to objectively delineate six or more child behaviors as potential communicative signals. Children like the child participants in this study are often considered to have no behaviors that have potential as communicative signals. The successful use of the NAC raises the possibility that by providing a profile of the child's occurrences of behaviors may change the common perception that the child with multiple disabilities "doesn't do anything." The identified behaviors may be targets for research or classroom intervention. This may be of benefit in preventing learned incompetence and iatrogenic retardation (Kearsley & Siegel, 1979) by accurately assessing what the child does. This may change service providers' perceptions of a child's abilities and thus may sensitize them to nonsymbolic behaviors and their communicative role. Caregiver sensitivity may prevent the child's repeated experiences of failing to exert personal control and promote competence in early communication exchanges. This is further supported in Seligman's (1979) premise that learned helplessness may result from the child's inability to affect or control the environment. The child who is nonsymbolic and has a limited range of behaviors may become passive and may stop attempting to exert control in social interactions.

Educators and parents need the option of additional techniques to motivate, tech, strengthen, and generalize behaviors. Children who are nonsymbolic and severely disabled are entitled to control aspects of their own behavior, interactions, and environment. These points highlight the need for future research in nonsymbolic interactions. Single-subject designs, which investigate more of the treatment variables that may have affected the nonsymbolic behaviors. would be desirable. Specifically, van Dijk's assumptions might be analyzed in multiple-probe designs or in longer alternating treatment or alternating block design formats. In addition, longitudinal interactional analyses of caregivers and nonsymbolic children with and without disabilities may elucidate important components that facilitate communication.

If accepted uncritically, and the limitations of the study have been delineated, this research indicated that movement intervention within social interactions increases the rate of and kind of nonsymbolic communication behaviors in some children with severe disabilities. Intervention models that incorporate contingent responding to a child's nonsymbolic, nonintentional behaviors may enhance traditional classroom techniques with young children with severe disabilities.

In summary, although overall results do not indicate that movement, a major component of van Dijk theory, was effective in increasing behaviors among all children in the study, three participants showed difference in their nonsymbolic behaviors during movement intervention. It is important to emphasize that research directed toward individuals with the most severe disabilities is not commonly done nor are treatment effects easy to demonstrate. All six participants had severe, multiple impairments. Thus, the effects of treatment as shown in increased nonsymbolic behaviors and altered types of nonsymbolic behaviors, are viewed positively.

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V. Training a Child with Multihandicaps to Use a Tactile Augmentative Communication Device

by

Pamela Mathy-Laikko, Teresa Iacono, Ann Ratcliff, Fransisco Villarruel, David Yoder, and Gregg Vanderheiden

Children with severe multihandicaps are limited in their potential for developing social, motor, cognitive, and language skills. The limitations arise from reduced ability and opportunities to act on the environment (Brinker & Lewis, 1982a) and to engage in sensorimotor experiences (Piaget, 1963). The problem is compounded to an unpredictable extent when the handicapping conditions include deaf-blindness (Stein, Palmer, & Weinberg, 1982).

Augmenting the communication of individuals with severe multihandicaps is particularly problematic. One barrier has been that decision rules for the implementation of augmentative communication techniques have stressed that the development of imitation skills and the ability to use adults as agents (i.e., Piaget's Stage 5 of sensorimotor development) be used as entry criteria for augmentative communication programs (Chapman & Miller, 1980; Owens & House, 1984; Shane, 1980; Shane & Bashier, 1980). The nature of the disabilities of an individual with severe multihandicaps may preclude the demonstration of certain cognitive skills. Reichle and Karlan (1985) take issue with proposed augmentative communication decision rules arguing that they are based on little empirical support and on information from the development of nonhandicapped children. They suggest the use of rules that require the demonstration of means-end behaviors allows for the implementation of augmentative systems only with "self-initiators." Instead, Reichle and Karlan (1985) advocate the implementation of augmentative systems with individuals before Stage 5 to facilitate the development of interactional communicative acts and prelinguistic skills. Resolving the issue of communicative competency versus production deficits may therefore be dependent on first implementing augmentative techniques and then assessing skills.

Providing a method to enhance prelinguistic development may be a particular necessity when multihandicapping conditions exist. McCormick (1984) noted that children with both hearing and visual impairments had severe communication difficulties and made limited progress in language development. Siegal-Causey, Ernst, and Guess (1989) suggested that children with deaf-blindness in many cases function at a developmental stage that is very similar to the prelinguistic level of nondisabled children. However, because of the nature of their disabilities, children with deaf-blindness in combination with other disabilities may never develop intentional communication. Because they may use unconventional and possibly idiosyncratic signals, their attempts to communicate may not be recognized and therefore responded to by adults. Also these children are possible candidates for the development of "learned helplessness" (Seligman, 1975) as a result of their inability to control environmental events (Brinker & Lewis, 1982a; Watson, 1966). An augmentative communication device may provide a means by which a child who is disabled can produce a signal that is conventional and consistent and therefore enhance the chances of obtaining a response from persons in the environment (e.g., parents, caregivers, and teachers).

Augmentative techniques and devices have been implemented with individuals with severe multihandicaps (see Beukelman, Yorkston, & Dowden, 1985; Blackstone & Bruskin, 1986). Technological advances have expanded the potential for users of augmentative devices who have varied and severe disabilities. For instance, Meyers (1984) reported a case study in which a 26-month-old-blind, nonspeaking child with cerebral palsy learned to activate a microcomputer by hitting a switch to "request" activities with his mother. A voice synthesizer "spoke" the request, to which the child's mother responded with the appropriate activity. In this situation the microcomputer acted as an augmentative communication device. Unfortunately there is a paucity of research into implementing augmentative systems with individuals whose multihandicapping conditions include deaf-blindness. Mathy-Laikko, Ratcliff, Villarruel, and Yoder (1989) stressed the need to address a number of basic issues when considering augmentative systems with this population, including whether visual, tactile, or three-dimensional abstract symbols would be the most appropriate type of symbol system.

Studies of children with blindness or deaf-blindness have indicated that the tactile modality may be utilized to compensate for their sensory deficits (Curtis, 1975; Fraiberg, 1977). Further, for children with deaf-blindness, the tactile modality may be the only sensory avenue that can be used for developing symbolic communication skills. Preliminary work is needed, however, in the development of tactile-based augmentative systems. The present study was designed to address two questions regarding the use of the tactile modality for communication by children with deaf-blindness. The first question was aimed at examining tactile surface preferences (out of a choice of four) of a child with deaf-blindness and severe/profound cognitive and motor impairments. The decision to use tactile surfaces as opposed to tangible objects or shapes was based on information regarding the tactile exploration skills of individuals who are nonhandicapped and those who are blind. Gottfried and Rose (1980) found that normal infants of 1 year of age were able to discriminate between tactile objects through tactile manipulation. Although nondisabled individuals demonstrate object manipulation and exploration within the first 2 years of development (Gottfried & Rose, 1980; Piaget, 1963), this may not be evident in children with motor disabilities and may be delayed in infants who are blind (Fraiberg, 1968). Passive, global exploration that utilizes mainly the palm of the hand (rather than finger and thumb) is the earliest type of tactile exploration to develop (Abravanel, 1968; Piaget & Inhelder, 1956). This type of exploration is sufficient for the discrimination of rough textures (Gibson, 1966; Revesz, 1950). Thus the use of tactile surfaces that vary in degrees of roughness can be discriminated using a method of exploration that requires limited cognitive and fine motor skills. An example of the utilization of tactile surfaces in a communication system was demonstrated in a recent case study by Locke and Mirenda (1988). The subject in this study, an 11-year-old nonspeaking boy with severe mental retardation and blindness, learned to request food items using a tactile communication board on which the symbols were materials of varied textures.

Our second aim was to determine if the pairing of a naturally occurring motor response (hitting a switch covered with the child's preferred tactile surface) with a response from a caregiver would result in an increase in the frequency of that motor response. The child in the present study, as well as having multiple handicaps, also was medically fragile and thus lived in a medically based residential care setting. Her ability and opportunity to control events in her environment had been severely limited. Therefore the present study aimed to provide the child with a method of obtaining her caregiver's attention and of communicating a desire for interaction.

Method

Participants

The participants in this study were L.S., an 8.4-year-old girl, and J. one of her caregivers. J. had been employed at the facility for 7 years and had worked with L.S. for 4 years. L.S.'s handicaps were a severe motor impairment as a result of atonic cerebral palsy, profound mental retardation (according to the AAMD classification, Grossman, 1983), cortical blindness, and a moderate, bilateral sensorineural hearing loss (BOA testing indicated localization tc speech at a 40 dB threshold). L.S. had resided in a state facility for the developmentally disabled for 7 years. She attended a day program for the handicapped.

Prior to L.S.'s participation in the study her adaptive behavior and language skills were assessed using the Wisconsin Behavior Rating Scale (Song et al., 1984) and the Callier-Azusa Scale (Stillman, 1978). Scores obtained on the WBRS indicated that L.S. was functioning within the profoundly retarded range on all subscales. Developmental language ages obtained on the Callier- Azusa Scale were 3 months for receptive and 5 months for expressive skills. From observations of L.S. interacting with her caregiver, it was evident that L.S. indicated distress by crying and pleasure by laughter and vocalization. She was responsive to social interactions, especially when tactile stimulation was included, with individuals in her environment and appeared to find this particularly enjoyable as indicated by laughing, vocalizing, and turning towards the individual.

Setting and Equipment

The study was carried out at L.S.'s residential facility. During each session L.S. was seated in her wheelchair and situated within her sleeping area on her ward, facing towards the ward activity area.

A wooden plywood crescent was placed on top of L.S.'s wheelchair laptray and secured with side clamps. On the crescent were four rectangular Zygo Tread switches (Zygo Industries, Inc., P.O. Box 1008, Portland, OR 97207-1008) measuring 2.5 by 5 inches (Switches 1 to 4). L.S.'s physical therapist was consulted to determine the optimum positioning for this device. The switches were adjusted to respond to 1.5 to 5 ounces of pressure so that the weight of L.S.'s hand resting on a switch was enough to activate it. Each switch was interfaced with a Toshiba 1100 portable computer (information available through commercial computer vendors), which was interfaced with a Votrax synthesizer (Votrax International, Inc., 1394 Rankin Drive, Troy, MI 48083), both of which were placed under L.S.'s wheelchair. The software used with the computer was Keytime, a program designed at the Trace Center (Trace Research and Development Center, University of Wisconsin-Madison, 1500 Highland Avenue, Madison, WI 53705) specifically for the data collection purposes of the present study. Also interfaced with the computer was a gating switch which was used as a timing device and was situated at the back of L.S.'s wheelchair.

Design

A basic ABA design was used to determine whether L.S. preferred any of four tactile surfaces. In the baseline (A) phase no tactile surfaces were used. In the B phase four tactile surfaces were introduced. The ABA was followed by a BC design to test the effect of pairing a contingent social response with a preferred surface texture. Therefore in the C phase a switch covered with the surface that the subject demonstrated a preference for (in B) was paired with the reinforcement of interaction from the caregiver. Further detail for each phase is provided below.

Procedures

Baseline. The aim of the baseline was to test for a possible position preference. The switches were bald (no tactile covering). The task was for L.S. to activate any one of the four switches on her lap tray without physical or verbal prompts. An experimenter set up the equipment and stayed in close proximity in order to deal with any unanticipated events. Whenever L.S. activated any one of the switches the Votrax synthesized-speech responded with "Hello L." It was not possible to determine L.S.'s perception or comprehension of the message delivered by the speech synthesizer. However the message was not intended as a reinforcer for L.S. (although it may have been so). The message was included in the baseline condition as a speech synthesized message was to be used during the social contingency treatment phase and therefore helped to maintain consistency in all but the treatment variables across all phases. All sessions were of 60-minute duration and occurred across consecutive weekdays (Monday through Friday).

Surface preference (SP). For the B phase each of Switches 1 to 4 was covered with one of four different tactile surface textures: aluminum (AL), velveteen (VE), quilt batting (BA) or sandpaper (SP). The primary aim of this first treatment condition was to test for any preferences for surface textures. However, to differentiate surface preference from position preference four different configurations were tested as depicted in Table 1. L.S. was allowed to initiate her own activations of the switches without the use of verbal or physical prompts. Activating any of the switches resulted in the greeting of "Hello L." by the speech synthesizer as in the baseline phase (A).

Social Contingency (SC). For the first C phase (SC_1) the surface texture for which L.S. showed a preference (i.e., activated with the greatest frequency during the B phases) was paired with a spoken request by the speech synthesizer, "J. please come and play with me." Again it was difficult to determine how intelligible or comprehensible this message was for L.S. The purpose of the vocal message was to attract J.'s attention, even when she was not in close proximity to L.S. and to request interaction with J. Activation (which again occurred without physical or verbal prompts) of this Contingency Switch resulted in J.'s responding to the request for play by interacting with L.S. Specifically the steps followed by J. were as follows: (a) walking over to L.S., (b) turning on the gating switch (to enable the duration of the interaction to be recorded by the computer), (c) placing L.S.'s hand on the Contingency Switch (to reinforce the association between the tactile surface and the contingent event), (d) socially interacting with L.S. for 15 to 25 seconds by talking, providing tactile stimulation, and 'rough-housing,' (e) ceasing activity, (f) turning the gating switch off to signal the computer to terminate the interaction session, and (g) walking away. It should be noted that at certain times J. was not in the immediate vicinity where she could hear the speech synthesizer, being involved in her usual tasks on the ward during the sessions. When this occurred the

Table 1

Configurations for Tactile Surfaces Across Switches for Treatment Phases

	Switch/Position			
Phase	1	2	3	4
SP1	BA	AL	VE	SP
SP2	AL	BA	SP	VE
SP3	SP	VE	AL	BA
SP4	VE	SP	BA	AL
SC1	VE	SP	BA	AL
SC2	VE	SP	AL	BA

Note: SP=surface preference; SC=social contingency; AL=aluminium; BA=batting; SP=sand paper; VE=velveteen.

experimenter, with whom L.S. was familiar, provided the contingency response following the same steps as outlined.

Activation of any of the other three switches, which remained covered with each of one of the remaining surface textures, resulted in the same response as in baseline (greeting by the speech synthesizer). No contingent social reinforcement was delivered following activation of any of the three noncontingency switches. All sessions lasted 60 minutes and were carried out on weekdays.

The second stage of the SC treatment (SC_2) was implemented to determine the effect of changing the Contingency Switch to a second tactile surface. It was anticipated that should any observed increase in activation of SC_1 have been due to treatment (the social contingent reinforcement), then this effect could be repeated in SC_2 with another tactile surface for which L.S. had not necessarily shown any preference. The tactile surface (BA) used for the Contingency Switch was the one for which L.S. had not shown any particular preference for (as indicated by relatively low frequencies of activation) during previous SP phase. The tactile surface used for the Contingency Switch in SC_1 was used on a noncontingency switch. All other procedures were as in SC_1.

Data Collection

All data collection was carried out through a Toshiba 1100 computer. The Keytime software program enabled both frequency and duration information to be recorded through activation of any of the five switches. It was felt that both frequency of activations and their durations would provide information on L.S.'s preference for and interest in each switch.

The gating switch (Switch 5) was used for two purposes. First, when the gating switch was turned on, activations of Switches 1 to 4 were not recorded in the Keytime program. This was done so that the assisted activations of the contingency switch made during the reinforcement phase (i.e., when J. placed L.S.'s hand on the contingency switch) would not be counted in the frequency data. Second, the time between activation and deactivation of the gating switch was recorded in the computer data logging program, thus providing information on the duration of the contingent social interactions between J. and L.S.

Results and Discussion

The present study was designed to evaluate the ability of a child with multihandicaps, including deaf-blindness, to demonstrate a tactile preference and to learn to pair a preferred surface with a socially contingent response from her primary caregiver.

Durational Information

The data collection procedure yielded information on the length of time that each switch was depressed for each activation. Mean depression times for switches across sessions within each phase ranged from .09 to 17.1 seconds; however, no patterns were discernable. Overall, L.S. depressed switches for only brief periods with occasionally lengthier depressions possibly being related to physical problems, for example, reflexive behavior. These results may be indicative of L.S.'s lack of interest in prolonged exploration of the switches, indicating that duration was not a good measure of her interest or preference for surfaces.

Frequency Data

The means medians, and ranges for the frequency of switch closures for Switches 1, 2, 3 and 4 for each phase are presented in Table 2. It is evident that L.'s total level of activation varied across phases with the lowest frequencies occurring during the first baseline ($\bar{x}$ range=6.3-14.8). The pattern of L.S.'s performance may be indicative of a satiation effect. As shown in Table 2 the greatest jump in frequency of activations occurred between Baseline 1 and SP_1. A stabilization in the level of activation occurred in SP_2 and SP_3. The fact that the frequency of activations in Baseline 2 did not return to the levels in Baseline 1 suggests a learning effect (Hersen & Barlow, 1976). It is possible, for example, that L.S. may have increased her activations of the switches during this phase in an attempt to find the tactile surfaces. A relatively large increase in activations occurred in SP_4 (similar to the increase from Baseline 1 to SP_1). This second increase also was followed by a leveling off and stabilization in SC_1 and SC_2. Other factors such as L.S.'s fluctuating health status (resulting from the nature of her disabilities) and general interest levels may have contributed to the variability in her total activations of switches.

Proportional Frequency Data

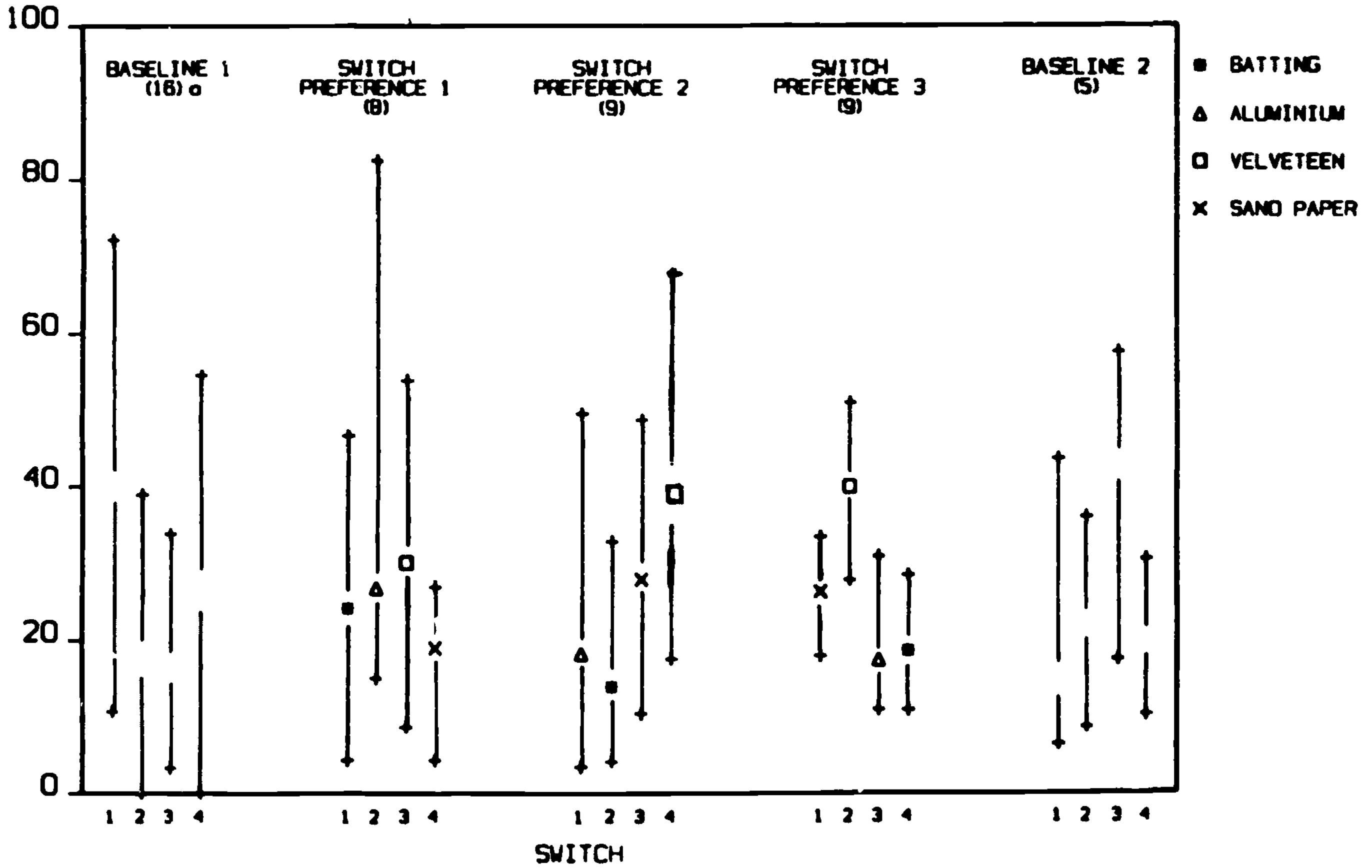
The variability in frequency of switch activations across phases led to problems in comparing frequencies across phases. Therefore the data was converted to proportions that allowed the examination of the activity for each switch in relation to other switches both within and across sessions. The proportional data was calculated by taking the number of times each switch was activated divided by the total number of switch activations per session multiplied by 100 to obtain a percentage. The results are discussed in terms of the proportional means and ranges of activations for each switch, as presented in Figure 1 for the Surface Preference (ABA) phases and Figure 2 for the Social Contingency (BC) phases.

Surface preference. Inspection of the results for Baseline 1 in Figure 1 indicates that L.S. appeared to favor the switches at the extreme ends of the configuration (Switches 1 and 4), especially Switch 1. The two middle switches received significantly fewer activations. However the ranges for Switches 1 and 4 indicate that there was a great deal of variability across sessions. The introduction of surface textures in the first treatment phase (SP_1) led to a preference for the two middle switches (2 and 3). When comparing the proportional means for the sessions in SP_1 it seems that L.S. favored the velveteen surface, followed by aluminum. While the proportional ranges for SP_1 indicate that there were instances where either BA or AL was preferred over VE, these actually represent only a total of four instances where this was the case, three for BA, and one for AL. Proportional range information indicates similarities between velveteen and aluminum, but comparison of means indicates an overall preference for velveteen during SP_2. The preference for velveteen is more pronounced during SP_3 when the difference between the mean frequency proportions for velveteen and all other surfaces is increased, while less variability is evident. The surface preference evidenced by L.S. appears stronger and more consistent than the position preference noted for Baseline 1 as the proportional mean for velveteen remains high despite the random rotation of its position on the laptray

Table 2

Frequency of Switch Activations

Phase		Position 1	2	3	4
Baseline 1	Mean	14.8	6 3	7 3	10.6
	Median	14.0	5 5	5.5	7.5
	Min	3 0	0.0	1.0	0.0
	Max	50 0	13.0	25.0	42.0
Surface Preference 1					
Surface		BA	AL	VE	SP
	Mean	33.0	32.4	58 9	34 2
	Median	33.5	30 0	48 0	27.5
	Min	1.0	9 0	2.0	1.0
	Max	71.0	60.0	138.0	86.0
Switch Preference 2					
Surface		AL	BA	SP	VE
	Mean	11 6	17.9	32.6	31.7
	Median	11.0	5 0	16 0	30.0
	Min	5 0	2 0	6.0	7.0
	Max	23.0	77 0	139 0	59 0
Switch Preference 3					
Surface		SP	VE	AL	BA
	Mean	14 3	22 7	9.3	10.0
	Median	12 0	26 0	10.0	8.0
	Min	7.0	13.0	5 0	7.0
	Max	23.0	28 0	17 0	19.0
Baseline 2	Mean	11 2	26.0	61 4	24.4
	Median	10 0	23.0	42.0	16.0
	Min	3 0	2.0	4.0	4 0
	Max	18 0	56.0	162.0	67.0
Switch Preference 4					
Surface		VE	SP	BA	AL
	Mean	50.7	31.4	43.8	33.0
	Median	55 0	32.0	28 0	25.0
	Min	16 0	2.0	9.0	4.0
	Max	75 0	71.0	107.0	91.0
Social Contingency 1					
Surface		VE	SP	BA	AL
	Mean	41.0	21.7	25 3	30.7
	Median	45.0	15 0	24 0	30.0
	Min	5.0	1 0	1 0	2.0
	Max	89.0	62 0	55 0	91.0
Social Contingency 2					
Surface		VE	SP	AL	BA
	Mean	25.3	19.9	23.8	31.4
	Median	28.0	18 0	20.5	33.0
	Min	5.0	1.0	1.0	0.0
	Max	52.0	60.0	61 0	67.0



a. Number of sessions per phase

Figure 1

Proportional Means and Ranges for Switch Preference (A,B,A) Design

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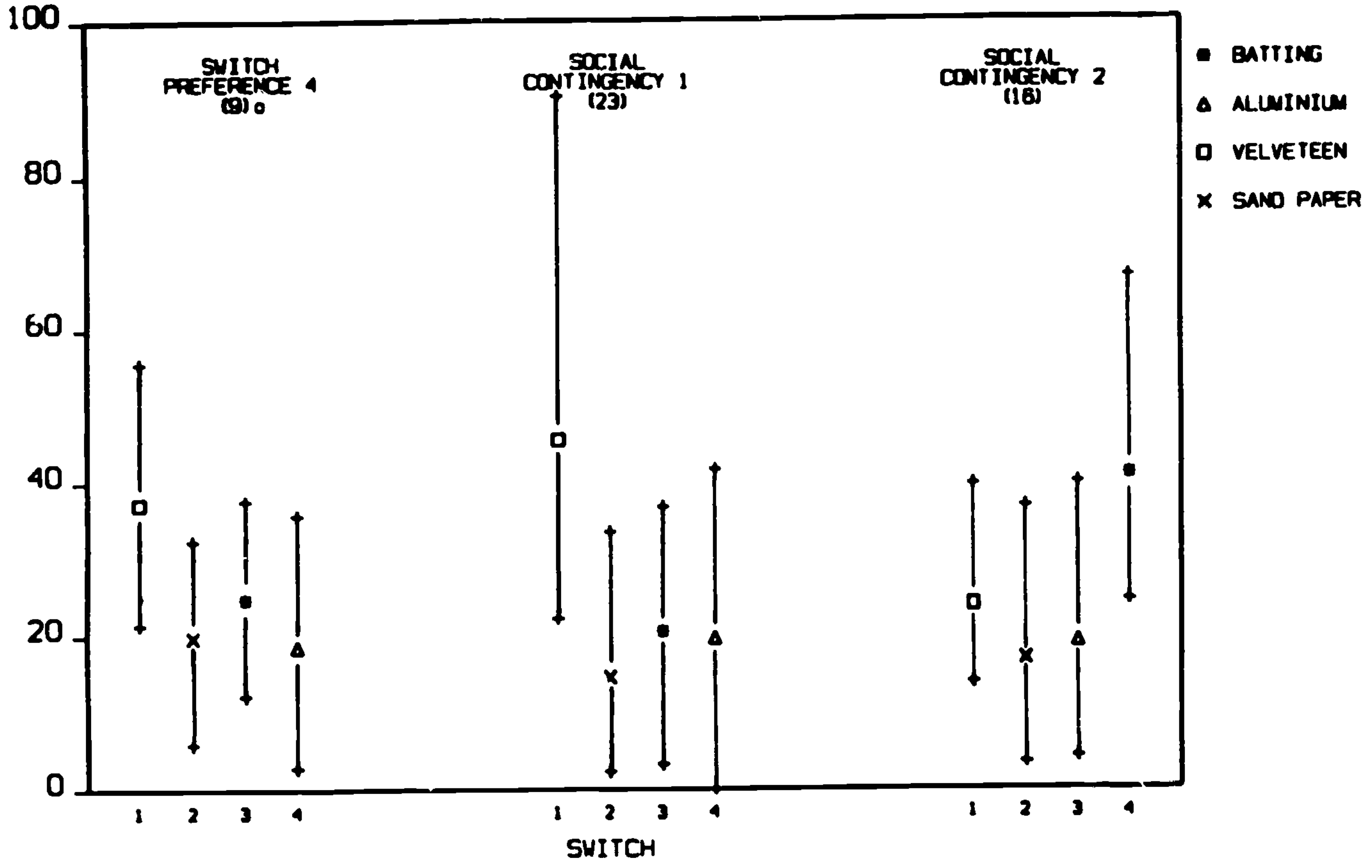

a. Number of sessions per phase

Figure 2

Proportional Means and Ranges for Social Contingency (A,B) Design configuration. The results for Baseline 2 (return to bald surfaces) indicate a preference for Switch 3. It is difficult to explain L.S.'s preference for this switch as it received relatively few activations during Baseline 1, nor does it reflect the last position for velveteen. However, it is possible that L.S. remembered that velveteen had last been in a middle position and was still seeking it, a factor which may account for the recurrence of a great deal of variability.

The results of the Surface Preference phases indicate that L.S. tended to prefer one of four highly discriminable surface textures, and that this preference appeared stronger than an initial position preference. L.S's preference for velveteen was somewhat variable during SP_1 and SP_2 during which there were sessions when a preference for aluminum or batting was evident, but stabilized in SP_3.

Social contingency. The aim of the Social Contingency (SC) phases of the study was to determine if L.'s proportion of activations of the switch with her preferred surface would increase if it was paired with the contingency of social input from her caregiver. Inspection of Figure 2 indicates that L.S.'s activation of the velveteen-covered switch was proportionately much higher during SC_1, reaching a maximum of 90.3 percent, than during SP_4. However, it is evident from Table 2 that the total frequency of activations was in fact less during SC_1. These results may reflect an increased selectivity in L.S.'s activations. She may have become more goal directed and less exploratory in her activations of the switches. On the other hand, the results may reflect a satiation effect.

During SC_2 the contingency switch was paired with the surface of batting, (a surface for which L.S. had not shown a pattern of preference in the SP phase). As shown in Figure 2, there was an increase in the mean proportion of activations for batting over the other three surfaces, including velveteen. The reward of social interaction was apparently more powerful than her surface preference. As in SC_1 there was no increase in the frequency of activations.

Conclusions and Implications

The present study demonstrated that a child with multihandicaps including deaf-blindness did develop a preference for certain tactile surfaces. When the surface for which an overall preference had been shown was paired with a contingency of social interaction, she increased her proportional use of the tactile surface in comparison with other surfaces. The power of the contingent reinforcement was demonstrated when it was used to shift the child's preference from one surface texture to another.

The results obtained in the present study suggest that the tactile surfaces may be viable for use as "symbols" on augmentative communication systems with individuals who have both deafness and blindness as well as other handicapping conditions. In the case study by Locke and Mirenda (1988), a more advanced tactile augmentative system was implemented in which their subject was able to choose and request specific food items. The next step in an augmentative communication program with the child in the present study would be to match the various tactile surfaces with specific items or activities so that she could communicate her preferences.

One problem with attempting to implement augmentative systems with individuals with severe handicaps is that they may not have a wide range of preferences. This may be the result of a history of few opportunities to make choices and therefore to develop preferences and because of physical limitations. Often the earliest choices made by young children are of favored food items. Also food is frequently used early in augmentative communication programs as it is often highly motivating to the individual and provides an immediate and meaningful consequence to the communication. Unfortunately food was not an option for the child in the present study as she received her nutrients through a gastrostomy tube. Preferences for other items or for activities may be difficult to determine when severe communication handicaps are present. Dattilo (1986; 1987) and Dattilo and Mirenda (1987) utilized a computerized assessment procedure to determine the leisure preferences of individuals with severe handicaps. The activities used in these studies included music, watching videos, and feeling vibrations from a vibrating pad. The assessment procedures described by Dattilo and Mirenda (1987) consisted of the number of switch activations and the amount of time spent on a particular activity. The results of the present study indicate that a similar method may be useful for determining the preferences of L.S. This information could be utilized to develop an augmentative communication system that would allow requests for items and activities as well as interaction with those in her environment.

Within the limits of the present study, it was evident that the child was able to initiate interaction with her caregiver. While numerous other communicative functions and choices will need to be considered for this child, it was felt that providing L.S. with this capability would help to reduce the effects of learned helplessness (Brinker & Lewis, 1982b). Furthermore, as communication skills are founded in social interactions (Bruner, 1982; Rogow, 1984), it was felt that the computerized system enabled L.S. to perform a function that would form the basis for further development of communicative skills.

The present study lacks generalizability. This problem results not only from it's being limited to one individual but also to the characteristic heterogeneity of individuals who have severe handicaps. Most clinical work with persons who have severe communicative handicaps is naturally experimental. It is suggested that, either in further research or in attempts to clinically apply the procedures used in this study, shorter sessions be used so as to reduce the risk of satiation that was a possible confounding variable in the results obtained.

The results do, however, highlight some important considerations. First, physical limitations may make certain positions on an augmentative board or device appear to be favored, a factor which may interfere with learning to associate contingency events with activation of a switch. In the present study, L.S. at first activated switches placed at the extreme ends more frequently than middle switches. However, her increased activation of the middle switches in later phases ruled out the possibility that her choice of switches was determined by the physical ease with which she could access them.

A second consideration in using tactile surfaces in augmentative devices is possible limitations in the number of discriminable surfaces. Surfaces which vary along the dimension of roughness have been found to be highly discriminable even when only a gross, stroking touch is used (Gibson, 1966; Revesz, 1950). Furthermore, 1-year-old infants have been found to be capable of tactile recognition memory (Gottfried & Rose, 1980). These factors suggest that severely handicapped individuals could be taught to discriminate between a number of surfaces. It may be possible that once an individual has learned that behaviors can have an effect on environment (i.e., contingency awareness) then they may learn to associate different contingencies with particular surface textures.

A third problem in considering an system occurs when an individual fails to demonstrate skills thought to be prerequisite to such a program (e.g., Chapman & Miller, 1980). In the present study, L.S.'s use of the contingency switch to "request" social interaction was indicative of goal-directed behavior and the utilization of novel means to achieve a familiar end. It is difficult to know whether her failure to demonstrate such skills before intervention was a result of deficits in competence or in performance. It is possible that either the system used in the present study enabled her to demonstrate certain competencies or that the intervention was responsible for the development of such competencies. Certainly the results of the present study support Reichle and Karlan (1985) in their recommendation that children who fail to demonstrate certain prelinguistic sensorimotor skills nonetheless be included in augmentative communication programs.

Much investigation is needed into the development of augmentative systems for individuals who have severe multihandicaps, including deaf-blindness. Utilization of the tactile modality may provide these individuals with a means of controlling their environment. The nature of an individual's disabilities may limit the extent of that control. Nonetheless the effect on their interactions with adults in the environment may encourage the assignment of meaning to the child's communicative attempts (Bates, 1979) and, in turn, further communication development.

Acknowledgements

Portions of this paper were presented at the 1988 Biennial ISAAC Conference, Anaheim, California, October 23-26.

The authors are grateful to Scott Schwartz for assistance in data collection, and to Charity Rowland and Pat Mirenda for comments on earlier versions of the manuscript.

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VI. Play as an Intervention Strategy with Young Children with Deaf-Blindness

by

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Beginning at birth, infants initiate interactions and respond to the actions of others. These early actions are gradually shaped into meaningful social exchanges. Prior to the emergence of language, infants use their senses as their primary means of exploring people and objects in their world. As they develop cognitive and social skills, infants can share their understanding of the world with caregivers through joint attention to an object, and through affective displays of smiling and laughter. Gradually, infants begin to organize their understanding of the environment around them and to share experiences with others through actions, gestures, sounds, and words.

Play is the context for most of the infant's early social and communicative experiences. Play provides the preverbal child both with the opportunities to make discoveries about the physical world through the manipulation and exploration of objects and also with occasions to practice the social interactions--the turn taking, imitation, and use of symbols and gestures--that are precursors for communication.

Young children with the dual sensory impairments of deafness and blindness, often compounded by mental retardation, have severely reduced opportunities to make discoveries about their environment and to practice sharing their experiences with others. They are likely to hear and see fewer things to explore or act upon, since much of their perceived world is within an arm's reach. Parents and other caregivers are encouraged to make sure that objects, persons, and experiences are within the child's limited world, and that these experiences and events invite the child to explore or interact. Play intervention therefore offers an opportunity for exploring surroundings, experiencing these explorations with a parent or careprovider, and being reinforced by the pleasurable context of the play activity. In this chapter we first review current literature on cognition and communication as it relates to the play of young children with handicaps. Second, a rationale for our investigation of play as an intervention strategy for young children with deaf-blindness is presented. Finally, findings from our investigation of play in deaf-blind children are reported and implications for instruction are discussed.

Relationships Observed Among Play, Communication, and Cognition

Piagetian theory (Piaget, 1962) characterizes the child's first 2 years as a period in which sensorimotor experiences contribute to the development of representation, first through symbolic or representational play and later through language. Others (Bates, Benigni, Bretherton, Camaioni, & Volterra, 1979) have found support for Piaget's theory and have described their observations of children demonstrating symbolic conduct in action or play, and later through language. Clark's (1975) explanation of the precursors of language focus on the infant's early action and interactions with his or her mother. Clark describes a progression in which actions first lead to gestures that represent action and finally to arbitrary sounds that represent actions. Play routines, in their predictable formats (Ratner & Bruner, 1978) and their reciprocal turn-taking sequences (Garvey, 1974), offer children natural settings in which to acquire language.

Researchers have since attempted to identify specific cognitive abilities and early preverbal communicative behaviors to determine how they are related. Harding (1984) examined prelinguistic acts of infants and their relation to cognitive tasks and found that, as the infants' cognitive abilities developed, their communicative behaviors became more organized and intentional. At the same time, the behavior of the infants' mothers changed, and mothers set up expectations for the infants to use conventional communicative behaviors. The findings indicate that the infant's developing cognitive structures interact with the caregiver's behaviors and expectations, leading to the infant's intention to communicate.

The work of Bates and other researchers (Corrigan, 1981; Sinclair, 1970; Smilansky, 1968; Werner & Kaplan, 1963) focusses on the prerequisite cognitive skills that play and language share, such as the ability to understand the relationship between a sign and its referent, to think about a complete action, and to be independent of the here-and-now (Bates, Bretherton, Shore, & McNew, 1984; Sachs, 1983). Bates et al. (1979) reported that measures of play correlated with cognitive measures and predicted language and gesture. Specifically, combinative play predicted language comprehension and production, and symbolic play predicted language production.

Shore (1986) examined the combinative skills of 18- to 20-month-olds in language, symbolic play, block building, and nonsemantic action sequences and found that the use of word combinations was correlated with combinative abilities in symbolic play. Shore concluded that the emergence of multiword speech is related to the ability to isolate elements and combine them in new ways and to distinguish the essential characteristics of object groups.

The relationship between children's early communication behaviors and their cognitive development has been studied by Harding and Golinkoff (1977) and by Halpern and Aviezer (1976), who observed correlations between object permanence and language. Nicolich (1975, 1977) has described the transition from presymbolic activities to symbolic games and expressions through correlational investigations. She found that children's use of multiword utterances corresponded to their use of planned sequences in their play behaviors. Greenfield and her colleagues (Goodson & Greenfield, 1975; Greenfield, Nelson, & Saltman, 1972) observed that language and play reflect the development of similar underlying cognitive skills.

In their study of 19 preterm and 20 full-term infants, Ungerer and Sigman (1984) observed various associations between play and language. Subjects were tested at 13 1/2 and 22 months of age on an observational play assessment, the Casati and Levine (1968) measure of sensorimotor behaviors, the Gesell Scales (Knobloch & Pasaminick, 1974), and the Receptive and Expressive Emergent Language Scale (Bzoch & League, 1971). The researchers observed significant positive correlations between other-directed functional play and language at both test times.

The question has been raised whether the child's intention to share meaning is a necessary attribute of children's early intentional communication behaviors, or whether it is the adult who often attributes this intentionality to the child.

Scoville (1984) pointed out the difficulty of pinpointing the origins of intentionality and suggests that intention be regarded as an interpersonal rather than a cognitive structure. Scoville's position, like that of Bruner, Roy, and Ratner (1982), attests to the importance of the caregiver/teacher's role in stimulating the child's early requesting behaviors in play and routine interactions. If one takes the position that early communication has a functional rather than a grammatical basis, then play activities can be considered to be indispensable for the child's communication development.

A body of research documents the deficits that children with handicaps experience in play, cognitive, and language development (Darbyshire, 1977; Hulme & Lunzer, 1966; Kaplan & McHale, 1979; Mogford, 1977). In Snyder's (1975) study of nonhandicapped children and children with language delays, the means-end measures of cognitive development were significantly lower for children with language delays. Wing, Gould, Yeates, and Brierly (1977) reported that children with developmental delays did not demonstrate symbolic play behaviors until they attained a mental age of 20 months, and Jeffree and McConkey (1976) reported significant correlations between play and developmental age in both normally developing children and children with developmental delays. Finally, play level was more highly correlated with mental age than with chronological age in Hill and McCune-Nicholich's (1981) study of children with Down syndrome.

Other researchers (Johnston & Ramstead, 1977; Moorehead & Ingram, 1973) have observed that children with language delays do poorly on tests of representation and symbol use. In their study of children with Down syndrome, Moore et al. (1977) reported significant correlations between object permanence and mean length of utterance. Casby and Ruder (1983) matched two groups of children, 20 without disabilities and 29 children with mental retardation but at similar levels of language development, and found that there were no quantitative differences between the symbolic play of the two groups. The researchers observed a significantly positive relationship between children's language level and their symbolic play scores. More recently, Roth and Clark (1987) examined the symbolic play and social participation of six language-impaired and eight nondelayed children. The results of three play assessments indicated that the language-impaired children had significant deficits in symbolic play, adaptation of play behaviors, and integration of play materials. Further, the language-impaired children also were deficient in social interactions with peers, as well as in solitary and parallel play behaviors. Roth and Clark stressed the implications of their results: that impairments in symbolic play can be as great or greater than linguistic impairments and that there is great variation in the relationship between play and language in the developing child.

Rationale for This Study

Assessment of children with deaf-blindness presents extraordinary challenges to those psychologists or other members of multidisciplinary teams responsible for their assessment. Traditional assessment measures commonly used with children with mild or moderate handicaps are based on the premise that these children have intact auditory and visual systems. Given the paucity of psychological and educational methods to meet assessment and instructional needs of children with sensory impairments, teachers and other field specialists have attempted to adapt traditional developmental assessments and instructional procedures to serve these children who are deaf and blind. Stillman's (1978)

Callier-Azusa Scale is probably the most widely used example of this type of adaptation. Fewell and her colleagues (Cole, Swisher, Thompson & Fewell, 1985; Diebold, Curtis, & DuBose, 1978a, b; DuBose, 1979a, b; Fewell-DuBose, 1982; Kiernan & DuBose, 1974) have also used similar adaptations of traditional measures to meet these pressing needs.

Although adaptations of traditional procedures have helped us learn much about the assessment of young children with deaf-blindness, the procedures have also convinced us that we have failed to measure many of the behaviors and skills that we observed as these children engaged in informal, highly motivating activities. These experiences led us to investigate the use of play for purposes of both assessment and instruction. Children's play, as we have noted in the literature reviewed above and in our more in-depth chapters on this topic (Fewell & Kaminski, 1988; Finn, Fewell, & Vadasy, 1988; Rich, 1987) reflects associated and underlying communication and cognition skills. It was our desire to investigate the relationships among these domains in a population of deaf-blind children, and to determine whether instructional programs that focus on the facilitation of play development would have an impact on children's play, language, and communication skills. In Fewell and Rich (:37) we presented our findings concerning the relationship of play to cognition and language in deaf-blind children. In this study, we address our second concern related to changes in developmental skills when instruction is presented through the medium of play. Specifically we asked: Would children's performances on measures of play, communication skills (receptive, expressive and speech skills) and cognition change over time when children were provided an intervention centered around play skills?

Method

Subjects

The subjects in this study included 10 children, all listed on their state registries for deaf-blind individuals. The subjects were recruited from Washington and Minnesota. Demographic data on the subjects is presented in Table 1. All of the children were moderately to severely impaired with dual sensory impairments and attended full- or half-day public school programs, and all were recommended for participation in this study by their teachers and program coordinators. The group included six males and four females who ranged in age from 3 years 1 month to 5 years 7 months at pretest. Their mean chronological age was 4 years 4 months, and their median chronological age was 4 years 2 months. Due to prolonged hospitalization for one child, a testing problem with another child, and absenteeism with two other children analyses were limited to six to nine subjects. The fact that the examiners were located in different locales from most of the subjects may have contributed to this problem. If subjects were not present on the days the examiners traveled to the site for scheduled testing, it was not possible to reschedule testing.

Measures

All children were evaluated with six measures at several intervals over a 2-year period. The following measures were selected to assess the children's cognitive, communication, social, and play skills.

Table 1

Subject Characteristics

			Primary Sensory Impairment			
ID#	(yr-mo) Age	Sex	Vision	Hearing	Other Handicaps	State of Residence
1	3-1	M		X	X	MN
2	3-6	F		X		MN
3	4-2	M	X	X		WA
4	5-6	M		X	X	MN
5	4-3	F	X			MN
6	5-1	F	X	X		WA
7	3-9	M		X	X	MN
8	5-7	M		X		WA
9	3-9	F		X		WA
10	4-6	M		X	X	WA

The Play Assessment Scale (PAS) (Fewell, 1986). PAS is an experimental, observational measure of play development, consisting of 45 developmentally sequenced items appropriate for children between the ages of 2 and 36 months. The PAS procedures describe eight sets of toys to be gathered prior to administration. The examiner presents the child with one set of toys, based on the child's estimated developmental level, and then observes and scores the child at play. The toy sets are changed several times during the assessment to provide children maximal opportunities to demonstrate a wide range of play skills. The scale appears to be a nonthreatening, enjoyable procedure that taps areas of the child's development that are often underestimated by traditional measures. The examiner may observe the child in both spontaneous play situations and in elicited conditions. In this study, only the spontaneous play condition was scored, and a Play Age score was obtained.

Because the PAS is an experimental scale, only minimal information on its validity and reliability is available. Fewell (1986) administered the PAS and the Developmental Activities Screening Inventory II (DASI II) (Fewell & Langley, 1984) to 30 nonhandicapped children, mean CA of 19 months (range 4-36 months). When Play Ages were correlated with their Chronological Ages, a coefficient of .95 was obtained. When the children's mean Play Age was compared to the Developmental Age on the DASI II, a positive correlation of .91 was obtained. These high positive correlations suggest the Play Ages obtained on the PAS are consistent with the general and developmental ages of nonhandicapped children. Scale internal consistency has not yet been determined.

To establish interrater agreement in using the PAS, the examiners for this study were trained in the administration of the Scale. As a training criterion they achieved an agreement index of .90 based first on the scoring of videotapes designed for reliability testing and then on their observations of two children. This scale is scored in developmental Play Age equivalencies only, therefore age scores were used in all the analyses in this study.

The Callier Azusa Scale (CA) (Stillman, 1978). The CA was created at the Callier Center in Dallas, Texas, specifically for developmental assessment of children with deaf-blindness; it is also used for children with multiple handicaps and other handicapping conditions. The CA assesses (a) motor, (b) perceptual, (c) self-help and daily living skills, (d) cognitive, communication, and language, and (e) social development. The subscales are postural control, locomotion, fine motor, visual motor, vision, auditory, tactile, dressing, personal hygiene, feeding, toilet, cognition, receptive language, expressive language, speech, adults social, peers social, and environment. This scale, like the PAS, was developmentally based on normal sequences of development; however, the scale is not standardized.

The Early Intervention Developmental Profile (EIDP) - Volume 2 of Developmental Programming for Infants and Young Children (Schaefer & Moersch, 1981). The EIDP is a compilation of major developmental milestones for use with children whose skills fall within the birth to 36-month developmental range. The subscales within the EIDP are perceptual/fine motor, cognition, language, social/emotional, self-care, and gross motor. This scale has not been standardized; however, age-range assignment was developed based on standardization data and research of other instruments. Concurrent validity of the EIDP ranges from a low of .33 between the EIDP gross motor subtest and the Receptive-Expressive Emergent Language Scale, to a high of .96 between the EIDP social/emotional subtest and the Bayley Scales of Infant Development Mental Scale and between the EIDP cognitive subtest and the Bayley Mental Scale. The authors also reported significant correlations between the EIDP subtest and the Vineland Social Maturity Scale.

The Gestural Approach to Thought and Expression (GATE) (Langley, 1980) is an index of nonverbal communicative behaviors (facial expressions, gestures, visual tracking, laughing, touching, imitation, signing) and related social and cognitive skills arranged into age levels at intervals of 0 to 4, 4 to 8, 8 to 12, 12 to 18, 18 to 24, and 24 to 36-months. The GATE was designed to be used with children with deaf-blindness or single sensory handicaps. It produces a single communication age score. It is not a standardized measure; however, items were selected based on sequences of development reported in standardized tests and on information on development from research studies. Langley and Stagg (1980) reported an interobserver reliability coefficient of .99 in an administration to a group of 37 children, ages 14 to 228 months with multiple handicaps. They also found a strong positive relationship (r = .97) between the GATE and chronological age in a nondisabled group of 16 infants ages 4 to 27 months. Finally, they reported an index of consistency of .60 to .73 supporting ordinality of scale items, suggesting that as numbered items set higher the items fall along an advancing developmental continuum.

The Learning-Through-Play Checklist (PCL) (Fewell & Vadasy, 1983) is a guide for using a resource manual of play activities for children 0 to 3 years of age containing adaptations for physically, visually, and hearing impaired children. The checklist is used to determine the level at which to begin activities in each area. The checklist can be analyzed to obtain developmental levels in sensory, perception/fine motor, movement in space, cognitive, language, and social development. The checklist is not a standardized measure but has been developed from well-established developmental milestones. There have been no specific studies of the reliability or validity of this checklist.

The Wisconsin Behavior Rating Scale (WBRS) (Song et al., 1980) is a criterion-based as well as a norm-referenced instrument for use with individuals of all ages functioning at a developmental level under approximately 3 years. Alternative items are available for deaf-blind individuals. The subscales include gross motor, fine motor, expressive language, receptive language, play skills, socialization, domestic activity, eating, toileting, dressing, and grooming.

The WBRS was standardized on 325 residents of the Central Wisconsin Center for the Developmentally Disabled. The subjects ranged from 1 to 72 years of age, and 35 persons were identified as deaf and/or blind. Interrater reliability ranged from .87 to .99 for the subscales with a .95 score for the total scale. Concurrent validity was measured by comparison with the Fairview Self Help Scale (r = .93) and the Vineland Social Maturity Scale (r = 97). Construct validity was shown by measures of age differentiation, correlation with other tests, internal consistency, and factor analysis. Age equivalent norms were established by using scatter diagrams and regression curves with quadratic regression equations. Behavioral ages were validated by comparison with the Vineland Social Maturity Scale (Song et al., 1980). The revised version of the WBRS was used with subjects who were functioning above the 36-month level in at least one subtest. In the few cases where this happened, we report developmental age scores from the revised edition.

In this study we are reporting the single total score from two of the dependent measures, the PAS and the GATE. From the remaining measures, we have selected those subtests that are most closely applicable to the research questions of this investigation.

Assessment and Intervention Procedures

The literature on play and its relation to communication and cognitive development suggests that play interventions would be a recommended approach to intervention with children whose development in those areas is delayed or jeopardized. Sachs (1983) has summarized the opportunities that play offers the child in development of communication skills: its relaxed context and freedom from goal attainment; the context of shared attention to objects/events which facilitates vocabulary teaching; the reciprocal role structure and opportunities for variations, features inherent in language; and the opportunities provided to practice turn-taking skills, which are regarded as precursors to language. Therefore, the strategy that we have employed in our work within the Communication Skills Consortium includes play intervention and assessment. Subjects in this study received play activities designed to elicit behaviors that were absent or delayed. These activity packages consisted of about 10 play activities written to target specific communication skills and designed to be implemented during the course of the child's daily routines. Each child received one package tailored for school and one for home. The play activities were revised quarterly and children were assessed annually. An example of a child's activity is as follows:

OBJECTIVE: John will perform the same action on at least two persons or dolls.

RATIONALE: Children understand and internalize the meaning of an act when they spontaneously use the action in several appropriate circumstances.

ACTIVITY: Combing the hair of two persons (B, DB, D)

PROCEDURES: After John has learned to perform a dressing skill with another person or doll, help him learn to pay attention to two people and apply the skill to 2 people or dolls in sequence. For example, if John enjoys brushing or combing a doll's hair, help him brush the hair of two different dolls in sequence. Place two dolls in front of John and draw his attention to each doll. Say/sign "COMB BOTH DOLLS' HAIR," then say/sign "COMB BIG/LITTLE DOLL" as you comb each doll's hair. Give John the comb and point to, or have him feel each doll. Prompt him to comb each doll's hair, and gradually fade your verbal/sign prompts. If John enjoys combing his own hair, have him comb his hair then your hair or a doll's hair.

Try this activity using the following suggestions:

POSITION: John is sitting on the floor, you are opposite him
LIGHTING: should be from behind John's shoulder
INSTRUCTIONS: cues should be signed and said
WHERE: in living room or play area
WHEN: family members are playing with John

This activity will also help to develop the following related COMMUNICATION SKILL: This activity helps the child apply the same action to different people in sequence. This may help John understand sentences with a direct object -- "COMB (Mommy)" and (John).

All children participating in this study were assessed between February and April of 1985, again between February and April of 1986, and for a final time between February and April, 1987. The first of the activity packets were developed in May, 1985, and were first used in June, 1985. These initial packets were followed by four other activity packets, with a 3-month period between mailings. The subjects in this intervention study thus participated for an 18-month period that ended in 1986.

Analysis and Results

The impact of the play activities on the subjects with deaf-blindness was measured through analyses of pre- to posttest differences in developmental age scores. The four areas examined were play, language, cognition, and social skills. Given the major problems these children have with expressive language, it was decided that a fifth area, speech, would be examined separately from the two language areas. On the basis of a literature review, these five areas were judged to be highly related to play. A previous study with this population (Fewell & Rich, 1987) confirmed very high correlations (.80 to .94) across these measures. However, the correlation between the mean play score and the Callier-Azusa Speech Subscale was only .28. These findings suggest considerable overlap may exist between the developmental performances of deaf-blind children on play measures and performances on measures of cognition, communication and social skills, but play is not related to actual speech performance scores. If less than six subjects had scores available for pre- and posttest analysis, those subtests were not analyzed due to the small subject size.

Table 2 presents the results for the 7 children who were enrolled in the experimental play activities group for the entire 2 years of the program and who were available at both the first and third testing periods. The table includes pre- and posttest developmental age score means, standard deviations, t-test results, and the probability of significance values. A correlated t-test (2 tailed) was used for data analysis.

Two play measures were examined, one of which was the primary measure of this study, the PAS. On the PAS, the children demonstrated a significant ($P = .005$) gain from pre- to posttesting of 8.29 months across the 15 to 18 months of intervention and the 24-month testing period. The other play measure used in this analysis was the play subtest from the WBRS-R. The mean gain score of 13.29 months on the WBRS-R was likewise significant ($P = .029$).

In the area of language and communication skills, seven test results were examined: two were receptive (RL) test scores, two were expressive (EL) results, and the remaining three scores (L) were single scores summarizing expressive and receptive skills. As can be seen in Table 3, significant gains from pre- to posttesting were found on five of the seven language measures. The two tests that did not reflect significant gains were two of the three tests in which a single language score is produced. The one single score that reached an acceptable level of significance was the GATE, a nonverbal test that measures language through signs and gestures.

Table 2

Analyses of Pre and Posttest Developmental Age Score Differences for Years 1 to 3 in Play, Language, Cognitive, Social, and Speech Tests

Domain and Test	N	Pretest (1985) Mean	Pretest (1985) SD	Posttest (1987) Mean	Posttest (1987) SD	T	P
Play							
PAS	7	12.57	9.85	20.86	14.26	-4.25	.005
WBRS-PL	7	17.00	19.45	32.29	22.14	-2.87	.029
Language							
WBRS-RL	7	19.14	19.99	26.86	25.31	-2.83	.030
CA-RL	7	13.93	11.76	22.57	16.03	-3.97	.007
WBRS-EL	7	13.57	12.45	25.71	17.55	-3.69	.010
CA-EL	7	15.50	12.59	23.29	12.53	-4.19	.006
PCL-L	7	18.36	16.65	21.5.	15.79	- .94	.383
EIDP-L	7	16.71	13.12	21.57	15.58	-1.35	.225
GATE	7	18.31	14.59	22.96	12.79	-2.61	.040
Cognitive							
EIDP-Cog.	7	17.29	13.67	22.57	13.04	-2.66	.037
CA-Cog.	7	14.50	16.50	35.43	28.37	-3.71	.010
PCL-Cog.	7	18.93	16.21	20.00	15.26	-0.69	.514
Social							
WBRS-Soc.	7	20.29	20.44	34.57	23.38	-2.55	.044
Speech							
CA-Speech	6	8.25	5.67	9.50	11.35	-0.45	.672

Note:
PAS = Play Assessment Scale
WBRS-PL = WBRS Play subscale
WBRS-RL = WBRS Receptive Language subscale
CA-RL = Callier Azusa Receptive Language subscale
WBRS-EL = WBRS Expressive Language subscale
CA-EL = Callier Azusa Expressive Language subscale
PCL-L = Play Checklist-Language
EIDP-L = EIDP Language subscale
EIDP-Cog = EIDP Cognitive subscale
CA-Cog = Callier Azusa Cognitive subscale
PCL-Cog = Play Checklist-Cognitive
WBRS-Soc = WBRS Social subscale
CA-Speech = Callier Azusa Speech subscale

Table 3

Analyses of Play, Language, Cognitive, and Environmental Pre and Post Test Developmental Age Scores

Measure	Group	N	Pretest (1985) Mean	Pretest (1985) SD	Posttest (1986) Mean	Posttest (1986) SD	Difference Mean	Difference SD	t
PAS	1	9	11.5	8.8	16.0	8.5	4.4	3.7	3.56**
CA-CCL	1	9	13.5	10.5	15.2	10.1	1.6	4.5	1.07
CA-RL	1	9	11.7	11.1	15.8	11.6	4.2	4.0	3.09**
CA-EL	1	9	13.9	11.4	18.1	11.1	4.2	5.7	2.20*
GATE	1	9	16.0	13.5	19.6	12.8	3.6	2.9	3.76**
CA-COG	1	9	12.8	14.8	18.8	18.4	5.9	7.9	-2.24*
CA-ENV	1	9	12.4	10.4	14.5	10.9	2.1	2.3	2.74*

Note: PAS = Play Assessment Scale
CA-CCL = Callier Azusa Cognition, Communication, and Language Area Summary
CA-RL = Callier Azusa, Receptive Language subscale
CA-EL = Callier Azusa, Expressive Language subscale
GATE = Gestural Approach to Thought and Expression
CA-COG = Callier Azusa, Cognition subscale
CA-ENV = Callier Azusa, Environment subscale

*p. = < .05

**p. = < .01

In the area of cognition, three measures were examined. Again, two of the three measures reached an acceptable level of significance. One measure of social skills (WBRS) was thought to be directly related to the focus of this intervention and was therefore included in the analysis. On this measure, a pre to posttest difference of 14 months was noted as significant ($p = .044$).

The final area examined, that of speech, included only one measure. In this area, the very small pre- to posttest difference of 1.25 months was not significant.

The developmental age scores of children were analyzed after the first year of intervention (1985-1986), at which time nine children had scores that were available for analysis. Pretest to posttest comparisons were made across one play score (PAS), four language scores including one summary score on the CA, which was a mean of the Cognition, Communication, and Language area scores for the Callier Expressive and Receptive subscales, and the GATE, one measure of cognition (Callier subscale), and one measure of environmental skills (Callier subscale). We then examined differences from pre- to posttest on developmental age scores for the subtests listed. As can be seen in Table 3, significant gains were made on six of the seven tests. Given the results presented in Tables 3, one can observe generally positive effects of the play activities on children.

Discussion

The major purpose of this investigation was to determine whether an intervention program that uses play to facilitate development could have an impact on children's performance on measures that assess areas related to play, as well as on an experimental measure of play skills.

The results support a carryover effect of the play intervention. For the children with deaf-blindness who participated in this intervention, positive and significant gains were seen in their play scores and in their scores in related areas. The results of these analyses offer some support that play activities can be used to enhance the development of deaf-blind children. The findings also suggest that the areas most likely affected will be those closely related to play, that is, language, cognition, and social skills.

These results, however, must be viewed with extreme caution. They present an initial, exploratory effort to understand the role play might have in supporting the deaf-blind child's development in the more traditional areas of cognition, communication, and social skill development. A number of the shortcomings of this study must be noted.

First, the small number of subjects was a serious limitation. With a sample as small as six or seven, the generalizability of the results is difficult to establish. Despite impressive gains from pre- to posttests, and despite the use of age scores as opposed to the more traditional quotient scores, it is virtually impossible to achieve an acceptable level of statistical significance,.

Second, the severity of the developmental delays of these children greatly hampered this research. It is very difficult to use developmental scales as dependent measures in order to assess changes in these children. As a result, we refrained from controlling for maturation and, in essence, have tested the hypothesis that the children would not gain at all during the intervention period. While this practice is quite common in early intervention programs in which handicapped children are tested with developmental measures (Bailey & Bricker, 1985; Hanson, 1985), it is not viewed as a valid procedure (Dunst, Cushing, & Vance, 1985). Our experience in using these measures leads us to echo the plea of Dunst et al. (1985) that alternative procedures be used to measure progress in severely handicapped children.

A third concern is also related to the measures used. Many of these measures are not standardized, and it is unwise to compare scores on one measure to those on others, despite the assumption of an underlying common developmental continuum. The measures were selected because they were among the best known to the authors for use with these children. In that regard, they were appropriate; however, they are all basically clinical tools and most need considerable refinement before they are suitable for research purposes. Again, we point out that it was necessary for us to use developmental age equivalent scores for some measures.

Fourth, the subjects were multihandicapped. These children are subject to frequent hospitalizations and illnesses, and large subject losses in such population are common. As we noted earlier, many of the subjects were located at great distance from the researchers, and attrition resulted when subjects were not available for testing at our scheduled visits.

Finally, the quality of the play intervention implementation was difficult to ascertain. Telephone calls and correspondence were the primary means used to monitor implementation. These methods proved to be imprecise, and we were unable to evaluate the implementation of procedures in a manner consistent with good research practices.

In summary, the research completed on these deaf-blind children suggests that play activities may be a viable means of increasing these children's communication skills. While there are many ways to teach such skills, particularly when targeting specific language skills, play appears to facilitate children's interactions with persons and with objects in spontaneous, pleasurable, and memorable events. These actions, when encouraged through planned play events, may result in comparable developmental changes in skills closely related to play.

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VII. Evaluation of a Training Program to Enhance Social Interactions Between Children with Severe/Profound Multihandicaps and Deaf-Blindness and Their Caregivers

by
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The impact of multihandicapping conditions on infant development can best be understood in light of the complexity and intricacy of achievements of nonhandicapped infants. According to Piaget (1963) the developing infant is goal directed, acting on the environment in response to information obtained through the senses. As early as Stage 4 of sensorimotor development the infant is seen to engage in social behaviors, such as routine games (Bruner, 1982; Rogow, 1984), that set the scene for communicative development.

In the literature on the development of communication skills, the child has been acknowledged as an active learner and social being (Bates, Camaioni, & Volterra, 1975; Bruner, 1975, 1982, 1983; Halliday, 1975; Stern, 1974a, 1974b). Furthermore Robinson (1982) noted a recent increase in the number of published studies focusing on child development across the domains of cognition, language, social, and emotional skills, and the reciprocal influences of these domains on communication development. Reciprocity within child and adult interactions has been hypothesized to affect the development of the child as a communicatively competent individual. For example, according to Bates and her colleagues (Bates et al., 1975) a child's first intentional communicative acts are a direct result of his or her mothers' inferring of intentions to their pre-intentional gestures. Mothers respond to a child's gaze or pointing by naming or commenting on the object looked at, and thus early joint referencing occurs (Bruner, 1975). This is often the basis for the development of a child's first spoken words (Golinkoff, 1983).

It has been well documented that mothers adjust their language and style of interactions according to their child's linguistic level (e.g., Cross, 1978; Snow, 1977) and that the responsiveness of an infant is important to the maintenance and style of parental interactions (Fraiberg, 1977; Murray & Trevarthen, 1986; Rogow, 1984). Appell's (1988) review of studies of interaction between mothers and prelinguistic infants indicates that, as early as 2 months of age, infants are able to attract and maintain adult interest and interaction through their patterns of eye contact and gaze (Fogel, 1982) and smiling and vocalizing (Trevarthan, 1977). Mothers have been found to modify their patterns of vocalizations according to those of their infants (Stern, Jaffe, Beebe, & Bennett, 1978). The gaze behaviors of an infant also appear to influence patterns of vocal interactions (e.g., Stevenson, VerHoeve, Roach & Levitt, 1986).

It is therefore apparent that early in life children experience the effects of their own actions on caregivers in their environment. Responses from the environment are not restricted to those provided by other individuals but also occur when the infant acts on objects (Piaget, 1963; Brinker & Lewis, 1982a). This creates the potential for infants to develop contingency awareness (Watson, 1966), that is, an expectation that an effect will occur in response to their own actions. According to Brinker and Lewis (1982a) the realization of this potential is dependent on the infant's ability to detect co-occurrences between his or her own behaviors and events in the environment, which in turn is partially dependent on the infant's sensory abilities.

The presence of a disability may severely disrupt the development of contingency awareness by impairing the infant's ability to obtain information from, or to act on, the environment. Furthermore, disruptions in mother-child interactions have been noted with children with varied disabilities (e.g., Fraiberg, 1977; Hanzlick & Stevenson, 1986; Rowland, 1984; Tait, 1972). This disruption may be due to a lack of responsiveness on the part of the infant. Murray and Trevarthen (1986) found that moth of nonhandicapped infants changed their interaction patterns and became distressed in a situation in which they perceived that their infants were not responding to their attempts to interact. Field (1983) found that mothers of high-risk infants had a tendency to persist in their attempts to elicit responses from their infants, which often resulted in the infant becoming overstimulated and "fussy." Another factor that also may disrupt the mother-child interaction is that the responses of a handicapped infant may be idiosyncratic or inconsistent, and therefore difficult for parents to interpret (Siegal-Causey, Ernst, & Guess, 1988; Sugarman, 1981).

Children who are institutionalized may suffer further disadvantages in that the caregiving staff may lack the time or expertise needed to compensate for their special problems (Harris, Veit, Allen, & Chinsky, 1974; Seys & Duker, 1986) and to provide a socially stimulating environment (Carlson & Bricker, 1982). The physical environment may not be conducive to communicative interactions and therefore residents may have few opportunities for spontaneous activities or choices, as most of their day may be spent in routine activities (Owens, McNerney, Biglo-Burke, & Lempre-Clark, 1987). Studies of resident-caregiver interactions have shown that they are often limited to physical management and custodial care with little time being spent in training or social interactions. Further, most caregiver child interactions appear to be dominated by the caregiver whose communications are often directive, while resident initiations tend to be ignored (Daily, Allen, Chinsky, & Veit, 1974; Owens et al., 1987; Veit, Allen & Chinsky, 1976). Owens et al. (1987) reported that adults who are retarded and have a history of institutionalization learn that "their attempts to communicate are inconsistently reinforced, if at all, and that communication is not often used as a working tool" (p. 49). The result can be the development of passivity, withdrawal, and inhibition of spontaneous communicative events. Similar indications of learned helplessness (Seligman, 1975) have been noted in individuals who have handicaps whose behaviors in general fail to have an effect on their environment (Brinker & Lewis, 1982a, 1982b).

Various intervention measures have proven effective in modifying resident-caregiver interactions. Harris et al. (1974) found that simply reducing the number of residents under one caregiver resulted in an increase in the frequency of desirable behaviors such as the caregiver engaging in social play with residents. Seys and Duker (1986) introduced a supervisory training package with a group of caregivers working with children who were mentally retarded. The training package consisted of daily staff meetings and supervisory feedback and prompting of organizational, custodial, resident-oriented behavior and off-task behavior. The treatment package was found to influence staff behaviors, for example, there was an increase of more than 200 percent in time engaged in resident training (although this translated to only 15 minutes more per day). One problem with working with caregiver staff in efforts to increase social interactions and to train specific skills such as communication is that they are often engaged in daily routine tasks, such as bathing, feeding, and toileting. Ivancic, Reid, Iwata, Faw, & Page (1981) attempted to overcome this problem by incorporating language training into a daily care activity of bathing. Staff working with children with profound mental retardation were observed to increase their antecedent vocalizations, descriptive praise, sound imitation and sound prompting over baseline performance. Another strategy reported by Owens et al. (1987) was training foster grandparents to facilitate presymbolic skills in an institutional population.

The results of training caregiving staff have been encouraging in terms of changing the caregivers' behaviors. Unfortunately, few investigations have addressed the effects of caregiver behavior change on the behavior of the residents. Those that have measured resident behaviors have not always been encouraging (Ivancic et al., 1981; Seys & Duker, 1986). However, Owens et al. (1987) did report positive findings in that residents increased their social interactions with caregivers (e.g., increasing eye contacts and vocalizations) as a result of caregiver training. Their results suggest that when dealing with individuals who are multihandicapped and prelinguistic, target behaviors may need to be specified in fine detail in order to enable the detection of possible changes.

Recent descriptions of intervention programs attempting to increase social-communicative skills of individuals with multihandicaps have reflected the developmental literature which views the handicapped infant as a competent and active learner (Brinker & Lewis, 1982a; Dunst, 1985; Halle, 1984). Research has indicated that individuals with handicaps can be trained to increase specific behaviors when responses from the environment are made contingent on those behaviors (Brinker & Lewis, 1982b; Dunst, Cushing, & Vance, 1985; Utley, Duncan, Strain & Scanlon, 1983; Warren & Hooper, 1985; Watson, 1972). Such studies indicate that programs based on contingency responses may be more successful than programs that utilize general stimulation (Brinker & Lewis, 1982a; Dunst et al., 1985). Most studies on training contingent responses have involved the infant acting on objects in the environment, but studies emphasizing social interactions between handicapped individuals and their caregivers are lacking (Schweigart, 1988). This is despite the belief that such awareness is germane to the development of intentional behavior and communication skills (Rogow, 1984) and overcoming the problems of passivity in handicapped individuals and the directive role taken by their parents or caregivers (Brinker & Lewis, 1982a).
According to Carlson and Bricker (1982) and Owens et al. (1987) intervention should focus on the child's caregiver, or the individual who has the most sustained contact and opportunities for input to the handicapped individual. Carlson and Bricker (1982) describe a program in which observation of the caregiver and handicapped individual is recommended so that caregivers can be taught to interpret behaviors. These authors believe that caregivers require training in the organization and structuring of the environment and the provision of responses contingent to the behaviors they have learned to interpret. In such a program the role of the interventionist becomes one of director and supporter of the caregiver (Affleck, McGrade, McQueeney, & Allen, 1982) so as to empower them to facilitate changes within the handicapped individual (Dunst, 1985).

Another aspect of recent intervention programs is the incorporation of intervention strategies into natural environments or settings and routines of the caregivers (Affleck et al., 1982; Carlson & Bricker, 1982; Halle, 1984). Intervention thus becomes more practically viable, especially within institutional settings. Furthermore, communicative interactions come to be seen as integral to daily activities, occurring in natural conversational contexts, rather than as separate behaviors within artificially contrived interactions (Higginbotham & Yoder, 1982).

The present study aimed to document changes in both caregiver and resident behaviors resulting from an intervention program aimed at increasing social interactions within an institutional setting for individuals with severe/profound disabilities (including deaf- blindness). The intervention program was designed to train caregiver staff first to monitor specific social interactive behaviors of residents and, second, to increase those behaviors. The study therefore aimed to address gaps in the research literature by investigating the effects of training caregiver staff on resident prelinguistic behaviors that are thought to enhance responsiveness, and of providing contingent responses within social interactions. The specific questions addressed were (a) Does training caregivers to become more attuned to early "communicative" behaviors of children with deaf-blindness result in caregivers increasing the proportion of socially contingent input and in turn decreasing the proportion of noncontingent (e.g., directive) input to these children during face-to-face interaction? (b) Does training caregivers to engage in specific socially contingent behaviors during face-to-face interaction result in an increase in the proportion of these behaviors by caregivers and in a concomitant decrease in the proportion of noncontingent behaviors? and (c) Will children with severe multihandicaps and deaf-blindness increase their levels of communicative behavior as a result of increases in socially contingent input from the caregiver?

Method

Subjects

Children. Four children participated in the study (three females and one male)--D., K., L., and J. They were from a large Midwestern residential and educational training center for individuals with developmental disabilities. The children met two selection criteria: (a) They scored at or below 15 months developmentally on the cognitive and communicative scales of the Wisconsin Behavioral Rating Scale (Song et al., 1984), and (b) They demonstrated significant functional or organic auditory and visual impairments. The children's ages ranged from 4.9 to 8.1 years (X=6.2) at the beginning of the study. Details of the children's ages, etiologies, impairments, and performance on assessments are given in Table 1.

Caregivers. The direct care staff of the residential center from whom the participants in the study were chosen were in charge of four to five children within a quadrant of living area. Their duties included administering to the residents' custodial, paramedical, and social-emotional needs. The caregivers worked 5 days a week on a rotating weekday/weekend schedule. The caregivers in the study, chosen from a number who volunteered to participate, worked the "swingshift" (2:30 to 10:30 p.m.). An attempt was made to choose caregivers who were most familiar with the children in the study. A direct care staff member was assigned to each child so as to form four dyads--L./K., J./L., D./J. and G./D. Three of the caregivers had worked at the center for 6 or more years and one had been a staff member for 6 months. Two caregivers had worked with the child in their dyad for more than 6 months (J./L. & L./K.), while the other caregivers had worked with their child for at least 1 month (D./J., G./D.).

Table 1

Subject Descriptions

Child/ age	Diagnosis Status	Visual Status	Auditory	WBRS[a]	Callier-Azusa
KK 4:9	PMR due to Encephalopathy Congenital Adrenal Hyperplasia	Cortical blindness	Moderate bilateral loss	57	0-5 mo.
LS 8:1	PMR due to Perinatal Hypoxia Atonic Cerebral Palsy	ERG: Normal VER: Absent or abnormal bilaterally	Moderate bilateral loss	77	0-6 mo
JA 5:9	PMR due to Postnatal Hypoxia	Aware of light	BOA: No resp. to pure tones from 500-2000 Hz	41	0-5 mo
DM 6:1	PMR due to Leigh's Disease	Cortical Blindness	Moderate Bilateral loss suspected	63	0-5 mo

Note: a=Composite Score; BOA=Behavioral Observation Audiometry; ERG=Electroretinogram; PMR= Profound Mental Retardation; VER=Visual Evoked Response.

Setting and Organization

The study was carried out at the residential setting within the children's ward. The experimenters attended the center 5 days a week. They worked with Dyads 1 and 2 (L./K. & J./L.) until all phases of the study were completed, then with Dyads 3 and 4 (D./J. & G./D.). The dyad worked with on a particular day depended on which of the caregivers were on duty.

Behavior Code Development

Codes for face-to-face interaction behaviors of caregivers were based on those behaviors described in research on caregiver-child interactions, both with children who are nonhandicapped (e.g., Chapman, 1981) and children with handicaps (Carlson & Bricker, 1982; Clark & Seifer, 1983; Vietze & Anderson, 1981). See Appendix A for the coding conventions for the caregiver interaction behaviors.

Child behavior codes were developed from observations of video recordings of the experimenters and children from the center (functioning at comparable levels and with similar impairments to those of the subjects) in dyadic interactions. See Appendix B for the coding conventions for the child behaviors. The behaviors identified in the subject dyads during the present study (i.e., not all behaviors in the protocols were evidenced by these dyads) and their operational definitions appear in Tables 2 (adult behaviors) and 3 (child behaviors).

Behaviors Monitored

Caregiver. The aim of targeting those behaviors that would be most powerful in facilitating cognitive/communicative skills led to predictions, not only about those behaviors that were specifically trained, but also about other, related behaviors. This gave rise to four categories of caregiver behaviors which were monitored for change:

1. Trained behaviors which were predicted to increase in proportion to certain non-trained behaviors (see below), i.e., the dependent variables, were chosen on the basis of three criteria. First, behaviors were chosen which could be trained to occur contingently to child behaviors. Secondly, they had been predicted to facilitate the "fine-tuning" of caregiver-child interactions, resulting in increased reciprocity of behaviors (Vietze & Anderson, 1981). The third criterion was that they have been identified in the literature as being facilitative of cognitive/communicative development (e.g., Bricker & Carlson, 1981; Carlson & Bricker, 1982; Chapman, 1981; Clark & Seifer, 1983). Three behaviors that met these criteria were imitation (vocal or gestural), positive comment, and elaboration (see Table 2 for operational definitions). A fourth behavior also was targeted--strategic use of touch. This is touch which is paired with verbal or nonverbal behavior and which occurs in response to a child behavior. It was felt that because of the nature of the children's impairments it was important to provide input through a variety of modalities, providing them with information as to the effect of their own behaviors on the caregiver.

2. Nontrained behaviors that were predicted to increase proportionally in conjunction with trained behaviors were monitored. These also have been identified as facilitative of caregiver-child interactions and of cognitive/communicative development, but they were not independent of the trained

Table 2

Adult Behaviors

Behavior	Operational Definition
Give	Caregiver extends object in order that child can/will grasp it, hold or otherwise "possess" it
Show	Caregiver puts an object within child's sensory arena so that child can see, hear, or feel it
Touch Body	Intentional physical contact of torso area (chest, belly, abdomen, back) of child.
Touch Extremities	Intentional physical contact of arms (hands), or legs (feet) of child.
Touch Head	Intentional physical contact of head, hair face of child
<u>Verbal</u>	
Laugh	Any sound the caregiver makes that is devoid of linguistic content but expresses joy or amusement
Vocalization	Vocal production that is not vegetative, laugh, cry, or a true word
Elaboration	Caregiver comments and/or interprets as a response to the child's immediate activity, behavior, or change of state in the present time
Description	Utterances by the caregiver that describe caregiver behavior acting upon child in the here and now Can also describe the child's activity in the here and now.
Comment	Caregiver utterances which are not descriptive, directive or responsive to child behaviors
Negative Comments	Verbalization specifically conveying rejection or disapproval by stating what not to do
Positive Comments	Verbalizations which spontaneously praise or show approval of the child's behaviors
Requests	Caregiver commands for attention, action, etc., on the part of the child.
Questions	Questions (wh, yes/no, and tag) accompanied by appropriate intonation patterns
Imitation	vocal or motor reproduction of another child's behavior, sound, facial expression, and/or motor movement within five seconds of the original behavior, sound, facial expression, and/or motor movement
Delayed Imitation	Caregiver makes sounds which the child has been known to produce in hopes of eliciting them from the child

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Table 3

Child Behaviors

Behavior	Operational Definition
Socially Appropriate	
Arm Movement	Any voluntary intentional movement of one or both arms in any position.
Eyes Open	Whites of eyes can be seen
Head Righting	Child voluntarily moves head or child's head is moved by caregiver to create space between the chin and the chest or the cheek and the shoulder.
Imitation	Vocal or motor reproduction of another person's sound or motor movement within 5 seconds of the original sound.
Laugh	Any sound the child makes that is devoid of linguistic content but expresses joy or amusement
Look	Child voluntarily moves head in the direction (facing) of an object and/or person or part of an object or person and holds that position for a least 1 second.
Mouth Open	Child's jaw is voluntarily drawn downward and maintained in this position.
Reach	Child moves arm(s) toward an object and/or person or part of person/object.
Smile	Child exhibits facial expression of upward curving of the corners of the mouth.
Vocalization	Vocal production that is not vegetative, laugh, or cry.
Idiosyncratic	
Cry/fuss Noise	Objection or protest with inarticulate sobbing sounds or weeps
Frown	Child's lips are pulled back in a pursed/pout position
Looks Away	Child voluntarily moves head away from the object/person or part of the object/person
Mouth Movement	Mouth makes a repetitive rhythmic motion of the lips and/or jaws.
Nonvocal	Sneeze, cough, breathing noises, clearing of throat, etc
Head Drop	Head motion characterized by the head falling downward with chin to chest or cheek to shoulder
Startle	An involuntary, momentary whole or partial body jerk.

behaviors (and therefore could not be independently manipulated). These behaviors included descriptions, delayed imitation, and laugh (see Table 2 for operational definitions).

3. This category included nontrained behaviors that were predicted to decrease proportionally to trained behaviors. These behaviors--questions, negative comments, and requests--have been found to occur in adult-directed interactions in which there is little opportunity for child initiations (e.g., Field, 1983; Owens et al., 1987). This prediction was based on an expectation that proportional increases in behaviors facilitative of caregiver-child interactions would have the reciprocal effect on detrimental behaviors (see Table 2 for operational definitions).

4. The final category consisted of those behaviors that were predicted to remain their static in relationship to trained as well as to the other nontrained behaviors. These behaviors were comments and vocalizations (see Table 2 for operational definitions).

Child. Information on the effect of training caregiver behaviors on the children's cognitive and communicative skills was obtained by monitoring those behavior codes developed from the initial experimenter-child interactions. These behaviors were classified as either communicative or noncommunicative. Most of the communicative behaviors exhibited by the children were those that have been noted in the literature as being exhibited by children in early caregiver-child social interactions. These included looking, smiling, and vocalization. One exception was the behavior of mouth-open. This was a behavior that occurred with other communicative behaviors and was interpreted by the caregivers as indicating the child's pleasurable response to caregiver attention. Noncommunicative behaviors were those that have not been identified in studies of normal social interactions and that did not appear to facilitate interactions. They included such behaviors as head drop, frown, and look away (see Table 3 for all child behaviors).

Data Collection System

A portable microcomputer-based coding program was used for data collection. MICROLOG (Ver Hoeve, 1985) software, which runs on a Radio Shack Model 100 microcomputer, enables the identification of keys on the computer to be defined to correspond with the behavior codes. Data could be collected in running time, providing both the frequency and time of occurrence of behaviors. All training and followup sessions were video recorded, and data were collected from 5 minutes of each, beginning from 4 seconds into the video (the data collection system stopped automatically at the end of this time). Experimenters involved in the initial behavior code development observed each session and coded all caregiver and child behaviors. Three passes through the video tapes were required to code all behaviors. During the first pass the child behaviors were coded. In the second and third passes the adult verbal and adult nonverbal (touch) behaviors were coded, respectively.

Design

An ABC design was implemented with a multiple baseline on the C phase. This design enabled a no-treatment baseline condition to be compared with a general stimulation condition (B), and the effects of training specific behaviors (C).

Procedures

Baseline. Video recordings were made of each caregiver during face-to-face interactions with the child in their dyad. In an attempt to reduce possible feelings of self-consciousness on the part of the caregivers, the instructions given by the experimenters stated that they were interested in the child's behaviors. There were no further instructions to the caregiver.

General Stimulation Training. The caregivers received training in social rapport procedures, based on those outlined in the Early Communication Skills Curriculum (Higginbotham, Mathy-Laikko, Reichle, Lippert, & Yoder, 1984). The curriculum was designed to facilitate social and communicative skills of individuals who have severe handicaps and who function below a 15-month developmental level. ? social rapport procedures were implemented to increase the caregiver's awareness of the children's behaviors during social interactions, but no specific caregiver behaviors were trained. The experimenters instructed the caregivers in structured assessments of the children's behaviors, based on video-recorded interactions. The caregivers were involved in labeling and describing behaviors, which they recorded in a catalogue, and in coding behaviors during intervention. At the beginning of each session (excluding the first session) 10 minutes of caregiver-child interaction was video recorded. Segments of 5 minutes from these recordings were coded in order to probe the effects of the previous session's training, thus providing the data for later analysis.

Training Specific Behaviors. The behaviors of imitation, positive comment, elaboration, and strategic touch were trained under multiple baseline conditions. Ordering for the verbal behaviors was counterbalanced across subjects. Strategic touch was always trained last so as to optimize the chance for the use of touch in conjunction with the trained verbal behaviors. Adult behaviors were trained to occur in response to child behaviors. The general training procedures used for all behaviors were as follows: The experimenter demonstrated the behavior with the child; video recordings of caregiver-child interactions were observed; the experimenter and caregiver discussed opportunities for the behaviors; and the experimenter engaged in supervisory style feedback after observing the dyads. As with general stimulation training, a 10 minute period at the beginning of each (except the first) session was video recorded for later coding.

Interobserver Agreement Establishment Procedures

Video recordings from all baseline, general stimulation training and specific behavior training sessions were coded by two observers (experimenters). Interobserver reliability was obtained by comparing agreements and disagreements between observers on 25 percent of data from each of the caregiver verbal, caregiver touch, and child behaviors. Agreements were determined using a 4 second time interval (the actual time units were half-seconds: 4 half-seconds before and 4 half-seconds after any specific target). When the two observers' data were compared, an agreement was said to occur when the same codes were recorded within a 4-second time interval. A disagreement was counted when two different codes were in the same time interval, when a code from one observer was the same as that from the other observer, but was not in the same time interval, or when a code from one observer could not be matched with a code from the other observer within the time interval. Interobserver reliability was determined by calculating the ratio of the agreements to agreements plus one-half the disagreements. This formula for calculating interobserver agreement has been found to be the most valid for sequential data (Kaye, 1982).

Interobserver agreement for the caregiver verbal behaviors ranged from 81.1 to 95.5 percent across dyads with a mean of 88 percent. For the caregiver touch behaviors agreements ranged from 80.7 percent to 100 percent, with a mean of 91 percent. Interobserver agreements for child behaviors ranged from 77.3 to 94.5 percent with a mean of 86.2 percent.

Results and Discussion

The aim of this study was to train caregivers, when engaged in social/communicative interactions with children who have severe multihandicaps including deaf-blindness, to increase communicative behaviors that have been shown to facilitate communicative development. Frequency counts for each caregiver behavior coded were converted to proportions: The total frequency of each behavior counted within a session was divided by the total number of behaviors, coded for the caregiver. The reason for using proportions was that the amount of trained adult behaviors that could possibly occur was dependent on child behaviors (as adult behaviors were trained to occur contingently to those of the child). As the children showed great variability in their total frequency of behaviors the use of proportions is more meaningful for comparison across dyads. Because the subjects in this study had various degrees of visual and auditory impairments, simply training caregivers to provide a contingent verbal input was not sufficient. Therefore, after they had learned to monitor and respond contingently to child behaviors, they were trained to pair touch with their verbal input. The provision of touch input in conjunction with contingent verbal input was called "strategic touch." The proportion of strategic touch was calculated by dividing the number of touch onsets which co-occurred within 5 seconds of positive comment, imitation or elaboration by the total number of touch onsets within a session.

The results for the child behaviors are reported as the sum of the frequencies of the "communicative" behaviors compared to the sum of the frequencies of the "noncommunicative" behaviors. Frequencies were used for the child data because it is expected that their responses to a more facilitative communicative environment would be to increase their numbers of communicative behaviors while the number of noncommunicative behaviors would remain static or decrease. It should be kept in mind when interpreting these results, however, that the research design used in this study did not enable direct experimental control over the child behaviors and, thus, caution should be used in interpreting those results.

It was planned that sessions within phases would occur across consecutive days. Unfortunately, because of problems such as timetable changes, caregiver leave-time and, most frequently, children's illnesses, this was possible only with the baseline sessions. The total number of days that both caregiver and child members of the dyads were available varied from 3 to 12 days per month. This resulted in discrepancies in the number of sessions within each training phase, as they often had to be terminated so as to ensure that all phases were included within a designated time for completion of the study. The data collection period for Dyads 1, 2, 3 and 4 occurred over 5, 6, 4 and 5 months, respectively. All dyads received four sessions of baseline. General stimulation training was conducted for five sessions for Dyads 1, 2, and 3, and four sessions for Dyad 4. The training on specific communicative behavior phases ranged from three to eight sessions across dyads, with means of 5.25, 4.5, 5.25, and 5.5 for Dyads 1, 2, 3, and 4, respectively. Followup sessions occurred 1 month after the final training sessions. Dyad 4 was seen for seven sessions, while the other three dyads received eight sessions of followup.

The results for each caregiver are presented in Figures 1, 2, 3, and 4, and the results for each child's behaviors are presented in Figure 5. Area graphs are used to display the results for both caregivers and children. This type of graph was chosen because it is useful for making comparisons between sets of data over time and among categories (Rafferty & Norling, 1987). It must be kept in mind, when viewing the data, however, that each behavior in each graph is stacked (successively added to) on the value of the previous behavior. The behaviors were entered into the graphs beginning with the lowest proportion behavior and ending with the highest proportion behavior in each graph. Thus, while, the proportions on the y-axis are not reflective of the actual proportions found, the relationships between the behaviors (proportions) are preserved.

The results of caregiver behaviors will be discussed first. Following the discussion of the caregiver behaviors, a discussion of the child behaviors will be presented.

Caregiver Trained Behaviors

Dyad 1. The proportions of trained behaviors for each session for L. are presented in Figure 1a. It is evident that during general stimulation training there were minimal gains in positive comment and imitation, while elaboration and strategic touch decreased. This caregiver (L.) appeared to respond to the training of facilitative behaviors, but there was little transfer across phases. Some dependency between elaboration and imitation is apparent as both these behaviors increased with training of one or the other, and decreased in phases when neither were trained. L. used a high proportion of strategic touch during baseline, and increases over baseline were noted during the training of elaboration and strategic touch. During follow up, the only behaviors to evidence maintenance were positive comment and strategic touch. Elaboration and imitation returned to baseline levels.

Dyad 2. As with Dyad 1, general stimulation did not co-occur with increases in any behaviors, with the exception of elaboration, and strategic touch, as shown in Figure 2a. The pattern for trained caregiver behaviors for J. is that all behaviors responded to training but, in a similar manner to L. (above), increases do not always correspond with the specific behaviors being trained. The caregiver (J.) began to show increases in all facilitative behaviors when imitation was being trained. The most sustained increases occurred with elaboration, especially during the phases of imitation, elaboration and positive comment. J. used a high proportion of strategic touch during all phases, but was much more variable in using it during baseline and followup than during the training phases. During followup all verbal behaviors occurred with a greater proportion than during baseline, but none reached the peaks noted during training.

Dyad 3. The results for caregiver D. are presented in Figure 3a. No increases in trained behaviors were noted during general stimulation training, but increases were evident in response to specific training. Both positive comment and strategic touch showed sustained increases with transfer occurring

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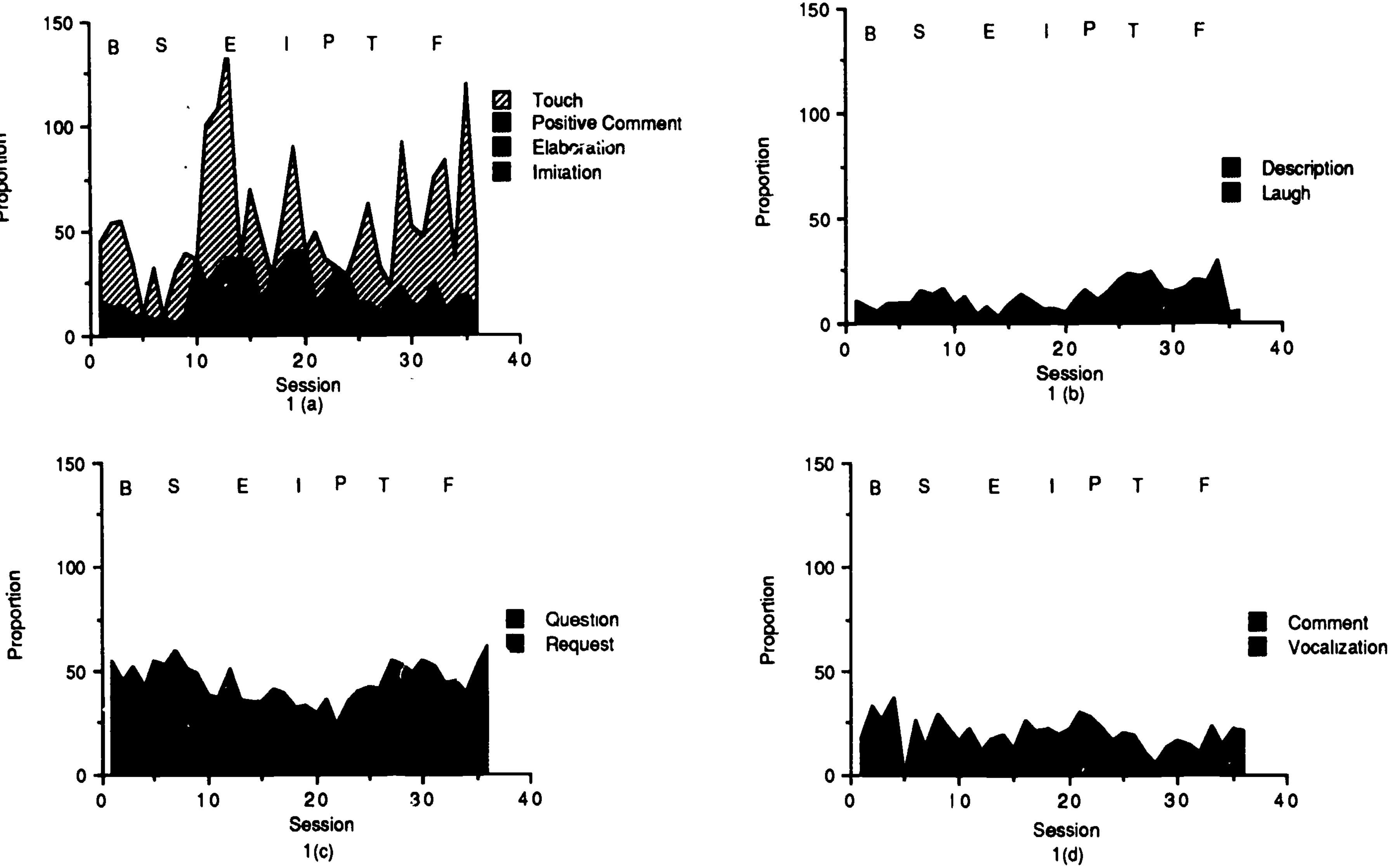
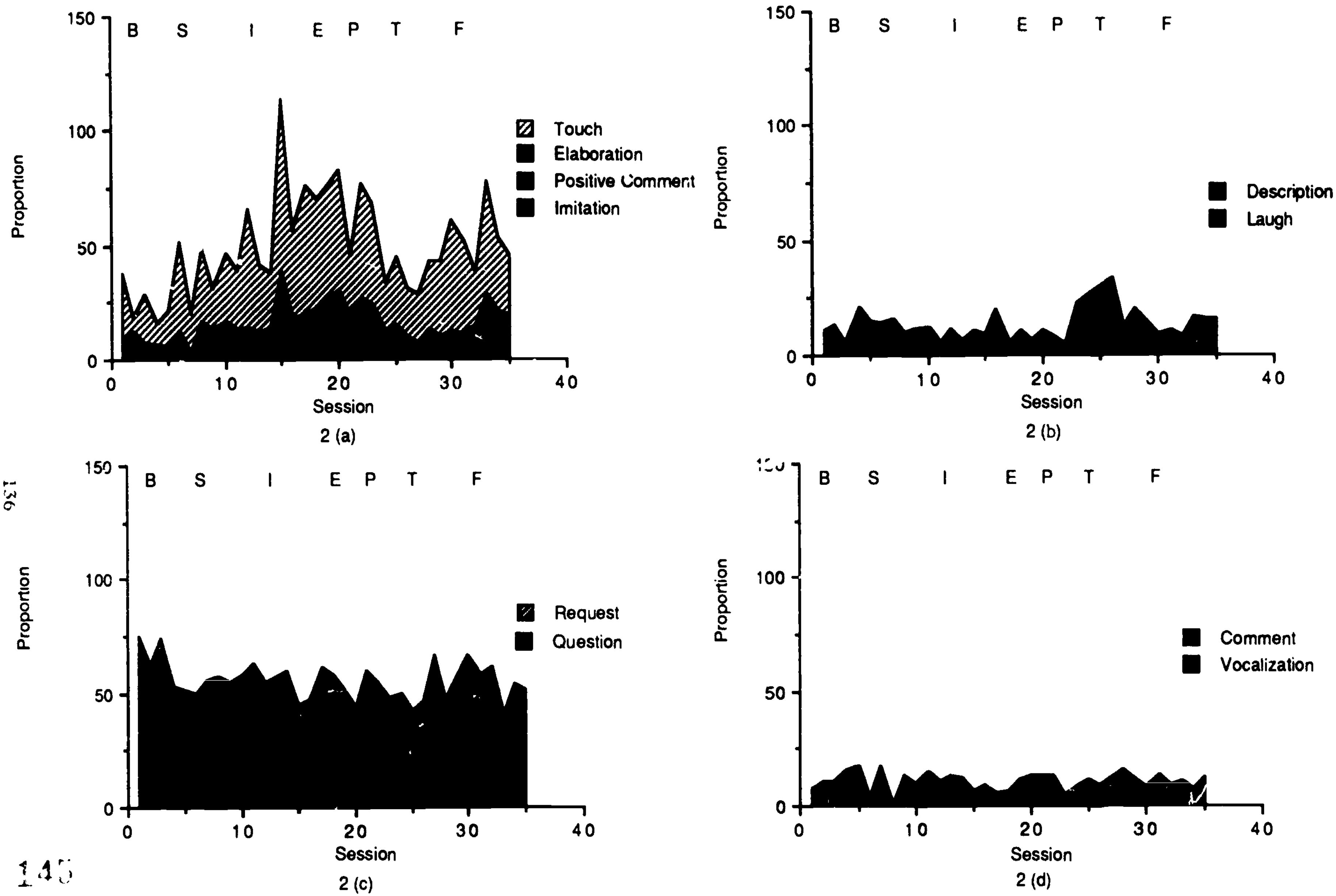


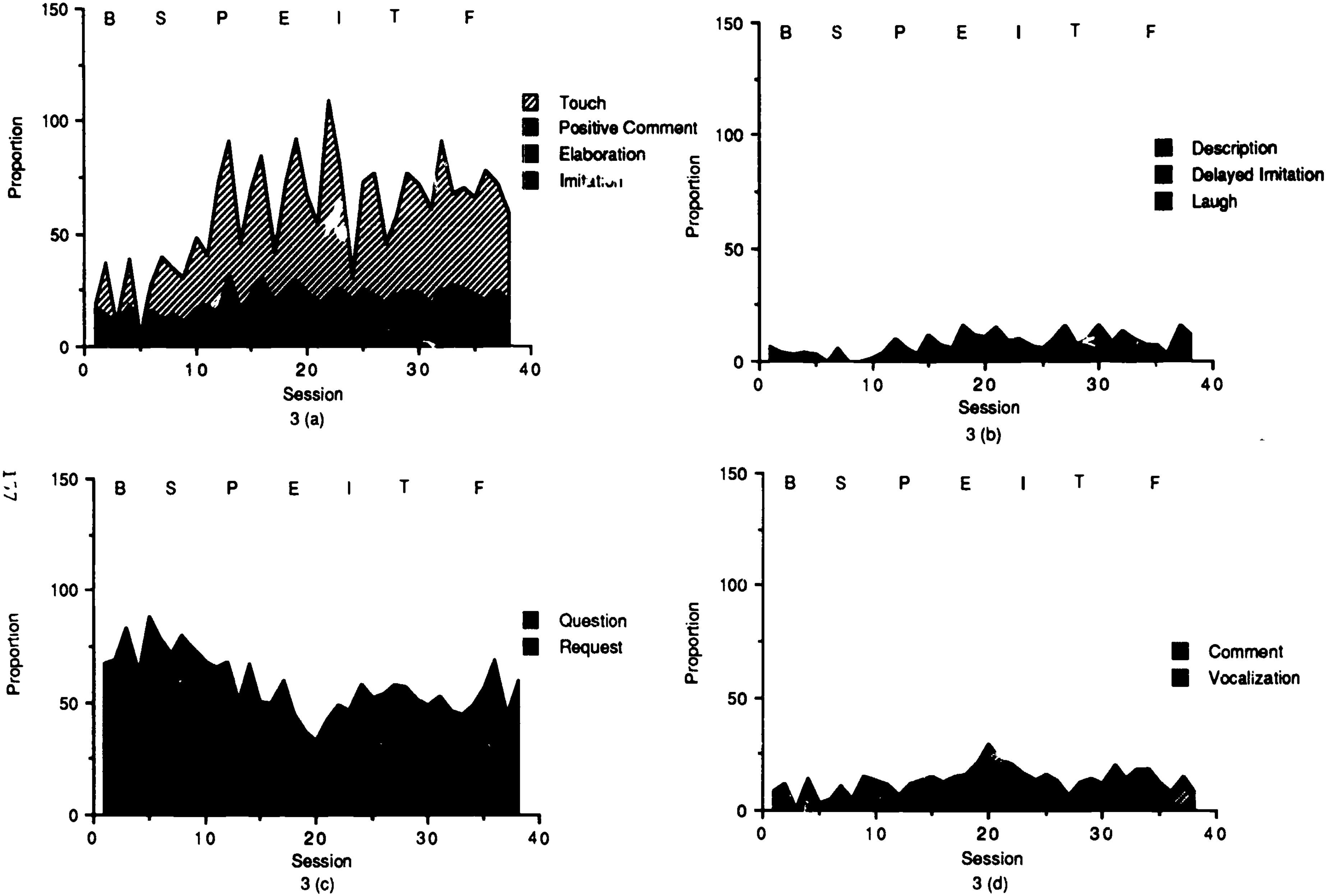
Note: B=Baseline; S=Social Rapport; I=Imitation; E=Elaboration; P=Positive Comment; T=Touch; F=Followup.

Figure 1. Adult behaviors for Dyad 1 (L./K.): (a) trained, (b) nontrained, predicted to increase, (c) nontrained, predicted to decrease, (d) nontrained, not predicted to change.



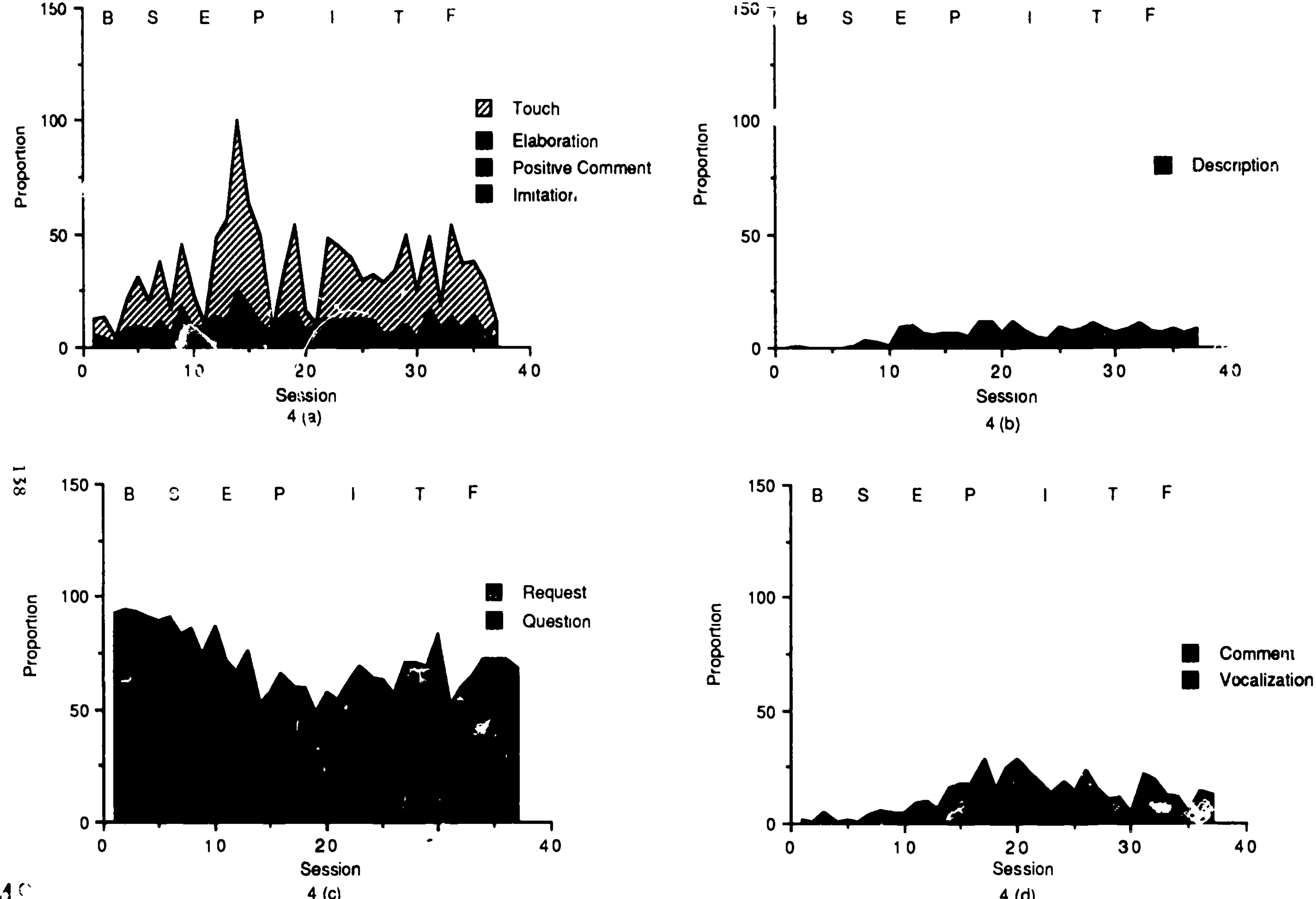
Note: B = Baseline; S = Social Rapport; I = Imitation; E = Elaboration; P = Positive Comment; T = Touch; F = Followup.

Figure 2. Adult behaviors for Dyad 2 (J./L.): (a) trained, (b) nontrained, predicted to increase, (c) nontrained, predicted to decrease, (d) nontrained, not predicted to change.



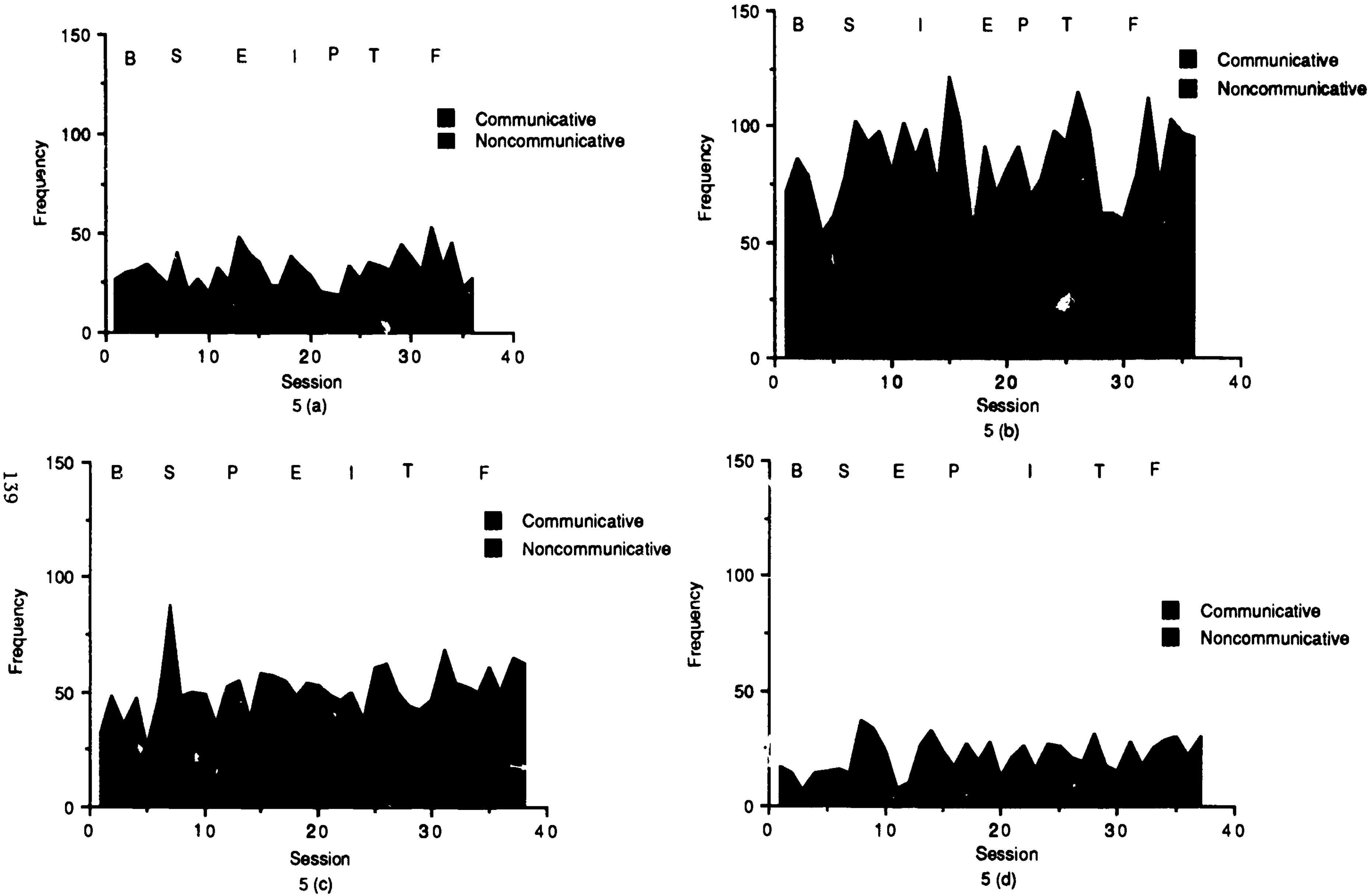
Note: B = Baseline; S = Social Rapport; I = Imitation; E = Elaboration; P = Positive Comment; T = Touch; F = Followup.

Figure 3. Adult behaviors for Dyad 3 (D./J.): (a) trained, (b) nontrained, predicted to increase, (c) nontrained, predicted to decrease, (d) nontrained, not predicted to change.



Note: B = Baseline; S = Social Rapport; I = Imitation; E = Elaboration; P = Positive Comment; T = Touch; F = Followup.

Figure 4. Adult behaviors for Dyad 4 (G./D.): (a) trained, (b) nontrained, predicted to increase, (c) nontrained, predicted to decrease, (d) nontrained, not predicted to change.



Note: B = Baseline; S = Social Rapport; I = Imitation; E = Elaboration; P = Positive Comment; T = Touch; F = Followup.

Figure 5. Totals of communicative and noncommunicative behaviors for the child in each dyad: (a) Dyad 1 (K.); (b) Dyad 2 (L.); (c) Dyad 3 (J.); Dyad 4 (D.).

across phases and maintained at followup. The pattern for elaboration was one of an overall reduction over the baseline level, with an increase (but not to baseline level) when it was trained. This pattern may have reflected some reciprocity between elaboration and the other verbal behaviors, with increases in imitation and positive comment resulting in decrements in elaboration and vice versa. During baseline, D. used a high proportion of strategic touch, which increased during training phases and stayed at a high level at followup.

Dyad 4. As is apparent in Figure 4a, with the exception of elaboration and strategic touch, little change in the proportion of trained behaviors was evident for G. G. used very little, if any, positive comment or imitation during baseline, training or at followup. However elaboration did show significant increases during the specific training of verbal behaviors, with a noted decrease during the training of strategic touch and then an increase at followup. An overall increase in the use of strategic touch is evident during training and followup over baseline levels. The results obtained for G. may be attributed in part to his general inexperience at the center and his unfamiliarity with D. (having worked with her for only 1 month) as compared with the other dyads. Further, as can be seen in the child data (Figure 5d), D. exhibited very few "communicative" behaviors, which are the group of behaviors to which G. would be most likely to respond using the trained behaviors.

Caregiver Nontrained Behaviors Predicted to Proportionally Increase

The proportions of nontrained behaviors predicted to increase indicate that only description increased as predicted. As shown in Figures 1b, 2b, 3b, and 4b, there was some variability in this behavior across caregivers. Delayed imitation and laugh occurred very infrequently across all caregivers and sessions. The difference in the levels of these behaviors at baseline may suggest the reason for the increases in proportion being limited to description. None of the caregivers evidenced any delayed imitation at baseline, while only one caregiver evidenced laugh, but very infrequently. It may be that the training encouraged greater use of behaviors already utilized by the caregivers, but did not result in the use of new behaviors. Another reason for the failure to see increases, particularly in delayed imitation, may have been due to some self-consciousness at imitating the child's behaviors. Increases in the trained behavior of direct imitation tended to be restricted to when it was being directly trained, and was never maintained at followup, thus again suggesting a lack of ease on the part of the caregiver.

Caregiver Non-Trained Behaviors Predicted to Proportionally Decrease

The proportion of requests were found to show overall reductions across training sessions for all caregivers, as shown in Figures 1c, 2c, 3c and 4c. These reductions were maintained at followup only for Dyads 2 and 4. The most notable reduction occurred with the Dyad 4 caregiver who had used a high proportion of requests at Baseline (over 50%). This result was felt to be significant in light of the few changes evident in this caregiver's trained behaviors.

The results for questions (see Figures 1c, 2c, 3c, and 4c) indicate some differences across caregivers in patterns of changes. Dyad 1 showed a reduction in questions during training of elaboration, imitation, and positive comment, but an increase in her use of questions during the training of strategic touch.

The caregiver in Dyad 2 used a relatively high proportion of questions during most phases, but used fewer during general stimulation and strategic touch training. Some variation was noted in the use of questions by the caregiver in Dyad 3. There are reductions over baseline levels evident during the phases of positive comment and elaboration, but increases during the training of imitation and strategic touch. However the level of questions at followup was less than that at baseline. Dyad 4 did not evidence any changes in the use of questions across phases.

Caregiver Behaviors Predicted to Remain Static

An interesting trend was noted with commenting, which suggested that 10 percent of total behaviors was a level common to caregivers (Figures 1d, 2d, 3d, and 4d). Caregivers in Dyads 2 and 3 began with approximately this level of commenting, which they maintained across all phases. On the other hand, the caregiver in Dyad 1 began with a higher level during baseline and reduced her use of comments as training progressed and at follow-up. The caregiver in Dyad 4 began with a much lower level and increased his use of comments towards the 10 percent level across training and at followup.

Vocalizations occurred infrequently across all caregivers and remained static, as predicted, as training progressed.

Summary of Caregiver Behaviors

The results indicate that the treatment of specific behaviors did effect changes in caregiver behaviors, as seen in comparison with no treatment (baseline) and general stimulation training. However, the individual treatment conditions did not appear to correlate directly with the caregivers' behaviors. It would appear that the behaviors of positive comment, imitation, and elaboration may not be independent of each other and that the results obtained may be due to a factor common to all these behaviors (i.e., their contingent nature). Within certain dyads it was evident that continued training was needed to facilitate the use of a behavior across phases, i.e., when the focus was shifted the caregiver often reduced his/her use of that behavior. The problems with carry over may indicate that some behaviors were too difficult to maintain. For example, imitation, as well as possibly not being a "comfortable" technique, would have been difficult to maintain with these children who were relatively unresponsive and emitted too few communicative behaviors for the caregivers to imitate.

It was apparent that the caregivers tended to use high proportions of strategic touch at baseline, and generally maintained these high levels across training and followup. The results for touch indicate that increased use of verbal behaviors were accompanied by strategic touch, thus maximizing sources of input for the children.

The results at followup indicate that at least some, but not all, behaviors trained maintain over time. The trained behaviors seen during followup may be a result of reactivity, (the experimenter's presence acting as a prompting for the caregiver to use them) as observations were overt. Nonetheless, the followup results do indicate that the general techniques of facilitating interaction with the child, and at least some specific trained behaviors were remembered after a period of time.

The consistent reduction in requests, and the general reduction in questioning suggests that caregivers were becoming less directive in their interactions with the children. This coupled with increases in the use of the behaviors trained and also of description indicate that the training did have the effect of creating an environment which was predicted to enhance the social interactions within the dyads.

Although the proportion of directive behaviors decreased as a result of training, they continued to make up a relatively large proportion of the behaviors emitted by the caregivers. Therefore just training caregivers to increase their proportion of contingent input was not sufficient to eliminate overly directive input, These results suggest that programs designed to train caregivers to provide more contingent input and to reduce their directive input may need to provide direct training aimed at reducing directive behaviors rather than expecting them to decrease solely as a result of training contingent behaviors as was done in the present study.

Child Behaviors

The results for the child behaviors are illustrated in Figures 5a, b, c, and d. With the exception of the child in Dyad 4, the group of behaviors labeled noncommunicative remained fairly stable during the course of the study. Predictions were not made regarding noncommunicative behaviors at the outset of this study as they appear to reflect the child's vegetative state (e.g., mouth movements appear to be internally generated) rather than their responses to the interactions,

While the amount of noncommunicative behaviors remained relatively stable, the children in Dyads 1, 2, and 3 showed increases in their number of communicative behaviors over the course of the caregiver training. D., the child in Dyad 4, showed little if any increase in the amount of communicative behaviors she emitted from the beginning to the end of the caregiver training. However, beginning in the general stimulation training phase, she did increase the number of noncommunicative behaviors she emitted and this increase continued throughout the remainder of the caregiver training phases. D. increased her head drop onsets across all training phases, and a significant increase in frowns was evident during strategic touch training, possibly due to tactile defensiveness.

Although the increases in communicative behaviors are limited to only three of the children, the results are nonetheless encouraging. Considering the nature and severity of the children's impairments, the characteristic variability of this population, their frequent illnesses, and the fact that training occurred over a protracted time with frequent breaks would indicate that even minimum gains may be of clinical, if not experimental, significance. More consistent and intensive training may have led to greater changes in the children's behaviors. As caregivers did show maintenance of certain facilitative behaviors at followup, it is possible that the children continued to make gains.

It should be noted that no self-abusive behaviors occurred during baseline, treatment, or followup sessions. This factor suggests that the children did not appear to find the treatment aversive (except for the noted possible defensiveness to touch for the child in Dyad 4).

Relationship of Child Behaviors to Caregiver Behaviors

Figure 6 depicts the sums of all child behaviors in relation to the sums of all caregiver verbal behaviors within each phase (adult touch behaviors were not included because they typically occurred simultaneously with verbal behaviors) for each dyad. This figure provides a way to view the patterns of reciprocity between the caregivers and children over the course of the intervention phases.

There is considerably more synchronousness between the caregivers and children in Dyads 1, 2, and 3, and these dyads demonstrated a similar pattern of interaction over time. During the general stimulation phase, the numbers of caregiver and child behaviors drew closer together when compared to baseline. Following this, some divergence occurred (especially in Dyad 3) until the training of strategic touch was initiated. During this phase, the numbers of behaviors began to converge again and this trend continued during the followup sessions.

In contrast to the other dyads, G. engaged in high levels of behaviors, while D.'s behaviors remained at low levels. The divergent pattern of behaviors for Dyad 4 may reflect the caregiver's unsuccessful attempts to compensate for the child's nonresponsiveness. Similar interactions were noted by Field (1983) in her investigation of mothers of "at-risk" infants. Field noted that such attempts by mothers are often nonproductive and reflect general increases in stimulation, rather than contingent responding Another reason for the dissonance in the interactions of Dyad 4 may be the caregiver's inexperience with the residents of the center, due to his short history of employment there.

The "mirroring" seen in Dyads 1, 2, and 3 is probably due primarily to adjustments on the part of the caregivers. However, research on contingency training using object interactions indicates that contingent responses from the environment will lead to increases in child interactive behaviors (e.g., Brinker & Lewis, 1982b; Dunst et al., 1985). Rogow (1984) discussed the reciprocal effects when adults allow infants to initiate behaviors and make their responses contingent on those of the infant. The result is a mutual modification of behavior which appears to reflected in the results of the present study.

Conclusions and Implications

The results of the present study demonstrated that caregivers of children who have multihandicaps including deaf-blindness respond to training aimed to increase behaviors facilitative of communicative development. This finding is supportive of previous investigations into training caregivers of handicapped individuals (Ivancic et al., 1981; Owens et al., 1987; Seys & Duker, 1986). Some children also demonstrated a positive response to interactions with caregivers involved in training by increasing their communicative behaviors, a result also obtained by Owens et al. (1987). Although the effects on the children were not consistent across all behaviors or subjects, it was felt that the detailed specification of target child behaviors enhanced the detection of any change. Such detail is important with severely handicapped individuals whose gains may be small, but nonetheless significant in light of their poor potential for learning.

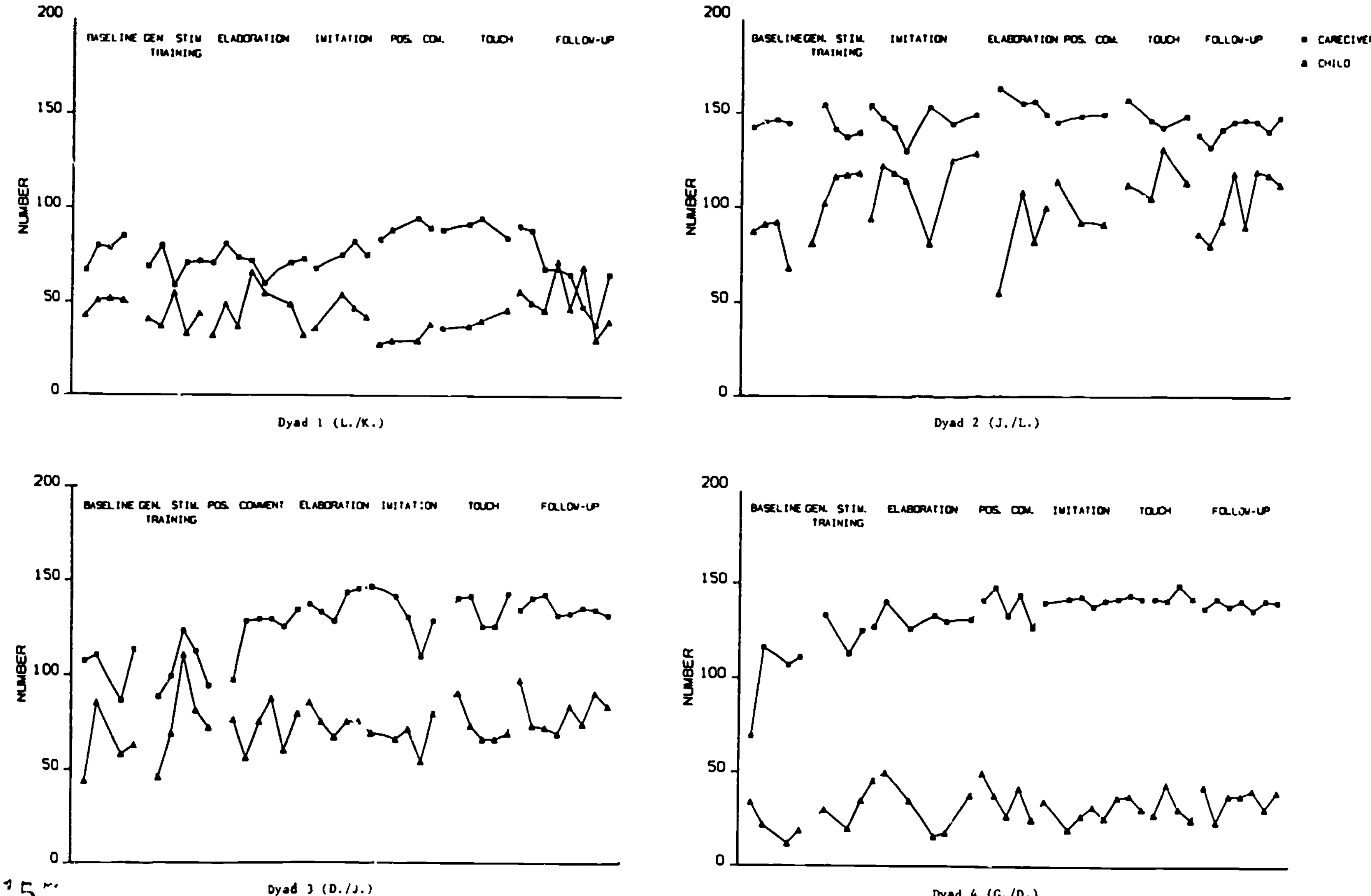


Figure 6. Total Child Behaviors in Relation to Total Caregiver Behaviors

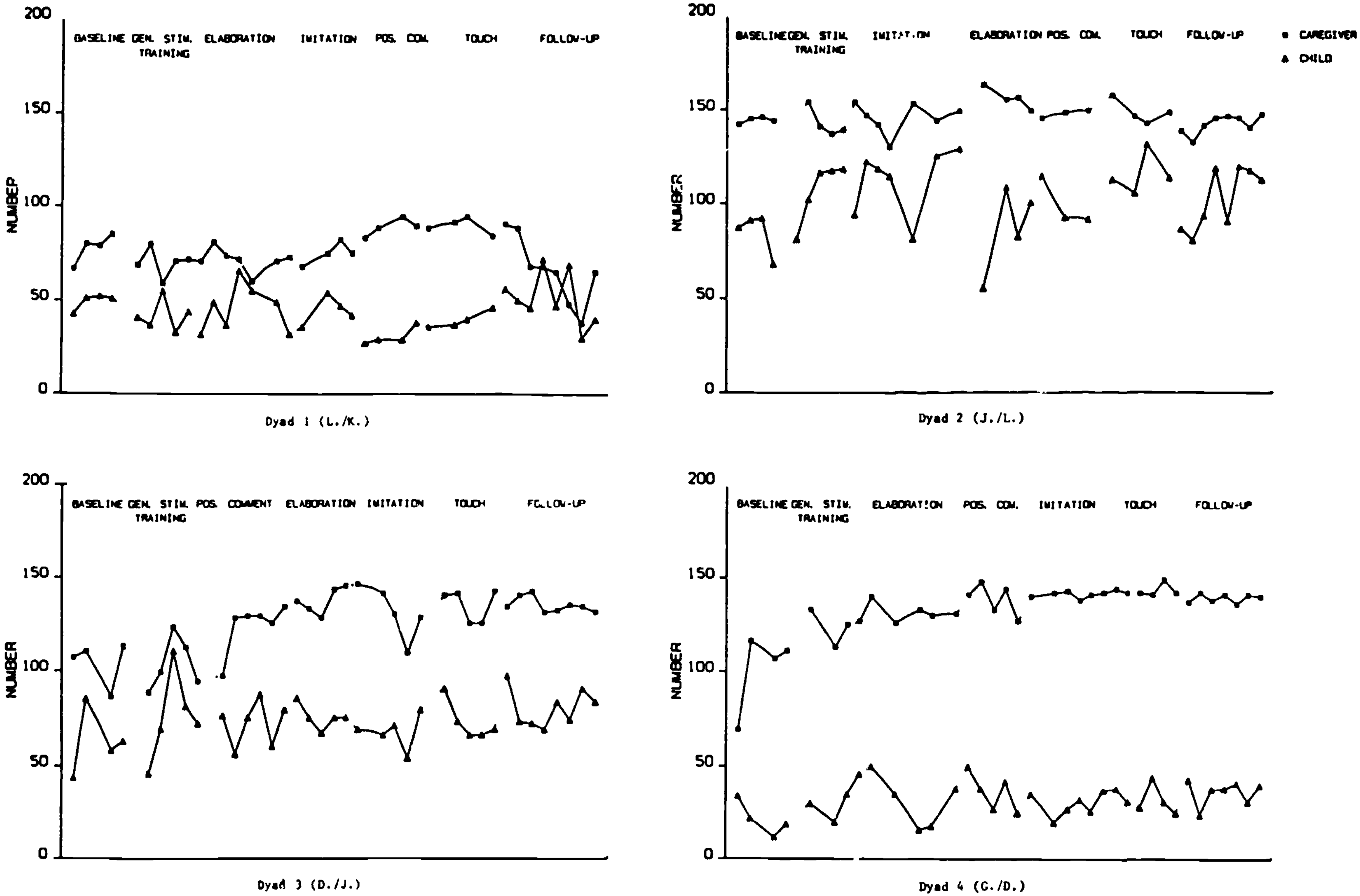


Figure 6 concluded

The lack of responsiveness of persons who have severe multihandicaps often means that they are unrewarding to work with. Yet these children require consistent and sustained input in order to evoke changes in behavior. It may be unrealistic to expect caregivers to maintain enthusiasm for intervention unless they receive support from a supervisor or manager (the role taken by the experimenters in the present study). The success of a supervisory training package was demonstrated by Seys and Duker (1986) and included continued support by a supervisor, acting in a consultative capacity. The Early Communication Skills Curriculum (Higginbotham et al., 1984), on which the treatment used in the present study was modeled, incorporates such continued input by a supervisor.

The followup data from the present study indicated that select behaviors were maintained. While this is encouraging it is felt that certain modifications to the program may further enhance maintenance. Changes in the behaviors taught may be necessary, taking into account the child's age and the nature and frequency of child behaviors (e.g., imitation may not be appropriate with a child demonstrating a high frequency of noncommunicative behaviors). Training may need to be more consistent and intensive and be extended to all caregivers working with the children. Incorporating training into daily, custodial activities as done by Ivancic et al. (1981) also may facilitate program maintenance. However programmers attempting to increase the amount of work with dyads are likely to encounter problems similar to those in the present study. Staffing changes and problems caused by the children being medically fragile resulted in numerous interruptions to training, significantly reducing the rate at which the program could proceed. However, the gains noted in certain children and the maintenance of aspects of training by caregivers suggests that continued monitoring may have revealed further gains. It would seem that the detection of even small gains by the children in the present study in the face of numerous obstacles suggests that continued attempts to enhance cognitive and communicative skills would be rewarding both for the children and their caregivers.

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Appendix A

Catalogue of Codable Adult Behaviors

TOUCH

--Touch Head (+-TH)-- Intentional physical contact of head, hair, face of child.

--Touch Body (+-TB)-- Intentional physical contact of torso area (chest, belly, abdomen, back) of child.

--Touch Extremities (+-TE)--Intentional, physical contact of arms (hands), or legs (feet) of child.

NOTE: These touch codes are mutually exclusive of one another.

Rules:

1. Do not code a touch code when child is being physically supported and/or held on the lap of a caregiver when no other touch is happening.

2. Do not code a touch until physical contact has been maintained for at least 2 seconds.

3. If touch is mediated by something like a stuffed toy or sucker, code it as a touch code. If the sucker or toy is placed in the child's sensory arena, code it as a +OS (show) and then +T when the object actually touches the child.

4. If the caregiver uses the child's hands to touch his own face/head code TE and then TH.

--Maintain Head Righting Position (+-U)--Intentional physical contact of head, chin, or face of child to maintain head in an upright position.

Rule:

1. Caregiver must maintain the position of the child's head for 2 or more seconds for this code to be turned on.

2. This is not mutually exclusive with other touch codes, Therefore, it may be coded simultaneously with other touch codes.

--Head Righting (R)-- The caregiver right's the child's head from a partially, or fully dropped position back to a central, upright position.

SHOW AND GIVE

--Show (+OS -OS)-- Caregiver puts object within child's sensory arena; object is held or placed so that child could see, hear, or feel it. This includes demonstrating properties of the object for the child (bounce, roll, squeeze etc.) or showing the object for the child's own discovery. Object mediated contact of child or child's clothes should be coded +OS since it involves putting something within child's sensory arena. It should also be coded with the appropriate touch code.

Rules:

1. If the object subsequently touches the child after being put in the child's sensory arena, code OS and then the appropriate touch code.

2. If an object is left on the child's lap tray and is not being used in interacting with the child code -OS,

--Give (G)-- Caregiver extends object in order that child can/will grasp it, hold it or otherwise "possess" it.

Rule:

1. To help decide between show and give, pay attention verbal cues. Words like "here" may indicate a give whereas words like "see" would indicate a show.

VOCAL SOUNDS

--Vocalization (V)-- directed or nondirected, nondistressed vocal production that is not vegetative. laugh, cry, or a true word

Rules:

1. Vocalization strings are separated by (a) utterance final intonation patterns (falling or rise falling), and/or (b) a pause of one second and/or (c) another speaker turn.

2. Vocalizations are not coded when the person is not clearly trying to intentionally vocalize, Heavy breathing and little sounds that do not specifically involve the vocal chords are not coded as vocalizations.

3. Whispers are coded as vocalizations if they are audible, even when content cannot be discerned. However, a sound must be heard before it is coded, so lip movements alone are not coded.

4. Quick intakes of breath indicating surprise will be coded as intentional, meaningful vocalizations.

5. If coder heard something from the caregiver and could not understand what it was, code it a V if the intonation does not clarify it to be any other type of coded behavior.

--Laugh (XL)-- Any sound the caregiver makes that is devoid of linguistic content but expresses joy or amusement.

Rules:

1. Laughs are usually characterized by more than one quick exhalation breath followed by a Crescendo of sound and then a pause (i.e., giggles and chuckles)

VERBALIZATION

--Elaboration (EE)-- Comments, elaborations, and/or interpretations as a response to the child's immediate activity, behavior, or change of state in the present tin. .

Rules:

1. The key idea to consider about coding XE is responsiveness of the utterance to the child's change of state through an activity or behavior.

2. If the caregiver utters a question as an immediate/adjacent response to something the child did (e.g., Did you smile at me? code it XE instead of a Q. Keep in mind the function of the caregiver utterance rather than the syntax as a coding priority.

3. "Thank you" is responsive and should be coded XE.

4. Another key to coding XE is the immediacy of the caregiver's response. activity that elicited the XE.

   Subsequent caregiver utterances will not be coded E unless they refer to a new behavior change on the part of the child. (e.g., "Oh! did you hear something" = XE; "Did you hear the cart?" = Q; "You look like you heard something" = XD.)

--Description (XD)--Utterances by the caregiver that describe caregiver behavior acting upon child in the here and now (e,g., "I'm tickling you!"). XD behaviors also describe the child's activity, in the here and now (e.g., "You're playing with the ball.")

Rules:

1. Phrases like "That's too far back' should be coded XD since they address what is going on in the present. However, more ambiguous phrases such as "There you go," should be coded as comments rather than descriptions.

2. Physical touch/manipulation accompanying talk about the touch/manipulation is a cue for coding XD. The caregiver is giving multiple modality input in order for the child to "understand" what is happening at that point in time; therefore, anything the caregiver does to help the child know what is going on during the present slice of time could be a cue to code XD.

3. Words to songs such as Eensy Weensy Spider and the numbers in a counting fingers/toes game should be coded XD.

--Comment (XC)--Initiations that are not (XE), (XD), (SC), (PC), or (I), (DI)

Rules:

1. Words or semiwords such as "oops", "wow", "yippee" should he coded as comments.

2. Expressions such "There you go," "You silly goose," "You can do it," and "here" should also be coded as comments since they are not necessarily responsive to nor do they describe the child's action/state, nor are they unequivocally positive or negative judgments of the child's behavior.

3. Talk about the child's static state which does not change, such as "You're so handsome" or "You have such blue eyes" should be coded XC.

--Negative comment--(NC)--Verbalization specifically conveying rejection or disapproval by stating what not to do.

Rules:

1. Negative comments are usually characterized by the word "don't."

2. Requests that convey what not to do are coded (NC) instead of (XR).

3. Warnings are not coded as (NC) unless they specifically state disapproval. E.g., "Be careful" is not coded (NC).

--Positive comment-- (PC) --Verbalization in which the person spontaneously praises or in some way shows approval of the other's behavior. Positive comments are responsive to immediate action/change of state of the child. They are judgments on the active cooperation of the child and are conveyed by the words used.

Examples of words/phrases showing approval are "right," "good," "great," "I like that." Intonation patterns can also contribute to the decision to code PC.

Rules:

1. Phrases of affection or endearment are not to be confused with positive comments. If the words do not convey approval or praise they are not coded (PC). Examples of (PC) are the following: "Big boy," "That a girl," "That's pretty good." Examples of non(PC) codes are the following: "You silly," and "You sweetie."

2. Comments about objects can be confusing. If the object being praised has been there from the start, it is not coded (PC) (e.g., "What nice blocks"). However, if the object being praised has been cted upon by the partner or is a result of that partner's actions, then the comment is interpreted as praising the partner's performance or creation and is coded (PC) (e.g., Child builds a tower and adult

says, "What nice blocks").

3. "There you go" and other ambiguous phrases are not coded as PC.

4. If caregiver is using a phrase such as "good girl" that does not appear to be immediately responsive to what the child is doing, code it XC instead of PC.

--Requests (XR)-- Commands for attention, action, etc., on the part of the child.

Rules:

1. All commands are coded as vocal requests such as those utterances to the child beginning with the following words: "Say," "Look at," "Watch," "See," or "Shh shh," "Will you," "Can you," "How about," "Would you," "Why don't you," "Come on."

2. Suggestions that involve both partners are not coded as requests such as "Shall we play ball?" or "Let's push the balloons."

3. In ambiguous cases, such as "here," "here you go," and other variations where a specific verb is not stated, code as comment rather than requests.

--Questions (Q)-- Questions (WH, yes/no, and tag) accompanied by appropriate intonation patterns.

Rules:

1. "Huh?" and other turn-passing vocalizations such as "um," "mmm" are considered a question and should be coded as Q. "Huh?" can follow any type of verbalization. For example "You like that doll, huh?" should be coded XD Q. "Your mommy came to visit you yesterday, huh?" should be XC Q. "Do you want to sit up, huh?" should be Q.

2. Distinguishing questions from requests should be done based on the intent of the utterance rather than the syntax. For example "Where's the ball?" would be coded Q, while "Can you show me the ball?" would be coded XR.

--Imitation (I)-- Vocal or motor reproduction of another person's behavior, sound, facial expression, and/or motor movement within 5 seconds of the original behavior, sounds, facial expression, and/or motor movement. Keep in mind that and I has responsive qualities like the XE code.

--Delayed Imitation (DI)-- Vocalizations generally are initiations to a child and may be 'delayed' imitations of sounds the child has been known to produce in hopes of eliciting them from the child.

Rules:

1. Caregiver must imitate the exact vocalization of the child to have it coded as imitation. E.g., child says "ba" and caregiver says "ball", is not coded as an imitation since it is more of an expansion of the child's vocalization. In this case it would be coded XE since it is responsive to the child's prior vocalization.

2. If the child's vocalization is longer than the caregiver's imitation, it is still coded as imitation (e.g., child says "ma ma ma ma ma ma" and the caregiver says "ma ma ma").

FAR/NEAR

--Far (+F)-- Code this if caregiver is not in immediate proximity of child.

--Near (-F)-- this only from a +F code to indicate the caregiver was far but returned to the immediate proximity of the child.

ADMINISTERS CARE

--Bathing (+-AB)-- grooming including combing hair, brushing teeth (+-AG), dressing including diapering (+-AD), feeding (+-AF), health (physical) care including positioning, medicating, (+-AH).

Rules:

1. These codes provide a general context for behaviors. When they are used, other codable behaviors will continue to be coded.

2. If nursery rhymes/songs etc., are being 'performed" and the child is being actively engaged/manipulated, code SP XE. If the caregiver is performing the rhyme/song and the child is a passive observer, code SP V.
3. This code should be used only for generally recognized, standard play routines and not for such things as tickling or counting fingers/toes.

Appendix B

Catalogue of Codable Child Behaviors

EYE

--Open (+E)-- Lids are up enough that the whites of the child's eyeball can be seen.

--Closed (-E)-- Lids are covering eyes so that no part of eyeball can be seen.

Rules:

1. This code is to be used by residents who habitually have their eyes closed. Begin session by noting eye state. If eyes are open, code +E.

MOUTH

--Mouth movement (+M, -M)-- From a neutral, relaxed mouth position child makes a repetitive chewing motion involving intermittent rhythmic motion of lips and/or jaw.

Rules:

1. This behavior is not coded simultaneously with other mouth behaviors.

2. Cessation of movement for 1 second constitutes a -M.

--Mouth open (O)-- from neutral, relaxed, relatively closed position child's jaw is voluntarily drawn downward, parting lips wide enough to take a spoonful of food.

--Frown (F)-- from mouth in any starting position (open or closed), the lips are pulled back in a pursed/pout position.

--Smile (S)-- Child demonstrates a widening of the mouth, deepening of grooves from upturned corners of the mouth to the nose with possible raising of cheek areas, narrowing of eyes, and wrinkling in the corners of the eyes.

Rules:

1. Includes broad beaming as well as partial smiles.

2. Includes chuckles or laughs accompanied by upturning of mouth.

VOCAL SOUNDS

--Vocalization (V)-- directed or nondirected, nondistressed vocal production that is not vegetative, laugh, or cry.

Rules.

1. Vocalization strings are separated by a pause of 1 second or another speaker turn.

2. Vocalizations are not coded when the person is not clearly trying to intentionally vocalize. Heavy breathing and little sounds that do not specifically involve the vocal chords are not coded as vocalizations.

3. Whispers are coded as vocalizations if they are audible, even when content cannot be discerned, However, a sound must be heard before it is coded, so lip movements alone are not coded.

4. Quick intakes of breath indicating surprise will be coded as intentional, meaningful vocalizations.

--Nonvocal sounds (N)-- Any audible vegetative type sound the child makes such as sneeze, cough, or breathing noise etc.

--Laugh (giggle) (VL)-- Any sound the child makes that is devoid of linguistic content but expresses joy or amusement.

Rules:

1. Laughs are usually characterized by more than one quick exhale of breath followed by a crescendo of sound and then a pause (i.e., giggles and chuckles).

2. Short one-syllable or otherwise questionable laughing vocalizations are only coded when immediately preceded by a laugh.

--Cry/fuss noise (+C, -C)-- vocal objection or protest characterized by more than one quick inhalation of breath followed by a crescendo of sound and a pause.

Rules:

1. Short one-syllable or otherwise questionable fussing vocalizations are coded when immediately preceded by a +C.

2. Fusses are usually characterized by higher pitched and more forced vocalizations, as if they were being held back and pushed through a little at a time.

--Imitation (I)--Vocal or motor reproduction of another person's sound or motor movement within 5 seconds of the original sound.

Rules:

1. Regardless of its potential codability, a behavior meeting the definition of I is coded as such and not for example a vocalization or laugh, etc.

--**Look** (L)-- Orients toward object or person or a part of an object or person. Child voluntarily moves head in the direction (facing) of an object and/or person or part of an object or person and holds that position for at least 1 second.

Rules:

1. Orientation can be manifested by behaviors such as gaze fixation, head turning, etc.

2. This code should be used when the child moves from a "default" behavior of nonattention.

--Looks away from object or person (LA)-- Child voluntarily moves head away from the object/person or part of the object/person.

Rules:

1. Head moves away from tactile [or other] stimulation in withdrawal.

2. From a neutral/midline position (nonattention) or any other position where the child is demonstrating a look (attention/orienting) behavior the child turns head at a 45 degree angle for at least 1 second duration.

--Head drop (+D)--Head motion characterized by the head falling downward with chin to chest or cheek to shoulder.

--Head righting (-D)-- from a coded +D behavior child voluntarily moves head or child's head is moved by caregiver to create space between the chin and the chest or the cheek and the shoulder.

Rules:

1. At the beginning of the session note head position. If head is dropped, code (+D).

ARM

--Movement (A)-- any voluntary intentional movement of one or both arms in any position.

--Reach (R)-- movement of arm(s) directed toward an object and/or person or part of person/object.

--Touch (+-TE, +-TB, +-TH)-- momentary discrete physical or object mediated contact with an object or the face, body or clothes of a partner. TE refers to touching extremity (arms, legs), TB refers to touching the torso area (stomach, chest, back) and TH refers to touching the face or head.

--Manipulate object (+P) (-P)-- child acts on object in some way such as banging, mouthing, etc.

REFLEXIVE MOVEMENT

--Startle (J)-- child demonstrates an involuntary, momentary whole or partial body jerk.

Rules:

1. This behavior is noted as more than likely reflexive.