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NONVERBAL COMMUNICATION TRAINING WITH NONAMBULATORY PROFOUNDLY MENTALLY RETARDED ADOLESCENTS AND YOUNG ADULTS

By

Dave Samolesky

A Thesis Submitted to the Faculty of Graduate Studies

In Partial Fulfillment of the Requirements

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ABSTRACT

This study examined a nonverbal communication training procedure with nine nonambulatory profoundly mentally retarded adolescents and young adults. The objectives of this training were: (a) to teach subjects to operate a lever which illuminated a panel serving as a communication board, (b) to teach subjects to visually fixate an illuminated picture presented on the panel, (c) to teach selective visual scanning of pictures presented on four quadrants of the communication board, (d) to teach two-, three-, and four-part picture discrimination by match-to-sample training, and (e) to teach receptive language by verbally cueing pictures presented on the visual array board. Results indicated that three subjects acquired the lever response and visual fixation. Two of these subjects progressed through each of the procedural phases to complete four-picture discrimination training. One subject demonstrated receptive language for eight pictorial stimuli. Variables associated

with successful responding in these subjects were: systematic use of gestural prompting and physical guidance to establish manipulative control over the lever device, physical modification of the manipulandum to reduce response effort, variations in multi-dimensional reinforcing stimuli, and extended training. Two of the subjects did not progress beyond seletive visual scanning of pictures. Their low correct response rates were related to the presence of choreic-athetoid movements in one subject and emotional distress in the other subject. Four of the subjects failed to exhibit discriminitive responding. Problems associated with their poor performance included complications of reinforcer delivery, and the presence of spastic contractures of the upper limbs. Implications for future research are discussed.

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INTRODUCTION

Research with institutionalized, nonambulatory profoundly mentally retarded (NPMR) persons has demonstrated that operant conditioning can be achieved with many of these handicapped people and that their responses can be brought under stimulus control. However, there has been a lack of studies designed to use these behavioral technologies for establishing nonspeech communication with this population. It was the intent of this study to develop a methodology for teaching nonspeech communication that takes into account the physical and behavioral deficiencies of NPMR persons.

Children and adolescents who are profoundly mentally retarded and multiply handicapped are an extremely heterogeneous group in terms of physical growth and development, response variability, and behavioral repertoires. Recently, however, an attempt has been made to define these individuals as a distinct population. Landesman-Dwyer and Sacket (1978) refer to NPMR children as having three major characteristics: they are (a) incapable of moving through space even with prosthetic devices or physical assistance, (b) totally lacking in all adaptive behavior skills, and (c) extremely small for their chronological age. These children are typically untestable with standardized intelligence tests and behavioral rating devices. They suffer conditions of profound neurological impairment, such as cerebral palsy,

associated with extremely deviant posture and involuntary spastic movement of limbs. They are doubly incontinent, require blended food as they have difficulty in masticating, and spend their time confined to a mat, bed, or wheelchair.

Operant Studies

Several operant conditioning studies with NPMR subjects have examined the effects of various appetitive and sensory reinforcements. The first operant conditioning study of an NPMR individual to appear in the psychological literature was the frequently cited classic experiment by Fuller (1949). Fuller was able to successfully demonstrate operant conditioning of a vertical arm-raising response during four 20-min sessions run on consecutive days using a warm sugar-milk solution as a reinforcer. In a second demonstration several months later, the subject again showed a significant increase in responding, but this time he opened his mouth simultaneous with arm-raising, suggesting an anticipation of the reinforcer.

In a series of three studies (Rice, 1968; Rice & McDaniel, 1966; Rice, McDaniel, Stallings, & Gatz, 1967), successful conditioning with several NPMR children was demonstrated. By a number of shaping procedures, Rice (1968) was able to establish a midline head positioning from a deflection to the left, and subsequently, limb movement was operantly conditioned

with a tube fed semi-comatose 16-year-old girl. In this case a peppermint solution, Kool-Aid, and ice-cream served as reinforcers. Rice and McDaniel (1966) discovered, while training an arm-raising response with one subject, that chocolate ice-cream was a powerful reinforcer, but introduction of lime sherbert served to substantially decrease responding. Reintroduction of ice-cream improved response rate to pre-sherbert levels. Rice et al. (1967) reported a series of experiments with two NPMR children. One subject responded at a high rate when a movie sound track was provided contingent upon touching a ring placed over him in his crib. The rate of responding dropped to zero when the sound track was replaced with classical music and returned to previous high rates when the sound track was reinstated. The same subject also demonstrated response preference for slides of Venus de Milo and photographs of famous art works versus slides of Yellowstone Park.

Dewson (1981) conducted a series of four experiments with NPMR subjects in which sensory stimuli was provided contingent upon lateral head-turning. In the first experiment four 30-min sessions were conducted. Each session consisted of 10-min of baseline, 10-min of conditioning, and 10-min of reversal. Five subjects were assigned to a CRF schedule during conditioning and five subjects were reinforced for omitting a

response (DRO) for 5-sec. Higher response rates were found for both groups during the conditioning phases but an overall decline in response rates occurred across sessions. The suggestion was made that sensory reinforcement elicited head turning or raised general arousal levels, and that subjects habituated to the experimental situation across sessions.

In the second experiment, there were two 30-min baseline sessions, eight 30-min conditioning sessions and two 30-min reversal sessions. Only one of the four CRF subjects demonstrated a reliable increase in lateral head turning during the conditioning phase.

The third experiment explored CRF contingencies only, while the stimulus content of reinforcement was varied across sessions. Two subjects displayed highly reliable increases in response rates during conditioning. One subject responded with high rates of lateral head turning to pictures after vibration and music were removed as reinforcing stimuli. The other subject exhibited a decline in response rates after vibration was removed, and a significant increase in responding after vibration was reinstated.

The fourth experiment involved the systematic variation of sensory reinforcement, and the use of physical prompts. Six of nine subjects successfully conditioned to a variety of

combinations of sensory stimuli. Conclusions reached were that the use of a low effort response such as head turning, prompting, extended training, and systematic variation in contingent sensory stimuli were variables contributing to successful conditioning in this population.

Contingent vibratory stimulation has also proven effective as a reinforcer for suppressing self-injurious behavior in a profoundly retarded child (Meyerson, Kerr, & Michael, 1967), establishing high rates of lever pressing (Bailey & Meyerson, 1969), developing coordinated arm movement (Murphy & Doughty, 1977), and shaping head movement (Rice et al., 1967) with NPMR individuals.

Discriminative responding has also been achieved in NPMR individuals by using various auditory stimuli such as rhymes, blues, drum music and tones (Remington, Foxen, & Hogg, 1977), single chimes versus continuous playing of an organ scale (Friedlander, McCarthy, & Soforenko, 1967), and 5-sec presentations of Handel's Messiah (Haskett & Hollar, 1978). This research suggests that NPMR individuals have a much greater awareness of their environment than previously recognized as demonstrated by their considerable selectivity in preference for certain reinforcers within a common class.

Nonspeech Communication

The development and implementation of nonspeech or nonverbal communication programs for the physically handicapped and mentally retarded has been dramatic over the past decade. These programs have recognized that although severe motor dysfunction may impede the development of vocal speech or complex manual skills, it may have little negative effect on receptive abilities (Harris-Vanderheiden, Brown, MacKenzie, Reimen, & Schiebel, 1975). Profoundly handicapped persons, therefore, might benefit greatly in communication instruction which accommodates extremely limited and often idiosyncratic motor topographies (Elder & Bergman, 1978).

Several nonverbal communication methodologies have been developed specifically for persons with mental and physical handicaps. The most popular and widely known is a stimulus format system referred to as Blissymbolics (Bliss, 1965) in which objects and concepts are represented by different combinations of geometric lines. This system was originally intended as a communication system to supplement existing languages for use with stroke victims, but has been increasingly applied to severely mentally retarded adolescents (Song, 1979). However, there is no documented evidence available as to effective applied usage with NPMR persons.

A different system employs the use of simple iconic line drawings or pictographs widely referred to as rebuses (Clark, Davies, & Woodcock, 1974). These drawings, unlike Blissymbolics, depict a high degree of similarity to the objects they represent. Hurlbut, Iawata, and Green (1982) compared training in Blissymbolics and an iconic picture system for three severely handicapped nonvocal adolescents. Results indicated that iconic line drawings were superior to Bliss symbols in acquisition rates, maintenance, stimulus generalization, and spontaneous usage of items learned. These results were consistent with those obtained by Welch and Pear (1980) who conducted a study comparing pictorial representations versus real objects in teaching object naming. It was concluded that iconicity or formal similarity between a representational stimulus and its corresponding object enhances generalization. Given the above findings, it would appear that stimulus presentations involving large photographs of objects would be appropriate for NPMR persons.

The Non-SLIP (Non-Speech Language Initiation Program) was developed by Carrier and Peak (1975) as an adaptation of a program developed by Premack and Premack (1974) to teach language training exercises to a chimpanzee named Sarah. Non-SLIP involves a finely graded series of training steps to teach discrimination among colors, pictures, and symbols as preparation for language instruction, and employs a

contingent reinforcement delivery system. The first phase of training is designed to teach a child to respond in a rote-sequential manner for seven appropriately cued symbols. The terminal behavior involves placing a symbol with one red marker in the slot at the left of the response tray, then placing a symbol with one orange marker in the second slot of the tray, a symbol with a green marker in the third slot, a symbol with a blue marker in the fourth slot, a symbol with a black marker in the fifth slot, a symbol with two red markers in the sixth slot, and a symbol with two orange markers in the seventh slot (Carrier, 1976). The program commences with a match-to-sample task for number matching which progresses to color matching and eventually to rote-sequencing using shaping strategies in a forward-chaining format. Carrier (1976) does concede that children with motor problems that interfere with response requirements either have learned very slowly or have not been able to progress to the other program phases which include labelling, subject noun training, verb training, object of preposition training, and preposition training. Porter and Schroeder (1980) have also pointed out that some of the subjects selected for Non-SLIP training were eliminated early from additional training for failure to acquire the motor behavior prerequisites described above.

Bricker and Bricker (1974) experimented with 22 severely retarded children by using motor movements to facilitate

acquisition of receptive language. Subjects were taught gestural representations for 30 objects (e.g., running the hand over the hair for comb). Words were then introduced and the child was taught to make a motor response to the word. Words were then presented in conjunction with actual objects. Results suggested that motor movements facilitated the learning of word-object associations. NPMR individuals, however, lack the coordinated muscle control needed to perform such movements of the upper extremities.

Woolman (1980) has established some excellent specific training procedures to teach prelinguistic skills to nonverbal trainable mentally retarded children. The program is divided into three levels; namely, physical and visual attending to task, scanning and discrimination of visual stimuli, and use of short term memory for recognition and recall. Within the first level, the terminal objective defined for physical attending includes the requirements that the child will sit in a chair across from the trainer with shoulders back, head erect, hands at rest, with no interfering behaviors for 10 consecutive 30-sec trials. Procedures with respect to visual attending to task first focus upon establishing eye-contact with the teacher, and subsequently train visual fixation to three objects pointed to by the teacher. Scanning and visual discrimination of stimuli involves a match-to-sample training

program initially for one, two, and three pairs of concrete objects, which progresses to object-picture matches and ultimately to picture-picture matches. The third level provides training in the development of short term memory. The child is required to recognize the visual stimulus card as matching one of three cards placed facedown in front of him, and recall where that card is located. Training steps, reinforcement procedures, and criterion testing procedures are clearly defined for physical attending requirements. Although certain features of this program may be adaptable to NPMR individuals (such as visual attending and discrimination of visual stimuli), the severity of postural deformities and involuntary body movement would classify such individuals as unacceptable for program entry. In addition, NPMR individuals incapable of managing a pointing response would require electronic aids to facilitate development of a more effective response modality.

The match-to-sample training format has been found to be an effective discrimination training procedure for severely retarded children. Rosenberger, Stoddard, and Sidman (1972) used nonverbal responding and sample matching techniques with a wall-mounted display and response panel. This consisted of a square matrix of nine translucent windows, each two-inches square and arranged in three rows of three squares. Visual

stimuli presented on the windows were projected as slides from the rear of the panel. The sample image was first projected to the centre window. The subject then pressed the window (making an observing response), and the choices appeared on the eight peripheral windows of the matrix for simultaneous comparison with the sample. Correct responses resulted in automated delivery of edible reinforcement. The response requirements for this device, however, makes it unsuitable for NPMR individuals who lack the range of voluntary upper limb movement and fine muscle control necessary to press response windows.

Augmentative Communication Techniques and Aids

Communication aids are used widely with nonverbal severely physically and mentally handicapped children and adults who are unable to communicate effectively through speaking or writing and these devices have been described in considerable detail (Harris & Vanderheiden, 1980; Schurman, 1974; Vanderheiden & Grilley, 1976).

Harris and Vanderheiden (1980) mention three basic approaches to nonverbal communication systems for nonvocal severely physically handicapped persons; direct selection, scanning, and encoding. Direct selection refers to techniques in which the message sender demonstrates elements of the

message by directly pointing to them in some manner. In addition to headsticks and mouthpieces, several mechanical switches for the extremities have been devised to act as "pointers", such as pushbuttons, paddles and levers, wobble-sticks, joysticks, sliding or trolley switches, poke switches and pillow switches (Vanderheiden & Grilley, 1976). Mechanical switches have also been devised to be operated by a specific body part; such as, the chin, eyebrow, thumb, wrist, knee, and tongue. Furthermore, touch sensitive, moisture sensitive, optical, pneumonic, and sonic switches have been adapted for use with this population (Vanderheiden & Grilley, 1976).

Scanning techniques involve the presentation of message elements (such as pictures) one at a time to the handicapped person who signals by pointing out the desired element. Harris and Vanderheiden (1980) point out that the major advantage of this approach is that it can be used even with the most severely handicapped individual; although, its use is slower and less motivating than direct selection. It is particularly recommended for individuals who are severely limited in range of motion and who lack an effective pointing skill.

Encoding is a communication approach which uses colors or combinations of colors and numbers as a pattern or code of signals to provide a message element. The response requirements for this method of communication are more complex and abstract

in nature than the systems presented above, and therefore its utility for NPMR individuals would be doubtful.

The most common and widely used communication aid is a communication board. Typically, the board's display features an array of rows and columns depicting Bliss symbols, alphabetic characters and numbers, pictographs, or photographs (Vanderheiden & Grilley, 1976). However, most communication boards present several disadvantages for NPMR persons. The size of such stimuli are typically small and the number of items displayed range from four to over 100. In a review of visual disorders of developmentally disabled children, Donlon (1976) suggested that 25-75% of all children with cerebral palsy had at least one abnormality in oculo-motor function. It would therefore seem appropriate to provide NPMR individuals with a few large, visually attractive stimuli with the focus on simplicity rather than complexity in configurational features.

One very important factor in the construction of communication boards for the handicapped is the response topography of the subject. An appropriate response that can be measured must be identified and shaped to the point where it can occur reliably. Reid and Hurlbut (1977) in a study with multihandicapped severely retarded adults examined the use of instructions, praise, and physical guidance in developing a

pointing response with either a head pointer or the hand. The subjects were first taught to point to selected target areas of a communication board made of plywood and measuring 37.5-cm x 62.5-cm. Twelve to 16 rectangular blocks of approximately 7.5-cm x 12.5-cm were drawn on the board, each of equal size. After success at this level was achieved, photographs and description words depicting five leisure areas about the institution (television cubicle, radio area, library, lobby, porch) were introduced on the communication board. During baseline no subject consistently pointed to correct pictures following verbal prompts such as "Show me where you would point if you wanted to go to the library". After identification training was implemented correct responding increased for all three subjects. Each subject correctly pointed to all five areas during follow-up sessions.

Elder (1978) devised a training program to systematically teach visual symbol communication (Visual Symbol Communication Instruction) to students ranging from profound to mild mental retardation. The program involved use of a communication display board originally developed for subjects incapable of traditional pointing responses. The display board contained a clear plastic envelope centered in each of four quadrants below which a red pointer light was situated. The pointer lights were used to reinforce correct responses as well as to

provide directional correction for incorrect responses. The response mode employed was either gestural (pointing) or visual (scanning and fixating the symbol within 5-sec of presentation, and maintaining fixation for a 3-sec duration prior to reinforcement). Criteria for candidate selection included: (a) attention to task for approximately 5-min, exhibiting appropriate attending to verbal and visual stimuli, (b) displaying receptive language which could be paired with visual symbols, (c) exhibiting and maintaining eye contact with people, objects, and pictures for at least 3-sec on demand, and (d) exhibiting interactive social behavior indicating need and desire to communicate. Twenty subjects were selected for field testing ranging in age from 3 years, 9 months to 42 years. The level of functioning of the subjects was described as ranging from profound to mild mental retardation. Subjects exhibited nonverbal vocabulary recognition ages on the Peabody Picture Vocabulary Test ranging from 2 years, 2 months to 10 years, 5 months. Performance on the Carrow Test for Auditory Comprehension of Language resulted in Age Equivalency scores ranging from 3 years to 6 years, 9 months. Although the procedure for the communication instruction program was adequately described, there were no results of the field testing published.

In a subsequent report (Elder & Bergman, 1978) using

Blissymbolics as a visual symbol system and directed eye gaze as the primary response mode, reported results for five subjects ranging in functioning level from profound to mild mental retardation. Four of the subjects were diagnosed as spastic quadriplegic. The data revealed acquisition rates of .69 to 1.18 symbols learned per session with a mean of .93. The slowest rate of learning was seen in the youngest subject (3 years, 9 months of age), and the next two slowest rates of learning (.84 and .92 symbols per session) were seen in the two clients described as profoundly retarded. However, many NPMR individuals do not exhibit the receptive language capabilities, demonstration and maintenance of eye contact on demand, nor interactive social behavior considered as essential as behavioral prerequisites for entry into such a program of instruction.

It has been asserted that in some instances communication boards could be enhanced considerably if the specific physical capacities of the individuals using them were considered more carefully (Anderson, 1980). This author suggests further that communication aids sometimes appear to be constructed to conform more to the wheelchair tray or the needs of the observers rather than to the specific needs and abilities of the non-speaking users.

What appears to be needed is a nonverbal communication

system which takes into account the individual postural and behavioral idiosyncracies of NPMR individuals. Such a program would include the use of effective sensory or appetitive reinforcers, and provide a response system that could be used by the student. The purpose of the present study was to develop and assess the effectiveness of a communication training program with NPMR subjects. The objectives of this training were: (a) to teach subjects to operate a lever to illuminate a panel serving as a communication board, (b) to teach subjects to visually fixate on an illuminated picture presented on the panel, (c) to teach selective visual scanning of pictures presented on four quadrants of the communication board, (d) to teach two-, three-, and four-part picture discrimination by match-to-sample training, and (e) to teach receptive language by verbally cueing pictures presented on the visual array board.

The experimental design employed in this study is similar to the changing-criterion design used by Murphy and Doughty (1977). When subject performance consistently meets criterion, the criterion for reinforcer delivery is made more stringent across procedural phases.

Method

Subjects

Nine NPMR adolescents and young adults residing on the

Parkhaven and Hawthorne wards of the Manitoba School for Retardates served as subjects. The range in age for the seven female subjects and two male subjects was 14 years, 1 month to 29 years, 0 months with a mean age of 21 years, 5 months.

The subjects had been assigned to these wards on the basis of their severe mental and physical handicaps. All nine subjects had been diagnosed as profoundly retarded and each of the subjects had major physical disabilities. Six of the nine subjects were diagnosed as spastic quadriplegic. One subject had a diagnosis of spastic diplegia and another subject had a diagnosis of spastic hemiplegia. Six of the subjects were epileptic and all had major physical abnormalities, including scoliosis and congenital deformities of the hips. Disabilities in oculomotor function occurred in six of the subjects who had conditions ranging from nystagmus and strabismus to bilateral cataracts and optic atrophy. Two of the subjects (Sherry-Lynn and Doug) had such severe postural deformities that wheelchairs were unable to be suitably modified for them. Consequently, they spent all of their waking hours either in bed or on floor mats in the ward dayroom.

Institutional records indicated that all subjects had been assessed on the Vineland Social Maturity Scale and had attained Social Ages ranging from less than 5 months to 11 months. Prior to participation in the study each subject was assessed on 45 selected items of the Mental Scale from the Bayley Scales of

Infant Development pertaining to visual fixation, visual tracking, and manipulation of various stimulus objects (Whiteley & Krenn, Note 1). Scores ranging from 7 to 36 were obtained for eight of the subjects. One of the subjects (Doug) was found to be untestable by his lack of visual orientation and response to stimulus materials. A summary of the subjects' physical characteristics and medical evaluations appears in Table 1.

The criteria for the selection of subjects for the present study were as follows: (a) they did not demonstrate any expressive or receptive vocabulary, (b) they lacked sufficient manipulation skills to enter existing nonspeech communication programs, and (c) they were classified as nonambulatory and profoundly retarded. Six of the subjects selected (Monica, Terry, Ramona, Sherry-Lynn, Dawn and Linda) had demonstrated operant conditioning with sensory reinforcement in a previous series of experiments (Dewson, 1981).

Apparatus

The apparatus consisted of a freestanding 1.8-m x 1.8-m metal visual array board with four equivalent recessed light panels measuring 26-cm x 26-cm (see Figure 1). These panels will be referred to as Right Lower Quadrant (RLQ), Left Lower Quadrant (LLQ), Right Upper Quadrant (RUQ), and Left Upper Quadrant (LUQ). The glass portion of the light panels measured 19-cm x 19-cm.

Table 1

Summary of Subjects' Characteristics[a]

Name	Sex	Age[b]	Weight[c]	Diagnosis	Motor	Sensory	Medications	Psychological
Monica	F	16-10	25.2	Spastic Quadriplegia Epilepsy Microcephaly	Scoliosis Bilateral equino-valgus ankles		Valium	VSMS[d] 11 mo BMS[e] 36
Doug	M	29-4	29.0	Spastic Diplegia Epilepsy	Fixed flexion contracture to right knee		Diazepam Dilantin Glysennid Tabs	VSMS 9 mo BMS untest-able
Chris	M	14.1	16.0	Spastic Hemiplegia Microcephaly	Gross dorsal spine hyperextension	Nystag-mus	Infantol	VSMS 7 mo BMS 16
Dawn	F	20-0	26.1	Spastic Quadriplegia Encephalitis due to postnatal infection causing cerebral atrophy Epilepsy	Scoliosis Gross choreiform movements		Diazepam Dilantin Glysennid Tabs.	VSMS 5 mo BMS 32
Ramona	F	25-6	22.0	Encephalopathy due to prenatal infection (Rubella). Microcephaly	Kyphoscoliosis Bilateral dis-location and contractures of hips. Right knee flexion contracture Right ankle lateral deviation Generalized muscle atrophy	Bilateral cataracts Bilateral micro-cornea		VSMS 5 mo BMS 34

Table 1 (cont'd)

Name	Sex	Age	Weight	Diagnosis	Motor	Sensory	Medications	Psychological
Sherry-Lynn	F	19-5	18.4	Spastic Quadriplegia	Congenital dislocation of right hip Flexion-adduction contracture Scoliosis	Strabismus	Diazepam Glysennid Tabs.	VSMS 3 mo BMS 28
Terry	M	24-1	34.5	Spastic Quadriplegia Epilepsy Microcephaly	Kyphoscoliosis Congenital dislocation of hips	Blindness due to bilateral optic atrophy	Dilantin Phenobarbital	VSMS 6 mo BMS 7
Linda	F	21-10	24.2	Spastic Quadriplegia Epilepsy Diffuse cerebral atrophy	Congenital left hip dislocation Flexion contractures of knees and elbows	Bilateral rotational nystagmus	Dilantin Phenobarbital Glysennid Tabs.	VSMS 3 mo BMS 12
Madelynne	F	21-10	33.8	Spastic Quadriplegia Microcephaly Epilepsy	Kyphoscoliosis Flexion contractures of knees	Congenital bilateral cataracts	Dilantin Phenobarbital Oval	VSMS 4 mo BMS 25

[a] With the exception of BMS scores, information is based on institutional records.

[b] Age at beginning of experiment in years and months.

[c] Weight in kilograms.

[d] Vineland Social Maturity Scale.

[e] Score on 45 items of the Mental Scale from the Bayley Scales of Infant Development.

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Figure 1. Photograph of communication training board.

All four light panels were covered with a 1.8-m x 1.8-m piece of transparent Lexan plastic secured to the metal frame. Each quadrant was illuminated by a standard 60-W white bulb. The visual array board was connected to a relay rack which regulated panel illumination and sequential rotation of illuminated panels.

A modified omnidirectional joystick served as the response manipulandum (see Figure 2). The lever was positioned and fastened to a wheelchair tray with the use of strips of velcro mounted to the bottom of the lever and the top of the tray. The subject's hand and wrist was secured by velcro straps to an arm splint bolted to the lever to minimize slippage. The lever rested on four microswitches which were activated by minimal forward, backward, or lateral movement. The lever was connected through the relay rack to the visual array board.

During the scanning phase of the study it was found that for some subjects the lever was too sensitive. Involuntary movements would trigger the mechanism to transfer the illumination rapidly from one quadrant to the next. At this time a metal insert was fastened to the lever stem by a hinge. When positioned, the insert allowed the lever stem to be moved only in a forward-backward direction. This modification to the apparatus facilitated control of the lever by some of the subjects.

The discriminative stimuli were 13-cm x 15-cm color photographs depicting familiar functional objects and staff

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Figure 2. Photograph of lever device.

present on the ward, and pieces of blank grey cardboard the same size as the photographs. The pictorial stimuli and blank cards were secured to the visual array board by placement in transparent plastic envelopes taped to the centre of each quadrant.

Procedure

All sessions were conducted in a separate room away from the ward measuring approximately 3-m x 4-m. Each subject was positioned in his or her wheelchair in front of the visual array board which stood on a table surface in front of the subject approximately 1-m off the floor. The session commenced when the subject was awake with eyes open, facing forward, and in no apparent state of distress. Daily sessions were held for each of the nine subjects, seven days per week at the same time each day. The duration of each session varied from subject to subject and across sessions for each subject. Session length was 20 minutes or until at least 10 trials were completed. Data sheets were prepared for each phase as shown in Appendix A.

Response-contingent sensory stimuli consisted of different combinations of automated delivery of 10-sec of tape-recorded Spike Jones music, 10-sec of slides projected onto a screen located to the left of the visual array board, and 10-sec of stimulation provided by a vibrating cushion positioned behind

the subject's back or lying flat on the subject's lap. Additionally, appetitive stimuli consisting of 5-ml portions of vanilla ice-cream, chocolate milk, pink lemonade, raspberry jello, peach delight, or several granules of crushed Jersey Milk chocolate bar were employed with some subjects. The appetitive stimuli were given by spoon or plastic syringe. Social reinforcement consisting of patting the subject on the head, cheek and shoulders, smiling, and talking to the subject was also provided for all subjects. Initial selection of contingent stimuli was determined by reinforcer preferences found in previous research with the same subjects (Dewson, 1981), or by reports from ward personnel familiar with the subjects. Subsequent manipulation of the response contingent stimuli was determined by the response characteristics of each subject through the various phases of the study.

Lever response and visual fixation training. During this condition subjects were taught to operate the lever to light the panel and to visually fixate on the panel. The Right Lower Quadrant (RLQ); that is, the lower quadrant on the subject's right, was the only panel illuminated at this time. A colored photograph depicting a familiar staff member, resident, or functional object was centered on RLQ in a transparent plastic envelope. A piece of grey cardboard matching the dimensions of the photograph was secured to the

Left Lower Quadrant (LLQ), Left Upper Quadrant (LUQ), and Right Upper Quadrant (RUQ).

At the beginning of each trial subjects were given the instruction, "Move the lever, (subject's name)." If the subject moved the lever sufficiently to activate the microswitch within 10-sec, the RLQ was illuminated for 15-sec. If the subject visually fixated the illuminated panel within this 15-sec interval, he or she received positive reinforcement on a CRF schedule. Each subject meeting both of these conditions was scored as having made a correct response for the trial. Following the initial trial each successive trial commenced immediately after the RLQ light had switched off. In this phase of the study, the illumination remained stationary on RLQ and was not transferred to adjacent quadrants by additional lever pressing. If the subject moved the lever but did not fixate the illuminated picture panel, gestural prompts and physical guidance to fixate were provided, and following the prompted response the subject was reinforced. Gestural prompts consisted of the experimenter tapping the picture secured to RLQ with a pen five times in rapid succession for a 2-sec interval. If the subject still did not fixate the panel within 5-sec of the gestural prompt, the experimenter provided physical guidance by lifting the subject's chin or turning his or her head in the direction of the illuminated

panel. Details of fading procedures can be seen in Appendix B. For some subjects, it was necessary to hold their heads stationary to prevent frequent lateral head movement or to prevent them from assuming a position where the visual array board would not be within their visual field.

If the subject did not operate the lever within a 10-sec period following the verbal instruction, the instruction was repeated and gestural prompting or physical guidance was provided by the experimenter such that the lever was activated, RLQ was illuminated, and the subject was reinforced. A gestural prompt consisted of the experimenter moving his arm and hand in a clenched fist forward and backward directly over the lever device without touching the subject. Physical guidance consisted of the experimenter moving the subject's hand sufficiently to activate the lever and illuminate the panel.

If the subject required physical guidance to operate the lever for five consecutive trials, a series of massed practice trials occurred. This procedure consisted of the experimenter providing physical guidance sufficient to activate the lever and illuminate the panel. A button was then pushed which ended the illumination. This sequence of turning the illumination on and off was repeated rapidly at least 10 times in succession after which the subject was reinforced.

The criterion for subject selection for continuation in

the study was 80% correct trials per session for two consecutive sessions. Subjects were trained for a minimum of eight sessions. If no significant progress in achieving correct responses was seen, they were then terminated from the study.

Selective scanning and match-to-sample training. During this phase, one colored photograph was displayed on one of the quadrants commencing initially at RLQ. Blank pieces of cardboard with the same dimension as the photograph were displayed on the remaining three quadrants. The difference between this and the preceding phase of the experiment was that each lever press transferred panel illumination to an adjacent quadrant in a clockwise sequence; that is RLQ - LLQ - LUQ - RUQ - off. At the beginning of each trial, the experimenter presented a picture identical to that displayed on the target quadrant. The instruction, "Show me the (picture name)", "Where is the (picture name)?" was provided. The response requirement for reinforcement was that the subject activate the lever to illuminate the picture panel, visually fixate the target panel, and refrain from further lever pressing for a 5-sec interval from onset of target panel illumination. The maximum interval of illumination remained at 15-sec. During reinforcement the illuminated panel was "locked in"; that is, subsequent lever pressing could not transfer the illumination to an adjacent quadrant. At the end of the 15-sec illumination, the light turned off, and an automatic reset mechanism

was activated to start the next trial at RLQ. Lever pressing instances during reinforcement delivery were not recorded and did not operate the lights.

Subjects were first trained to a criterion of 80% correct trials per session for two consecutive sessions with one of the target quadrants. Further training was then provided, using the same criterion, with each of the other target quadrants.

If the subject demonstrated an error by failing to move the illumination to the target quadrant, the experimenter employed gestural prompts and physical guidance to move the illumination to the target quadrant and to "hold" for a 5-sec interval in order for the subject to obtain reinforcement. Gestural prompts consisted of (a) the experimenter placing the sample stimulus picture over the matching picture on the appropriate quadrant, and (b) the experimenter extending his arm with hand open and palm downward toward the lever and simultaneously saying "stop". Physical guidance consisted of the experimenter moving the subject's arm to activate the quadrant lights through the correct sequence to the target quadrant and pausing for the required 5-sec interval. If the subject made an error by tracking the illumination past the target quadrant, or pausing for a 5-sec interval on a quadrant other than the target quadrant, the automatic reset mechanism was activated and the illumination was turned off. The trial

was then repeated with gestural prompts provided by the experimenter. If a second error occurred, the trial was repeated again with physical guidance employed and reinforcement provided.

Generalization probe. During this condition each subject who reached criterion at each quadrant location was given generalization sessions in which the picture was randomly assigned to a different quadrant for each trial within sessions. Blank pieces of cardboard were displayed on the remaining three quadrants. A criterion of 80% correct trials per session for two consecutive sessions was required for each subject to progress to the next phase of the study.

Two-Picture Discrimination Phase. During this phase of training a second picture depicting an object with different configurational features than the first picture was displayed on the visual array board with the picture presented during the previous phases of the study. Both pictures were randomly assigned to two of the four quadrants for each trial within each session such that both pictures were presented on each of the four quadrants an equivalent number of times. The remaining two quadrants displayed blank pieces of cardboard. At the commencement of each trial, in random order of presentation, the experimenter held up a picture identical to one of the two pictures displayed on the visual array board, and

instructed the subject to "Show me (name of picture)", "Where is the (name of picture)?". By operating the lever, the subject was required to move the illumination to the target panel and refrain from lever pressing for a 5-sec period following onset of illumination. If response requirements were met, the subject received reinforcement. If an error was observed, the trial was repeated. If a second error occurred, the experimenter employed gestural prompts or physical guidance as previously described during the selective scanning and match-to-sample training phase, and the subject received reinforcement.

Criterion for progressing to the next phase was 80% correct matches with each picture per session for two consecutive sessions. Failure to achieve criterion with the novel picture resulted in the subject being assigned to a series of sessions involving match-to-sample training with the novel stimulus only. Following completion of this training the subjects received a replication of the two-picture discrimination phase until criterion was established.

Three-Picture Discrimination Phase. This condition involved retention of the two previous photographs and introduction of a third photograph depicting an object or person with different configurational features to the other two pictures. The match-to-sample training format possessed the

same response requirement for obtaining reinforcement as in the two-picture discrimination phase. Eighty percent correct trials for all three pictures for two consecutive sessions constituted the criterion for progression to the next phase. Similar gestural prompting and physical guidance was provided for subjects who made consistent errors. Failure to achieve criterion with the novel picture resulted in the subject being assigned to a series of sessions involving match-to-sample training with the novel picture stimulus only. Following completion of this training the subjects then received a replication of the three picture discrimination phase until criterion was established.

Four-Picture Discrimination Phase. This condition involved retention of the three previous photographs and introduction of a fourth photograph depicting an object or person with different configurational features to the other three pictures. Response requirements for contingent reinforcement and criterion for successful completion were identical to the preceding phase. Gestural prompting and physical guidance were provided to subjects who demonstrated consistent errors, as described previously. For each trial, the four pictures were randomly assigned to the four quadrants. Over a series of 24 trials each sample picture was presented 5 to 7 times.

Receptive Language Training Phase. During this condition,

the subject received training involving presentation of a verbal stimulus cue (picture name) in the absence of the sample picture. The subject was required to move the illumination to the target quadrant containing the picture indicated by the verbal cue. On each trial, the four pictures previously learned in the Four-Picture Discrimination Phase were randomly distributed over each of the four quadrants. Additionally, each verbal cue was presented five to seven times in a 24 trial session. If an error occurred on any trial, the trial was repeated. If a second error occurred the sample picture was presented in addition to the verbal cue. Correct responses were scored if the subject tracked to the target quadrant in the presence of only the verbal cue. Criterion for successful completion of this phase was identical to the preceding phase of the study.

Four-Picture Discrimination Phase II. During this phase, four novel pictures were displayed on the visual array board and a match-to-sample teaching format was utilized. Response requirements for contingent reinforcement, criterion for successful completion, prompts and guidance following errors, and random presentation of picture stimuli were identical to the first four-picture discrimination phase.

Receptive Language Phase II. This phase of the study replicated the previous receptive language training phase

with some modifications in training procedures. If a subject demonstrated consistent errors and was unable to reach the criterion of 80% correct responses over two consecutive sessions for a particular picture, a separate series of sessions was conducted. During these sessions all four pictures were randomly distributed in different quadrant locations from a predetermined sequence for each trial. However, on every trial of a session, the same verbal cue was presented. A fading procedure was also introduced. This consisted of presentation of the sample picture stimulus to the subject for a 3-sec interval. The picture stimulus was then turned face down, and the subject was given the verbal cue. On successive trials the picture was displayed, removed from view, and following a 5-sec delay, the verbal cue was given. Responses were scored as correct if the subject tracked the illumination to the target quadrant when provided only with the verbal cue. As the percentage of correct responses increased, verbal cues corresponding to the three other pictures were gradually introduced until the four verbal cues were presented an equivalent number of times.

During the remainder of this phase, various combinations of pictorial stimuli were presented on the visual array board while the cue for responding remained verbal. The stimuli consisted of pictures previously learned to criterion during

the four picture discrimination phases, in addition to new pictures not previously introduced.

Results

Performance on each phase of training was evaluated by plotting percentage of correct trials per session, percentage of trials per session in which gestural prompting and physical guidance were provided to obtain visual fixation of the panel, and percentage of trials per session in which physical guidance and gestural prompting were provided to obtain a lever response. For subjects who progressed to the two-picture discrimination phase as well as other phases in the study, performance was also evaluated by plotting percentage of correct trials per session for tracking to the target visual stimulus.

Lever response and visual fixation training. As can be seen in Figure 3, Monica progressed rapidly in this phase of the study, achieving well above criterion on her first three sessions. During the first three trials of the initial session, she displayed considerable laughter and arm movements during reinforcement which consisted of automated slides and social stimulation (see Table 2). With the exception of one trial in both the first and second session, this subject did

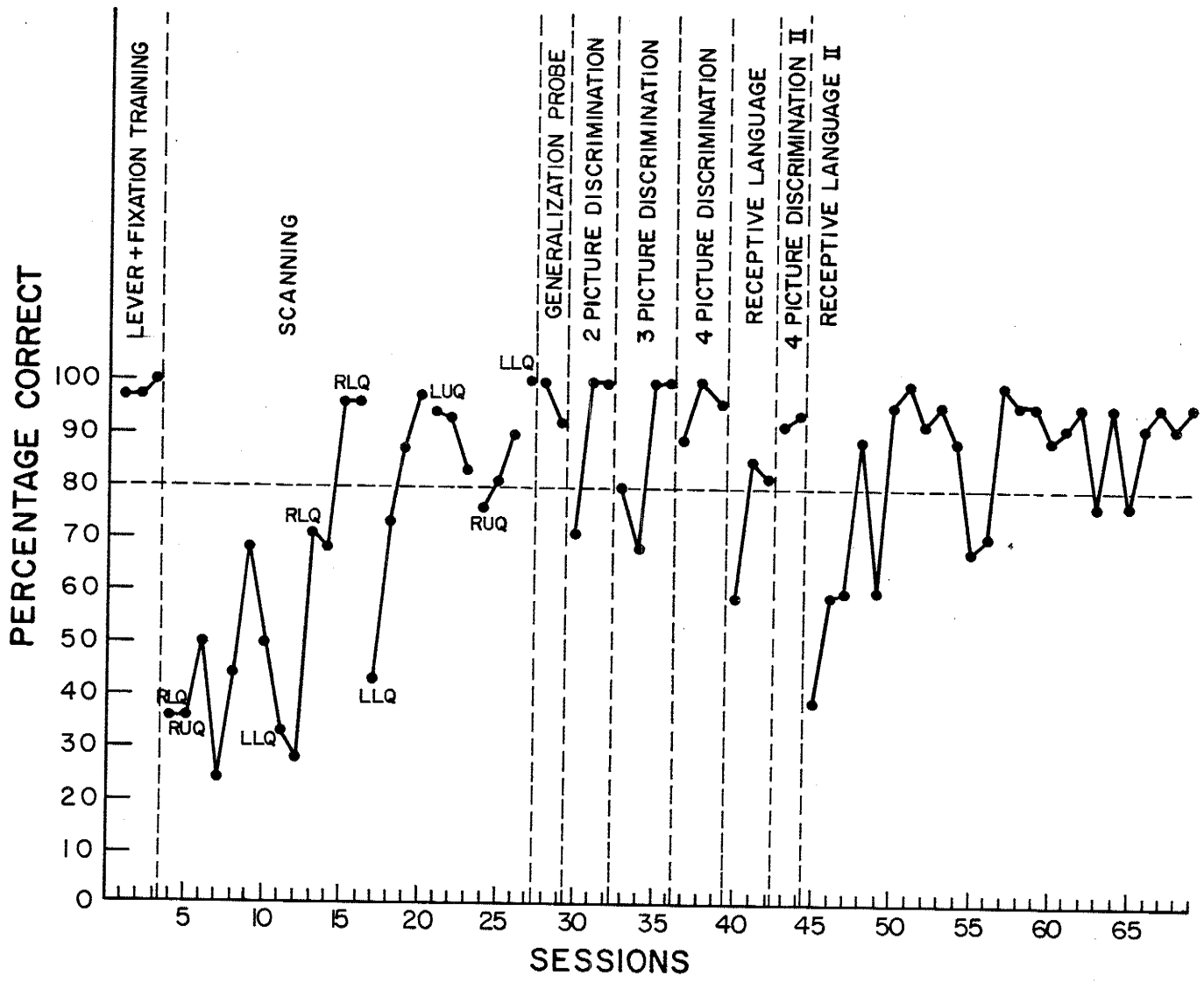

Figure 3. Percentage of correct trials per session across all experimental phases for Monica.

Table 2

Reinforcer Combinations for Each Subject Across Each Experimental Phase[a]

Subject	Lever Response and Fixation Training	Selective Scanning and Match-to-Sample Training	Two-Picture Discrimination	Three-Picture Discrimination	Four-Picture Discrimination	Receptive Language I & II Four-Picture Discrimination I & II
Monica	S(1-3)	S(4-11) S, M(12-26) S, M, C(27-29)	S, M, C(30-32)	S, M, C(33-36)	S, M, C(37-39)	S, M, C(40-42) S, M, C(43-44) S, M, C(45-60) S, M(61-65) S, M, C(66-69)
Doug	S, M(1-3)	S, M(4-5) S, M, C(6) S, M(7) S, M, C(8-10) S, M, V(11) S, M, V, C(12) S, M, V(13-20) M, V(21-22) M, V, C(23-24) M, V(25-29)	V, M(30-37)	V, M(38-41)	V, M(42-43) V, M, S(44-46)	
Chris	S, M(1-4)	S, M(5-14) S, M, V(15) S, M(16) S, M, V(17-19) S, M, V, C(20-24)				
Dawn	S, M, V(1-4)	S, M, V(5-7) S, M(8-20) S, M, V(21)				

Table 2 (cont'd)

Subject	Lever Response and Fixation Training	Selective Scanning and Match-to-Sample Training	Two-Picture Discrimination	Three-Picture Discrimination	Four-Picture Discrimination	Receptive Language I & II Four Picture Discrimination I & II
Sherry-Lynn	S, M(1-3)	S, M(4-6)				
Ramona	S, M, V(1-5) S, M, I(6) S, M(7-9) S, M, V(10-12) M, V, I(13-14) M, V, J(15) V, M, S, PD(16)					
Terry	S, M(1-3) I(4-6) CM(7) V, L(8) V, M, CM(9)					
Linda	S, V(1-3) I(4-5) CM(6) M, V, L(7) V, M, CM(8)					
Madelynne	S, M, V(1-3) I(4-5) CM(6) C(7) V, L(8) V, M, CM(9)					

Note. The numbers in parentheses refer to session numbers.

S = Slides, M = Music, C = Chocolate, V = Vibration, I = Ice-Cream, J = Jello,

PD = Peach Delight, CM = Chocolate Milk, L = Lemonade.

[a] Social reinforcement was given throughout training.

not require gestural prompting or physical guidance to visually fixate the panel. She only required physical guidance for lever responding on one trial during Session 1 (see Figure 4).

Doug demonstrated a similar pattern of learning by reaching criterion within the first three sessions of this phase as shown in Figure 5. Correct trials in Sessions 2 and 3 were in excess of 90%. As can be seen in Figure 6, this subject required physical guidance to make a lever response in the first session, but few trials required this assistance in Session 2, and none in Session 3. Because the posture of this subject resulted in his head falling downward, it was necessary for the experimenter to provide him with artificial support to hold his head erect such that the picture panel was within his visual field. After trying a number of neck and head restraints, the most successful method resulted from the experimenter holding his head erect at the forehead for the duration of each session. Consequently, there are no data presented concerning physical guidance for visual fixation. This subject did not require any gestural prompting to visually fixate the picture panel throughout the study. As indicated in Table 2, contingent reinforcing stimuli consisted of simultaneous presentations of social reinforcement, slides, and music for 10 sec.

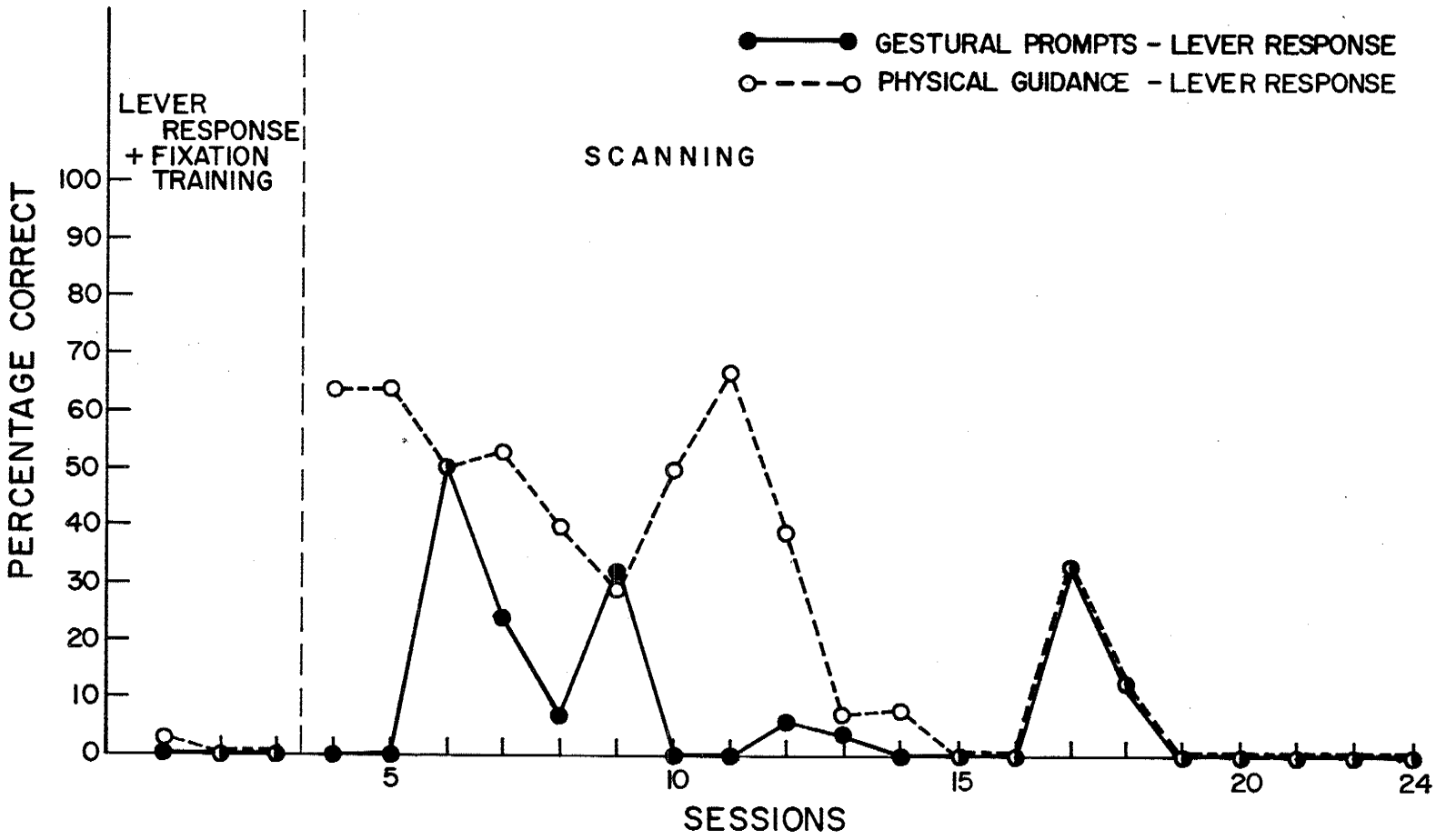

Figure 4. Percentage of trials per session in which gestural prompts and physical guidance for lever responding were provided to Monica.

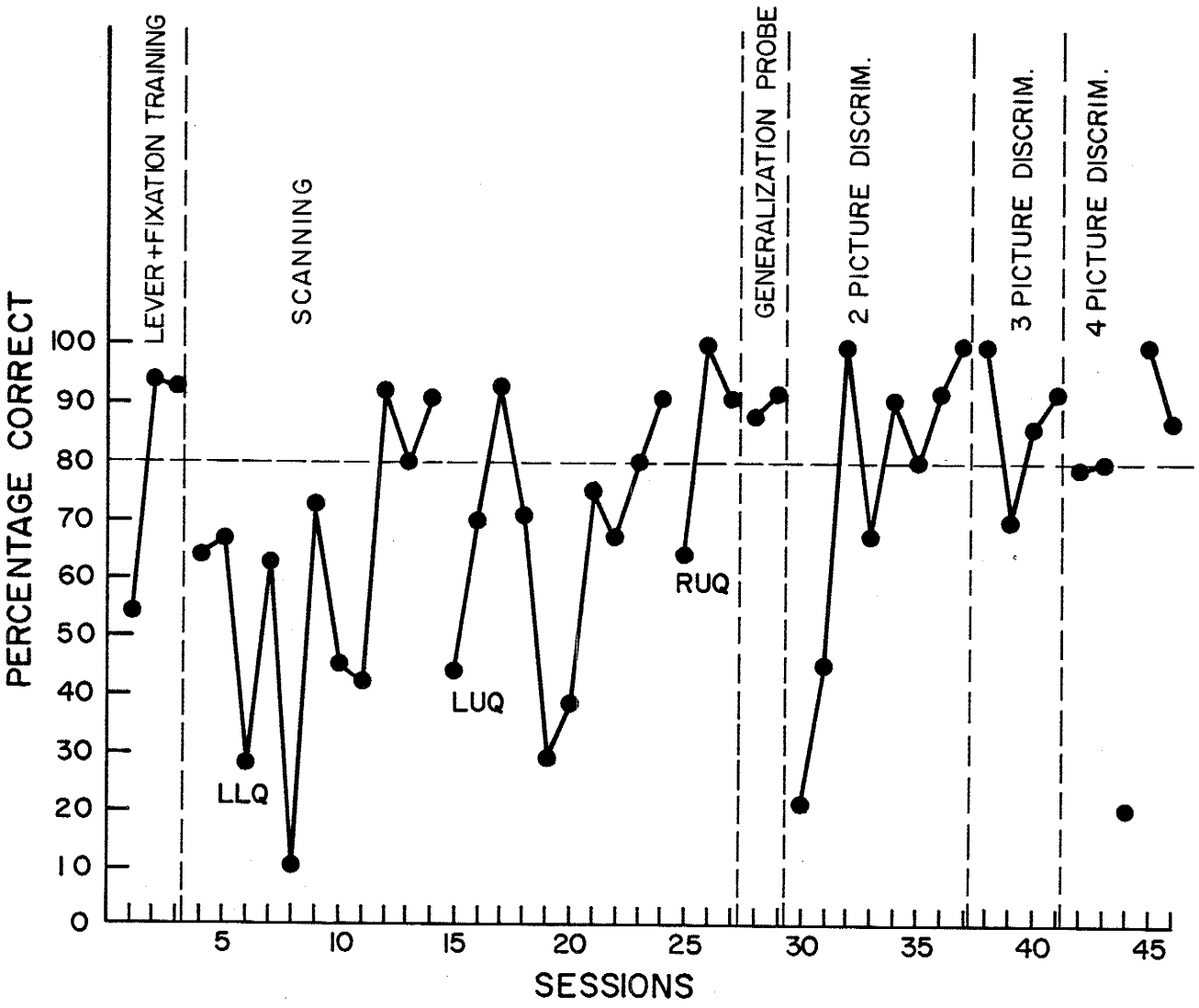

Figure 5. Percentage of correct trials per session across all experimental phases for Doug.

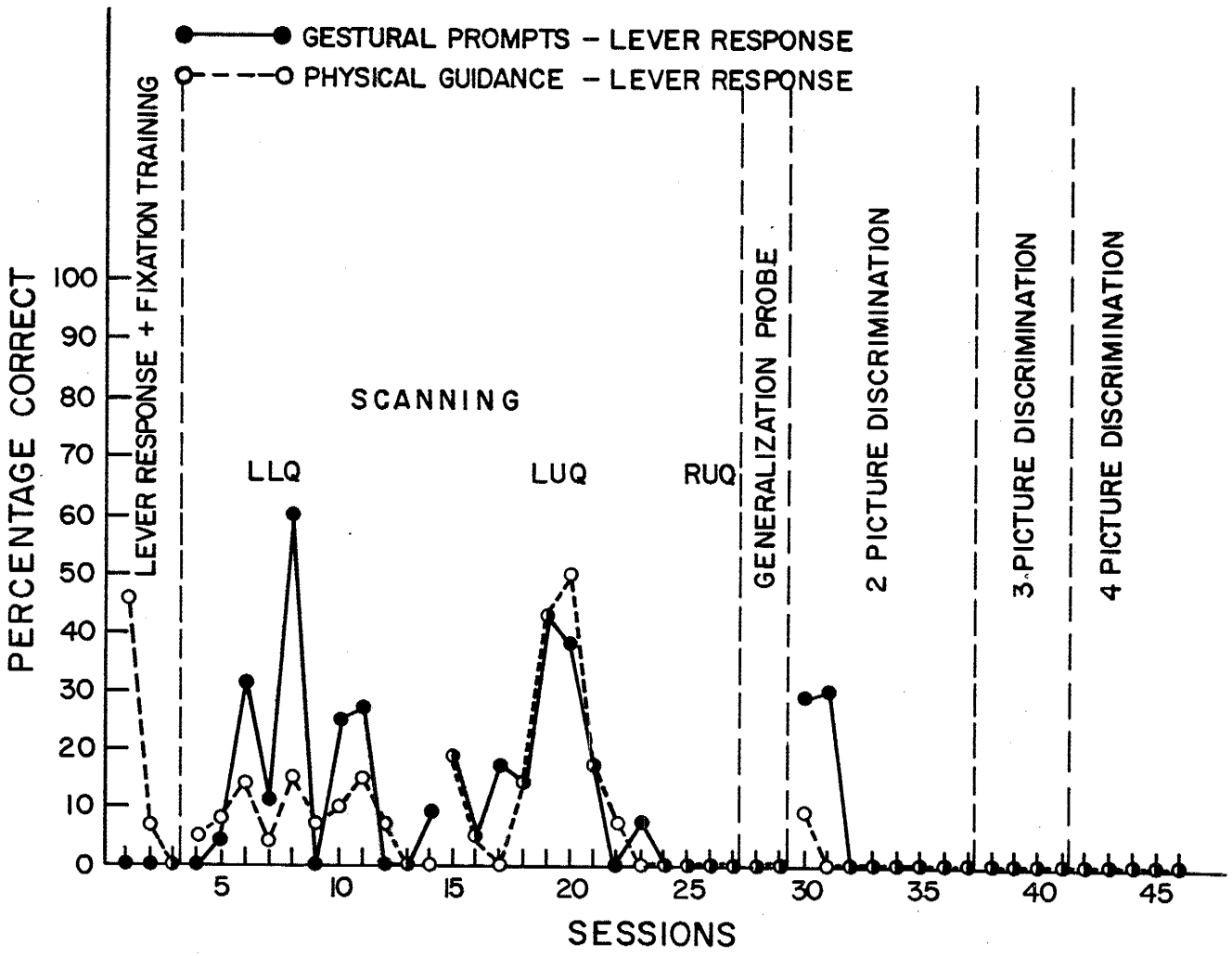

Figure 6. Percentage of trials per session in which gestural prompts and physical guidance for lever responding were provided to Doug.

Chris reached criterion within four sessions in this training phase (see Figure 7). On the third trial of the first session, a strong right arm spastic contracture was observed, and it was necessary to temporarily stop the session. With the exception of the two trials in the first session and one trial in the third session of this training phase, Chris did not require any additional prompting or guidance to fixate the picture panel. Some physical guidance was required to enable this subject to make a lever response in the second session, as indicated in Figure 8. However prompting and guidance were minimal during Sessions 1, 3 and 4. The reinforcing stimuli for this subject during this phase of the study consisted of social reinforcement, slides, and music (see Table 2).

Although Dawn had a correct response rate of less than 40% in four consecutive sessions, as can be seen in Figure 9, she was moved to the selective scanning and match-to-sample phase. It was hypothesized that the rapid illumination of picture panels in sequence might provide an attractive visual stimulus to elicit eye-contact with the display board. Gestural prompting and physical guidance for fixating the panel could then be faded out. This subject exhibited frequent choreiform movements during each session, characterized by rotational head movement in conjunction with bilateral extensor thrusts

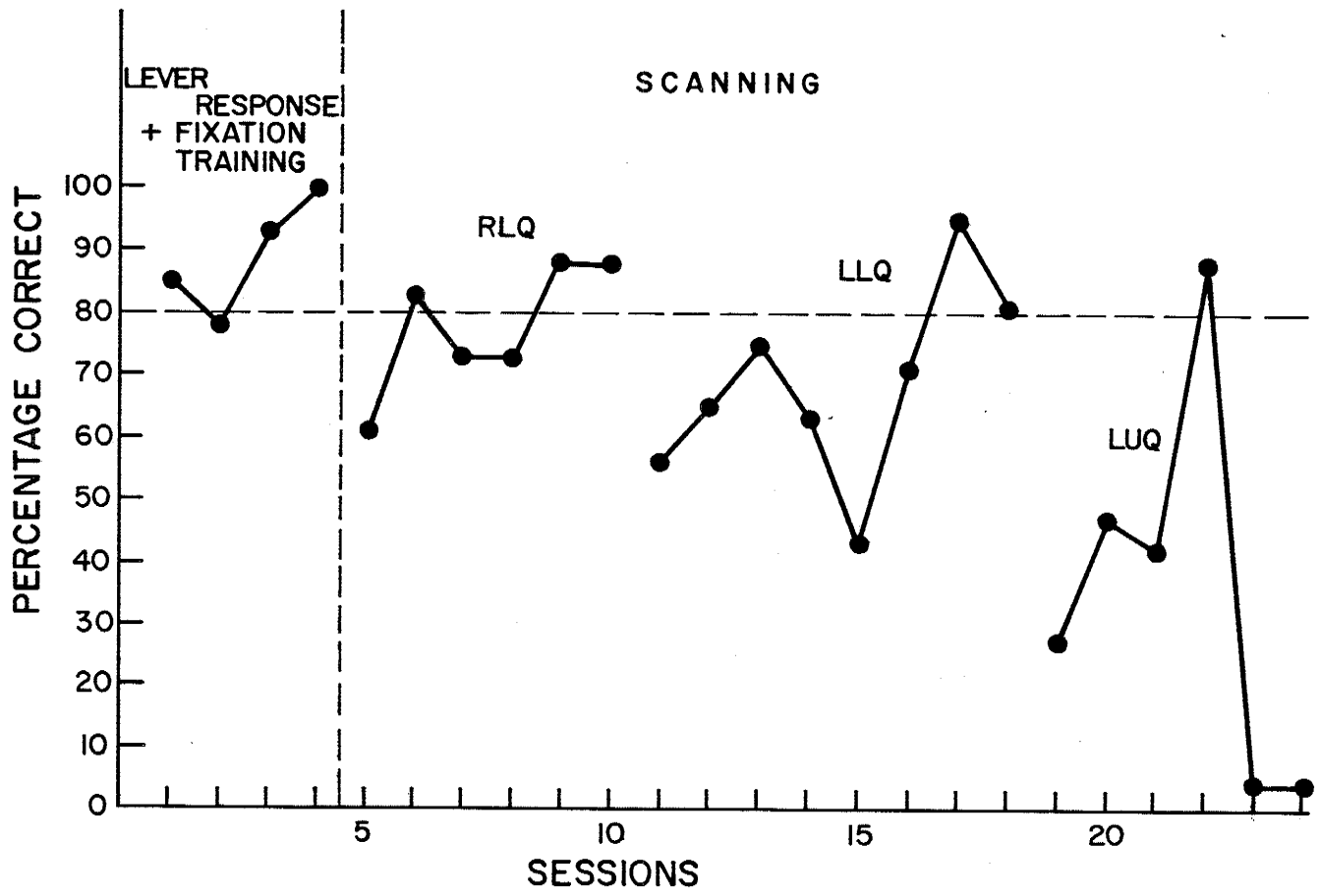

Figure 7. Percentage of correct trials per session across experimental phases for Chris.

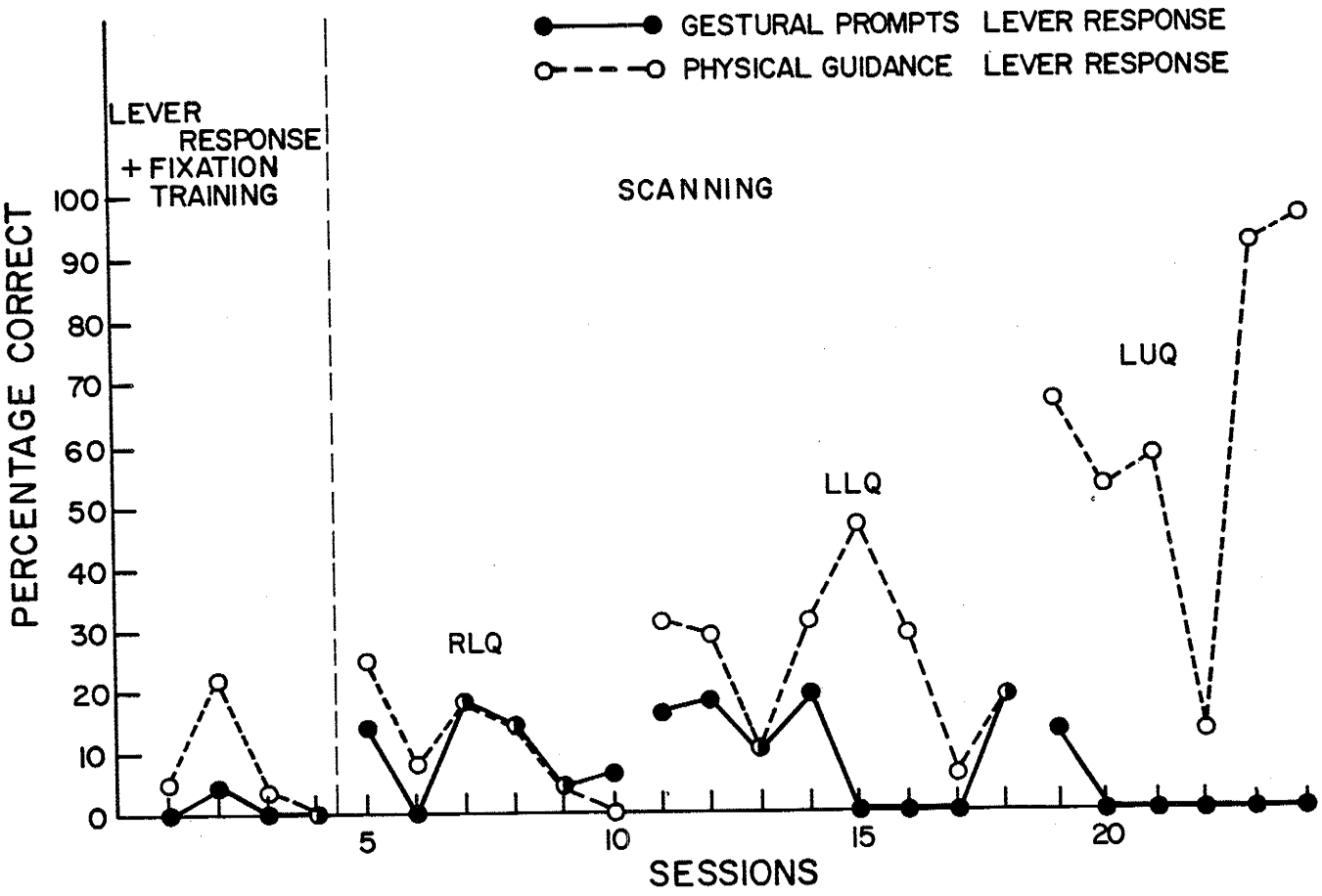

Figure 8. Percentage of trials per session in which gestural prompts and physical guidance for lever responding were provided to Chris.

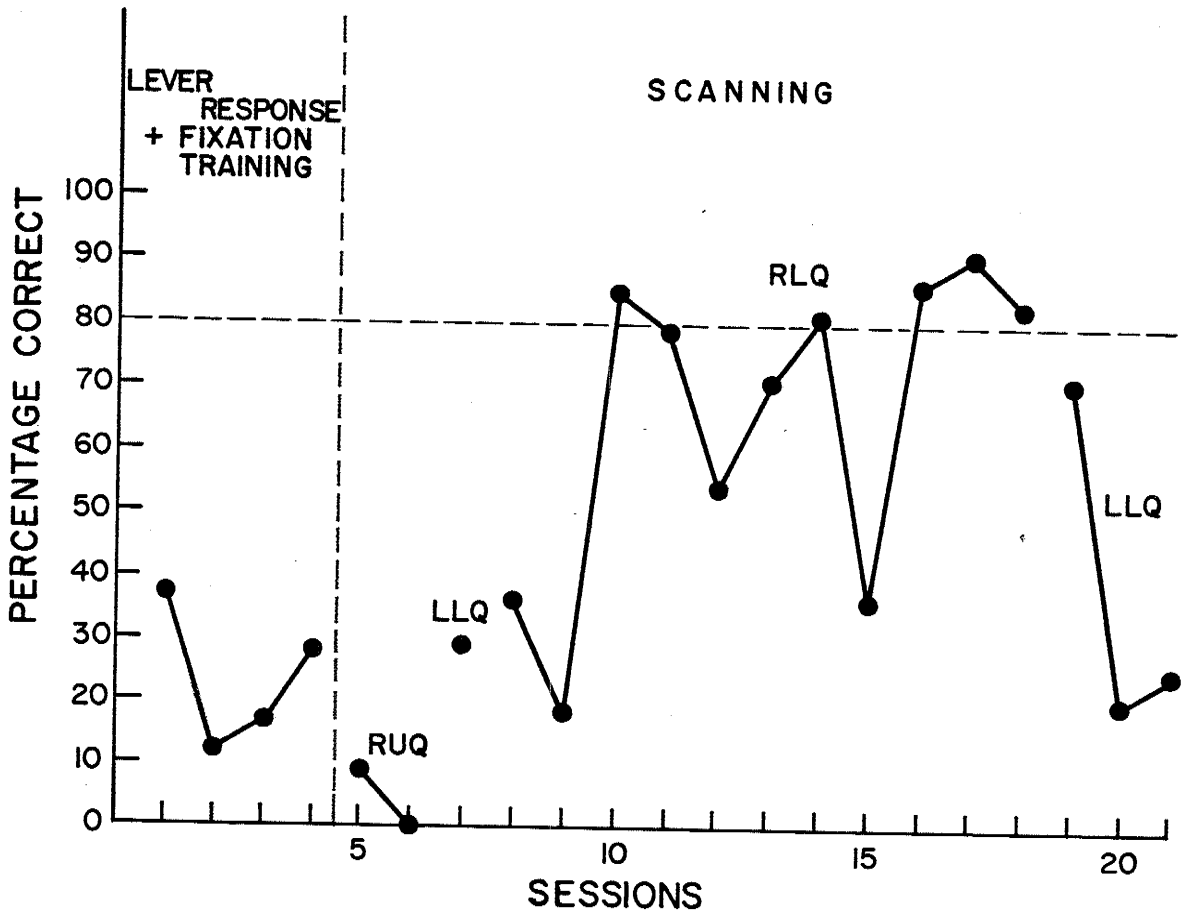

Figure 9. Percentage of correct trials per session across experimental phases for Dawn.

of her arms. The result of these movements was that her head frequently turned away from the visual array board, simultaneous with her arm moving the lever and activating illumination of the picture panel. Commencing with the second session, a rubber wedge was positioned behind her neck to inhibit head movement, but this change met with limited success and therefore, as can be seen in Figure 10, this subject required considerable gestural prompts and physical guidance to visually fixate the illuminated picture panel. Two major right arm contractures, sufficient in strength to dislodge the lever device from the wheelchair tray, were observed in Session 3. These extraneous movements partially account for the amount of prompting and guidance required for manipulation of the lever in Session 3 (see Figure 11). Following the ninth trial in this session, massed practice in lever manipulation was provided. However, this did not appear to be effective as this subject continued to require physical guidance to make a lever response on five subsequent trials. Although the degree of assistance required to make a lever response dropped significantly during the fourth session, the level of assistance required to visually fixate the panel remained at approximately 50% of the trials (see Figure 10). Simultaneous presentations of social reinforcement, slides, music, and vibration constituted the reinforcing stimuli (see Table 2). Rotational

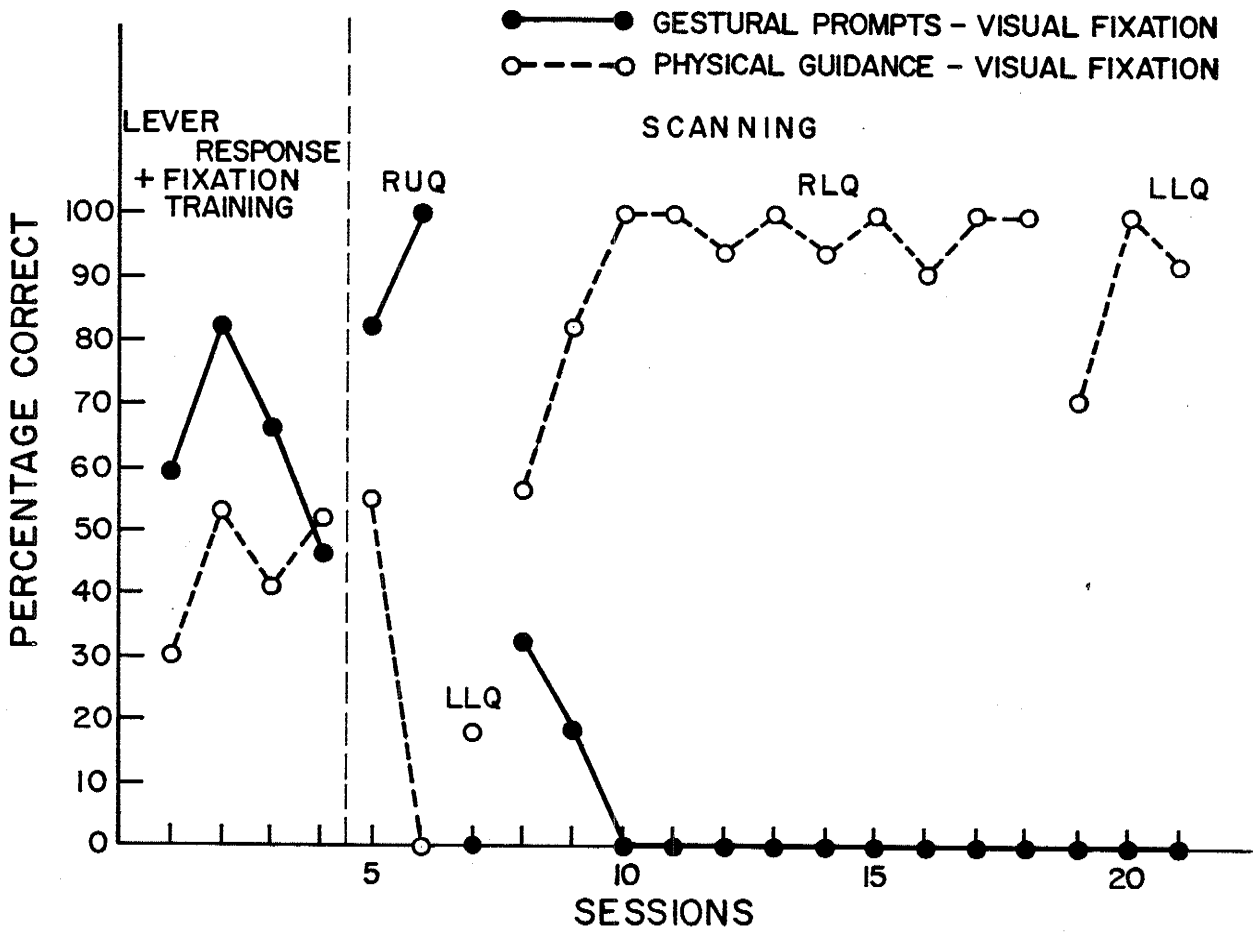

Figure 10. Percentage of trials per session in which gestural prompts and physical guidance for visual fixation were provided to Dawn.

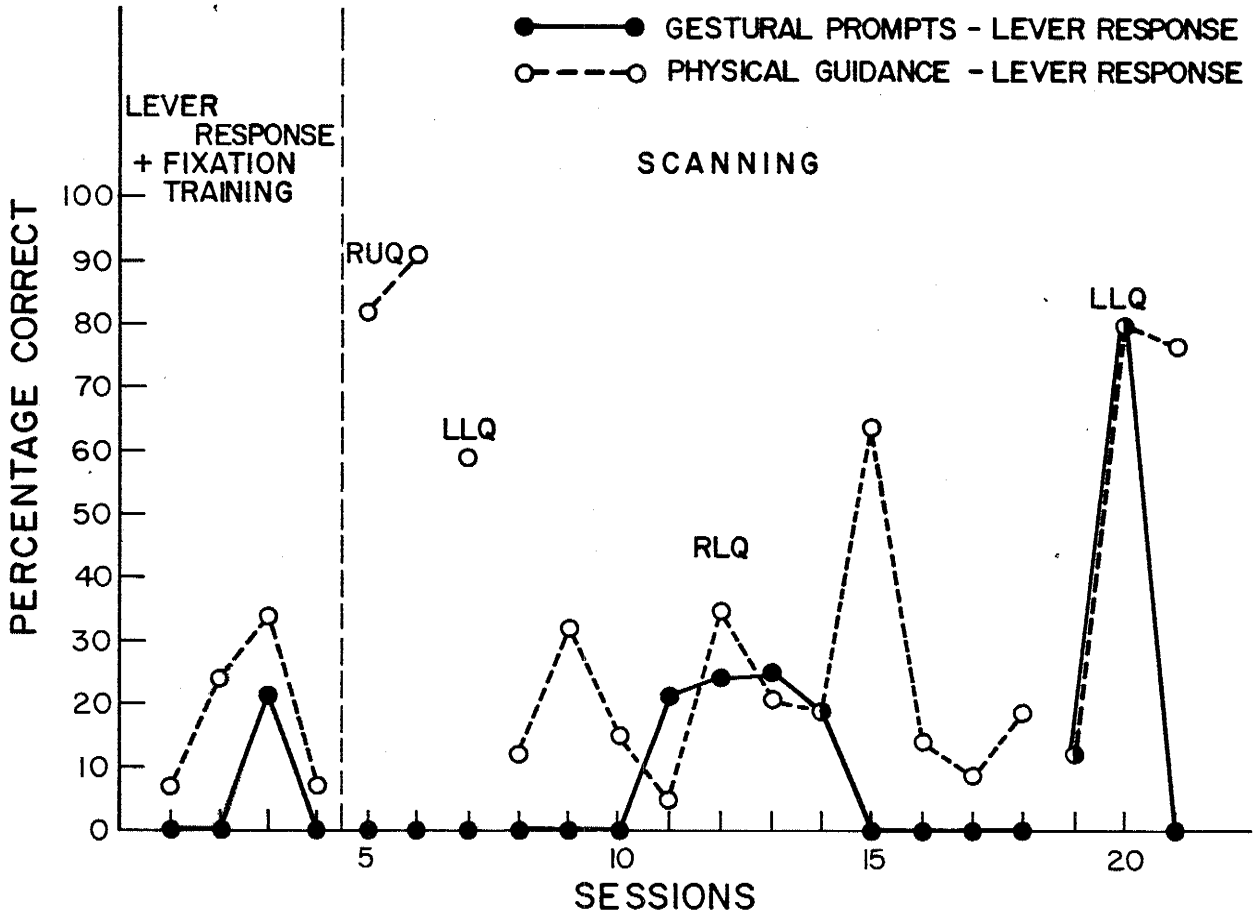

Figure 11. Percentage of trials per session in which gestural prompts and physical guidance for lever responding were provided to Dawn.

head movements were found to interfere with consistent viewing of the slides for this subject.

Sherry-Lynn demonstrated good improvement from the first to second session as her correct responses increased from 58% to 86% (see Figure 12), and physical guidance to make a lever response dropped to zero. She required gestural prompts and physical guidance to fixate the illuminated picture panel. Reinforcing stimuli consisted of social reinforcement, slides, and music (see Table 2). This subject was highly susceptible to upper respiratory infection, and had a history of frequent and lengthy hospitalizations. Although technically she did not reach criterion, it was decided on the basis of her health to move her to the next phase of the study.

Ramona demonstrated highly variable correct response rates across sessions (see Figure 13). Low percentages of correct trials within sessions were related to the frequency and severity of contractures of the right arm. Several variations in the combination of multi-dimensional contingent stimuli proved ineffective in improving correct response rates (see Table 2). Her best performance was seen in the 14th session where she obtained a 95% correct response rate. However, this was followed by a reduction in correct responses in the next session to 7%. Commencing with Session 7, physical

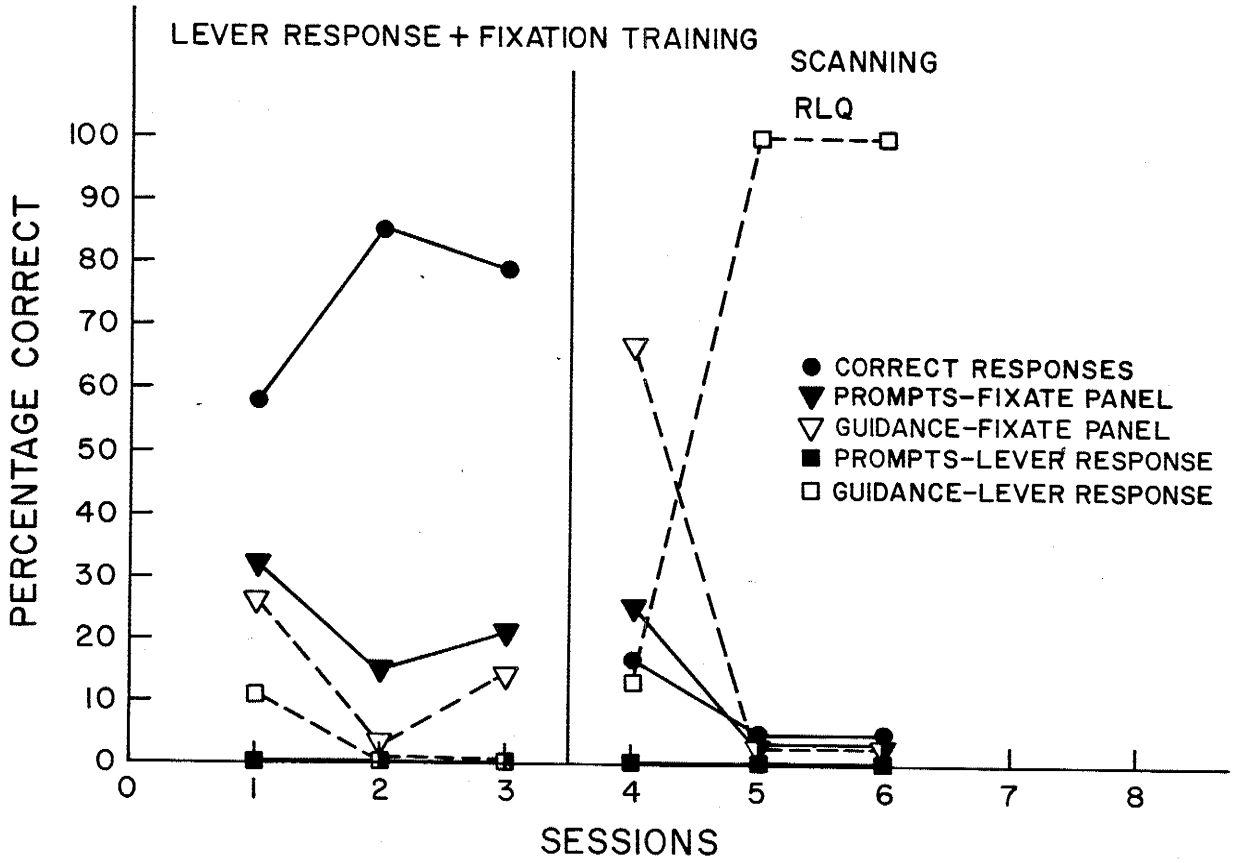

Figure 12. Percentage of correct trials per session for Sherry-Lynn and percentage of trials per session in which gestural prompts, and physical guidance were provided to Sherry-Lynn for visual fixation and lever responding.

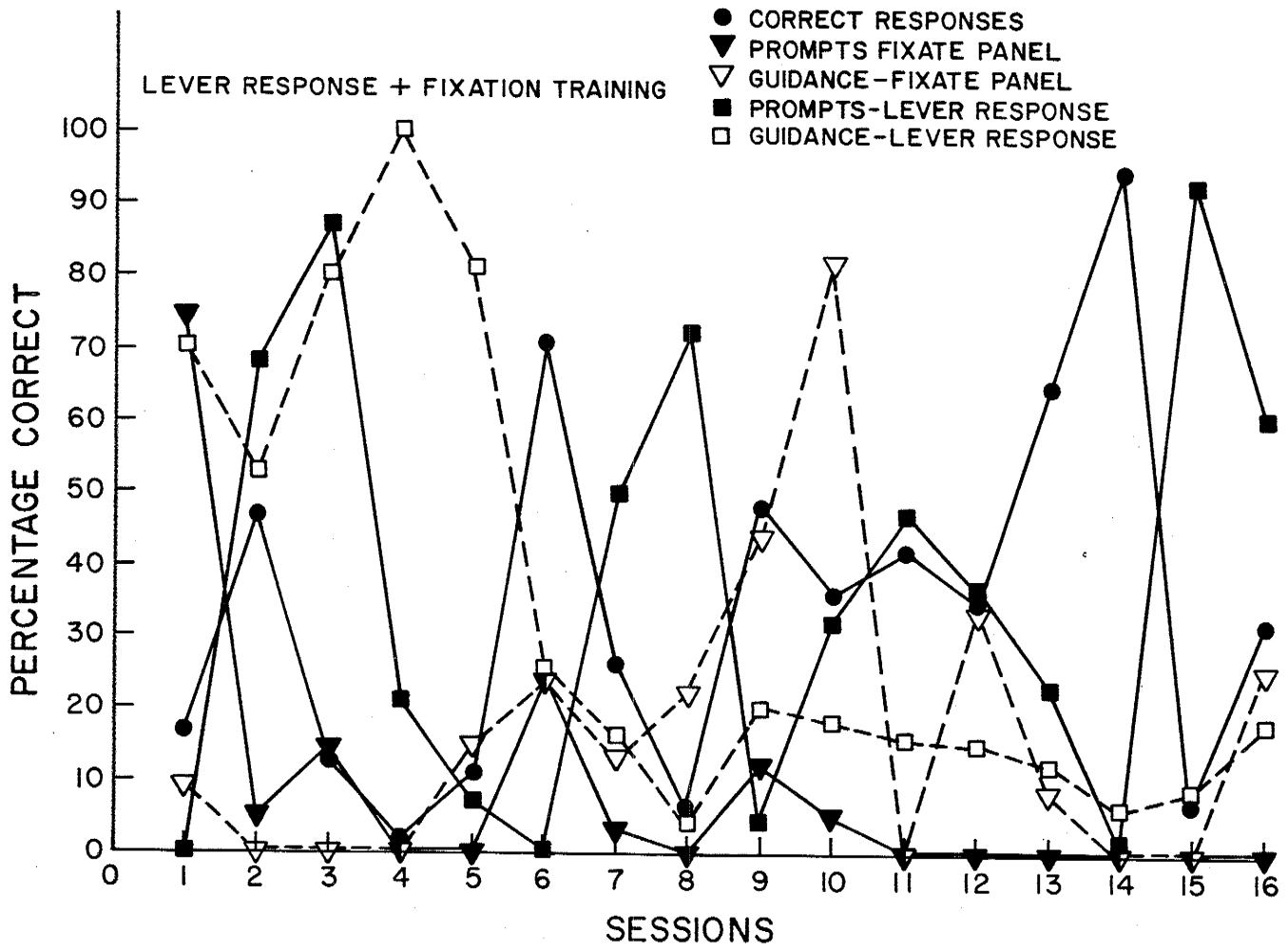

Figure 13. Percentage of correct trials per session for Ramona, and percentage of trials per session in which gestural prompts and physical guidance were provided to Ramona for visual fixation and lever responding.

guidance for lever manipulation consisted of a tickling under the subject's right arm which facilitated a lever response. This prompt was faded gradually across trials to a slight tap, and ultimately, finger pointing at her arm to elicit a lever response. This procedure accounts for the low level of physical guidance required to operate the lever while gestural prompts fluctuated across sessions. Since the frequency of contractures escalated in Session 15 and 16 and correct response rates remained low, it was decided to terminate this subject from the study.

Figure 14 indicates that Terry did not demonstrate any correct responses over sessions 1 to 8. However, during the ninth session this subject made six consecutive correct responses. Lever manipulation at this time was associated with movements resulting from a coughing spasm which was quite likely brought on by the chocolate milk dispensed by a syringe in this session. However, the following eight trials did not result in any correct responses, and subsequently the subject was terminated from the study. Figure 14 also indicates a dramatic decline in gestural prompts and physical guidance to fixate the panel. This is related to the use of an artificial neck restraint which was used to position the subject's head in a manner which would enable him to view the visual array board. Terry remained motionless

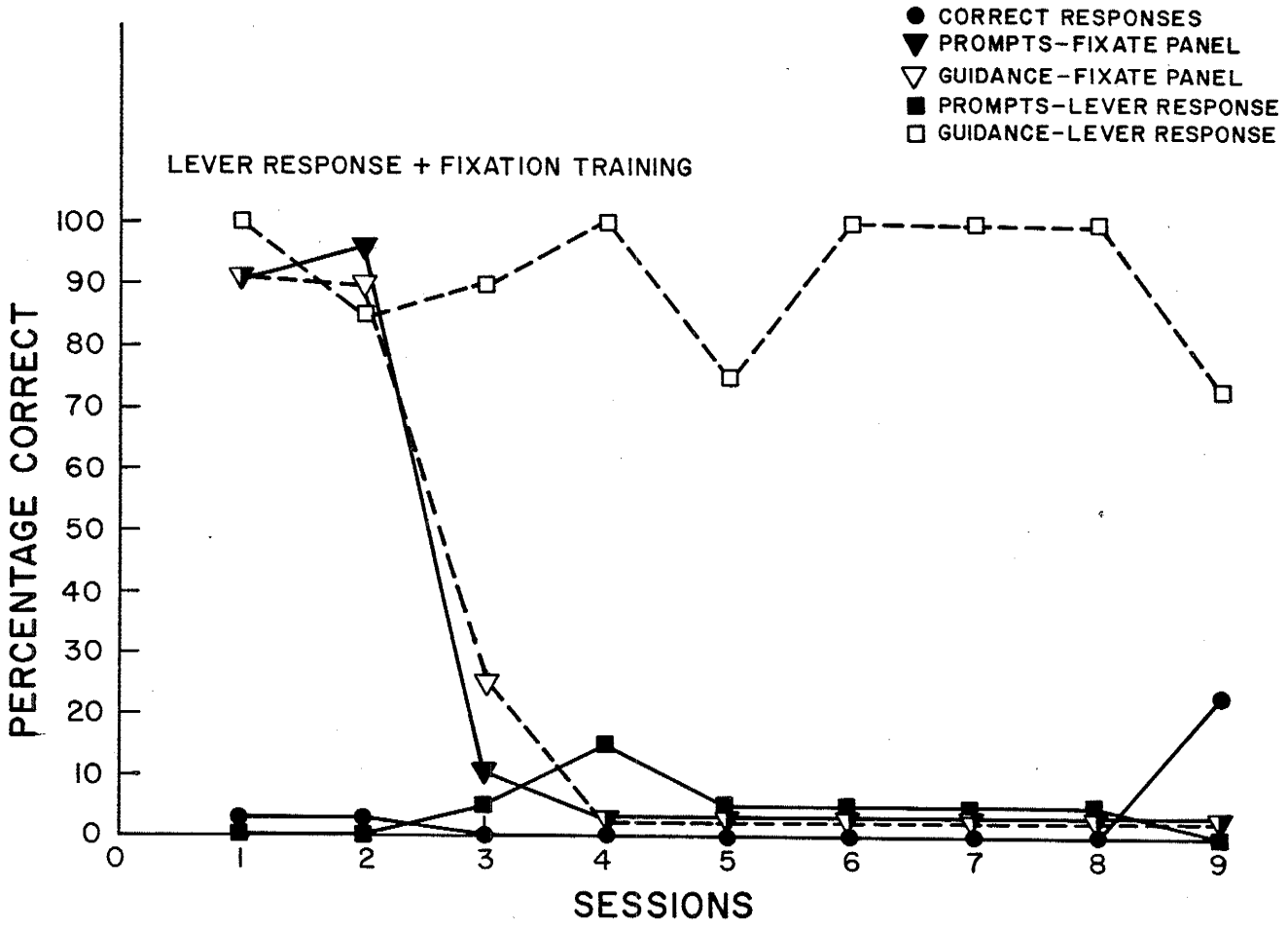

Figure 14. Percentage of correct trials per session for Terry, and percentage of trials per session in which gestural prompts and physical guidance were provided to Terry for visual fixation and lever responding.

for the duration of each session with the exception of lateral head turning and teeth grinding. Changing stimulus combinations across sessions, as shown in Table 2, proved ineffective in facilitating correct responses.

Linda's performance, as shown in Figure 15, was characterized by a low correct response rate over eight sessions in this phase. The increase in correct responding from zero during Session 5 to 20% in Session 6 was associated with coughing spasms similar to those experienced with Terry. This subject learned to fixate the visual array board after the first training session, but required considerable physical guidance to manipulate the lever. As seen in Table 2, changes in combinations of reinforcing stimuli failed to produce performance improvements. Although physical guidance was reduced and gestural prompts were increased to facilitate a lever response in Sessions 7 and 8, correct responses still remained at zero; consequently, the subject was terminated at this point.

Madelynne visually fixated the illuminated display board consistently after four sessions, but required almost complete physical guidance for each trial to operate the lever (see Figure 16). Variations in response consequences failed to increase her correct responses (see Table 2). During the sixth session with Madelynne a correct lever response was

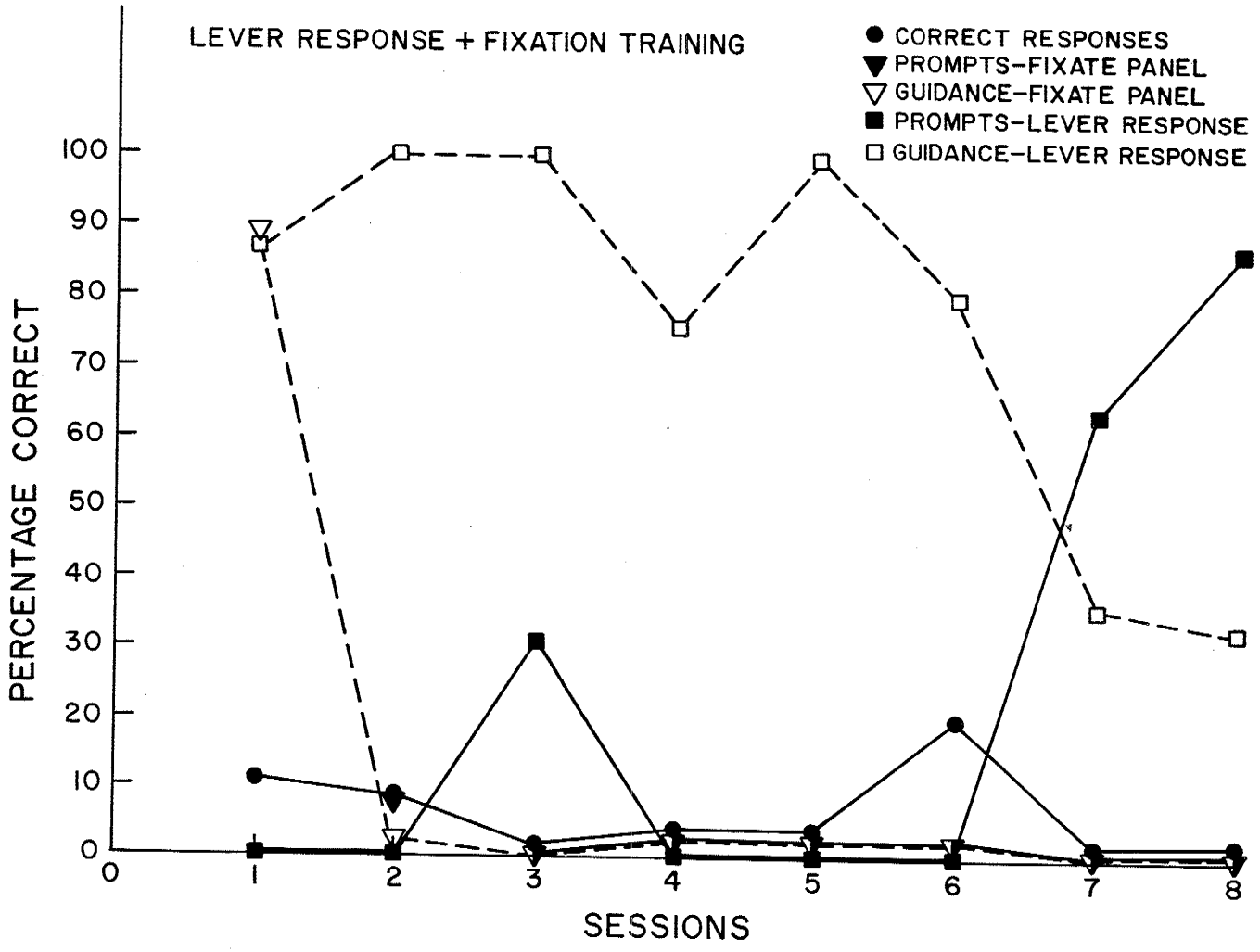

Figure 15. Percentage of correct trials per session for Linda, and percentage of trials per session in which gestural prompts and physical guidance were provided to Linda for visual fixation and lever responding.

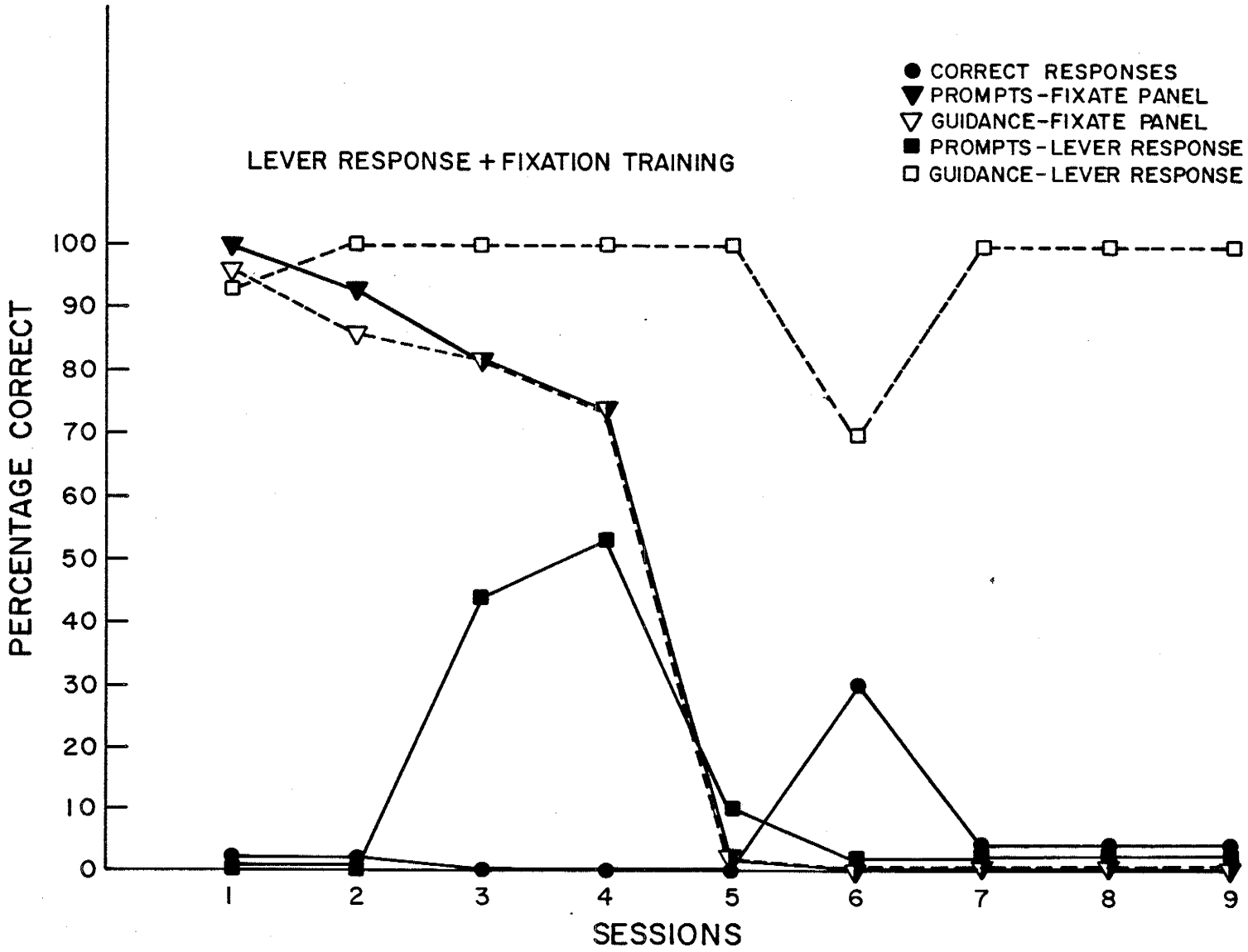

Figure 16. Percentage of correct trials per session for Madelynne and percentage of trials per session in which gestural prompts and physical guidance were provided to Madelynne for visual fixation and lever responding.

obtained on the eighth trial at which time the experimenter was positioned behind the subject outside her visual field. Five additional correct responses were observed during the following 11 trials, but correct responding failed to occur in Sessions 7, 8 or 9 so the subject was terminated from the study.

Selective scanning and match-to-sample training. During this phase of the study, following the first lever response which turned on the RLQ, each subsequent lever movement transferred the illumination to an adjacent quadrant. Monica had difficulty in refraining from moving the illumination past the target quadrant. Figure 3 shows that 23 sessions were necessary for this subject to reach criterion with target quadrants located at RLQ, LLQ, LUQ, and RUQ, respectively.

During the first session of the scanning phase, the visual stimulus Debbie (a photograph of a familiar staff person), was presented on quadrant RLQ. The subject was required to light the target quadrant, visually fixate the photograph, and inhibit further responding for at least 5 sec following onset of illumination. However, on 64% of the 42 trials of this session, tracking beyond the target to quadrant LLQ, LUQ or RUQ was observed. It was hypothesized that a response requirement of four lever movements would be more easily managed by this subject. The next session,

therefore, involved the target quadrant situated at RUQ. The target quadrant remained in this location for six sessions, but the subject did not reach criterion.

The lever device was then modified so that a forward-backward movement would activate only two microswitches, enabling the subject to develop greater control of the device. Various quadrant locations including LLQ and RLQ were tried, and the subject was taught to move the lever completely forward and all the way backward. Criterion was then obtained at RLQ, LLQ, LUQ and RUQ, sequentially. Figure 3 shows that a substantially lower number of sessions was required for this subject to reach criterion at LLQ, LUQ, and RUQ when compared with training at RLQ, suggesting her gradual development of manipulative control over the device. Session number 27 was conducted with the target quadrant situated at LLQ as a pre-test prior to the generalization probe. Monica tracked to the correct quadrant and met correct response requirements on 100% of the trials for this session.

Figure 4 indicates the gradual reduction in aid provided to this subject as she improved in performance. From Session 19 on, this subject did not require any physical aid to operate the lever device. The response consequences were changed from slides alone to slides and music, and finally

to slides, music, and chocolate (see Table 2).

Doug also had difficulty in controlling the manipulandum so that the illumination could be maintained on the target quadrant for the required 5-sec interval (see Figure 5). It was hypothesized that a response requirement involving two lever movements (LLQ) might be more easily achieved than a response requirement involving only one movement (RLQ). In his case, the target quadrant began at the LLQ location. Eleven sessions were required to obtain criterion with the target quadrant at LLQ and 10 sessions at LUQ; whereas, only 3 sessions were required to reach criterion at RUQ. In Figure 6, one can see the amount of gestural prompts and physical guidance provided to inhibit further lever responses after the target quadrant was illuminated. The significant increase in gestural prompts and physical guidance for lever responses which occurred in Sessions 19 and 20 may be partially attributed to an interval of 15 days between Session 18 and Session 19 during which no sessions were conducted. After reaching criterion at LUQ on Session 24, the amount of assistance provided by the experimenter remained negligible.

This subject gradually acquired a specific lever manipulation technique. He rested the palm of his right hand on the microswitch box while gripping the base of the lever between his index and middle fingers. Upon reaching the target

quadrant, he spread his fingers, released the lever, and pulled his arm clear of the device. Additionally, during this phase several combinations of consequating stimuli were used in an attempt to improve his poor performance rates (see Table 2).

As can be seen in Figure 7, Chris reached criterion during this phase of the study for two quadrant positions, that of RLQ and LLQ. During training with the target quadrant located at RLQ, Chris required gestural prompts and physical guidance to refrain from moving the illumination to LLQ or LUQ (see Figure 8). This pattern of responding could be due to the rapid changes in illumination which provoked raucous laughter from the subject during the fifth and eighth sessions. Such changes may have reinforced incorrect responses. Figure 8 reveals the escalation of physical guidance required by this subject to operate the lever device with the target quadrant located at LLQ and LUQ. Complications arose in that the best position for lever operation required complete extension of the subject's right arm, which also contributed to fatigue. Frequent changes in combination of consequent stimuli failed to establish improvement in responding (see Table 2). Because of the progressive increase in physical guidance and progressive decrease in correct responses across sessions,

this subject was terminated from the study.

Dawn's choreic-athetoid movements resulted in her head turning away from the visual array board when she moved the lever and activated illumination of the picture panel. It was hypothesized that the rapid illumination of picture panels in sequence might provide an attractive visual stimulus to elicit eye-contact with the display board. Therefore, Dawn commenced the scanning phase with RUQ as target location (see Figure 9); however, low rates of correct responses resulted. Consequently, the target location was changed to LLQ for Session 7, but poor performance was found. She reached criterion after 11 sessions with the target at RLQ. However, this subject failed to respond to the transfer of target location to LLQ, and was terminated from the study at this point. Removal and reinstatement of vibration in combination with slides and music as reinforcing stimuli failed to produce differential response rates across sessions (see Table 2).

This subject required considerable physical guidance to fixate the illuminated panel, especially in Sessions 8 to 18 (see Figure 10). Gestural prompts and physical guidance to obtain a lever response remained variable, and increased significantly when LLQ became the target location on Sessions 20 and 21 (see Figure 11). Responding in this phase of the

study was hampered by the occurrence of severe contractures of both arms which were powerful enough to dislodge the lever mechanism from the wheelchair tray. Use of the lever block modification and change in target quadrant location did not facilitate greater motor control of the lever device for this subject.

Sherry-Lynn demonstrated 17% correct responses during the first session in this phase, but responding dropped to zero over the next two sessions (see Figure 12). Although physical guidance to fixate the panel diminished to zero after the first session, guidance to operate the lever increased to 100% for the second and third sessions in this phase. As can be seen in Table 2, the reinforcing stimulus combination of slides and music was not altered for this subject. Progressive occurrences of coughing and labored breathing contraindicated the use of appetitive stimuli. Increasing vocalizations and struggling against the plastic arm sleeve was characteristic of the subject's behavior during these sessions, and therefore she was terminated from the study.

Generalization probe. During this phase, two sessions were conducted where the target quadrant position was randomly presented either at RLQ, LLQ, LUQ or RUQ across trials. In the first session, Monica demonstrated 100% correct trials (see Figure 3). The second session entailed use of a different

visual stimulus for the first time in the study - a picture of a bowl if ice-cream. During this session, 92% correct responses were obtained.

Doug also performed well in this phase (see Figure 5); he received random presentations of the visual stimulus (Richard) at the four quadrant locations across trials. Correct response rates of 88% and 92%, for the first and second sessions respectively, were obtained.

Two-Picture Discrimination Phase. During this phase of the study Monica required only three sessions to reach criterion (see Figure 3). The visual stimuli consisted of pictures of a bowl of ice-cream and Debbie. Figure 17 demonstrates the differential correct response rates for the two visual stimuli during Session 30. Perfect performance was obtained over the second and third sessions in this phase. The combination of slides, music, and chocolate was maintained as reinforcer for this subject.

Doug, however, required 8 sessions in this phase to reach criterion (see Figure 5). In the first session involving the pictures Richard and Ice-Cream, 43% of the trials involved movement past the target quadrant location, necessitating physical prompts as seen in Figure 6. For the third and remaining sessions within this phase, the visual stimulus Ice-Cream was changed to a picture of the dayroom television.

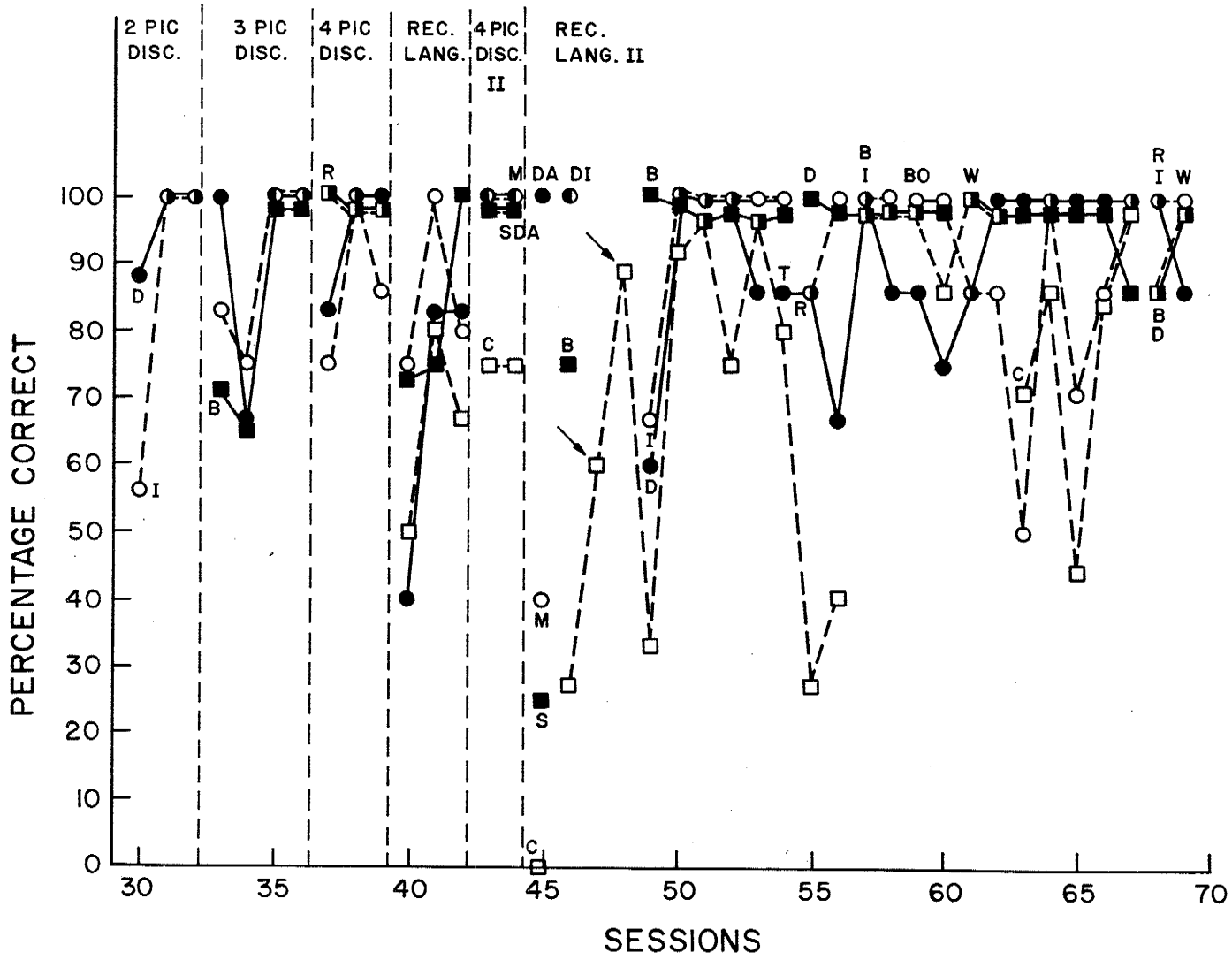

Figure 17. Percentage of correct trials per session for each picture for Monica (D=Debbie, I=Ice-Cream, B=Bed, R=Richard, C=Cup, M=Monica, T=Television, Bo=Bowl, W=Wheelchair, S=Syringe, Da=Dawn). The arrow indicates sessions involving verbal cueing of only one visual stimulus across trials.

On the eighth session in this phase (Session 37), 100% correct responses were obtained for Television and Richard (see Figure 18). Vibration and music constituted the reinforcing stimuli for this subject. Onset of reinforcement delivery produced frequent smiling, vocalizations, and a reduction of body movement for Doug.

Three-Picture Discrimination Phase. During this phase for Monica, three pictures (Ice-Cream, Debbie, Bed) were presented simultaneously on the visual array board with locations varying across trials. In the first session (Session 33) percentage of correct responses for Ice-Cream decreased from high levels in the preceding phase as illustrated in Figure 17 and responses to the new picture, Bed, were correct on only 71% of the trials. However, criterion was reached within four sessions, with this subject attaining 100% correct responses for the latter two sessions. Slides, music, and chocolate were maintained as reinforcing stimuli.

With Doug as a subject the three pictures (Richard, Television, and Bed) were employed, and total correct trials per session reached 86% and 92% respectively for Sessions 40 and 41 (see Figure 5). Examining the individual target stimuli across sessions, Figure 18 shows 100% correct response for each visual stimulus in the first session in this training phase. All three stimuli met with a subsequent decline in

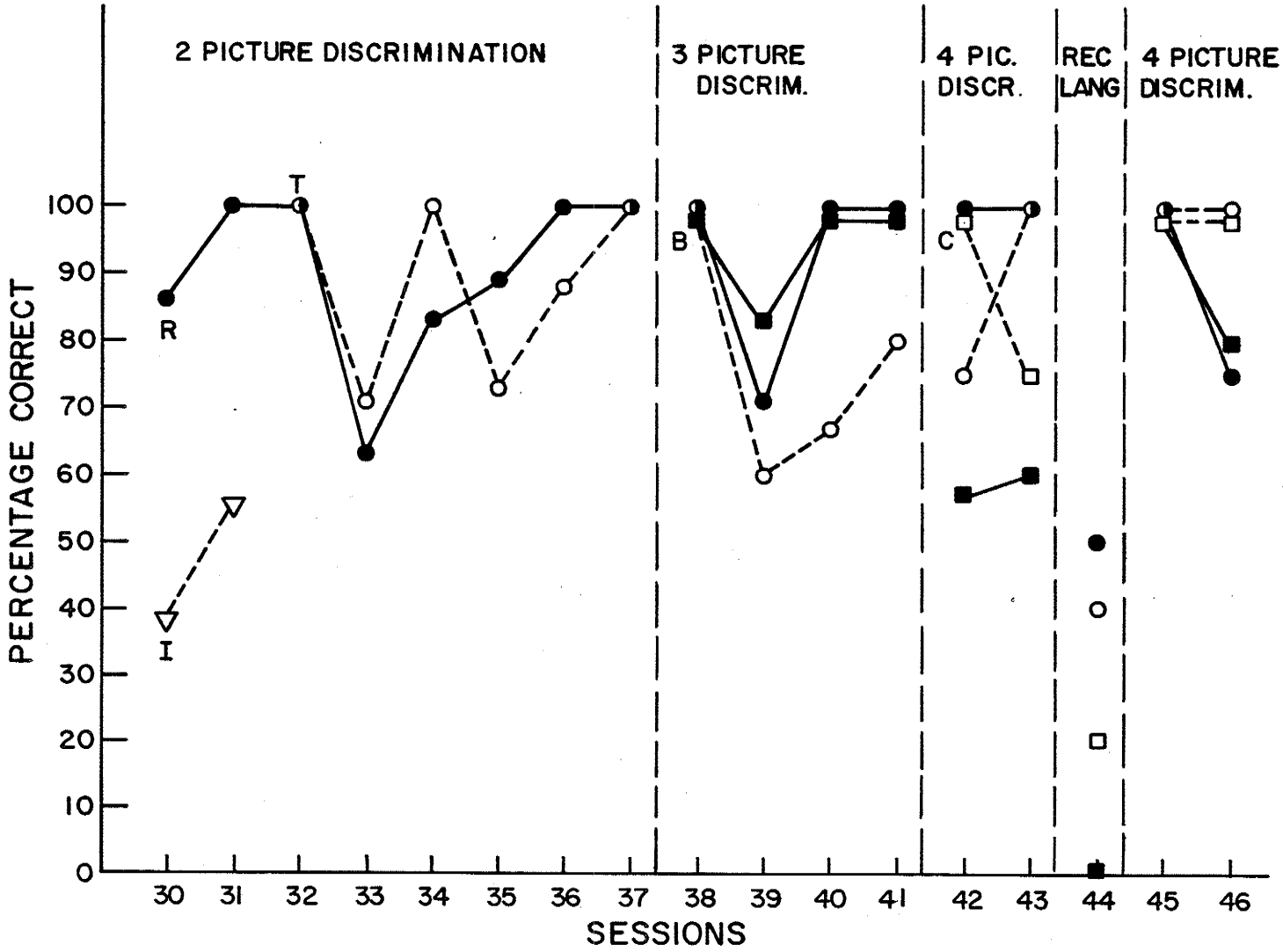

Figure 18. Percentage of correct trials per session for each picture for Doug (I=Ice-Cream, R=Richard, T=Television, B=Bed, C=Cup).

correct response rates in the next session, and an increase in correct response rate over sessions 40 and 41. The stimuli Richard and Bed achieved 100% correct responses while Television increased from 67% to 80%. Vibration and music were maintained as reinforcing stimuli.

Four-Picture Discrimination Phase. For Monica the picture Richard was introduced in addition to the three pictures from the preceding phase. As seen in Figure 17, the novel stimulus Richard achieved a 100% correct response rate across Sessions 37 to 39, and performance on the other three pictures remained above 80%. The same combination of reinforcing stimuli was maintained for Monica in this phase.

Doug received stimulus presentations in the same manner described above with the exception that the fourth picture was Cup. Total correct responses over the first and second sessions were 79% and 80% respectively (see Figure 5). This phase was also marked by the reinstatement of slides combined with vibration and music as reinforcing stimuli (see Table 2).

In Session 44, Doug was given a probe for receptive language. The sample visual stimulus was absent, and only the verbal cue corresponding to the name of the target stimulus on the visual array board was presented. As shown in Figure 18, poor responding to each of the four verbal stimuli resulted. Doug's behavior was characterized by inactivity

and crying episodes. Consequently, on Sessions 45 and 46 the former conditions with sample picture presentation were reinstated. During Session 45, 100% correct responding for all four pictorial stimuli was obtained. Although Session 46 seems to represent a decrease in correct responding for the stimuli Bed and Richard it should be noted that all errors encountered in this phase were caused by the subject tracking past the target quadrant. This behavior would appear to result from a manipulation problem with the lever device, as Doug spontaneously corrected the error by repeating the trial and tracking to the target quadrant.

Receptive Language Training Phase. During this phase three sessions were conducted with Monica. As indicated by Figure 3, the initial session in this phase (Session 40) resulted in a considerable decline in overall performance with less than 60% of the trials performed correctly. The next two sessions, however, showed a significant increase in correct response rates to 85% and 82% for Sessions 41 and 42. Figure 17 demonstrates that this subject attained criterion for the verbal cues Ice-Cream and Debbie, while Bed attained 75% correct responses in Session 40 and 41, and 100% in Session 43. The most novel stimulus introduced through the different phases of the study (Richard) resulted in the lowest percentage of correct responses during this

phase. Reinforcing stimuli consisted of slides, music, and chocolate.

Four-Picture Discrimination Phase II. In this phase (Sessions 43 and 44) four novel pictorial stimuli were presented to Monica in a match-to-sample training format (Monica, Syringe, Dawn, and Cup). Total correct responses for Sessions 43 and 44 were 92% and 94%, respectively. Figure 17 shows that 100% correct performance was attained across both sessions for the stimuli Monica, Syringe, and Dawn, while Cup attained a correct response rate of 75% over both sessions. The same combination of reinforcing stimuli as in the preceding phase was maintained for Monica.

Receptive Language Phase II. This phase constituted the final experimental condition with Monica as subject. The phase utilized pictures taught to criterion during the previous phases of the study and introduced additional pictures not employed thus far. Session 45 involved the presentation of verbal cues for the pictures used in Four-Picture Discrimination Phase II. Figure 17 illustrates that Dawn achieved 100% correct responses while Monica, Syringe, and Cup attained successively lower correct response rates. During Session 46, therefore, it was decided to present the subject with verbal cues for pictures previously taught to criterion in the initial receptive language training phase while retaining

an item exhibiting difficulty (Cup). Correct response rates for Cup remained well below 30% in this session.

Sessions 47 and 48 were conducted with the verbal cue Cup presented on each trial while the four matching pictures were randomly distributed over the visual array board across trials. Improvement in performance rose from 60% correct during Session 47 to 89% correct in Session 48. During Session 49 all four pictures on the visual array board were cued equally. With the exception of Bed which attained a perfect performance, the three other stimuli received low correct percentage rates across trials. However, during Sessions 50 to 54 high rates of correct performance were seen for Bed, Debbie and Ice-Cream, and criterion was reached for all four pictures during Sessions 50 and 51. Following Session 52, an interval of 15 days transpired during which no sessions were conducted. High correct response rates were maintained in Session 53 with responses to the stimulus Debbie achieving 86%, and Ice-Cream, Cup, and Bed each 100% correct. The pictorial stimulus for Television was introduced to Monica in Session 54 and 55, and criterion was reached. She reached criterion for Richard on Session 56, and for the stimuli Bed, Ice-Cream, Television and Debbie on Session 58. The novel stimuli Bowl and Wheelchair reached criterion with the stimuli Television and Ice-Cream over

Sessions 61 and 62, with correct response rates of 86% and 100%. The removal of chocolate as reinforcing stimuli across Sessions 61 to 65 did not appear to affect response rates for these particular stimuli (see Table 2). The stimulus Cup was again introduced in Session 63, and criterion was finally attained with the additional stimuli Television, Bowl, and Wheelchair across Sessions 66 and 67.

Session 69 was conducted following an interval of 15 days during which no sessions were conducted. As can be seen in Figure 17, high correct response rates were maintained with responses to the stimulus Ice-Cream achieving 86%, and Wheelchair, Bed, and Television each 100% correct.

Discussion

The results of this study show that two of the nine subjects (Monica and Doug) learned four-part picture discriminations by match-to-sample training techniques. One subject (Monica) progressed further in the study to acquire receptive language for eight pictures. The following variables are felt to be associated with successful responding during the scanning and visual discrimination phases for these subjects: systematic use of prompting and physical guidance to establish manipulative control over the lever device, physical modification to the manipulandum causing lower response effort in developing a "pointing and holding" skill, variations in multi-dimensional reinforcing stimuli, and extended training. In addition, certain features of the visual array board and pictorial stimuli as contrasted with the communication boards described by Vanderheiden and Grilley (1976) may have contributed to the relative ease with which these subjects developed visual discrimination skills. More specifically, brightly illuminated display quadrants and large colored photographs depicting familiar functional objects and persons may have provided an attractive stimulus array to motivate visual attending as compared to communication boards which do not have these features.

Two additional subjects (Chris and Sherry-Lynn) were

successful in manipulating the lever and visually fixating the illuminated target quadrant during the first procedural phase. Dawn acquired the ability to scan the pictorial stimuli presented at RLQ, and Chris learned to scan to the quadrants RLQ and LLQ successfully. However, these two subjects failed to respond correctly to stimuli located on the remaining quadrants of the visual array board. In the case of Chris, the rapid transfer of illumination may have provided a stronger rewarding effect than the contingent stimuli for correct responding. For Sherry-Lynn, the apparatus appeared aversive as judged by her loud vocalizations and progressively increasing crying behavior across sessions. In addition, this subject exhibited coughing and labored breathing due to a chronic upper respiratory condition. Her seated position during the sessions may have contributed to discomfort resulting in poor performance.

Individual differences in these subjects can be described in terms of the AVC Scale developed by Kerr, Meyerson and Flora (1977). These researchers have devised a practical assessment and training procedure for teaching simple two-choice discrimination skills to retarded children and adults. Their data suggests that severely retarded children can learn very rapidly if they are trained on tasks corresponding with their discrimination skills. Their AVC Scale consists of

six tasks which require a nonverbal, motor response across increasingly complex behaviors: Level 1 Imitation; Level 2 Position response; Level 3 Visual discrimination; Level 4 Match-to-sample; Level 5 Auditory speech discrimination; and Level 6 Combined auditory and visual discrimination (AVC). Results of a study involving 117 mentally retarded subjects ranging in age from 3 to 36 years old indicated that position discriminations were the easiest to learn while auditory discrimination was the most difficult. Pass-fail patterns showed that the sequential order of difficulty was the same for almost all participants, and the ability to identify quickly the discrimination skills of the subjects was high. Subjects whose motor responses made it difficult to pick up a piece of rubber foam and drop it in a container were excluded from the sample. In terms of the present study, with the exception of the imitation task, the remaining five levels of discrimination were incorporated within the procedural phases. Position response, visual discrimination, and match-to-sample were trained in the selective scanning and match-to-sample training phase; whereas, combined auditory and visual discriminations were taught in the receptive language phases. Therefore, Monica can be assumed to be functioning at the AVC level of discrimination, and future training for her could be provided at this skill level. Doug,

however, remains at the match-to-sample level of discrimination and would require further training in auditory speech discriminations. Chris, Sherry-Lynn, and Dawn would require additional training in position responses and visual discriminations.

The remaining four subjects in the study (Ramona, Terry, Linda, and Madelynne) failed to reach criterion in the lever and fixation training phase. With the exception of Ramona who demonstrated variable response rates across sessions, Terry, Linda, and Madelynne remained quiet, withdrawn and generally unresponsive during the sessions. Systematic use of gestural prompting and physical guidance was ineffective in facilitating lever movement with these individuals; although, only a low effort response was needed to activate the manipulandum. Considerable variation in the combinations of reinforcing stimuli presented across sessions failed to produce improvement in responding. Complications in reinforcer delivery were experienced with Terry and Linda who exhibited inadequate swallow reflexes. This problem limited consumption of liquid reinforcement and resulted in sporadic coughing spells.

The failure of Linda, Terry, and Madelynne to acquire selective responding may be in part due to their noncontingent reinforcement histories. The extreme passivity and

unresponsiveness characterized by these subjects is likely due to the severe lack of contingent experiences in their environments. According to the learned helplessness model developed by Seligman (1975), noncontingent experiences may produce behavioral deficits such as reduction of behavioral initiation. DeVellis (1977) points out that learned helplessness may be produced by institutional environments. Therefore, caretakers should provide NPMR persons with systematic prompting, physical guidance, and experiences with multisensory contingent events in an attempt to arrest and reverse decline in functioning.

Physical disabilities produced difficulties for training several participants. The occurrence of severe unpredictable spastic contractures of the upper limbs were present during sessions with five of the subjects (Monica, Chris, Dawn, Ramona, and Linda). Several of these contractures were powerful enough to dislodge the lever mechanism from the wheelchair tray and bend the lever stem such that repairs were occasionally required. The frequency, duration, and intensity of these spasms varied across subjects and across sessions for each subject. Doug and Sherry-Lynn both had profound scoliosis resulting in extreme postural deviations. This necessitated artificial restraints being used to secure the subjects in a position conducive to viewing the visual array

board. During several sessions, realignment of Doug in his wheelchair was performed, and this change in position may have had an effect on response rates.

The subject sample displayed considerable heterogeneity in their behavior supporting the suggestion by Rice et al. (1967) that NPMR persons vary considerably in response rates and reinforcer preference. In the present study, four subjects showed variations in responding associated with changes in contingent stimuli. Monica displayed high rates of correct responding in the presence of slides as reinforcing stimuli during lever response and visual fixation training. However, during the selective scanning and match-to-sample phase her performance was inconsistent, and the reinforcing event was changed to the combination of slides and music for sessions 12 to 26. Monica also performed well for the reinforcer combination of slides, music, and chocolate which was maintained for seven of the eight training phases of the study (see Table 2). Doug exhibited high correct response rates for the reinforcer combinations of slides and music; slides, music, and vibration; music and vibration; music, vibration, and chocolate; and music, vibration, and slides. The change in reinforcing stimuli for Doug during four-picture discrimination training could be attributed to habituation to the effects of the same stimuli presented for 13

consecutive sessions. Chris showed strong performance in the presence of the reinforcer combination of slides, and music, and the combination of slides, music and vibration. Dawn performed with an acquisition rate at or above 80% for five sessions in the scanning phase with slides and music as reinforcers; whereas, several other combinations of stimuli resulted in low response rates. During the selective scanning phase several combinations of reinforcing stimuli were presented for Monica, Doug, Chris, and Dawn (see Table 2). However, in this phase low correct response rates were more likely due to the manual difficulty level inherent in the acquisition of a "point and hold" skill, then in inadequate reinforcing stimuli. Variability in behavior of the subjects was also demonstrated by Monica and Doug who developed entirely different motor topographies to inhibit lever movement in order to maintain illumination on target quadrants.

There is some evidence that variability in subjects' characteristics as detailed in Table 1 corresponded to the relative ease or difficulty in the acquisition of correct response rates for the subjects in this study. The two subjects who demonstrated the best performance in the present study also had the highest scores on the Vineland Social Maturity Scale (Monica and Doug). Monica also had the highest score on the abbreviated Mental Scale from the Bayley Scales

of Mental Development. It should also be noted that neither of these subjects had visual impairments.

Comparison of the findings of this study to previous research is complicated by differences among studies in the number of subjects and their functional abilities as well as differences in procedures. The finding of successful use of gestural prompting and physical guidance to promote responding with NPMR subjects is consistent with results obtained by Reid and Hurlbut (1977) and Dewson (1981).

The results of this study suggest that some institutionalized NPMR persons are capable of exerting a degree of control over their environment by their ability to make choices. Further training which incorporates the use of gestural prompts and physical guidance could be useful in preparing these people to participate in educational activities requiring low effort manipulative interaction with their environment. Moreover, such procedures that are effective in overcoming deficits in voluntary motor responding could have practical physical therapy benefits in terms of prevention of further muscle atrophy and improvement of muscle tone.

The findings of this study in relation to existing nonverbal communication technologies suggest some directions for future research. Additional studies should be conducted

to examine the effectiveness of different, low effort, mechanical response devices such as those reviewed by Vanderheiden and Grilley (1976). Spastic contractures interfered with consistent lever manipulation for five of the subjects in this study. In addition, one subject (Sherry-Lynn) may have found the apparatus to be aversive by virtue of its confining nature. Devices such as head switches activated by lateral head motion, or chin switches activated by movement of the chin toward the chest may use a more suitable response topography for some subjects.

The type and range of automated sensory reinforcement requires further exploration especially with regard to examination of a variety of sensory modalities. For instance, an electric train could be adapted as a linear scanning communication aid. With the units of communication placed at signposts along the track, and the engine functioning as a pointer, the user could operate the train until the engine reaches a desired picture (Electronic Aids for the Severely Handicapped, 1980). Research with NPMR individuals to investigate variables such as size and type of pictorial stimuli is also required. Furthermore, systematic examination of response to three-dimensional concrete objects, photographs of the same objects, and iconic drawings should provide some understanding of the level of abstraction that

can be successfully taught to this population.

The results of this study provide some evidence that institutionalized NPMR persons can be taught to visually discriminate pictures presented on a brightly illuminated free-standing visual array board. Moreover, this study has demonstrated that some NPMR individuals are capable of acquiring receptive language skills through use of a match-to-sample training format with a low effort response manipulandum. Variations in presentation of multi-dimensional reinforcing stimuli and the use of prompts and physical guidance to facilitate attending to visual stimuli may also have contributed to successful performance.

APPENDIX A

Data Sheets

DATA SHEET

Date: _____

Phase: 1. Lever Response and Visual Fixation Training
2. Scanning and Match-to-Sample Training

No. of Trials Completed:

Session Start _____ Session End _____

No. of Correct Responses _____
No. of Prompted Trials Fixate _____
No. of Trials with Physical Guidance (lever) _____
No. of Trials with Physical Guidance (fixate) _____
No. of Prompted Trials - Lever Response _____

Subject: _____

Session No.: _____

Rmft. Type _____ Sensory _____ Appetitive _____

Visual Stimulus Used _____ Quadrant _____

	Lever Press	Fixation Response	P.G. Lever	P. Lever	P.G. Fixate	P. Fixate	S^{r+}
Trial 1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
9.							
10.							
11.							
12.							
13.							
14.							
15.							
16.							
17.							
18.							
19.							
20.							
21.							
22.							
23.							
24.							

COMMENTS:

DATA SHEET

Date: _____

Phase: Two-Picture Discrimination Training

No. of Trials Completed:

Session Start _____ Session End _____

No. of Correct Responses _____
No. of Prompted Trials F _____
No. of Trials with Physical Guidance (lever) _____
No. of Trials with Physical Guidance (fixate) _____
No. of Prompted Trials - Lever Response _____

Subject: _____

Session No.: _____

Rmft. Type _____ Sensory _____ Appetitive _____

Visual Stimulus Used

I = Ice-Cream
D = Debbie

Percentage Correct Trials

_____
_____
_____

Quadrant _____

		Lever Press	Fixation Response	P.G. Lever	P. Lever	P.G. Fixate	P. Fixate	S^{r+}
Trial	1.							
	2.							
	3.							
	4.							
	5.							
	6.							
	7.							
	8.							
	9.							
	10.							
	11.							
	12.							
	13.							
	14.							
	15.							
	16.							
	17.							
	18.							
	19.							
	20.							
	21.							
	22.							
	23.							
	24.							

Trials
1. I-LU (D)-RU
2. (I)-RL D-RU
3. (I)-LU D-RL
4. I-LL (D)-RL
5. (I)-RU D-LL
6. I-LL (D)-LU
7. I-RL (D)-LL
8. (I)-RL D-LL
9. (I)-LL D-LU
10. I-RU (D)-RL
11. I-RL (D)-LL
12. I-RU (D)-LU
13. (I)-LU D-RL
14. I-LL (D)-RU
15. (I)-LU D-RU
16. (I)-RL D-LU
17. I-LL (D)-RU
18. (I)-LL D-RU
19. (I)-RL D-LL
20. I-LU (D)-LL
21. (I)-RU D-LU
22. I-LU (D)-RL
23. I-RU (D)-RL
24. (I)-RU D-LU

SAMPLE PICTORIAL STIMULUS IS INDICATED BY A CIRCLE.

COMMENTS:

DATA SHEET Date: _____

Phase: Three-Picture Discrimination Training

Name: _____

Start: _____ Reinforcing Stimuli: _____

Finish: _____

Visual Stimuli	Percentage Correct Trials	Total Percentage Correct Trials
Ice-Cream	1. _____	_____
Debbie	2. _____	
Bed	3. _____	

	Visual Stimuli				
Trials	Ice-Cream	Debbie	Bed	Visual Sample	Response
1.	RL	LU	RU	B	
2.	RU	LU	LL	D	
3.	LL	RU	RL	I	
4.	LL	RU	LU	I	
5.	RL	LU	RU	D	
6.	LL	LU	RL	I	
7.	RL	RU	LU	B	
8.	LU	RL	LL	D	
9.	LU	RU	LL	D	
10.	RL	LL	RU	B	
11.	RL	LU	LL	D	
12.	RU	RL	LU	D	
13.	RL	LU	LL	B	
14.	RU	RL	LL	I	
15.	LU	RL	RU	I	
16.	RL	LL	LU	D	
17.	LL	RU	LU	D	
18.	RL	RU	LL	B	
19.	LL	RL	LU	I	
20.	RU	LU	LL	B	
21.	LU	LL	RL	I	
22.	RU	LU	LL	B	
23.	LL	RU	RL	B	
24.	LU	RU	LL	I	

COMMENTS:

DATE SHEET Date: _____

Phase: 1. Four-Picture Discrimination I & II
2. Receptive Language I & II

Name: _____

No. of Trials Completed: _____

Session Start: _____ Session Ends: _____

Rmft.	Sensory	Appetitive	Visual Stimuli	Percentage Correct Trials
			1. Ice-Cream	_____
			2. Debbie	_____
			3. Bed	_____
			4. Richard	_____

Total Percentage Correct Trials: _____

Trials	Visual Stimuli/Quadrant				Sample Stimulus	Response
	Ice-Cream	Debbie	Bed	Richard		
1.	RU	LU	LL	RL	I	
2.	LU	RL	RU	LL	D	
3.	RL	LU	LL	RU	B	
4.	LL	RU	LU	RL	B	
5.	LU	RL	RU	LL	R	
6.	RU	LL	RL	LU	I	
7.	RL	LL	RU	LU	D	
8.	LL	RU	LU	RL	R	
9.	RL	LU	LL	RU	D	
10.	RU	LL	RL	LU	B	
11.	LU	RU	RL	LL	I	
12.	LL	RL	LU	RU	R	
13.	RU	LU	LL	RL	B	
14.	LU	RL	RU	LL	D	
15.	RL	LU	LL	RU	D	
16.	LL	RU	LU	RL	R	
17.	LU	RU	RU	LL	I	
18.	RU	LL	RL	LU	I	
19.	RL	LL	RU	LU	D	
20.	LL	RU	LU	RL	R	
21.	RL	LU	LL	RU	B	
22.	RU	LL	RL	LU	R	
23.	LU	RU	RL	LL	I	
24.	LL	RL	LU	RU	B	

COMMENTS:

APPENDIX B

Fading Procedures

Lever Response and Visual Fixation Training Phase

At the beginning of each trial subjects were given the instruction, "Move the lever, (subject's name)". Following the instruction a stop watch was activated to measure the passage of time. If the subject did not operate the lever within 10-sec following the verbal instruction a gestural prompt was provided by the experimenter. The prompt consisted of the experimenter moving his arm and hand in a clenched fist forward and backward directly over the lever device without touching the subject. If the subject failed to respond in the presence of the gestural prompt, the experimenter provided physical guidance by moving the subject's hand sufficiently to activate the lever and illuminate the picture panel. Gestural prompts were faded out in subsequent trials with the experimenter placing his hand over the lever device to raising his hand with clenched fist. Physical guidance was gradually faded out across subsequent trials with the experimenter providing less movement of the subject's hand to a light touch of the subject's hand in the lever device.

Gestural prompts for visual fixation were faded across trials from tapping the target quadrant to pointing to the illuminated picture panel. Physical guidance for visual fixation consisted initially of lifting the subject's chin or turning his or her head in the direction of the illuminated

panel. During subsequent trials, guidance was successively faded to eventually touching the subject's chin or head.

Selective Scanning and Match-to-Sample Training Phase

The response requirement for reinforcement was that the subject activated the lever to illuminate the picture panel, visually fixated the target panel, and refrained from further lever pressing for a 5-sec interval from onset of target panel illumination. Gestural prompts consisted of: (a) the experimenter placing the sample stimulus picture over the matching picture on the appropriate quadrant; and (b) the experimenter extending his arm with hand open and palm downward above the lever and simultaneously saying "stop". Gestural prompts were gradually faded across successive trials by placing the sample stimulus at the border of the target quadrant, then adjacent to the communication board and finally in front of the experimenter. Extension of the experimenter's arm was gradually moved further away from the lever device across trials while the command "stop" remained in effect. Eventually the verbal command was dropped and the subject responded to the presentation of the sample stimulus and the verbal instruction, "Show me Bed (subject's name)", "Where is Bed?". Physical guidance consisted of the expermenter moving the subject's arm to activate the

quadrant lights through the correct sequence to the target panel and inhibiting further movement for the required 5-sec interval. During subsequent trials physical guidance was reduced by providing assistance only on the target quadrant and by decreasing the time interval in which the experimenter held the illumination constant on the target quadrant. Guidance was eventually faded to a tap on the subject's arm, to pointing to the lever device when the target quadrant was illuminated.

Similar fading procedures for gestural prompts and physical guidance were maintained across the remaining procedural phases of the study.

REFERENCE NOTE

1. Whiteley, J.H., & Krenn, M.J. Uses of the Bayley Mental Scale with the Nonambulatory Profoundly Mentally Retarded. Paper presented to the American Association on Mental Deficiency Conference, Detroit, 1981.

REFERENCES

Anderson, J.D. Spatial arrangement of stimuli and the construction of communication boards for the physically handicapped. Mental Retardation, 1980, 18, 41-42.

Bailey, J., & Meyerson, L. Vibration as a reinforcer with a profoundly retarded child. Journal of Applied Behavior Analysis. 1969, 2, 135-137.

Bliss, C.K. Semantography. Sydney, Australia: Semantography Publications, 1965.

Bricker, W.A., & Bricker, D.D. An early language training strategy. In R.L. Schiefelbusch & L.L. Lloyd (Eds.), Language perspectives: acquisition, retardation and intervention. Baltimore: University Park Press, 1974.

Carrier, J.K., Jr., Application of a nonspeech language system with the severely language handicapped. In L.L. Lloyd (Ed.), Communication assessment and intervention strategies. Baltimore: University Park Press, 1976.

Carrier, J.K., Jr., & Peak, T. Non-speech language initiation program. Lawrence, Kansas: H & H Enterprises, 1975.

Clark, C.R., Davies, C.D., & Woodcock, R.W. Standard rebus glossary. Circle Pines, Minn.: American Guidance Service, 1974.

DeVellis, R.F. Learned helplessness in institutions. Mental Retardation, 1977, 15, 10-13.

Dewson, M. Sensory reinforcement in the operant conditioning of nonambulatory profoundly mentally retarded adolescents.

Unpublished doctoral dissertation, University of Manitoba, 1981.

Donlon, E.T. Visual disorders. In W.M. Cruickshank (Ed.), Cerebral Palsy: a developmental disability. Syracuse: Syracuse University Press, 1976.

Elder, P.S. Visual symbol communication instruction: Part I: receptive instruction. Birmingham: DESEMO Project, University of Alabama, 1978.

Elder, P.S., & Bergman, J.S. Visual symbol communication instruction with non-verbal, multiply-handicapped individuals. Mental Retardation, 1978, 16, 107-112.

Electronic aids for the severely handicapped. Shreve, Ohio: Prentke Romich, 1980.

Friedlander, B., McCarthy, M., & Soforenko, A.Z. Automated psychological evaluation with severely retarded institutionalized infants. American Journal of Mental Deficiency. 1967, 71, 909-919.

Fuller, P.R. Operant conditioning of a vegetative human organism. American Journal of Psychology, 1949, 62, 587-590.

Harris, D., & Vanderheiden, G.C. Augmentative communication techniques. In R.L. Schiefelbusch (Ed.), Nonspeech language and communication: analysis and intervention. Baltimore: University Park Press, 1980.

Harris-Vanderheiden, D., Brown, W.P., MacKenzie, P., Reinen, S., & Schiebel, C. Symbol communication for the mentally handicapped. Mental Retardation, 1975, 13, 34-37.

Haskett, J., & Hollar, W.D. Sensory reinforcement and contingency awareness of profoundly retarded children. American Journal of Mental Deficiency, 1978, 83, 60-68.

Hurlbut, B.I., Iawata, B.A., & Green, J.D. Nonvocal language acquisition in adolescents with severe physical disabilities: Blissymbol versus iconic stimulus formats. Journal of Applied Behavior Analysis, 1982, 15, 241-258.

Kerr, N., Meyerson, L., & Flora, J.A. The measurement of motor, visual and auditory discrimination skills. Rehabilitation Psychology, 1977, 24, 95-112.

Landesman-Dwyer, S., & Sackett, G.P. Behavioral changes in nonambulatory, profoundly retarded individuals. In C.E. Meyers (Ed.), Quality of life in severely and profoundly retarded people: research foundations for improvement. Washington, D.C.: American Association on Mental Deficiency Monograph #3, 1978.

Meyerson, L., Kerr, N., & Michael, J.L. Behavior modification in rehabilitation. In S.W. Bijou & D.M. Baer (Eds.), Child development: readings in experimental analysis. New York: Appleton-Century-Crafts, 1967.

Murphy, R.J., & Doughty, N.R. Establishment of controlled arm movements in profoundly retarded subjects using response contingent vibratory stimulation. American Journal of Mental Deficiency, 1977, 82, 212-216.

Premack, D., & Premack, A.J. Teaching visual language to apes and language-deficient persons. In R.L. Schiefelbusch & L.L. Lloyd (Eds.), Language perspectives: acquisition, retardation and intervention. Baltimore: University Park Press, 1974.

Porter, P.B., & Schroeder, S.R. Generalization and maintenance of skills acquired in non-speech language initiation program training. Applied Research in Mental Retardation, 1980, 1, 77-84.

Reid, D.H., & Hurlbut, B. Teaching nonvocal communication skills to multihandicapped retarded adults. Journal of Applied Behavior Analysis, 1977, 10, 591-603.

Remington, R.E., Foxen, T., & Hogg, J. Auditory reinforcement in profoundly retarded multiply handicapped children. American Journal of Mental Deficiency, 1977, 82, 299-304.

Rice, H.K. Operant behavior in vegetative patients III: Methodological consideration. Psychological Record, 1968, 16, 279-281.

Rice, H.K., & McDaniel, M.W. Operant conditioning in vegetative patients. Psychological Record, 1966, 16, 279-281.

Rice, H.K., McDaniel, M.W., Stallings, V.D., & Gatz, M.J. Operant behavior in vegetative patients II. Psychological Record, 1967, 17, 449-460.

Rosenberger, P.S., Stoddard, L.T., & Sidman, M. Sample-matching techniques in the study of children's language. In R.L. Schiefelbusch (Ed.), Language of the Mentally Retarded. Baltimore: University Park Press, 1972.

Schurman, J.A. Custom designing communication board frames: the role of the occupational therapist. In B.A. Vicker (Ed.), Nonoral Communication System Project 1964/1973. Iowa City, Iowa: Campus Stores, University of Iowa, 1974.

Seligman, M.E.P. Helplessness: on depression, development and death. San Francisco: Freeman, 1975.

Song, A. Acquisition and use of Blissymbols by severely mentally retarded adolescents. Mental Retardation, 1979, 17, 253-255.

Vanderheiden, G.C., & Grilley, K.G. Non-vocal communication techniques and aids for the severely physically handicapped. Baltimore: University Park Press, 1976.

Welch, S.J., & Pear, J.J. Generalization of naming responses to objects in the natural environment as a function of training stimulus modality with retarded children. Journal of Applied Behavior Analysis, 1980, 13, 629-643.

Woolman, D.H. A presymbolic training program. In R.L. Schiefelbusch (Ed.), Nonspeech language and communication: analysis and intervention. Baltimore: University Park Press, 1980.