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TRAINING STUDENTS WITH PROFOUND OR MULTIPLE HANDICAPS TO MAKE REQUESTS VIA MICROSWITCHES

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In a series of three experiments, we evaluated the use of microswitches as a means for students with profound, multiple handicaps to demonstrate preferences between toys and to make requests for specific activities. In Experiment 1, 5 students learned to demonstrate toy preferences by using microswitches to activate battery-operated toys. Experiment 2 was conducted to evaluate the students' preferences for social attention. Microswitches were used to activate prerecorded messages that signaled the classroom teacher to attend to the students. In Experiment 3, the students used the switches and prerecorded messages to make specific requests of educational staff in school and community settings. Results of these experiments, evaluated within multiple baseline, alternating treatments, and simultaneous treatments designs, indicated that these students could request specific activities. Results are discussed with respect to the continued use of microswitches and to program development.

DESCRIPTORS: microswitches, reinforcer preferences, profound handicaps

Several recent investigations have reported methods for identifying the stimulus preferences of persons with severe, profound, and multiple disabilities (Datillo, 1986; Dewson & Whiteley, 1987; Pace, Ivancic, Edwards, Iwata, & Page, 1985; Wacker, Berg, Wiggins, Muldoon, & Cavanaugh, 1985). Datillo (1986) and Wacker et al. (1985) used microswitches to activate various sensory stimuli. For example, in the Wacker et al. investigation, 5 students classified as profoundly or multiply handicapped used mercury switches (attached to an arm or to the head) to activate battery-operated toys. By comparing duration of toy activation across treatment conditions, reinforcers were defined for each student.

A different approach to identifying potential reinforcers was used by Pace et al. (1985). These investigators first evaluated the approach behaviors of six profoundly retarded individuals toward different stimuli (e.g., a light or a fan) to define preferred stimuli. The reinforcing effect of the preferred stimuli was then established by demonstrating that the contingent presentation of these stimuli resulted in greater frequencies of target behavior.

Although different methods were used in these investigations, two similarities occurred. First, potential reinforcers were identified for all participants, an important finding given the difficulty previous investigators have had in identifying stimulus events that serve as reinforcers for students with severe handicaps (Repp, Barton, & Brulle, 1983; Whitman, Scibak, & Reid, 1983). Second, idiosyncratic patterns of reinforcer preferences occurred for the participants, indicating that separate functional analyses of behavior must be performed for every individual in a training program.

A potentially important application of this research is to demonstrate the use of one or more of these approaches to effect programmatic change. It is important for applied researchers not only to demonstrate functional control over behavior, but also to demonstrate how this control can facilitate the development of functional programs (Burch, Clegg, & Bailey, 1987). Once program goals are

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selected for a student (based, for example, on philosophical or therapeutic criteria), the systematic application of available technology is needed to achieve those goals. Therefore, the incorporation of previously described methods for identifying reinforcers to facilitate program development is the next logical step for researchers working with profoundly handicapped students.

There are at least two approaches to program development that incorporate systematic identification of reinforcers for profoundly handicapped persons. The first approach, used by Pace et al. (1985), is to use reinforcers identified through assessment to shape other, more functional target behaviors. The second approach is to use the same target behavior used for assessment to achieve different outcomes during training. For example, the microswitch technology used by Wacker et al. (1985) to identify toy preferences might be used instead to signal others to perform specific activities (e.g., to bring a drink or to play). In this case, the same target response results in different outcomes.

The purpose of this paper is to report a series of experiments that occurred over 3 school years using this second approach to program development in which students with profound handicaps controlled specific aspects of their environment via microswitches. A major goal of the program was to teach the students to be more independent in school and community settings by more effectively communicating their preferences for activities. In other words, the goal was for the students to become more active participants in the programming they received.

Experiment 1 was conducted for two reasons. First, we wanted to replicate the previous findings of Wacker et al. (1985) with battery-operated toys with a second group of profoundly handicapped students. Replication of previous results with other students is needed given the few investigations reported in the literature that document reinforcer preferences for this population.

The second purpose was to demonstrate that these students could control specific aspects of their environment (e.g., the amount of time played with toys). The overall intent of the 3-year project was to train the students to become more active participants in their programming by controlling the presentation of specific reinforcers. Given this purpose, we began by establishing a response (pressing a microswitch) that resulted in control over the delivery of potential reinforcers.

During Experiment 2, the students independently activated prerecorded messages on tape recorders via microswitches to request social attention from educational staff. This experiment was designed to establish that the microswitch technology was generalizable across different classes of reinforcers (toy and social). The third experiment was conducted to determine whether the students could use the switches and prerecorded messages to request specific activities in both a school and a community setting (shopping mall).

EXPERIMENT 1: REPLICATION OF TOY REINFORCERS

Method

Participants and Setting

Participants were 5 students in 2 classrooms for students with profound, multiple handicaps. These students were selected because they had not been evaluated for reinforcer preferences (none of the students had participated in the previous investigation [Wacker et al., 1985]).

The setting was a large school in an urban area that provided secondary education for severely handicapped students. The students in these classrooms were considered by educational staff to be the most profoundly handicapped students in the school. The participants ranged in chronological age from 13 to 20 years, and all were estimated in school records to be functioning below the 1-year age level (3 to 9 months). Estimates of developmental level were based on adaptive behavior measures, fine and gross motor skills, and receptive responses to stimuli (e.g., turning head to sounds). All were untestable with standard psychometric assessment instruments and were diagnosed as profoundly mentally retarded. None of the students had an expressive communication system except for

crying, tantruming, or smiling. The students did not respond consistently to verbal, gestural, or physical prompts, and none used pictures or motoric responses (eye blinks, pointing, etc.) to communicate. All were dependent in their wheelchairs except for Sara, who walked with assistance. Three students had seizure disorders, and 2 were diagnosed as having cerebral palsy. All required assistance in self-care activities (e.g., none were toilet trained). These students were typical of the remaining 7 students in the classroom.

The experiment was conducted in the classrooms by the experimenters, teachers, and teacher associates; the physical and speech therapists assisted with the collection of reliability data. During the experiment, the students were situated in their wheelchairs with attached lap trays, or they were seated at a small table during regular classroom times and activities. Reinforcer identification was included in their normal school program as part of the training they received on active leisure skills.

Target Behavior and Materials

The target behavior for Jack was to raise his left arm because this was the only motor response he exhibited with his upper limbs during observations conducted prior to the experiment. For the remaining students, the target response was to reach and press a contact switch placed directly in front of them.

The contact switches consisted of two pieces of metal that completed an electric (battery-operated) circuit when pressed. The metal plates were covered with plastic, tape, or cloth (red, blue, yellow, or green) and ranged in size from 9.4 cm by 12.5 cm by 0.3 cm to 19.2 cm by 24.4 cm by 0.3 cm. The switches were made by the teachers (following the guidelines of Burkhart, 1982); the specific switch chosen for a student was based on teacher and therapist judgment. Different switches were used across sessions but were the same general size for a given student. For Jack, a standard mercury switch was used and was attached to his arm with a sweatband.

The selection of toys used for evaluation was based on the teachers' judgment of their potential as reinforcers and their availability in the classroom setting. Two items were chosen for each student from a selection which included a tape player, a radio, and various battery-operated devices that moved and made sounds.

When a student emitted the target behavior, a toy remained activated continuously as long as the behavior occurred. Duration of responding was recorded as the cumulative number of seconds a student engaged the switch, beginning with the activation of the toy and ending when the toy was deactivated. Only duration data were recorded because the goal was to increase the sustained response made by a student.

Reliability

Reliability probes were conducted at least three times per student (once during baseline and once for each toy). A maximum of five reliability probes were conducted for any given student. Total number of reliability probes was 18 (24% of sessions). During two sessions no responding occurred, and these sessions were not included in the computation of interobserver agreement.

During reliability sessions, two observers (investigators, teachers, teacher associates, or therapists) simultaneously but independently recorded responding. During baseline a tape recorder with a blank tape was activated, whereas during treatment a toy was activated. Both observers recorded with stopwatches the number of seconds a device was activated. Interobserver agreement was computed on a trial-by-trial basis by dividing the smaller duration by the larger duration and multiplying by 100. Interobserver agreement ranged from 80% to 100% across sessions, with the overall agreement being 92%. Length of duration recorded during a session ranged from 1 s to 270 s.

Design and Procedures

A multiple baseline (across students) with alternating treatments design (Barlow & Hayes, 1979) was used to evaluate the results. The number of baseline sessions ranged from three to seven, and the number of treatment sessions for each toy ranged from four to six.

Baseline. After the student had been positioned, the microswitch was placed before the student or attached to the student's arm (Jack) and connected to a tape player containing a blank tape. One of the potential reinforcers (alternated in a counterbalanced order across sessions) was placed behind the tape player. At the beginning of each session, the student was provided with a verbal request ("press this switch"), a demonstration, physical guidance to press the switch, and praise. An approximately 2-s delay occurred between the demonstration and the physical guidance, but physical guidance was always necessary. After the student ceased engaging in the target behavior or 5 s elapsed, the session began. The verbal prompt-demonstration-delay-physical guidance-praise sequence was presented once at the beginning of each session and was repeated every 5 min if the student had not engaged in the target response. Otherwise, no other prompting or reinforcement occurred.

Each session continued for 15 min, with up to four sessions completed each day. Usually only two sessions per day were conducted for a student, with at least 30 min elapsing between sessions.

Treatment. During these sessions, the switches activated one of the toys. Toys were counterbalanced across sessions, with each toy presented for a maximum of two consecutive sessions. All other procedures were identical to baseline.

Results and Discussion

The cumulative duration of the students' target behavior is presented in Figure 1. Four of 5 students demonstrated low durations of responding during baseline, with only Sandy emitting consistent responses. During the treatment condition, all students demonstrated substantial increases in their duration of responding, with Linda, Sara, and Jack demonstrating a preference for one toy over another. These results replicate those reported by Wacker et al. (1985) in that toy reinforcers were defined for every student. In addition, the observed effects on behavior occurred quickly (within six sessions); this also replicates previous findings.

Wacker et al. (1985) and Datillo (1986) suggested that the results of preference studies can be considered as part of an active leisure skills program. At the completion of those investigations and of this experiment, students were independently and actively engaged in behaviors that produced desired effects for them; that is, they were actively participating in leisure activities. For most of these students, it was the first time they had performed an educational activity independently. Of equal importance, this experiment was the first time that reinforcers had been identified systematically for the students.

Thus, Experiment 1 replicated previous studies by demonstrating that microswitches can be used to identify reinforcers quickly for individual students and that the students can activate the reinforcers independently. However, despite these positive outcomes, the results are limited in that they are dependent on the availability of specific battery-operated devices that are not easily transportable across many community settings.

EXPERIMENT 2: ASSESSMENT OF SOCIAL REINFORCERS

One class of reinforcers that may be more generalizable across situations than battery-operated toys is social reinforcers. Most educators use praise, attention, and physical contact to reward desired behaviors, as do parents and others in the community. Unfortunately, the use of these social rewards as reinforcers is seldom evaluated experimentally. Instead, informal assessments usually are conducted based on the observed reaction of the student (e.g., smiling, movement, etc.). This lack of systematic evaluation reduces the effectiveness with which social rewards might be used in training programs, assuming that social rewards are in fact reinforcing.

The use of microswitches to evaluate directly the reinforcing value of social rewards was the purpose of Experiment 2. During this experiment, students activated a pretaped message (the teacher's name) via microswitches that signaled the teacher to attend to them. We predicted that if social attention is reinforcing, the frequency of the teacher's name played across sessions would increase.

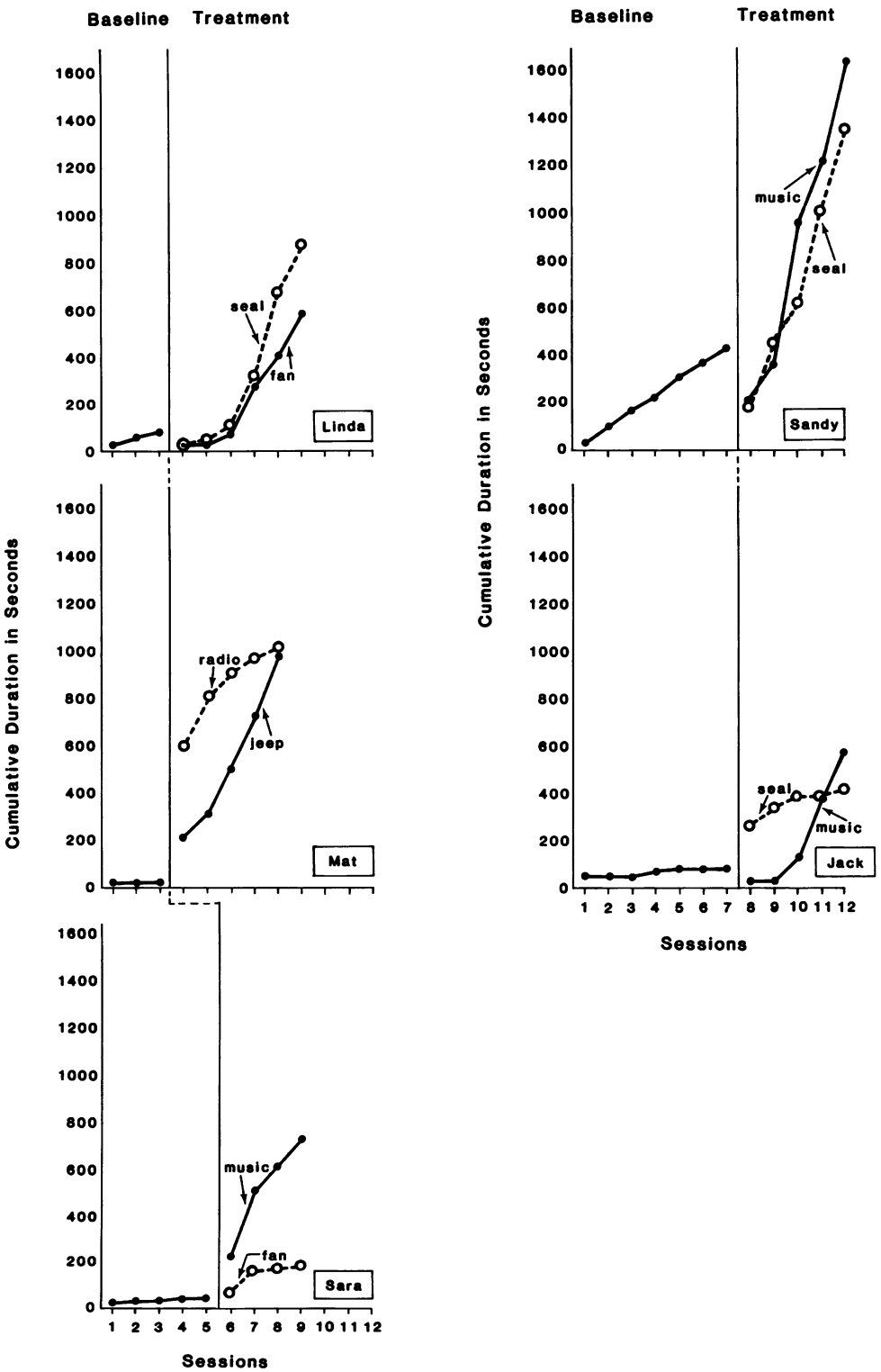

Figure 1. Cumulative duration of toy activation via microswitches.

Method

Participants, Setting, Materials, and Target Behavior

The participants were students in the same two classrooms that participated in Experiment 1, including 3 students (Sara, Jack, and Mat) who participated in Experiment 1. The remaining students had been evaluated previously for their toy preferences using microswitches and, therefore, were familiar with the equipment and procedures. Nine students participated in Experiment 2 and were similar to the students who participated in Experiment 1. They ranged in chronological age from 12 to 20 years, and all students were diagnosed as profoundly mentally retarded. Their functioning level was estimated to be below the 1-year age level based on estimates of their developmental ages (contained in school records); all were nonambulatory and nonverbal. None were able to communicate with gestures or eye blinks, and none responded to requests. All were dependent on staff members for personal care.

Experiment 2 was conducted in the students' classrooms. The students were provided with either contact switches (reach and press) or mercury switches (Sally and Jack for raising hand or arm, respectively), which were attached to a standard tape player located on their lap tray or on the table in front of them.

Design and Procedures

A multiple baseline (across students) with alternating treatments design was used for evaluation. Number of baseline sessions ranged from three to 11. All students received five sessions for each treatment condition (10 total sessions); the conditions were counterbalanced across sessions.

Data were recorded automatically by counters on the tape players (eliminating the need for continuous observation with stopwatches). The teachers recorded their names on the tapes, and the dependent variable was the number of names played during a session. Approximately 1 s was needed for each name to be played with 1 s separating each name.

Baseline. Baseline sessions were conducted with the same procedures as described for Experiment 1. The students were positioned in their wheelchairs or at a table, the switches were connected to a tape player containing a blank tape, and the teacher provided the prompt sequence. This sequence was repeated every 5 min as needed (if the student did not activate the switch). All baseline sessions continued for 30 min.

Treatment. There were two treatment conditions: (a) name-only and (b) name-plus-attention. Name-only sessions were identical to baseline, except that the tape with the teachers' names was played when the student emitted that target behavior. No other consequences to behavior were provided (i.e., no attention was received; the teachers' names were simply played). For the name-plus-attention condition, the teachers and/or teacher associates responded to the student by providing attention, praise, and/or physical contact. The teachers and associates were asked to respond "naturally," providing verbal and physical contact that they believed were enjoyable to the student. These included talking, rubbing a student's back, and brushing his or her hair. Social reinforcement was provided for at least 5 s or for as long as the student continued to activate the tape. After 5 s had elapsed, the teacher discontinued the social attention when the tape stopped playing.

Results and Discussion

The frequency of the teachers' names played across all conditions is provided in Figures 2 and 3. Eight of the 9 students demonstrated low frequencies during baseline, with only Sam displaying inconsistent responding across sessions. No increase in responding occurred for any of the students across baseline sessions.

An immediate increase in frequency occurred for 7 students during the first treatment session, with Mat displaying a delayed increase after three treatment sessions. For Lonnie, no increase in frequency occurred for either treatment condition.

Three patterns of performance emerged during treatment for the eight "successful" students: (a) the name-plus-attention condition produced higher

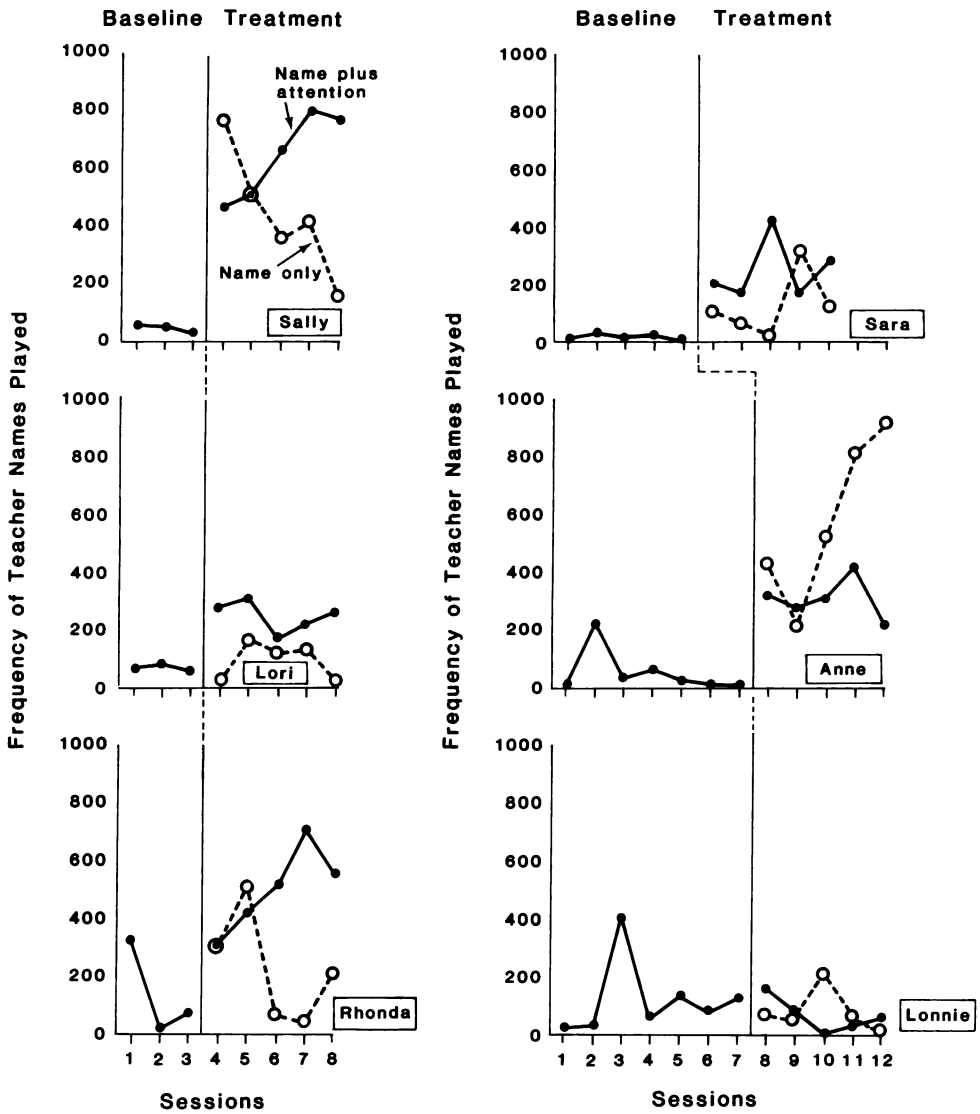

Figure 2. Frequency of teachers' names played across sessions for 6 students.

frequencies of responding from the beginning of treatment for Lori, Sara, and Jack, and with only one exception (one session for Sara), no overlap in performance occurred between the treatment conditions across sessions; (b) the two conditions produced similar frequencies initially, with the name-plus-attention condition producing higher frequencies by the completion of treatment for Rhonda, Sam, and Mat; and (c) one treatment condition was superior to the other initially, but by the completion of treatment the alternative condition produced greater frequencies (the attention condition eventually produced higher frequencies for Sally, whereas the name-only condition was superior for Anne).

By the completion of treatment, social attention appeared to be reinforcing for 8 of the students, and for 7 of them, it was more reinforcing than the name-only condition. These results indicate that the students were responding to the social attention they were receiving and were not responding simply to the names played on the recorder or to the

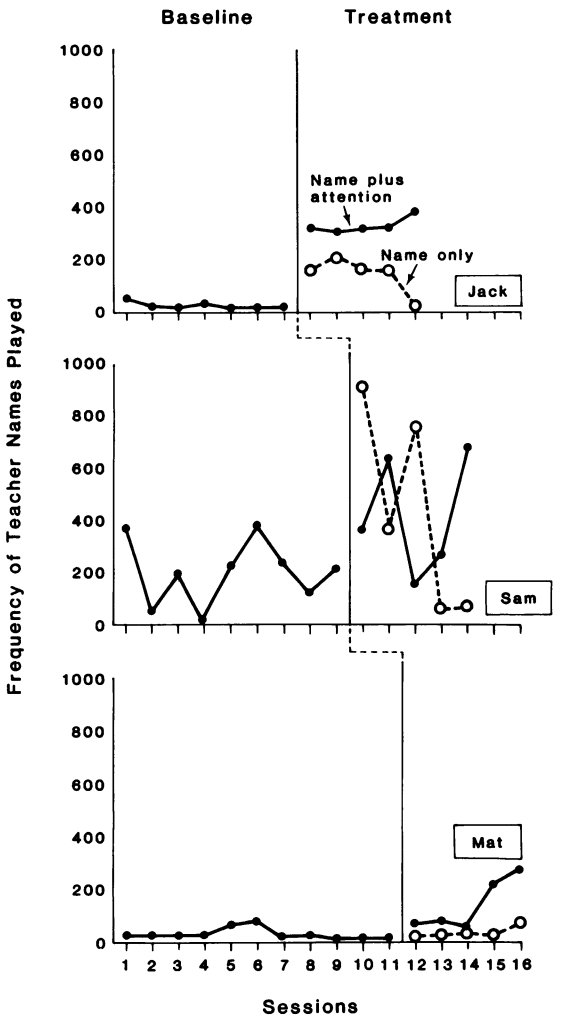

Figure 3. Frequency of teachers' names played across sessions for 3 students.

microswitch itself. Of potential importance, these results suggest that the students are responsive to their social environments, and that in most cases, they find social contact (at least of the type provided by their teachers) to be reinforcing. Of equal importance is the indication that the students were directing the behavior of staff by making clear requests to receive attention. As shown in the figures, some students (e.g., Sally and Rhonda) requested almost constant attention.

Based on these findings, it was expected that the students also could direct the specific behavior of educational staff by activating more specific prerecorded messages (via microswitches). The purpose of Experiment 3, conducted over 2 school years, was to evaluate this hypothesis. Instead of simply signaling the teacher for attention, the students requested specific activities. During Phase 1, 3 students requested either a drink or to play in their classrooms at school. During Phase 2, 6 students requested a drink in a community shopping center.

EXPERIMENT 3: REQUESTING SPECIFIC ACTIVITIES

Method

Participants, Setting, Materials, and Target Behavior

Three students (Sara, Sam, and Jack) from the same classrooms participated in Phase 1 of the experiments. These students were selected because they were available for further evaluation at the end of the school year and because each of these students responded to social attention from educational staff. All data were collected in the students' classrooms using the same switches and tape players used during Experiment 2. Sara and Sam used a contact switch (reach and press response), whereas Jack used a mercury switch (lifting his arm). The two activities selected for evaluation were receiving a drink from staff or playing.

During Phase 2, which was conducted after the completion of Phase 1, 6 students from the same classrooms participated. Three of the students (Anne, Sam, and Sara) had participated in Experiments 1 or 2, whereas the remaining 3 students had not participated in previous experiments. However, these remaining students all had received evaluations of their toy preferences and were familiar with the use of microswitches and with the presence of tape recorders on their lap trays. All 6 students used contact switches and pressed the switches to activate a prerecorded message. On the top surface of the switch, the word "drink" was printed with a line drawing of a glass.

All data for Phase 2 were collected in a community shopping mall, where the students could order drinks from either of two fast-food restaurants. This activity was selected based on a survey

completed by one classroom of nonhandicapped peers (the same age range as the target students) located in a nearby school. The peers all indicated in the survey that they enjoyed going to a shopping mall, with 59% answering that going to restaurants in a shopping mall was one of their favorite activities. Over half (54%) indicated that the shopping mall selected for training was their favorite mall. Therefore, the activity selected appeared to have good social validity.

When not going to a restaurant, approximately half of the peers (46%) indicated that window-shopping or just "hanging out" in the mall was a favorite activity. Therefore, this behavior was selected as the alternative behavior for the participants during Phase 2 of the experiment. Window-shopping was defined as the student's being pushed slowly by a teacher or associate through the mall. The teacher or associate talked to the student, pointed out displays, and, in general, engaged in social interactions.

Design and Procedures for Phase 1

An alternating treatments design was selected for evaluation. Each participant received 4 baseline sessions (20 min each) followed by 8 treatment sessions, 4 each for requesting a drink or for playing. The 4 treatment conditions were counterbalanced across sessions. Data again were recorded automatically by counters on the tape recorders. The statements "I want a drink" or "I want to play" were recorded by the teachers, taking approximately 2 s per message with approximately 2 s elapsing between messages.

Baseline. During baseline, a blank tape was inserted into the tape player, and the students received the same prompt sequence used in Experiments 1 and 2. Each session continued for 20 min. A maximum of 2 sessions were conducted per day.

Treatment. The treatment conditions were identical to those used in Experiment 2, except that specific messages were played. For the drink message, the teacher simply gave the student a drink and continued doing so as long as the tape player was activated. For the play message, the teacher attended to the student and played with him or her by manipulating items on the student's lap tray. Playing continued for at least 5 s or for as long as the message continued.

Design and Procedures for Phase 2

A simultaneous treatments design was selected to evaluate the results for Phase 2. The students window-shopped until they pressed the microswitch, which played the message, "I want _____ (specific drink), please." After the message was played, the students spent approximately 5 min in whichever restaurant was closest and ordered either juice or milk. The counters on the tape players automatically recorded the number of times a message was played. Reliability data were collected once for each student (25% of all sessions) to determine whether the time spent in the restaurant matched the frequency of requests. This was done by having two observers (teachers and/or investigators) independently record the time spent in the restaurant. An agreement occurred if both observers recorded the same amount of time (±1 min). No disagreements occurred.

At the beginning of each session, the student was taken to the ordering counter. The student was given 30 s to press the switch independently (order the drink). If he or she ordered the drink within 30 s, the student received the drink and spent 5 min drinking with the assistance of the teacher (all students required at least some assistance in drinking). The switch and the tape recorder were removed from the lap tray while the student was drinking. If 30 s elapsed and teacher guidance was needed to activate the recording, the student received the drink but immediately left the restaurant (i.e., they did not stay in the restaurant and drink). Instead, the teacher held the drink, and the student and teacher window-shopped until the student independently activated the taped message.

The student was returned to the restaurant for 5 min each time the message was activated; otherwise, the student and the teacher window-shopped. The drink ordered during the initial visit was saved and provided to the student in the restaurant each time he or she returned to the restaurant. Sessions continued for 20 min (±4 min) with one session

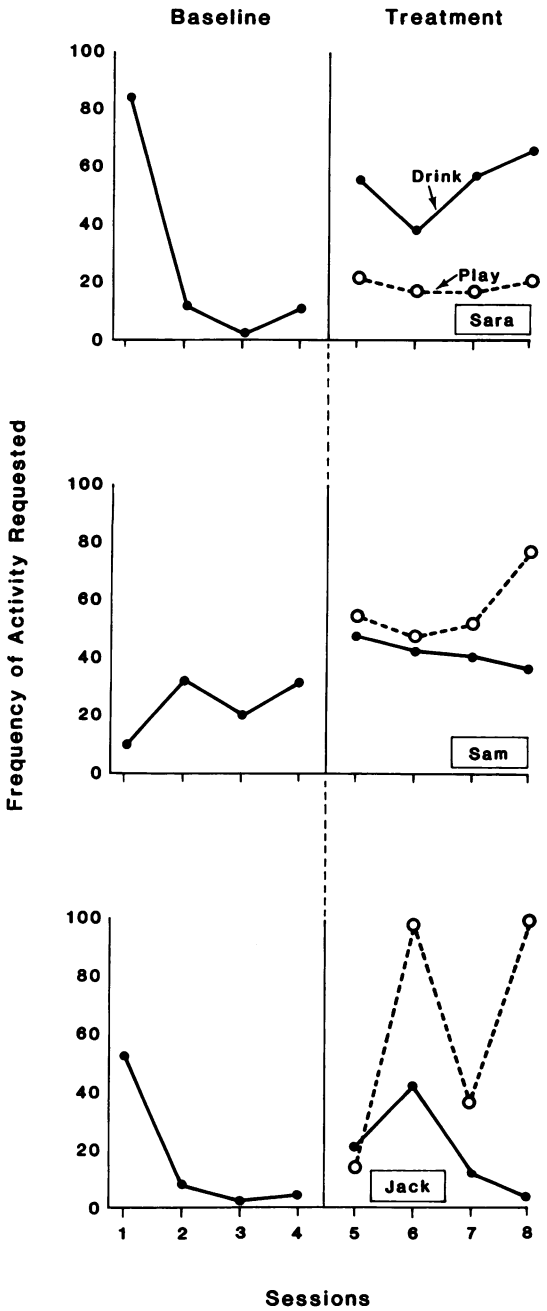

Figure 4. Frequency of requests for playing or drinking by each student.

conducted per week. Four sessions were conducted for each student.

Results and Discussion

The results of Phase 1 are provided in Figure 4. All 3 students demonstrated preferences, with 2 of the students preferring to play rather than to drink. More important, the students were actively directing the specific behavior of others in their environment and were presenting their requests in a clear, efficient manner.

As shown in Figure 5, the students continued to use their switches in the shopping mall. Five of 6 students (with the exception of Sam) spent substantially more time in the restaurants than they spent window-shopping. Because the time spent in either activity was controlled by the student, the results indicate that the students were using their switches to control behavior. In addition, they ordered their drinks with the same taped message, thus also controlling the behavior of the clerks in the restaurants by making requests for specific drinks.

Data also were recorded on the time taken by the students to order in the restaurants (the interval between the arrival at the ordering counter and the activation of the switch). On only three occasions did the students reach the 30-s criterion, requiring that they receive physical guidance from the teacher. Chuck and Cindy always ordered within 15 s, and of the remaining 4 students, 3 demonstrated decreases in the time taken to order. Only Sara demonstrated no improvement across sessions.

The results of Phase 2 demonstrate that the students used their microswitches and tape recorders to make specific requests in a community setting. For the first time, these students were interacting on an independent basis with others (educational staff and clerks) in the community and were directing the activity in which they engaged. Although the teachers needed to push the wheelchairs, to pick up the drinks, and so on, the students independently directed the time spent in those activities. The switches and prerecorded instructions provided them with the means to direct clearly the behavior of others and to participate more independently in functional activities that appeared to be reinforcing to them.

GENERAL DISCUSSION

The 3-year program described here began with the investigators identifying the toy preferences of

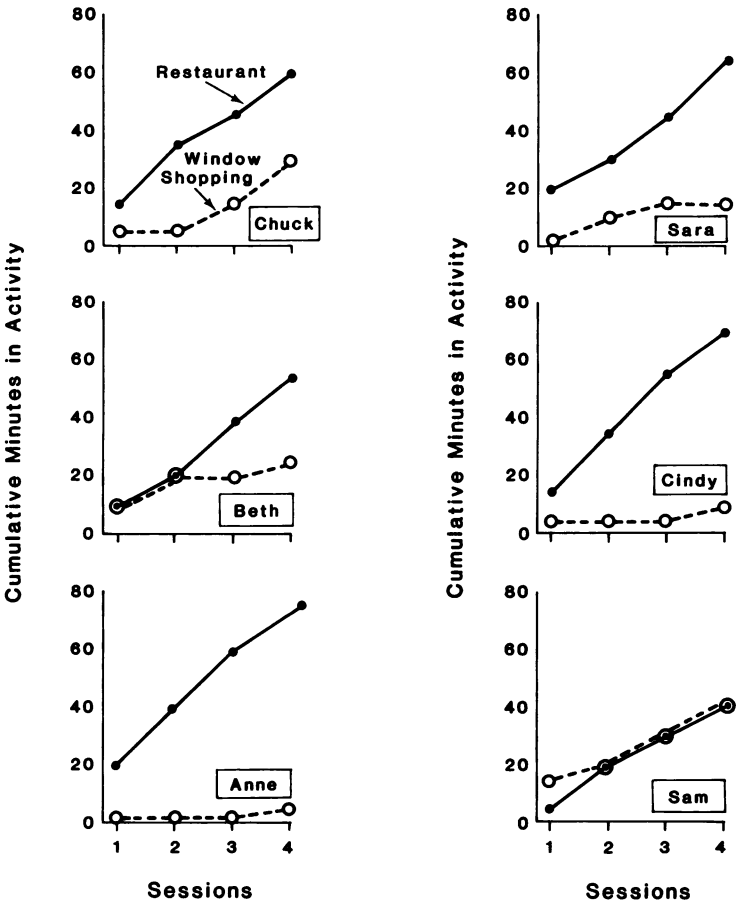

Figure 5. Cumulative length of time spent in restaurants and window-shopping.

individual students and ended with the students' ordering in restaurants and making independent requests of educational staff to provide assistance (drinking) or social activities (playing). These students, all classified as profoundly or multiply handicapped and as functioning below the 1-year level in terms of mental age, were able to achieve these outcomes because they had learned to use adaptive equipment to make their requests clearly understood by others.

Fehr, Wacker, Trezise, Lennon, and Meyerson (1979) suggested that unless profoundly handicapped persons are provided with the appropriate "manipulanda" to make their preferences known to staff, they may be provided inadvertently with noncontingent aversive stimuli (stimuli thought to be reinforcing based on informal assessments). The use of microswitches to regulate the presentation of stimuli was recommended to identify reinforcers and to guard against the inadvertent use of punishers.

Few empirical studies on the use of microswitches or other electromechanical devices have been reported in the literature (Nietupski, Hamre-Nietupski, & Ayres, 1984). This has been the case especially for the use of these devices in training programs for individuals with severe disabilities (Burch et al., 1987). Most previous studies have investigated the use of switches either as a method for controlling arbitrary motoric responding (Fehr et al., 1979; Murphy & Doughty, 1977) or as a means for defining reinforcers (Bailey & Meyerson, 1970). Although the results of these studies generally have been positive, the application of microswitch technology to ongoing programming has not been established.

At issue in the present study is whether or not microswitches can be used effectively as a communication system. Microswitches that are attached to tape recorders with pretaped messages have several pragmatic limitations: Only one message is played at a time, the switches and tape recorders have to be attached firmly to a lap tray or table, and the wires connecting the switches to the tape players can be distracting to students. Increasing a student's communication options requires that more than one switch, tape player, and set of wires be placed in front of the student. In most cases, this severely limits what else can be placed in front of the student, and the practical difficulties with using switches quickly magnify.

Several options appear possible to reduce these difficulties. First, it is possible to develop microswitches that activate battery-operated devices through sound waves, eliminating the need for wires. Second, very small recorders with continuous loop tapes can be attached on the underside of a lap tray or table. Third, students might be trained through stimulus-control procedures to discriminate between switches, with each switch being as small as possible. In this way, multichoice options would be available to at least some students. We believe that these options should be considered, because the use of switches with prerecorded messages appears to have several potential advantages over other augmentative communication systems. The prerecorded messages are clearly understood by trainers and others in the community. The volume can be turned up so that trainers do not have to be close to the student when a request is made. Finally, any activity can be requested by the student. These potential advantages make the continued development and refinement of microswitches as a functional communication system an important goal for applied behavior analysts.

York, Nietupski, and Hamre-Nietupski (1985) suggested that microswitches should be used to increase the training options for students with severe handicaps and the participation of students in normalized, functional activities. In each of the three experiments in the present study, the switches provided the students with increased opportunities to control their environments by directing the behavior of others in the environment. By the end of the investigation, the students were participating more actively in normal, age-appropriate activities.

However, there were several limitations in the present experiments that need to be addressed by subsequent researchers. The students were provided with only one switch at a time, reducing our interpretation of the students' actual preferences. No attempt was made to establish that the students' performances were sustained over long periods of time, and minimal reliability data were obtained. In addition, in each experiment, multiple training components (e.g., prompting system and type of reinforcer) were used in the treatment packages, but no attempt was made to separate the effects of each component.

Despite these limitations, in general the results were positive across students and situations, warranting further investigation. The development of a functional communication system, the establishment of sustained responses over time, and the functional assessment of reinforcers via microswitches for shaping other behaviors all require further investigation.

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