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TEACHING CHOICE MAKING DURING SOCIAL INTERACTIONS TO STUDENTS WITH PROFOUND MULTIPLE DISABILITIES

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We taught 4 students with profound multiple disabilities to use a microswitch communication system to request a change in recreational stimuli during social interactions with nondisabled peers. In Study 1, we conducted a preference assessment across a range of stimuli for each student. The most and least preferred stimuli were incorporated into microswitch communication system training in Study 2. During the second study, 3 of the 4 students (a) learned to use the microswitch communication system to control stimulus presentation, (b) more clearly differentiated their time among stimuli, and (c) increased their level of general alertness. Study 3 extended the use of the microswitch communication system to social interactions with nondisabled peers. Two students were more engaged in interactions when they chose when to change stimuli; 1 student was more alert when a peer chose when to change activities; a 4th student showed an undifferentiated pattern. The outcomes of the investigation are discussed in terms of the effects of controlling stimulus presentation on the behavior of students with profound multiple disabilities and the stability of preference hierarchies over time.

DESCRIPTORS: profound multiple disabilities, choice, social interactions, microswitch communication systems, augmentative communication, preference hierarchies

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Interventions for people with profound multiple disabilities initially focused on whether it was possible for their behavior to be brought under the control of positive reinforcers (Bailey & Meyerson, 1969; Fuller, 1949). As a result, operant control by visual, auditory, and tactile stimuli has been demonstrated over responses such as visual fixation, posture, limb movement, task engagement, and microswitch activation (Fehr, Wacker, Trezise, Lennon, & Meyerson, 1979; Jones, Favell, Lattimore, & Risley, 1984; Realon, Favell, & Dayvault, 1988; Reid, Phillips, & Green, 1991; Sailor, Gee, Goetz, & Graham, 1988; Utley, Duncan, Strain, & Scanlon, 1983). Several investigations have extended the work on response–consequence relations to encompass analyses of reinforcer hierarchies (Fisher et al., 1992; Green, Reid, Canipe, & Gardner, 1991). This work has shown that the reinforcing effectiveness of various consequences differs within and among individuals. For example, Pace, Ivancic, Edwards, Iwata, and Page (1985) developed an assessment procedure using students' reach-and-grasp responses as the dependent measure. The higher the proportion of reach-and-grasp responses for a particular stimulus, the more highly preferred a stimulus was ranked, relative to others. Wacker, Berg, Wiggins, Muldoon, and Cavanaugh (1985)

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and Dattilo (1986) used microswitches as a means of assessing preference by measuring the amount of time the microswitch was pressed to activate particular electronic stimuli.

Given that students with profound multiple disabilities differentially allocate responding among stimuli, researchers have begun to arrange educational environments so students can make choices regarding which stimuli they receive (Keogh & Reichle, 1985). Increasing opportunities for choice has become a major goal of educational efforts and has been related to a number of positive educational outcomes (Dunlap, Kern-Dunlap, Clarke, & Robbins, 1991; Dyer, Dunlap, & Winterling, 1990; Reichle, Sigafoos, & Piche, 1989). By arranging educational settings to maximize student choice, increased engagement with the environment can occur. For example, Wacker, Wiggins, Fowler, and Berg (1988) taught students to press a microswitch to select between alternative events in school and community settings (e.g., window shopping vs. eating at a restaurant). Results of their study also indicated that as a result of choosing activities, students were more active when engaged with preferred stimuli.

One possible result of teaching students with profound disabilities to make choices via a microswitch communication system is more active participation in social interactions. Whereas previous research has targeted student–teacher interactions, no investigation to date has extended the use of communication systems for students with profound multiple disabilities to engage more actively in social interactions with nondisabled peers. The social integration and interaction of these students with nondisabled peers is a primary goal of community-based education (Haring, 1992).

The purpose of our study was to extend research on augmentative communication systems so that students with multiple profound disabilities could make choices via microswitch activation when interacting with nondisabled peers. Study 1 was conducted to assess student preferences for various stimuli. In Study 2, the students were taught to press a microswitch that activated a tape-recorded message requesting a change in the stimulus with which they were interacting. Study 3 was conducted to assess generalization of the microswitch communication system to social interactions with nondisabled peers.

GENERAL METHOD

Students and Settings

Four students with profound multiple disabilities attending special education classes in integrated public schools were selected based on teacher nomination. The adaptive behavior of students was estimated to range from 6 months to 1.4 years (M = 10 months) on the Vineland Adaptive Behavior Scales. None of the students was testable using traditional psychometric instruments.

Doug was 6 years 10 months old and had microcephaly. Doug used a wheelchair for mobility but was unable to move the wheelchair himself due to physical restrictions in arm use. He occasionally had petit mal seizures but was not receiving medication. He had no formal communication system, but Doug's teachers interpreted his facial expressions and various sounds (laughing, whining) as a means of communicating preferences.

Peggy was 20 years 2 months old. Her disabilities were a result of a degenerative central nervous system disease (sudanophilic leukodystrophy) first diagnosed at 9 years of age. Peggy used a manually operated wheelchair for mobility and had a pictureboard, which could be attached to her wheelchair, to greet others and make basic requests; however, she rarely used the system spontaneously.

Enrico was 18 years 6 months old and had quadriparesis, hydrocephalus, and other significant health impairments as a result of a closed head injury at the age of 15 years. Enrico used a wheelchair but had limited mobility due to paralysis in all but his right arm. Enrico received 100 mg of Dilantin® daily for grand mal seizures. He used yes/no head nods when prompted, but responses to questions were inconsistent.

Natasha was 5 years 11 months old and had spastic quadriparesis in a diaplegic distribution and hydrocephalus. Because of restrictions in arm movement, she could not move her wheelchair independently. She occasionally had petit mal seizures but was not receiving medication. Natasha often smiled when various activities were presented to her, but she had no formal means of communication.

Sessions were conducted in the students' classrooms. Two classrooms were located in an elementary school (Doug and Natasha) and two were located in a high school (Peggy and Enrico). Sessions occurred at times when few people (other than the instructor and student) were present.

Response Definitions

Stimulus engagement. Students were scored as being engaged with stimuli if they (a) physically touched a stimulus with their hand or arm or (b) faced a stimulus. The total time a student was engaged with a stimulus was divided by the total time a stimulus was present to derive a percentage of stimulus engagement.

Microswitch press/stimulus present. Responses that closed a microswitch placed on the participant's wheelchair without any assistance from the instructor or a nondisabled peer were defined as microswitch presses. If a stimulus was in front of a student when the microswitch was pressed, the response was scored as a microswitch press/stimulus present.

Microswitch press/stimulus absent. These responses were defined the same as microswitch press/stimulus present except that no stimulus was present when the microswitch was pressed. These data were collected to determine whether switch pressing was under stimulus control.

Data Collection and Interobserver Agreement

Sessions were videotaped using a tripod-mounted Sony VHS camcorder. Scoring of stimulus engagement and microswitch presses was done using T1000SE® Toshiba portable computers with Communitech International software (see Repp, Harman, Felce, van Acker, & Karsh, 1989). Continuous scoring of student engagement (duration recording) and the frequency of microswitch presses (event recording) was provided by the observational software. Interobserver agreement measures were collected during 26% of sessions. For Study 1, interobserver agreement for engagement with stimuli across students was 91% (range, 85% to 95%). For Study 2, interobserver agreement was 92% for time engaged (range, 85% to 96%), 97% (range, 50% to 100%) for microswitch presses with a stimulus present, and 95% (range, 50% to 100%) for microswitch presses with a stimulus absent. For Study 3, overall interobserver agreement for engagement was 89% (range, 83% to 95%). Overall interobserver agreement was 96% (range, 67% to 100%) for microswitch presses with a stimulus present and 92% when a stimulus was absent (range, 50% to 100%).

STUDY 1: PREFERENCE ASSESSMENT

METHOD

Stimuli

Several stimuli were selected for each student based upon teacher nominations of activities perceived to be either preferred or nonpreferred. The rationale for including stimuli perceived to be high and low preference was to sample a range of stimuli that might occasion differing levels of engagement. The stimuli selected for assessment for each of the students are presented in Table 1. Twelve stimuli were selected for Doug, 11 for Peggy, 10 for Enrico, and 14 for Natasha.

Procedure

Students were seated in their wheelchairs with stimuli placed on a lapboard or table. One session per day for 4 days was conducted for each student, with each stimulus presented twice during a session (for a total of eight trials per stimulus). A trial began by placing a stimulus in front of the student and having the instructor manipulate the item in an appropriate manner. During the 60 s of each trial, the student was verbally prompted approximately every 10 s to engage in the activity (e.g., "look at the frog"). Following each trial, a 30-s intertrial interval occurred in which there were no stimuli present and no interactions between instructor and student. During a session, stimuli were presented in an arbitrary sequence that varied from day to day. Depending upon the student, sessions ranged in length from 30 to 45 min.

Results and Discussion

Table 1 shows the overall percentage of time a student was engaged with each stimulus. The students displayed patterns of engagement that varied across stimuli. For Doug, the percentage of time engaged ranged from 89% (ball) to 46% (computer game). The percentage of time engaged for Peggy varied from a high of 96% (playing cards) to a low of 49% (typewriter). For Enrico and Natasha, the percentage of time engaged ranged from 73% (playing cards) to 26% (typewriter) and 92% (ball) to 24% (talking book), respectively.

The findings from Study 1 replicated those of previous research regarding differential patterns of responding to stimuli by students with profound multiple disabilities (Dattilo, 1986; Green et al., 1988; Pace et al., 1985; Wacker et al., 1985). We used these results to identify stimuli associated with the highest and lowest levels of student engagement for use in training in Study 2. In Study 2, students were taught to press a microswitch that played a prerecorded message requesting a change in stimuli. The system was designed to allow students to choose how long a stimulus was present during interactions with another person.

STUDY 2: MICROSWITCH COMMUNICATION SYSTEM USE

Method

Microswitch Communication System

The microswitch communication system consisted of a tape recorder and cassette tape (activated by pressing a microswitch) that played a 15-s tape-loop recording of a same-gender, same-age nondisabled peer making several requests to change stimuli (e.g., "Can we do something else," "Let's try something new"). Doug used his right hand to press a contact switch (8 cm square) that activated the tape recorder for as long as the switch was depressed. A similar response and switch were used for Peggy and Enrico, with the addition of a timer circuit that allowed the taped message to play continuously for 5 s when the switch was initially depressed. Natasha used her right forearm to activate a toggle switch (15 cm) that, in conjunction with a timer circuit, activated the tape recorder for 5 s when the switch was contacted.

Procedure and Experimental Design

A multiple probe (across students) with alternating treatments design was used to demonstrate the effects of the instructional intervention on students' use of the microswitch communication system.

Baseline. Throughout baseline, the microswitch communication system was present to assess the frequency of microswitch presses prior to training. Stimuli were presented in a manner similar to Study 1. One session was conducted per day, with three to five sessions occurring per week. A session began by presenting a student with one of the stimuli as the instructor prompted the student to look at or touch the item. The interaction continued with a stimulus until (a) the student pressed the microswitch activating the communication system, (b) the student stopped engaging in the task for 5 continuous seconds, or (c) 5 min had elapsed. Once a stimulus was removed, a 10- to 15-s intertrial interval elapsed before the next stimulus was presented. The presentation of a stimulus, the subsequent interaction with the stimulus, and the eventual removal of a stimulus (given the above criterion), constituted an "opportunity" to press the microswitch to control stimulus presentation. This pattern of stimulus presentation, interaction, and removal continued throughout a session until each of the eight stimuli had been presented twice (for a total of 16 opportunities). No praise was provided during baseline for pressing the microswitch. Sessions lasted approximately 40 min.

Training. Training sessions were identical to baseline, with the following exceptions. First, when a student stopped engaging a stimulus for 5 continuous seconds, he or she was physically prompted to press the microswitch. Physical prompts con-

Table 1
Stimuli and the Mean Percentage of Engagement from the Preference Assessment in Study 1

Doug	Peggy	Enrico	Natasha
Ball (89)*	Playing cards (96)*	Playing cards (73)*	Ball (92)*
Wind-up toy 2 (77)*	Combing hair (94)*	Keyboard (63)*	Wind-up toy 2 (81)*
Keyboard (74)*	Board game (88)*	Magazine (62)*	Tambourine (76)*
Music (71)*	Drawing (86)*	Board game (60)*	Keyboard (71)*
Squeaky toy (71)*	Magazine (76)*	Drink of water (53)*	Hand videogame (67)*
Tambourine (65)	Keyboard (58)	Music (50)	Squeaky toy (66)
Wind-up toy 1 (64)	Jigsaw puzzle (55)	Talking book (42)	Wind-up toy 1 (65)
Jigsaw puzzle (61)	Computer game (54)	Combing hair (37)**	Jigsaw puzzle (60)
Magazine (54)	Music (51)**	Computer game (36)**	Drawing (58)
Board game (50)**	Talking book (50)**	Typewriter (26)**	Board game (38)
Drawing (47)**	Typewriter (49)**		Computer game (34)
Computer game (46)**			Music (33)**
			Magazine (30)**
			Talking book (24)**

* High-preference stimuli used in Study 2.
** Low-preference stimuli used in Study 2.

sisted of moving the student's arm or hand so that the microswitch was activated. The 5-s constant time delay was maintained throughout training. When the microswitch communication system had been activated, the stimulus was removed. If a student pressed the microswitch without a prompt, the stimulus was removed. Thus, a stimulus could be changed in either of two ways: (a) The student could independently depress the microswitch, or (b) after 5 s of nonengagement, the student was physically prompted to depress the microswitch. Following independent or physically prompted microswitch presses, the student was praised. Training continued until the student demonstrated a stable trend of independent microswitch presses across a minimum of eight sessions. Sessions ranged in length from 20 to 45 min.

Results and Discussion

The results of training are presented in Figure 1. When training was introduced, a gradual increase in the number of microswitch presses began, which continued until Doug used the communication system to request changes for 14 to 16 stimuli per session. Throughout training, Doug's microswitch presses in the absence of a stimulus remained low (M = 0.9; range, 0 to 4). The data for Peggy show a decreasing trend during baseline for microswitch presses when stimuli were both present and absent. As training proceeded, her microswitch presses increased to 15 or 16 occurrences when stimuli were present. Her microswitch presses when stimuli were absent remained low throughout training (M = 0.3, range, 0 to 2).

Enrico averaged 0.2 (range, 0 to 1) and 0.5 (range, 0 to 1) microswitch presses during baseline when stimuli were present and absent, respectively. Following the onset of training, Enrico's microswitch presses eventually increased to 15 or 16 per session when stimuli were present. The mean frequency of microswitch use when stimuli were absent during training was 0.8 (range, 0 to 3).

Natasha's microswitch use was infrequent when stimuli were present and absent during baseline. When training was implemented, an initial increase in microswitch presses occurred when stimuli were present. However, microswitch presses peaked at seven occurrences during Sessions 34 and 37, followed by a highly variable pattern of performance. Across training sessions, the mean frequency of microswitch presses when stimuli were present was 2.6 (range, 0 to 7) and was 1.2 (range, 0 to 9) when stimuli were absent. Thus, all 4 students' appropriate use of the microswitch communication system increased over baseline, and 3 of the 4 students used the microswitches to request changes

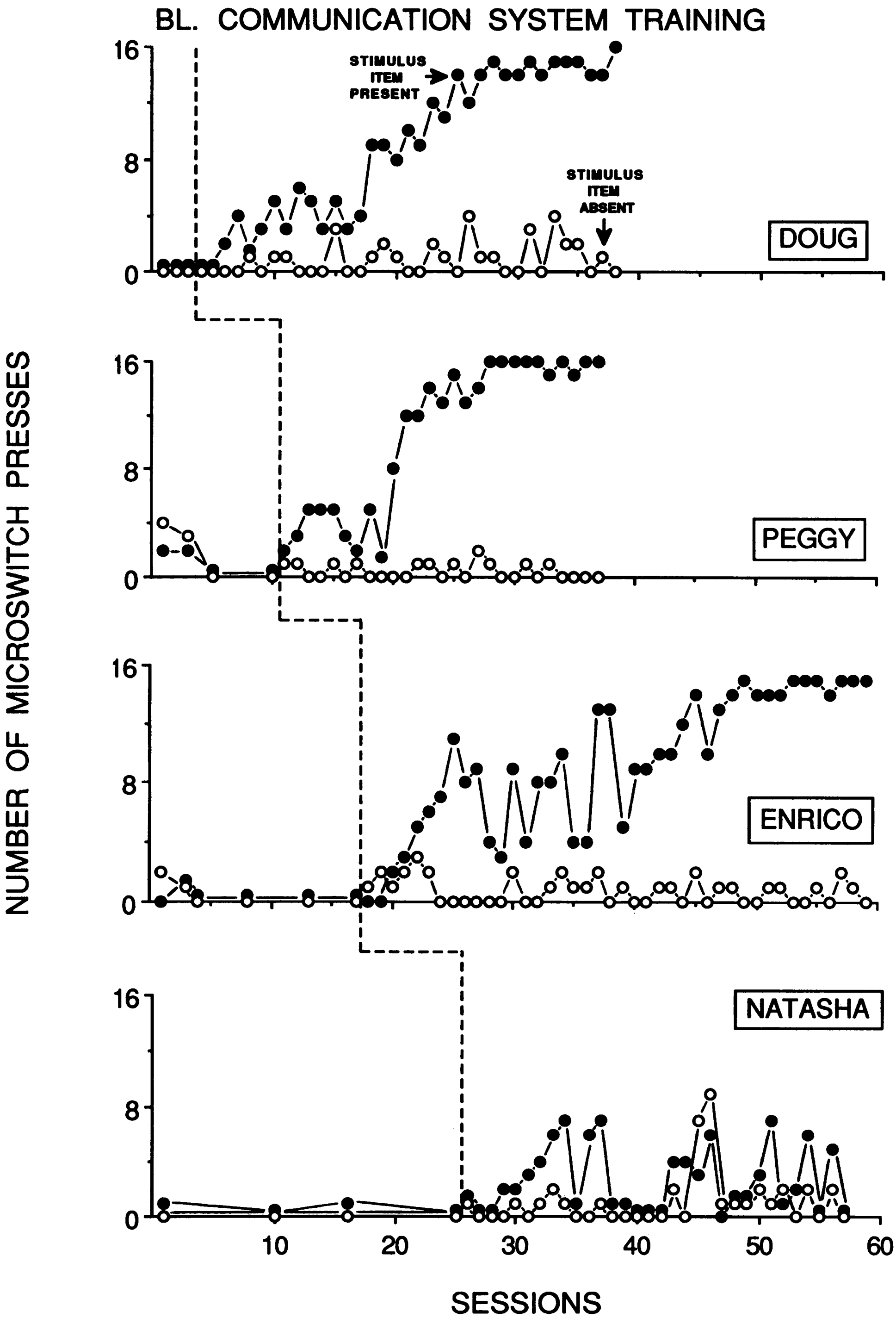

Figure 1. Results of microswitch communication system training in Study 2. The data are arrayed as the number of microswitch presses activating the communication system out of a possible 16 opportunities. Closed circles represent the number of microswitch presses occurring when a stimulus was present. Open circles represent the number of microswitch presses occurring when a stimulus was absent.

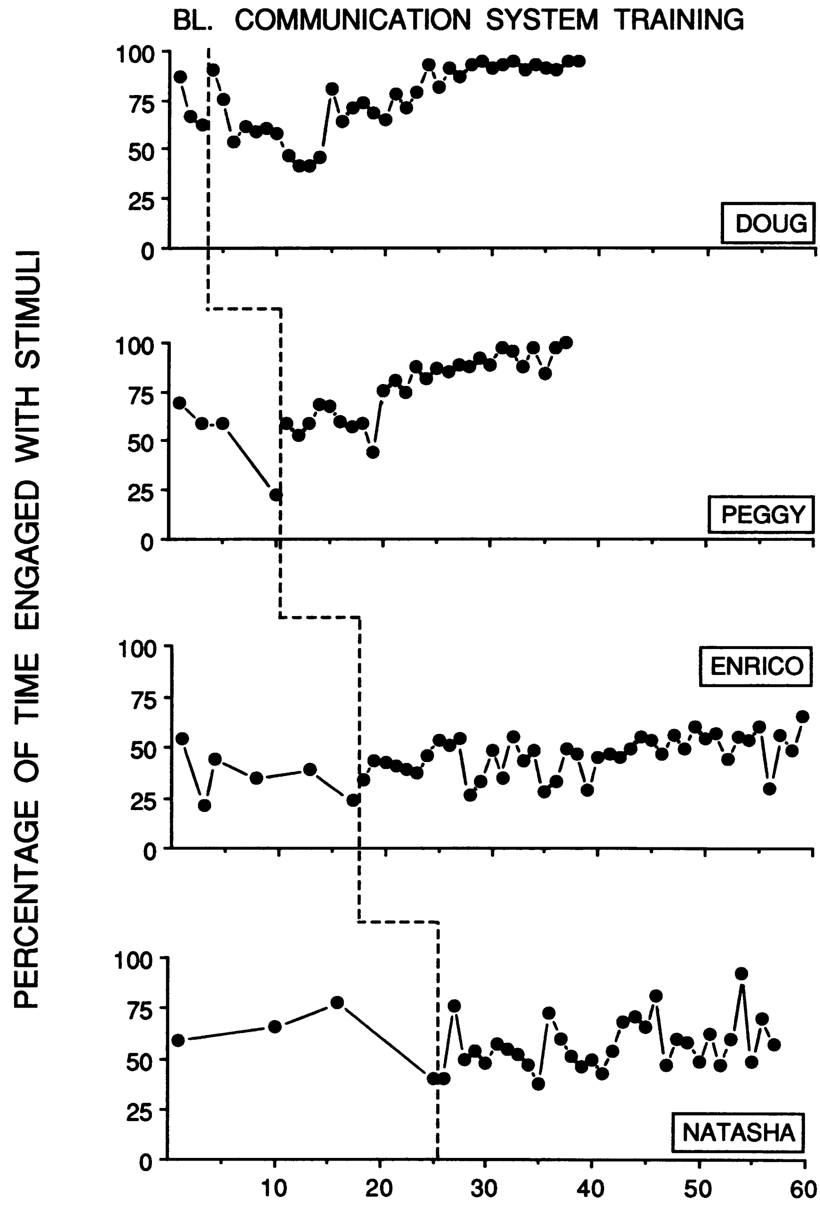

Figure 2. Effects of microswitch communication system training in Study 2 on students' engagement with stimuli. Information is presented as the percentage of time students were engaged with stimuli.

in stimuli during most of the opportunities available.

The percentage of time each student was engaged with stimuli during a session is provided in Figure 2. In comparing baseline to the final six training sessions, there was an increase in engagement from a mean of 72% to 92% for Doug, from 54% to 94% for Peggy, and from 36% to 52% for Enrico. The exception was Natasha, whose percentage of engagement changed only marginally, from 62%

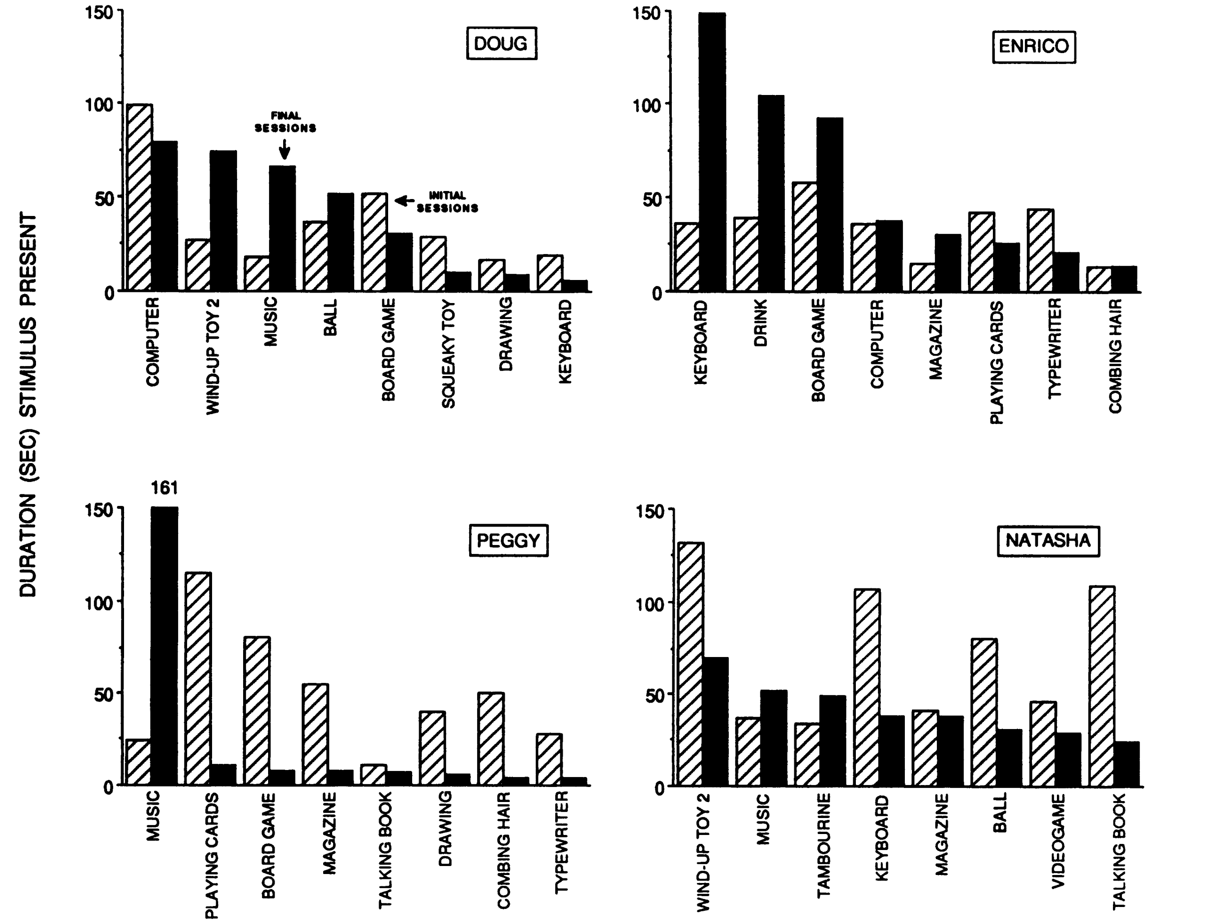

Figure 3. Students' differential allocation of time among stimuli during the four initial and four final sessions of training in Study 2. The data are arrayed as the mean duration (in seconds) that a stimulus was present during a given trial. Columns shaded with lines represent the initial four sessions. Columns shaded black represent the final four sessions.

to 63%. Overall, the results show that increases in communication use were correlated with increases in time engaged with stimuli for 3 of 4 students.

Allocation of time among stimuli during the four initial and four final training sessions is shown in Figure 3. Data are presented as the mean duration (in seconds) that a stimulus was present before the student either pressed the microswitch or was not engaged for 5 continuous seconds. In general, the time spent among various stimuli became more differentiated once microswitch communication system use was established. Both Doug and Enrico increased their duration of exposure to specific stimuli during the final sessions relative to baseline (e.g., ball, music, and the second wind-up toy for Doug; board game, drink, and keyboard for Enrico). They also decreased their exposure to certain stimuli across the course of training (e.g., board game, drawing, keyboard, and squeaky toy for Doug; cards and typewriter for Enrico). Similarly, Peggy allocated the majority of her time to just one stimulus by the end of training (music) and only briefly spent time with the other stimuli relative to baseline. Natasha's pattern differs from the other 3 students in showing less differentiation and a general decline in duration across stimuli.

These results show that the amount of time students spent with specific stimuli changed during the course of training. The reason for this change is unclear, but the result supports the observation that learning to use the microswitch communication system permitted greater opportunities to choose to interact more with preferred stimuli. However, it is also possible that students' preferences changed over time and unrelated to acquisition of microswitch use.

In Study 2, students learned to control stimulus presentation by controlling their duration of exposure to stimuli. Previous uses of microswitch systems for students with profound multiple disabilities have allowed students to participate in making choices by (a) selecting whether or not to engage a single stimulus (Dattilo, 1986; Pace et al., 1985; Wacker et al., 1985) or (b) selecting between alternative events (Wacker et al., 1988). The procedures used in the current investigation provide an additional means for students to interact with their environments. For 3 students, actively controlling stimulus duration resulted in both higher levels of engagement and a greater differentiation among stimuli. In Study 3, we sought to (a) assess the degree to which the findings in Study 2 would generalize to interactions with a nondisabled peer and (b) further analyze the effects of allowing students to control stimulus duration.

STUDY 3: SOCIAL INTERACTIONS WITH NONDISABLED PEERS

Method

Nondisabled Peers

For each student with disabilities, a nondisabled same-age peer was recruited through classroom-based peer tutoring programs to interact with the student during a break or recess time. Nondisabled peers were selected via teacher nominations of interested individuals who had had contact with the student for at least 1 year. For Doug, Peggy, Enrico, and Natasha, the peers identified were a 10-year-old female, 17-year-old female, 16-year-old male, and 8-year-old female, respectively.

Procedure and Experimental Design

We studied three conditions that varied the control of stimulus presentation. The microswitch system, stimuli, location, and response definitions were the same as in Study 2. Throughout Study 3, each of the stimuli was presented once a session, for a total of eight opportunities. During baseline, we provided the microswitch communication system to the students, and they controlled stimulus presentation. We conducted this type of baseline to assess the degree of stimulus generalization from instructor to peer. Following baseline, three treatment conditions were assessed for each student–peer dyad within an alternating treatments design.

In the student-determined condition, the student with profound multiple disabilities could use the microswitch communication system to control stimulus presentation. No prompts or social praise was provided for pressing the microswitch. Instead, the student and peer interacted with a particular stimulus that the peer replaced with another stimulus when the student pressed the microswitch. Otherwise, the interaction with the stimulus continued until the student was not engaged with a stimulus for 5 consecutive seconds.

In the peer-determined condition, the microswitch was absent, and the nondisabled peer controlled changes in stimuli. Peers were instructed to change stimuli whenever "they wanted."

The yoked control condition was designed to control for the sequence and duration of exposure to stimuli in the student-determined condition. Students and peers were presented with the same sequence and duration of exposure to each stimulus as had occurred in the previous student-determined condition, but the microswitch communication system was not present. This was accomplished by the experimenter telling the peer what stimulus to use and when to change stimuli.

Each session constituted a single condition per day and occurred 4 or 5 days per week; each lasted approximately 25 min. Before the initial session, the peer was asked to "play" or "hang out" with the student as he or she typically would. Peers were instructed that on some days the student could decide when to change stimuli (the student-determined condition), on some days the peer could decide when to change stimuli (peer-determined condition), and on other days the experimenter would decide when to change stimuli (the yoked control condition). No other instructions were provided to peers regarding when to change stimuli. Each session began with the experimenter telling the peer which condition was in effect for that day. A stimulus was then selected by the peer (student- and peer-determined sessions) or the experimenter (yoked control sessions), and the student–peer dyad interacted with the item. Because student–peer dyads had previous histories of social interaction, we provided no additional prompts to interact. During all sessions, the experimenter sat in a corner of the room 1 to 2 m away from the student–peer dyad.

Student Affect During Social Interactions

Along with microswitch presses and engagement, students' positive affect and negative affect were measured using a 10-s interval recording system. Instances of positive affect included smiling and laughing; negative affect included whining, frowning, and pushing objects or people away. During 34% of the sessions, interobserver agreement was assessed for the occurrence or nonoccurrence of positive and negative affect across students and conditions. Interobserver agreement was calculated by summing agreements and dividing by agreements plus disagreements. For the occurrence and nonoccurrence of positive affect, interobserver agreement was 90% (range, 70% to 98%) and 88% (range, 73% to 97%), respectively. For the occurrence and nonoccurrence of negative affect, interobserver agreement was 95% (range, 50% to 100%) and 97% (range, 67% to 100%), respectively.

Results and Discussion

The data for microswitch presses demonstrated that all 4 students displayed patterns similar to those in Study 2 regarding use of the microswitch communication system. In addition, for Doug, Peggy, and Enrico, use of the microswitch communication system averaged seven or more requests to change activities for the eight opportunities that occurred during each social interaction with a nondisabled peer.

A total of four baseline sessions occurred for Doug, which were followed by five sessions for each of the student-determined, yoked control, and peer-determined conditions (see Figure 4 for details). For Doug, the mean number of microswitch presses when the stimuli were present and absent, respectively, were 7.3 (range, 6 to 8) and 0.5 (range, 0 to 1) during baseline, and 7.3 (range, 7 to 8) and 0.7 (range, 0 to 1) during the student-determined condition. For Peggy, a mean of 7.6 microswitch presses occurred when stimuli were present (range, 7 to 8) and 0.3 when stimuli were absent during baseline (range, 0 to 1). Similarly, she pressed the microswitch a mean of 7.8 times during the student-determined condition when stimuli were present (range, 7 to 8) and 0.3 in the absence of stimuli (range, 0 to 1). With stimuli present, Enrico had a mean of 7.3 microswitch presses during baseline and the student-determined sessions (range, 7 to 8). Mean number of microswitch presses when stimuli were absent was 0.7 during baseline (range, 0 to 1). When stimuli were absent, Enrico pressed the switch once during each of the student-determined conditions. Natasha's mean number of microswitch presses when the stimuli were present and absent, respectively, was 2.0 (range, 0 to 5) and 1.3 (range, 1 to 3) during baseline, and 2.3 (range, 1 to 3) and 0.7 (range, 0 to 1) during the student-determined sessions.

The mean percentage of engagement with stimuli across all conditions is summarized in Figure 4. For Doug, engagement was highest when someone else determined when to change stimuli. Following a baseline mean of 72% (range, 63% to 81%), Doug's engagement with stimuli decreased to 58% (range, 39% to 73%) when the microswitch communication system was available. Conversely, he was engaged with stimuli 84% (range, 77% to 93%)and 82% (range, 71% to 89%) of the time during the peer-determined and yoked control conditions, respectively.

For Peggy and Enrico, engagement was highest when they controlled the presentation of stimuli. For Peggy, task engagement increased from 74% in baseline (range, 65% to 88%) to 85% during the student-determined condition (range, 63% to 96%). Her engagement with stimuli was lower during the peer-determined (M = 61%; range,

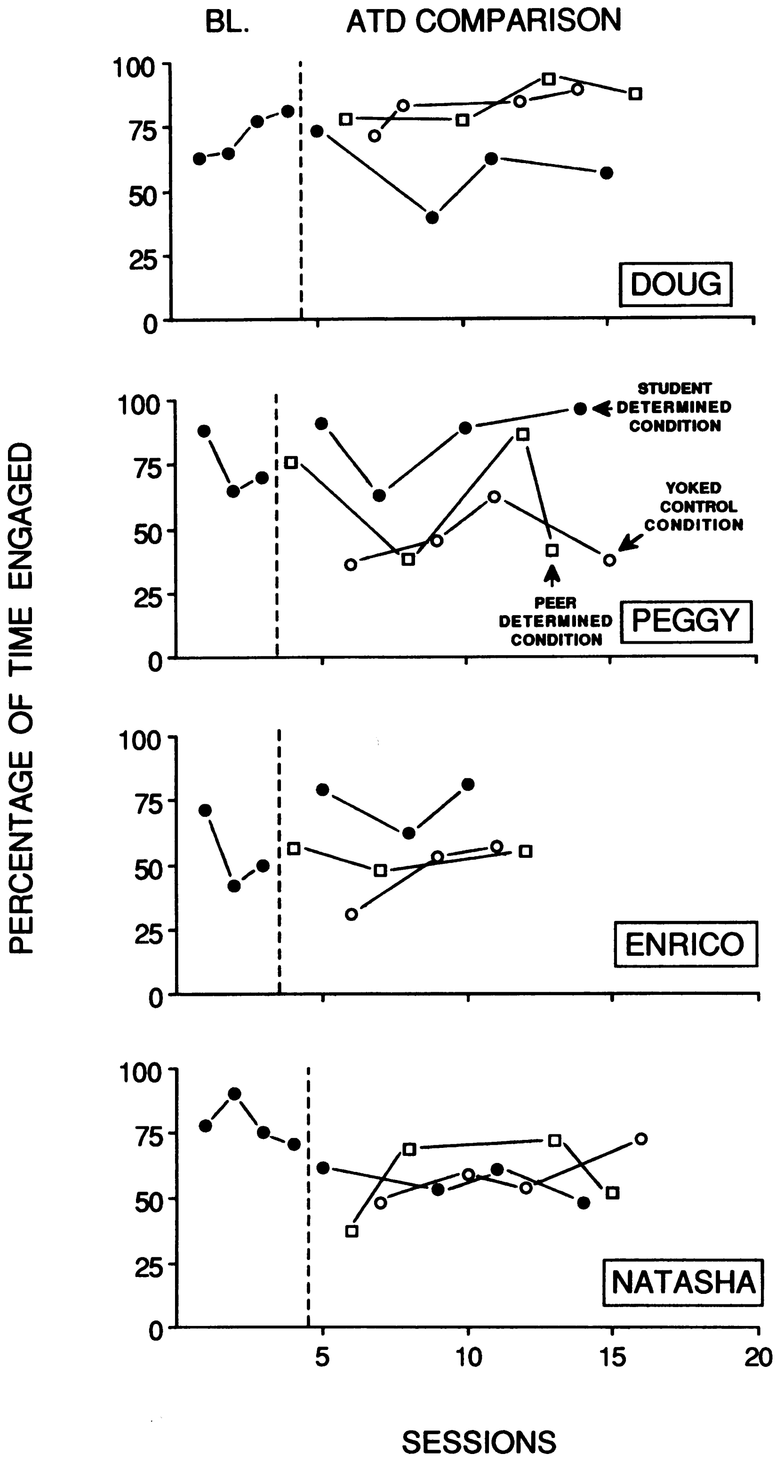

Figure 4. The percentage of time students with profound multiple disabilities were engaged with stimuli during Study 3. Closed circles indicate that the microswitch communication system was present and available for students to use. Open squares represent sessions in which a nondisabled peer chose when to change stimuli. Open circles indicate the yoked control condition.

Table 2
Mean Percentage of Intervals in Which Positive and/or Negative Student Affect Was Observed in Study 3 (with Ranges in Parentheses)

	Condition			
Student	Baseline	Student-determined	Peer-determined	Yoked control
Doug				
Positive	57 (50–68)	32 (23–37)	56 (50–64)	61 (54–64)
Negative	7 (1–10)	26 (17–38)	16 (10–22)	20 (12–33)
Peggy				
Positive	73 (70–77)	77 (69–83)	49 (36–64)	42 (30–57)
Negative	3 (0–8)	4 (0–9)	7 (2–14)	7 (2–17)
Enrico				
Positive	29 (29–30)	29 (26–31)	14 (11–16)	8 (6–9)
Negative	3 (2–5)	1 (0–4)	3 (1–5)	7 (3–13)
Natasha				
Positive	27 (18–39)	15 (10–23)	15 (9–23)	14 (8–18)
Negative	2 (0–6)	9 (0–21)	3 (0–7)	4 (0–7)

38% to 86%) and yoked control (M = 45%; range, 36% to 62%) conditions. Similarly, engagement increased for Enrico from 54% during baseline (range, 42% to 71%) to 74% during the student-determined condition (range, 62% to 81%). Engagement for Enrico was lower during the peer-determined (M = 53%; range, 48% to 56%) and yoked control (M = 47%; range, 31% to 57%) conditions. Natasha showed a largely undifferentiated pattern of engagement across conditions, with a high for the peer-determined sessions of 67% (range, 37% to 72%) and a low for the yoked control sessions of 59% (range, 48% to 75%).

Table 2 shows the percentage of intervals in which students emitted responses indicative of positive or negative affect during social interactions with nondisabled peers. Doug's positive affect was highest during the baseline, peer-determined, and yoked control conditions; his negative affect was slightly higher during the student-determined condition. Peggy and Enrico displayed their highest levels of positive affect during baseline and student-determined conditions, with negative affect generally low across all conditions. Natasha showed an undifferentiated pattern of affect.

The results of Study 3 indicate that students generalized their use of the microswitch communication system to social interactions with nondisabled peers. For Doug, Peggy, and Enrico, use of the microswitch communication system occurred during most opportunities, but use of the microswitch system had a differing effect on engagement with stimuli across students. For Peggy and Enrico, use of the microswitch system increased the percentage of time engaged, whereas for Doug the percentage of time engaged was highest when someone other than himself controlled stimulus presentation. Measures of positive and negative affect were consistent with the observations regarding student engagement.

GENERAL DISCUSSION

Our findings indicate that (a) students with profound multiple disabilities show distinct patterns of stimulus preference that are idiosyncratic across individuals; (b) when taught to control stimulus presentation, these students increased their engagement with stimuli and more clearly differentiated their time spent with particular items; (c) preference hierarchies were not fixed over time but were dynamic, indicating the need for frequent preference assessments to optimize the reinforcing functions of stimuli; (d) students generalized their use of the augmentative communication system to different people; and (e) choice itself may not always be a preferred or positively reinforcing outcome for some students.

As indicated in Table 1, the students, particularly Natasha and Enrico, had relatively distinct preferences for some stimuli versus others (Study 1). For example, when Natasha was presented with a ball, she spent 92% of her time engaged with that object; but when presented with the talking book, she was engaged only 24% of the time. The data from Study 1 support the recommendation that careful preference assessments should be conducted when instructing and interacting with students with profound multiple disabilities (Pace et al., 1985; Wacker et al., 1985).

Study 2 indicates a potentially important variable other than preference in increasing the engagement of students with profound multiple disabilities: specifically, the role of active participation in controlling stimulus presentation. This is most clearly shown in Figure 2. These data show that 3 of 4 students who learned to use the microswitch system spent more time engaged with stimuli. In considering the results from Studies 1 and 2, optimal instruction for many students with profound multiple disabilities might include both preference assessment and a mechanism for students to control the presentation of stimuli.

An important issue in assessing preference for students with profound multiple disabilities is to understand the shifting nature of stimulus hierarchies. For example, our data indicate that the hierarchies of engagement with stimuli were not stable over time (see Figure 3). Peggy, for example, appeared to prefer music after 35 sessions, even though it was one of her least preferred stimuli initially. These data indicate that the preferences of students with profound multiple disabilities may not be easily categorized. To help create maximally effective educational environments, interventionists should be aware of the possibility of changing preferences for students and, at a minimum, provide frequent preference assessments.

Although the literature on augmentative communication systems is showing impressive growth, this technology has rarely been used in an interactive context with peers (see also Hunt, Alwell, Goetz, & Sailor, 1990). Demonstrating the feasibility of using a microswitch communication system with peers is important because it potentially increases the number of opportunities available to use the system in socially integrated settings. For 3 students, the results indicated that the system could be used successfully in the context of student–peer dyads (Study 3). However, the alternating treatments design yielded differing patterns. For the students who showed increases in engagement when they controlled stimulus changes, it is possible that exercising control over stimulus presentation served to increase the reinforcing function(s) of stimuli (see also Peck, 1985). Conclusions regarding this hypothesis should be highly qualified, however, because it is also possible that preference hierarchies shift on a moment-by-moment basis, making comparisons across time insufficient.

Interestingly, Doug's data show a pattern of engagement that was the opposite of those of Enrico and Peggy. Doug responded to continuous stimulus variation, but did so more often when he did not have to respond by pressing the microswitch to produce stimulus variation. These data again suggest that individualization in the means of producing stimulus variation and arranging for choice is critical (Dunlap, 1984; Dunlap & Koegel, 1980; Egel, 1981).

Choice making has become an important area of applied research for people with disabilities. Our findings suggest several areas in need of additional research. These include (a) developing means of assessing when and how students may choose not to make choices, (b) accounting for variables that control the stability of preference hierarchies over time, and (c) how choice interacts with the functional effects of positive and negative reinforcers to either increase or decrease the effectiveness of a reinforcer. The current series of studies may help researchers better understand the role of choice by demonstrating some effects on behavior of establishing control over stimulus duration by students with multiple profound disabilities.

REFERENCES

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

Dattilo, J. (1986). Computerized assessment of preference for severely handicapped individuals. *Journal of Applied Behavior Analysis, 19,* 445–448.

Dunlap, G. (1984). The influence of task variation and maintenance tasks on the learning and affect of autistic children. *Journal of Experimental Child Psychology, 37,* 41–64.

Dunlap, G., Kern-Dunlap, L., Clarke, S., & Robbins, F. R.

(1991). Functional assessment, curricular revision, and severe behavior problems. *Journal of Applied Behavior Analysis, 24,* 387–397.

Dunlap, G., & Koegel, R. L. (1980). Motivating autistic children through stimulus variation. *Journal of Applied Behavior Analysis, 13,* 619–628.

Dyer, K., Dunlap, G., & Winterling, V. (1990). Effects of choice making on the serious problem behavior of students with severe handicaps. *Journal of Applied Behavior Analysis, 23,* 515–524.

Egel, A. L. (1981). Reinforcer variation: Implications for motivating developmentally disabled children. *Journal of Applied Behavior Analysis, 14,* 345–350.

Fehr, M. J., Wacker, D. P., Trezise, J., Lennon, R., & Meyerson, L. (1979). Visual, auditory, and vibratory stimulation as reinforcers for profoundly retarded children. *Rehabilitation Psychology, 26,* 201–209.

Fisher, W., Piazza, C. C., Bowman, L. P., Hagopian, L. P., Owen, J. C., & Slevin, I. (1992). A comparison of two approaches for identifying reinforcers for persons with severe and profound disabilities. *Journal of Applied Behavior Analysis, 25,* 491–498.

Fuller, P. R. (1949). Operant conditioning of a vegetative human organism. *American Journal of Psychology, 62,* 587–590.

Green, C. W., Reid, D. H., Canipe, V. S., & Gardner, S. M. (1991). A comprehensive evaluation of reinforcer identification processes for persons with profound multiple handicaps. *Journal of Applied Behavior Analysis, 24,* 537–552.

Green, C. W., Reid, D. H., White, L. K., Halford, R. C., Brittain, D. P., & Gardner, S. M. (1988). Identifying reinforcers for persons with profound handicaps: Staff opinion versus systematic assessment of preferences. *Journal of Applied Behavior Analysis, 21,* 31–43.

Haring, T. G. (1992). The context of social competence: Relations, relationships, and generalization. In S. Odom, S. McConnell, & M. McEvoy (Eds.), *Social competence in students with severe disabilities* (pp. 289–306). Baltimore: Paul H. Brookes.

Hunt, P., Alwell, M., Goetz, L., & Sailor, W. (1990). Generalized effects of conversation skill training. *Journal of the Association for Persons with Severe Handicaps, 15,* 250–260.

Jones, M. L., Favell, J. E., Lattimore, J., & Risley, T. R. (1984). Improving independent engagement of nonambulatory multihandicapped persons through the systematic analysis of leisure materials. *Analysis and Intervention in Developmental Disabilities, 4,* 313–332.

Keogh, W., & Reichle, J. (1985). Communication intervention for the "difficult to teach" severely handicapped. In S. F. Warren & A. Rogers-Warren (Eds.), *Teaching functional language* (pp. 157–194). Austin, TX: Pro-Ed.

Pace, G. M., Ivancic, M. T., Edwards, G. L., Iwata, B. A., & Page, T. J. (1985). Assessment of stimulus preference and reinforcer value with profoundly retarded individuals. *Journal of Applied Behavior Analysis, 18,* 249–255.

Peck, C. A. (1985). Increasing opportunities for social control by children with autism and severe handicaps: Effects on student behavior and perceived classroom climate. *Journal of the Association for Persons with Severe Handicaps, 10,* 183–193.

Realon, R. E., Favell, J. E., & Dayvault, K. A. (1988). Evaluating the use of adapted leisure materials on the engagement of persons who are profoundly, multiply handicapped. *Education and Training of the Mentally Retarded, 23,* 228–237.

Reichle, J., Sigafoos, J., & Piche, L. (1989). Teaching an adolescent with blindness and severe disabilities: A correspondence between requesting and selecting preferred objects. *Journal of the Association for Persons with Severe Handicaps, 14,* 75–80.

Reid, D. H., Phillips, J. F., & Green, C. W. (1991). Teaching persons with profound multiple handicaps: A review of the effects of behavioral research. *Journal of Applied Behavior Analysis, 24,* 319–335.

Repp, A. C., Harman, M. C., Felce, D., van Acker, R., & Karsh, K. G. (1989). Conducting behavioral assessments on computer-collected data. *Behavioral Assessment, 11,* 249–265.

Sailor, W., Gee, K., Goetz, L., & Graham, N. (1988). Progress in educating students with the most severe disabilities: Is there any? *Journal of the Association for Persons with Severe Handicaps, 13,* 87–99.

Utley, B., Duncan, D., Strain, P., & Scanlon, K. (1983). Effects of contingent and noncontingent vision stimulation on visual fixation in multiply handicapped children. *Journal of the Association for Persons with Severe Handicaps, 8,* 29–42.

Wacker, D. P., Berg, W. K., Wiggins, B., Muldoon, M., & Cavanaugh, J. (1985). Evaluation of reinforcer preferences for profoundly handicapped students. *Journal of Applied Behavior Analysis, 18,* 173–178.

Wacker, D. P., Wiggins, B., Fowler, M., & Berg, W. K. (1988). Training students with profound or multiple handicaps to make requests via microswitches. *Journal of Applied Behavior Analysis, 21,* 331–343.

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