

*TEACHING PERSONS WITH PROFOUND MULTIPLE HANDICAPS:
A REVIEW OF THE EFFECTS OF BEHAVIORAL RESEARCH*

DENNIS H. REID, JAMES F. PHILLIPS, AND CAROLYN W. GREEN

WESTERN CAROLINA CENTER, MORGANTON, NORTH CAROLINA

The behavioral research on teaching individuals who have profound multiple handicaps is reviewed. The primary focus is on determining the degree to which behavioral research has demonstrated the teaching of meaningful skills to this population. Results of the review indicate that investigations have demonstrated, albeit inconsistently, that behavior change has resulted from contingency management interventions with persons who have profound multiple handicaps. However, there is little evidence that such interventions have resulted in meaningful behavior change according to currently accepted criteria for beneficially affecting the quality of life of persons with serious handicaps. Potential explanations for the lack of such evidence are offered, including the relative lack of research attention given to this issue, the possible ineffectiveness of the components of the technology applied, and possible ineffective application of the potentially effective technology. Suggestions for future research are discussed in terms of developing more effective educational and habilitative services for persons with profound multiple handicaps. In particular, we suggest research on a wider variety of behavioral teaching procedures, providing more comprehensive evaluations of the applications of procedures and developing treatment programs that do not focus solely on traditional skill acquisition.

DESCRIPTORS: profound multiple handicaps, developmental disabilities, behavioral research methodology

Since the early 1960s, one of the most significant areas of impact of applied behavioral research has been developmental disabilities. Hundreds of investigations have reported the successful use of behavioral procedures to improve adaptive functioning and decrease maladaptive behaviors of persons who have developmental disabilities (see Matson & Mulick, 1983; Whitman, Scibak, & Reid, 1983, for selected reviews). However, although the overall impact of applied behavioral research in this area has been quite significant, there is one population of persons with developmental disabilities for whom the impact has not been clear. Specifically, the utility of behavioral procedures for affecting adaptive behavior change among individuals who have profound mental and physical handicaps has been seriously questioned (Landesman-Dwyer & Sackett, 1978; Rainforth, 1982). The degree to which be-

havioral procedures have or have not been used to teach useful skills to persons with profound mental and physical handicaps represents an important consideration in the determination of appropriate educational and habilitative services for this population (Ulicny, Thompson, Favell, & Thompson, 1985). That is, because operant-oriented behavioral programs currently represent the predominant treatment approach for attempting to teach skills to persons with very serious developmental disabilities (cf. Berkson & Landesman-Dwyer, 1977), if these programs are not effective then questions must arise as to what should constitute appropriate treatment for these individuals.

Teaching useful skills to persons with profound mental and physical handicaps represents a particular dilemma for practitioners. On the one hand, there is the legal mandate requiring these persons, along with all school-aged individuals who have handicaps, to receive an appropriate education (see Sailor, Gee, Goetz, & Graham, 1988, for a recent discussion). Similarly, over \$2.5 billion (Fernald, 1986) of federal support for hundreds of residential programs serving these individuals through the Medicaid reimbursement process are contingent on

We thank Carole Daves, Mary Carswell, and Mary Keller for their assistance in preparing the manuscript and Tom Whitman, Marsha Parsons, and Martin Ivancic for their helpful comments on an earlier draft of the paper.

Correspondence and requests for reprints can be addressed to any of the authors at Western Carolina Center, Morganton, North Carolina 28655.

the documented provision of active treatment—treatment that is often expected to result in client skill acquisition. On the other hand, as suggested earlier, questions exist over the degree to which there is an available technology to teach useful skills to persons with profound multiple handicaps. In short, practitioners are charged with teaching a population whom practitioners may not know how to teach, due at least in part to the questionable availability of an effective behavior-change technology (cf. Guess *et al.*, 1988).

Although recently there has been increased professional attention directed to the training needs of individuals with profound disabilities (e.g., Evans & Scotti, 1989; Guess *et al.*, 1988), a critical review of the experimental methodology and efficacy of behavioral teaching research with this population has been lacking. This type of review is warranted to determine objectively the extent to which research has demonstrated the teaching of meaningful skills to persons with profound multiple disabilities. Specifically, this paper reviews the degree to which a behavioral technology currently exists for teaching persons with profound multiple handicaps, as well as the extent to which the existing technology has been used to teach skills of functional value. Based on the outcome of the review, implications for teaching persons who have profound multiple handicaps using commonly applied behavioral paradigms are discussed. Suggested directions for applied behavioral research also are provided.

FOCUS OF REVIEW

Individuals with Profound Multiple Handicaps

A major difficulty in discussing the efficacy of teaching programs involving people who have profound mental and physical developmental disabilities is confusion over who is included in this population (Guess *et al.*, 1988). The most common descriptor used with standardized quantification is *profound mental retardation* (Grossman, 1983). However, profound mental retardation as a diagnostic classification includes a very heterogeneous group of persons with a wide range of skills and

disabilities (Bailey, 1981; Rainforth, 1982). Our concern is with those persons whose handicaps are so debilitating that they fall at the extreme lower end of the continuum of profound mental retardation and who also possess profound physical impairments, such that no existing standardized intelligence tests are applicable (cf. Bailey, 1981).

We will refer to the population of concern here as individuals who have *profound multiple handicaps*. A number of descriptions have been used to characterize people who have profound multiple handicaps with the most frequent, and most accurate based on our experience, being the following (see Landesman-Dwyer & Sackett, 1978, for a thorough description of this population). First, as just noted, these individuals generally are considered untestable on intelligence tests because often they can perform none of the tasks comprising the tests (Bailey, 1981). Second, this population exhibits obvious signs of very serious neuromuscular dysfunction such as severe spasticity, muscle rigidity, and skeletal deformities (Landesman-Dwyer & Sackett, 1978) as well as sensory impairments (Guess *et al.*, 1988). As a result of neuromuscular dysfunction, these individuals are nonambulatory and are often quite small for their chronological age (Rice, McDaniel, Stallings, & Gatz, 1967), have little or no control over their movements (Guess *et al.*, 1988), and appear to have minimal or no physical potential to allow for independence in performing self-care routines (Bailey, 1981). Third, persons with profound multiple handicaps usually have frequent medical complications relating to, for example, seizure disorders (Guess *et al.*, 1988) and physical difficulties with food ingestion (Korabek, Reid, & Ivancic, 1981). In short, these individuals are totally dependent on caregivers for their survival.

Perhaps the best way to understand the degree of disability—and subsequent difficulty that trainers face—with persons who have profound multiple handicaps is to consider how researchers who have studied this population during the last 40 years have described them (Landesman-Dwyer & Sackett, 1978). Various descriptors used in this regard have included “vegetative” (Bailey & Mey-

erson, 1969; Fuller, 1949), "crib-bound" (Bailey & Meyerson, 1969), "hopelessly devastated" (Landesman-Dwyer & Sackett, 1978), "highly deviant organism" (Rice et al., 1967), "subtrainable" (Bailey, 1981) and "deprived organism" (Piper & MacKinnon, 1969). (These descriptors should not be taken out of context in regard to currently accepted terminology. Descriptors currently accepted were not necessarily appropriate at the time of the referenced citations.) Researchers have also reported a number of more specific behavioral characteristics that further attest to the difficulty trainers face when attempting to teach useful skills to these individuals. For example, it is frequently difficult to find a consistent motor response with which to begin developing a meaningful skill (Rice et al., 1967; Utley, Duncan, Strain, & Scanlon, 1983). Relatedly, finding stimuli that function as reinforcers can be problematic (Green et al., 1988; Haskett & Hollar, 1978). Stimuli that typically function as reinforcers with persons who have less serious disabilities (e.g., food) may not have reinforcing effects with individuals who have profound multiple handicaps, or these stimuli may be contraindicated due to physical complications with eating (Correa, Poulson, & Salzberg, 1984; Korabek et al., 1981). Levels of alertness also vary considerably across and within days, as indicated by the repeated observation that client response to teaching paradigms frequently is highly variable and that clients sometimes fall asleep during teaching sessions (Brownfield & Keehn, 1966; Deiker & Bruno, 1976; Haskett & Hollar, 1978). The latter problem often is related to the frequent use of medication as a means of attempting to control seizures, spasticity, allergies, and so forth, and the corresponding side effects of the medication (Haskett & Hollar, 1978).

Throughout this paper, investigations will be discussed that included one or more persons who have the types of handicaps reflected in the preceding summary. Specifically, participants must have been described as having profound mental retardation, physical disabilities that prohibit ambulation, and at least one other type of handicap (e.g., sensory impairment) to be included in the population of persons with profound multiple handicaps.

Unfortunately, however, it is often difficult to determine the degree of handicap among participants in past studies because of insufficient descriptions of participants. Also, in some cases persons with profound multiple handicaps were part of a larger group of experimental participants that included individuals with less serious disabilities, and results were not described in sufficient detail to allow an analysis of how the persons with profound multiple handicaps responded. We will focus our review on those published investigations for which the results can be analyzed specifically with regard to participants who have profound multiple handicaps.

Skill Acquisition Research

Within our focus on behavioral research with persons who have profound multiple handicaps, our primary concern is skill acquisition investigations. In particular, emphasis is directed to the degree to which behavioral research has demonstrated the teaching of meaningful skills to persons with profound multiple handicaps. Of course, determining what is meaningful is subject to debate. Nevertheless, we employ current criteria with which skills generally are judged to be functional in regard to meaningful educational programs for persons who have developmental disabilities (Bates, Renzaglia, & Wehman, 1981; Brown et al., 1979; Dyer, Schwartz, & Luce, 1984). The criteria to be used, although by no means a complete set of criteria for determining meaningfulness of behavior change, have received support from a variety of professional practitioners through social validity research (Parsons, Cash, & Reid, 1989; Reid et al., 1985). As discussed elsewhere (Reid et al., 1985), functional or meaningful skills involve behaviors that allow an individual to take some degree of care of himself or herself (self-help domain), express his or her wants or needs (social/communication domain), participate to some extent in remunerative work (vocational domain), function similarly to nonhandicapped persons in regard to use of leisure time (leisure domain), or participate in community experiences (community living domain). A detailed description of what constitutes functional skills is beyond the scope of this paper; the interested reader

is referred to the sources noted earlier (see also Evans & Scotti, 1989; Parsons, Schepis, Reid, McCarn, & Green, 1987). However, it is recognized that each individual's particular handicaps and environment must be considered in addition to general guidelines for determining meaningful skills, particularly for individuals who have profound physical impairments (Green, Canipe, Way, & Reid, 1986). Hence, individual investigations will be carefully reviewed in terms of whether or not the skills addressed were meaningful for the respective participants. Additionally, concern will be directed to those skills that may not meet the functional criteria just summarized *per se*, yet appear to be meaningful because they enhance the general enjoyment of a person with profound multiple handicaps (see Ivancic & Bailey, 1986). It should also be noted that even though we critique investigations in regard to skill acquisition, not all of the studies reviewed were necessarily concerned with teaching new skills *per se* (e.g., some studies may have focused on changing the frequency of behaviors already in a participant's repertoire).

FORMAT OF REVIEW

This review consists of three main sections. First, the early behavioral research involving persons with profound multiple handicaps is summarized to present an historical perspective with which to examine recent research endeavors with this population. In the second section, a critique of the more recent investigations that focused specifically on teaching adaptive skills is provided. This critique is based on the degree to which investigative criteria that are considered integral to sound applied behavioral research were adhered to. Such criteria have been discussed elsewhere (e.g., Baer, Wolf, & Riskey, 1968; Barlow & Hersen, 1984) and include research involving persons with profound mental retardation (Whitman *et al.*, 1983, chap. 3). Criteria include the degree of internal and external validity assumed to exist with given investigations, objectivity and reliability of measurement systems, significance and durability of behavior change, and generalization of specific treatment effects. Each article included in this review was evaluated in regard

to these criteria by at least two of the authors in an attempt to ensure the thoroughness and accuracy of the critiques.

The third section of the paper focuses on what can be legitimately concluded about the degree to which applied behavioral research has demonstrated the teaching of meaningful skills to individuals who have profound multiple handicaps. Additionally, suggested directions for applied behavioral research and related clinical practice with this population are offered.

HISTORICAL PERSPECTIVE

Early Behavioral Research

The first behavioral investigations involving persons with profound multiple handicaps were concerned primarily with determining whether operant procedures could change behavior in this population (Evans & Scotti, 1989). Researchers were not concerned necessarily with teaching a useful skill *per se*, but rather with demonstrating that a principle of learning—namely, positive reinforcement—could be used to change behavior. To evaluate the potential responsiveness of individuals to positive reinforcement paradigms, stimuli were provided contingently on very simple behaviors such as lifting an arm off a bed or pressing a lever. Research on positive reinforcement applications began with Fuller's (1949) initial report and subsequently represented the focus of the behavioral research among persons with profound multiple handicaps throughout the 1960s and most of the 1970s. A summary of the research during this period, in terms of the dependent and independent variables of concern, is provided in Table 1. In this research, a relatively wide variety of stimuli were evaluated for their potentially reinforcing properties (Table 1). In this regard, one important outcome of the early research was the identification of sensory reinforcers for individuals with profound multiple handicaps—stimuli such as flickering lights or vibrations whose reinforcing properties appear to stem from the heightened sensory input or stimulation they provide (Bailey & Meyerson, 1970). Interest in the potentially reinforcing value of sensory stimuli arose primarily because of the frequent lack of

Table 1
Summary of Early Behavioral Research Involving Persons with Profound Multiple Handicaps

Study	Number of participants	Target behaviors (dependent variables)	Stimuli applied contingently (independent variables)
Fuller (1949)	1	raising arm	sugar-milk solution
Rice and McDaniel (1966)	unclear	raising arm touching a suspended ring	ice cream movies music termination of verbalizations story reading by trainer Kool-aid® soft drinks praise food
Brownfield and Keehn (1966)	2	eyeblinks	
Rice, McDaniel, Stallings, and Gatz (1967)	2	moving the head pulling a ring touching a ring raising arm	vibration moving pictures music 35-mm slides ice cream praise recorded children's stories Coca-Cola® Kool-aid®
Rice (1968)	1	moving the head limb movement	peppermint on tongue Kool-aid® ice cream click (sound) food (tube fed)
Piper and MacKinnon (1969)	1	raising arm	
Bailey and Meyerson (1969)	1	pressing a lever	vibration
Bailey and Meyerson (1970)	1	self-injury pressing a lever	contingent/noncontingent vibration
Deiker and Bruno (1976)	1	eyeblinks	touching bottom of foot
Murphy and Dougherty (1977)	7	moving arm	vibration
Remington, Foxen, and Hogg (1977)	4	pulling a lever	verbalizations (praise, rhymes) songs pure tone (sound)
Haskett and Hollar (1978)	4	pressing a lever patting a foot smiling vocalizing	contingent/noncontingent light music
Fehr, Wacker Trezise, Lennon, and Meyerson (1979)	4	pressing a lever	vibration buzzer (sound) light click (sound)

reinforcing effects of stimuli that typically function as reinforcers (e.g., food) with less seriously handicapped populations. Also, it was assumed that because of the sensory impairments of many persons with profound multiple handicaps, intense sensory

input may be reinforcing because it overcomes a condition of relative sensory isolation (Bailey & Meyerson, 1969). The importance of the identification of sensory stimuli as likely reinforcers noted in the early research has been supported in more

recent investigations demonstrating the reinforcing properties of these types of stimuli (Dewson & Whiteley, 1987; Utley *et al.*, 1983), as has the lack of reinforcing effects of more traditional stimuli such as verbal praise (Hogg, 1983; Zucker, D'Alonzo, McMullen, & Williams, 1980).

Overall, the early behavioral investigations suggested that simple behaviors of persons with profound multiple handicaps could be changed to some degree through the contingent application of various stimuli. Our review of the 13 studies presented in Table 1 (as well as the four recent similar studies just cited) indicates that the investigations were conducted for the most part with valid experimental designs (usually reversals). Also, at least some behavior change was noted for approximately 90% of the experimental participants, although frequently several different treatment conditions (*i.e.*, different contingent stimulus applications) were applied prior to noting behavior change with participants. However, for purposes of this review, the degree to which these investigations provide information regarding whether the behavior of persons with profound multiple handicaps has been changed to a socially significant degree must be qualified. In particular, very small samples of behavior were addressed in most of the investigations. With few exceptions (Bailey & Meyerson, 1969, 1970), experimental sessions encompassed 30 min or less. Also, there often were small numbers of treatment sessions per experimental condition, with the majority of studies (of those reporting number of sessions) including experimental conditions with three or fewer sessions and, at times, only one session per condition. Hence, it was difficult to evaluate thoroughly changes in behavior across treatment conditions and to demonstrate functional control of behavior. Further, no study reported any follow-up measures to evaluate the durability of the initial behavior change (approximately 40% of the studies that relied on human observation of the dependent behaviors also did not report interobserver agreement measures).

As a result of the features just noted, the early behavioral research as a whole did not soundly demonstrate that substantial changes in simple be-

haviors could be controlled through behavioral procedures. However, it should be noted that this conclusion is based on current criteria for judging the adequacy of applied behavioral research, not on the criteria existing at the time most of the investigations were conducted. Many of the early studies were indeed representative of state-of-the-art research at the time and undoubtedly improved on the existing quality of behavioral research. Hence, our comments are not meant to be critical of the research, but instead indicate that the results of the early work provide somewhat limited information regarding the focus of this review on the degree to which behavioral research has demonstrated the teaching of meaningful skills to persons with profound multiple handicaps. Nevertheless, we have included a brief discussion of the early work because this research served the important function of setting the occasion for the more recent research concerned directly with teaching useful skills.

Improving Postural Control

One particular impact of early research on evaluating positive reinforcement applications was the initiation of research on methods of attempting to improve postural control among persons with profound multiple handicaps. The emphasis in this area, which was reported in the mid-1970s and early 1980s, was on evaluating the potentially reinforcing effects of certain stimuli for increasing and/or maintaining a physically therapeutic body position. Hence, whereas preceding research focused on demonstrating the utility of positive reinforcement as a process for changing simple behaviors, research on postural control focused on using that process to change more clinically relevant behavior. In this regard, a common problem of persons with profound multiple handicaps is difficulty in maintaining appropriate posture (*e.g.*, holding the head in an upright position). Such difficulty complicates adaptive neuromuscular development and related body control and also impedes functional interactions with the environment. Consequently, although improving postural control does not teach a functional skill *per se* in terms of the criteria of purposefulness noted earlier, there is

Table 2
Summary of Behavioral Research on Increasing Postural Control

Study	Number of participants with profound multiple handicaps	Target behaviors (dependent variables)	Stimuli applied contingently (independent variables)
Grove, Dalke, Fredericks, and Crowley (1975)	4	holding head erect	music verbal praise
Murphy, Dougherty, and Nunes (1979)	6	holding head erect	music
Hill (1980)	1	moving head to erect position purposeful arm/hand movements	cartoons
Wolfe (1980)	6	holding head erect	music
Walmsley, Crichton, and Droog (1981)	5	holding head erect	music verbal praise
Maloney and Kurtz (1982)	10	holding head erect	music

little question that such an outcome is beneficial from an overall health and developmental standpoint and, therefore, represents a useful target for behavior-change research.

A prototypical investigation on the evaluation of positive reinforcement as a means of improving postural control is described in a report by Grove, Dalke, Fredericks, and Crowley (1975), who evaluated the use of contingent music and social praise on the appropriate head positioning of 4 persons with profound multiple handicaps. A special collar was devised such that mercury switches were activated whenever the position of the head moved out of a therapeutic range. Results showed that music provided contingently on appropriate head position, and music paired with social praise, increased upright head positioning among all participants.

Following the Grove et al. (1975) report, several other investigators evaluated similar procedures for improving postural control, although various modifications were made with the mechanisms for delivering the reinforcing stimuli. A summary of the investigations in this area is presented in Table 2. Generally, this research was conducted with adequate experimental methodology. With some exceptions (Walmsley, Crichton, & Droog, 1981),

appropriate experimental designs (such as reversal and multielement designs) were used. Reliability generally was not an issue because head positioning was mechanically recorded or adequate interobserver agreement measures were reported. However, results of the investigations regarding the effects of stimuli delivered contingently on appropriate posture were not as consistent as the results noted with the earlier research summarized previously. In three of the six studies summarized in Table 2, no behavior change occurred, or the change was at best very small and/or inconsistent across participants. Results of the remaining three investigations were generally clear. Even where clear behavior change was noted, however, the clinical significance of the results must be scrutinized. Specifically, small samples of behavior were targeted, in that the average duration of experimental sessions was less than 15 min, and no session involved more than 30 min. Additionally, no measures were included to determine whether changes in posture observed during the brief experimental sessions carried over to other times during the day, and none of the investigations included follow-up measures to evaluate the durability of the changes that did occur. It is not readily apparent that increasing upright head positioning during a 15-min period for a few days

(or, at the most, a few weeks) resulted in any real therapeutic benefit in terms of neuromuscular development. Again, however, it should be noted that because of the primary concern of this review, our scrutiny of the postural control research is based on current methodological criteria for purposes of judging the meaningfulness of behavior change and is not necessarily based on accepted criteria existing at the time the research was conducted.

TEACHING ADAPTIVE SKILLS

Summary of Existing Research

Investigations evaluating methods of teaching adaptive skills to individuals with profound multiple handicaps represent the main target of this review. Skills traditionally considered to be adaptive (e.g., self-help, communication) most clearly fulfill the criteria noted earlier for functional behaviors. Hence, individual investigations in this area are reviewed in greater depth than the studies discussed in the preceding section. Generally, the research in this area has focused on skills falling within the five basic skill domains discussed previously. Some research also exists on what could be considered to be adaptive motor development overlapping across the five basic skill domains.

In the self-help skill domain, applied behavioral investigations have focused on improving eating skills. However, in several investigations (Riordan, Iwata, Finney, Wohl, & Stanley, 1984; Thompson, Iwata, & Poynter, 1979), it could not be determined from the information provided whether or not the participants had profound multiple handicaps. In the Riordan *et al.* study, the difficulty in determining the degree of handicapping conditions was hampered by the young age of the participants (as young as 16 months), which can hinder sensitive assessment processes in regard to diagnostic descriptions (Ulrey & Schnell, 1982). However, an investigation clearly focusing on eating skills with a person with profound multiple handicaps was reported by Ulicny *et al.* (1985), who improved an adolescent's eating skills using a state-of-the-art behavioral teaching program. However, the improvement reversed when the researchers discontin-

ued their teaching attempts and the teaching responsibility was assumed by the participant's routine caregivers. Also, the results are difficult to evaluate because of insufficient information provided by the brief-report format of the study, and because of a relatively weak experimental design (A-B-C design—see Barlow & Hersen, 1984, chap. 5) for demonstrating functional control of an intervention. Further, although improvement in the participant's self-feeding was reported, it was also noted that she did not master the teaching program (occurring across 138 days) and did not learn to feed herself independently.

Several studies were located pertaining to teaching social and communication behaviors to persons with profound multiple handicaps. Sternberg, Peggatore, and Hill (1983) attempted to increase the communication behaviors of 4 persons with developmental disabilities, 2 of whom appeared to have profound multiple handicaps. The target communication behavior for the latter 2 participants was smiling. The intervention involved the trainer maintaining physical contact and body movement with a given client and observing changes in smiling as a function of the contact and movement (the trainer also talked to the client). An increase in smiling was described as an indication of increased communicative awareness on the part of the participants. However, as the authors acknowledged, the relationship of smiling to communication *per se* was not entirely clear. Although the increased smiling certainly could be interpreted as an important increase in responsiveness to a change in the environment, it may not be representative of a means of expressing a want or need that generally is considered part of a functional communication skill.

Spiegel-McGill, Bambara, Shores, and Fox (1984) included definitions of target behaviors aligned somewhat more clearly with social and communication skills in their study involving 6 persons, 2 of whom appeared to have profound multiple handicaps. Head orientation, vocalizations, and gestures increased when clients were put in close physical proximity to each other. However, given the definitions used, it is not clear to what extent

the clients were actually communicating in terms of passing or receiving information. For example, the criterion for a communicative vocalization was that the participant must orient his or her face toward the head of another participant while emitting a sound; this may or may not represent an intentional communicative attempt. Behaviors with more apparent communicative intentions were targeted by Reid and Hurlbut (1977) in their investigation that involved teaching 4 persons to use communication boards. However, the participants were selected from a large group of nonambulatory individuals with profound or severe mental retardation based on caregiver recommendations that these particular individuals possessed the greatest intellectual potential of all the clients. Given the participant selection process (i.e., involving individuals with severe mental retardation) and the participant description regarding receptive communication skills, these 4 individuals seemed to be considerably less mentally retarded than our criteria require. Similar difficulties in determining whether the participant population represented persons with profound multiple handicaps exist with an investigation attempting to teach simple communication behaviors to children who were profoundly mentally retarded (Sternberg, McNerney, & Pegnatoro, 1987). Conclusions pertaining to the focus of this review cannot be made based on the results of this study because of uncertainty of the participant characteristics (e.g., 1 participant was ambulatory, all could imitate gross motor behaviors). Nevertheless, the procedures employed to teach the children to use an existing behavior (e.g., grasping a finger) to signal a desired response from a caregiver may be relevant if applied with individuals who do have profound multiple handicaps (see Wacker, Wiggins, Fowler, & Berg, 1988, later in this review).

In the motor skill area, Correa et al. (1984) evaluated the effects of a graduated prompting program and contingent stimulus application on teaching reach-grasp behavior to 3 young individuals, 2 of whom appeared to have profound multiple disabilities. The training strategy appeared to be effective in increasing the reaching and grasping of various noise-making toys, although the increase

with 1 of the participants was quite small. Several other studies in the motor area focused on walking skills among individuals who were profoundly mentally retarded and had physical handicaps (Tarnowski & Drabman, 1985; Walker & Vogelsberg, 1985). However, because the clients possessed the ability to walk at the beginning of the study, their physical disabilities probably were not within the criteria of profound multiple handicaps.

Several investigations have focused on increasing leisure skills among persons with profound multiple disabilities. Jones, Favell, Lattimore, and Risley (1984) attempted to increase the amount of time individuals interacted with infant toys. Jones et al. demonstrated that, by securing toy holders in specified positions on clients' wheelchairs, the frequency with which 11 of 13 clients interacted with the toys increased relative to toys simply being placed (nonsecurely) on the clients' wheelchair table tops or having no toys available. However, the relationship of these results to the demonstration of functional skill acquisition is not readily apparent. It is not clear, for example, whether the clients learned any new skills; it may have been that toy engagement previously existed in the clients' skill repertoire and increased because the toys remained available.

Wacker, Berg, Wiggins, Muldoon, and Cavanaugh (1985) also increased manipulation of leisure materials by persons with profound multiple handicaps. An additional purpose of this investigation was to identify reinforcing stimuli by using micro-switch adaptations through which clients could activate battery-operated toys by simply raising an arm or moving the head. Results of the Wacker et al. study, which demonstrated that 5 students' manipulation of microswitches increased when the manipulation resulted in activation of mechanical toys, suggest that individuals with profound multiple handicaps can provide themselves with leisure entertainment using specific material adaptations. Similar results were reported by Meehan, Mineo, and Lyon (1985), who demonstrated the efficacy of a graduated prompting strategy for teaching a child with profound multiple handicaps to activate a microswitch.

Results of the Wacker *et al.* (1985) investigation were replicated by Wacker *et al.* (1988). Additionally, the latter study demonstrated that essentially the same microswitch behavioral technology used to enable persons with profound multiple handicaps to interact with battery-operated toys could be used to (a) prompt social attention from caregivers and (b) interact—albeit with circumscribed requests—with nonhandicapped persons in normal community settings (e.g., to activate a recording of a message to request a drink in a restaurant).

Realon, Favell, and Dayvault (1988) also demonstrated that persons with profound multiple handicaps could use microswitch mechanisms to activate leisure items without requiring extensive training (i.e., with only exposure to the apparatus and initial prompting by an experimenter). However, only 5 of the 10 participants in the Realon *et al.* study exhibited these skills (see Realon, Favell, & Phillips, 1989, for similar results). When the other 5 participants were provided with systematic teaching to activate the toys via the microswitches, only 2 individuals eventually began to activate the toys independently; 3 persons continued to require trainer assistance to use the switches.

In contrast to most of the investigations on adaptive skill development that addressed just one skill area, Green *et al.* (1986) focused on a variety of skill areas (e.g., communication, leisure, self-help). Green *et al.* trained education staff to provide functional teaching tasks (instead of more traditional nonfunctional tasks) to their students as well as to manage student involvement with the tasks more efficiently through systematic and frequent prompting and reinforcing of students' attention to the tasks. Implementation of the classroom management program was accompanied by increased task-related behavior for 15 of 19 students. However, increases in attention directed to educational tasks (e.g., a student looking at a teacher who is instructing the student) do not necessarily mean that increases in independent skill development will occur, and Green *et al.* did not report data on skill acquisition (see Ranieri, Ford, Vincent, & Brown, 1984, for similar results).

Critique of Existing Research

Summarizing the adequacy of the behavioral research on teaching adaptive skills to persons with profound multiple handicaps represents a difficult task. The difficulty is due to the heterogeneous types of skills that were targeted across the different investigations and corresponding differences in research methodology. Some of the idiosyncratic shortcomings—and commendable features—of individual investigations related to the specific skills targeted have been noted already. This section summarizes more general issues.

Overall, the research sophistication of these studies was superior to that of the investigations included in the preceding section. Of course, methodological improvements would be expected because of the relative recency of these investigations when compared to the studies noted previously. With the few exceptions noted earlier, the investigations employed adequate experimental designs (e.g., reversals, alternating treatments) and all included interobserver agreement indices (or used electromechanical measures) regarding measurement of the dependent variables. All of the investigations also were conducted in the participants' routine environments (or very close approximations thereof) in contrast to more artificial, laboratory-type settings that characterized many of the earlier studies, and one study involved a normal community setting (Wacker *et al.*, 1988). Virtually all of the studies resulted in apparent behavior change (although not with all participants), and almost half included follow-up measures to demonstrate the durability of the changes.

In addition to the positive features of the research on adaptive skills there are also some concerns, which pertain primarily to the degree of utility of the behavior changes in terms of persons with profound multiple handicaps acquiring meaningful skills. The problems in this respect are two-fold. First, the purpose of the target behaviors in several of the investigations was not clear. For example, it is not apparent that increasing smiling represents a functional communication skill, although such behavior is certainly desirable in social contexts. Similarly, it is not readily apparent, at least to us, how

much therapeutic value exists in increasing an adult's touching and moving an infant toy extended on a toy holder in terms of purposeful skill development (although such behavior is clearly more desirable than no activity or maladaptive behavior). In essence, only two studies (Wacker et al., 1985, 1988) demonstrated that a person with profound multiple handicaps could acquire a skill meeting the generally accepted criterion of meaningfulness discussed earlier.

The second problem with the meaningful utility of the reported behavior changes is that essentially all changes were restricted to demonstrations involving very small samples of behavior. Experimental sessions were no more than an hour's duration, and most were 20 min or less. Hence, it is unclear whether observed changes would occur across substantial portions of a client's day. Realon et al. (1988) provided some data in this area by gradually extending their experimental sessions, in which 4 clients activated switch-controlled toys, from 10 min to a maximum of 75 min. However, it appeared that the amount of leisure engagement decreased for 2 of the 4 clients as session time increased. Of course, the concern with effects of circumscribed experimental sessions does not detract from the utility of the activity occurring within the sessions themselves, particularly when compared to the rather traditional lack of activity among this population during periods when no sessions are in effect (cf. Realon et al., 1989).

DISCUSSION

The primary purpose of the preceding sections was to evaluate the degree to which applied behavioral research has experimentally demonstrated the teaching of meaningful skills to persons with profound multiple handicaps, using currently accepted criteria for meaningfulness. Based on our critique of the literature, we believe such a demonstration has occurred, but only on an inconsistent basis and on a very small scale. More specifically, it has been demonstrated in a number of investigations that some functional control of the behavior of some persons with profound multiple handicaps

can be obtained through behavioral procedures. However, very few investigations targeted behavior meeting customary criteria of meaningfulness or purposefulness, and no investigation changed behavior during what we consider to be a very substantial portion of the life of a person with profound multiple handicaps.

As noted in our introductory comments, one reason for attempting to summarize objectively what behavioral research has demonstrated in terms of teaching persons with profound multiple handicaps is to provide useful information for determining appropriate educational and habilitative programming for this population. To interpret results of our review with respect to appropriate teaching and treatment programs, the conditions under which behavioral research has demonstrated success in teaching skills to these individuals should be considered. Relatedly, criteria for defining success in these demonstrations should be articulated carefully (Bailey, 1981). In one sense, if the commonly accepted notion regarding expected outcomes of training programs for persons with handicaps is employed (i.e., the development of independent functioning in adaptive skill areas), then the applied behavioral research has not been successful; the research has not demonstrated that persons with profound multiple handicaps can acquire any independent adaptive skills. Within even the most successful investigations of teaching functional skills (e.g., Wacker et al., 1988), the assistance of a caregiver was necessary for the client to exhibit the newly acquired skills.

Alternatively, if an approach to evaluating the outcome of skill acquisition programs that does not involve independent functioning is employed—such as partial participation in a meaningful activity (Brown et al., 1979)—then several of the above investigations might be considered to have resulted in successful outcomes (e.g., Correa et al., 1984; Ulicny et al., 1985). However, even partial participation must be evaluated in terms of how much such participation affects the lives of persons with profound multiple handicaps. In essence, applied behavioral investigations have not attempted to affect the lives of participants beyond brief experi-

mental sessions. This, of course, does not mean that behavior-change procedures effective during 20-min periods will not be effective if applied for longer periods; it means only that these applications have not been evaluated at this point.

A logical response to the concern over whether behavior-change procedures can be effective beyond brief experimental applications is that future investigations should evaluate the use of such procedures with more significant samples of behavior over time. If this line of research is pursued, a variable likely to have practical ramifications is the amount of trainer resources necessary to bring about substantial behavior change (see Bailey, 1981). The vast majority of the investigations we reviewed involved at least a one-to-one trainer-client ratio to conduct the training, representing a rather expensive process (Reid & Favell, 1984). Whether or not larger samples of behavior can be affected without continuous one-to-one ratios cannot be determined until research begins to examine this aspect of bringing about meaningful behavior change. If one-to-one teaching paradigms do prove necessary, then considerable effort probably will be needed on the part of persons responsible for service provision to individuals with profound multiple handicaps in order to secure and maintain necessary teaching resources.

Another condition or variable warranting consideration in evaluating the success of skill acquisition programs is the specific disabilities of each client. Even though each study we evaluated included participants who met the criteria of profound multiple handicaps (with the possible exceptions noted earlier), there was considerable variance in extent of disabilities among participants both across and within investigations. Such variability is of course likely to affect the probability of successful skill acquisition. For example, teaching meaningful skills to an individual without a cerebral cortex (see description of autopsy results following the individual's death prior to completion of a training endeavor: Deiker & Bruno, 1976) and whose only free-operant behavior is an eyeblink represents quite a different task than teaching meaningful skills to a client who previously has dem-

onstrated the skills to partially participate in a remunerative work task (Green *et al.*, 1986). In these two situations, both clients appeared to meet the criteria of having profound multiple handicaps, based on the information presented, although the probability of each client acquiring useful skills is likely to vary greatly.

To this point, our review of the literature and the related discussion have not been particularly positive regarding the degree to which behavioral research has demonstrated the teaching of meaningful and durable skills to persons with profound multiple handicaps. The lack of a convincing demonstration in this regard may be due to any number of possibilities. Two of the most obvious possibilities are that (a) we do not currently possess an effective teaching technology for this population or (b) we have not effectively applied the technology we do have. When considering which of these two possibilities is the more accurate, it becomes clear that an insufficient amount of research has been done to formulate a definitive, data-based decision. In essence, we have not been very diligent in our attempts to develop effective teaching programs for this population. Although the 39 investigations we located involving persons with profound multiple handicaps indicate in one respect a seemingly large amount of research attention, on a relative basis they represent a small percentage. In particular, the 39 studies have been reported over a 40-year period, an average of less than one investigation per year. Indeed, the 39 investigations appear almost insignificant relative to the amount of applied behavioral studies published involving the general population of persons with developmental disabilities. To illustrate, in a reprinting of articles from the *Journal of Applied Behavior Analysis* on behavioral research in developmental disabilities from 1968 through 1985 (Bailey, Shook, Iwata, Reid, & Repp, 1986), only 5 of the 62 studies involved skill acquisition research among persons who might be considered to have profound multiple handicaps (although in three of the studies, the clients probably did not have profound multiple handicaps as discussed here—see earlier comments regarding Reid & Hurlbut, 1977; Riordan *et al.*,

1984; Thomson et al., 1979). Of course, it should also be noted that persons with profound multiple handicaps represent a rather small segment of the entire population of persons with developmental disabilities (Landesman-Dwyer & Sackett, 1978). Nevertheless, it may be that if future research attention is given to persons with profound multiple handicaps at a level more commensurate with that given to individuals with less serious developmental disabilities, a future review of the research will be much more positive than this review.

The relative lack of research attention given to teaching meaningful skills to persons with profound multiple handicaps may be an important factor in regard to the shortcomings of the existing research discussed previously. That is, criticism of the investigations, for example, for focusing only on very small samples of behavior is in some ways premature (although the focus on small samples nevertheless must be considered when forming conclusions based on the existing research about the benefits to the experimental participants). In the early stages of an area of research, it is common to see investigations with circumscribed targets for the experimental interventions. More comprehensive samples are targeted in later investigations after the initial framework for the behavior-change technology has been established (Reid, 1987). Hence, if research emphasis on persons with profound multiple handicaps accelerates—and there is some indication that investigatory interest has increased since the early 1980s—the noted problems or gaps in the investigations may be resolved simply through the growth of applied behavioral research in this area. If this research activity does indeed continue to increase, there are several fruitful directions to take, based on our review of the literature.

Suggestions for Future Research

Development of a behavioral assessment protocol. As noted throughout this paper, it can be quite difficult to determine who has profound multiple handicaps. Based on our clinical experience and research, we agree with others who have studied the general population of people with mental retardation in concluding that these individuals rep-

resent a subgroup of people who have profound mental retardation (e.g., Bailey, 1981; Landesman-Dwyer & Sackett, 1978). That is, we believe persons with profound multiple disabilities have considerably more debilitating handicaps than the remainder of the population of persons with profound mental retardation. Hence, we do not intend conclusions based on our review to be extended to the entire population of persons with profound mental retardation. Because of the more seriously debilitating handicaps of persons with profound multiple disabilities, assessment procedures used to develop teaching programs for the general population of individuals with developmental disabilities are often of little value with the former population. Consequently, an important area for future research is the development of assessment procedures to assist teachers and other caregivers in developing teaching programs.

To develop a behavioral assessment protocol for persons with profound multiple handicaps, at least two sets of interdependent measures are relevant (see also section below on alertness levels). First, the number of controlled body movements an individual exhibits seems to represent an important factor in terms of suggesting the specific behaviors, and number of different behaviors, that can be the target of instructional programs. Generally, as the number of controlled movements possible increases (i.e., the number of potential free-operant behaviors), the possibilities also increase for attempting to shape and/or chain meaningful behaviors or skills. The importance of the number of controlled body movements as an indicator of the potential utility of operant training procedures, as well as an indicator of what behaviors to teach, was noted in the early research with persons with profound multiple handicaps (e.g., Rice, 1968), although to our knowledge this variable has not been incorporated into formal assessment processes.

A second set of relevant measures is the number of environmental stimuli to which an individual will reliably make a response. As the number of stimuli resulting in reliable responding increases (which may include controlled body movements on the part of the participant), more successful teach-

ing may occur. For example, some research suggests that by evaluating client approach behaviors to respective stimuli, stimuli that will function subsequently as reinforcers in skill training programs can be identified (Green *et al.*, 1988; Pace, Ivancic, Edwards, Iwata, & Page, 1985). Those stimuli to which individuals demonstrate the most consistent approach behaviors seem to be the most useful to incorporate into teaching programs.

Application and evaluation of additional behavioral teaching procedures. The primary behavioral procedure employed in the investigations to date has been positive reinforcement using an operant paradigm. There are other behavioral procedures that could be applied and evaluated. To illustrate, applications of negative reinforcement have received essentially no research attention within teaching programs for this population. Use of classical conditioning paradigms also has not received much research attention, although some early work in this area seemed rather encouraging (Rice, 1968). In short, we have not attempted to apply significant components of our existing behavioral technology, and these components warrant the attention of researchers to explore fully the benefits and limits of behavioral teaching procedures among persons with profound multiple handicaps.

Use of neuromotor behavioral interventions. The investigations summarized previously focusing on improving postural control emphasized one specific behavioral procedure—namely, operantly reinforcing therapeutic positioning. More recently, investigators have evaluated intervention programs that do not rely solely on traditional types of behavioral procedures, but instead incorporate behavioral strategies into more multifaceted approaches with a neuromotor emphasis. The latter approaches basically stem from theories of central nervous system development and are intended to inhibit abnormal reflex and muscle tone movements, with an indirect effect of promoting normal motor functioning (Horn & Warren, 1987; Noonan, 1984). Because of the variety of treatment components included in the neuromotor approaches that generally have not been considered operant in

nature, it is beyond the scope of this paper to review the investigations in this area. However, this line of research is noted here because it represents a relatively unexplored, yet potentially fruitful, area of impact of behavior analysis (Whitman *et al.*, 1983, chap. 5). As just mentioned, such impact is beginning to be addressed vis-à-vis the use of behavioral training strategies as part of neuromotor treatment programs (Campbell, McInerney, & Cooper, 1984; Horn & Warren, 1987; Noonan, 1984), and the use of behavioral assessment methodologies to evaluate the programs (Campbell & Stewart, 1986; Kuharski, Rues, Cook, & Guess, 1985; Sobsey & Orelove, 1984).

Analysis of alertness levels and responsiveness to training. An additional area of research that we support is similar to that currently referred to as biobehavioral state research (Guess *et al.*, 1988; Rainforth, 1982). Briefly, the components of this research we believe warrant attention are the evaluation of observable changes in alertness of persons with profound multiple handicaps and analysis of how responsiveness to training might vary as a function of existing alertness level. As noted earlier, there were reports of varying alertness levels among participants in studies reviewed in this paper both across and within experimental sessions, with at least an implication of corresponding effects on training outcomes. Our own clinical experience supports this concern because occurrences of seizures seem to affect the alertness level of given clients on a daily and weekly basis. Use of reliable observation procedures denoting variations in alertness concurrent with objective data on different rates of progress in teaching programs may enhance our ability to provide training at times when success is most likely and prevent us from subjecting nonalert clients to participation in teaching activities having essentially no likelihood of success.

Development of alternative treatment programs. A final area for future research is the development of treatment programs that do not focus solely on traditional skill acquisition per se (although concurrent research on skill acquisition should not be discouraged). Whereas future investigations may change conclusions regarding the

degree to which behavioral research demonstrates the teaching of meaningful skills to persons with profound multiple handicaps, service providers currently must determine appropriate treatment strategies. Based on the research to date, there is not much of a demonstrated technology upon which to base such strategies with many individuals, at least in regard to teaching meaningful skills. Consequently, an immediate need exists for the development and evaluation of alternative treatment programs. Some initial work has been reported recently in this area. For example, Green et al. (1988) and Ivancic and Bailey (1986) have suggested the use of behavioral observation procedures with certain clients to assess client preferences for certain stimuli—stimuli that clients appear to like in that they approach the stimuli to some degree, although not to the degree to suggest that the stimuli would function as reinforcers when applied contingently. Subsequently, living environments could be structured to ensure that preferred stimuli are provided as a means of enhancing the general enjoyment and quality of a client's life without focusing on the acquisition of adaptive skills per se (see also Bailey, 1981). Similarly, stimuli that clients appear to avoid (Green et al., 1988) during behavioral assessment processes could be removed from various situations to make environments less unpleasant. Also, treatment programs could take advantage of the relative successes of those studies affecting desirable behavior changes during short periods of a client's day (e.g., by increasing leisure activity via microswitches). The brief behavioral training period could be implemented in addition to other periods during the day involving neuromotor therapies and/or presentation of stimuli that evoke some approach responses. The ultimate goal of such programs would not necessarily be to develop independent adaptive skills in the traditional sense, but instead to maintain use of existing behavioral repertoires (e.g., Jones et al., 1984) and/or to prevent or decelerate regressive neuromuscular activity (Realon et al., 1988). An additional goal of such programs may be simply to provide more enjoyment in the lives of persons with profound multiple handicaps (Green et al., 1988; Ivancic &

Bailey, 1986). When considering this latter goal for future research endeavors, it is quite probable that our current criteria for meaningfulness of behavior change will need to be carefully examined and expanded beyond what was described earlier. Nevertheless, these areas of investigation, albeit different in many ways from traditional behavior-change research, are likely to be of considerable importance if applied behavioral research is to enhance significantly the quality of life of people with profound multiple handicaps.

REFERENCES

- Baer, D. M., Wolf, M. M., & Risley, T. R. (1968). Some current dimensions of applied behavior analysis. *Journal of Applied Behavior Analysis*, *1*, 91-97.
- Bailey, J. S. (1981). Wanted: A rational search for the limiting conditions of habilitation in the retarded. *Analysis and Intervention in Developmental Disabilities*, *1*, 45-52.
- Bailey, J., & Meyerson, L. (1969). Vibration as a reinforcer with a profoundly retarded child. *Journal of Applied Behavior Analysis*, *2*, 135-137.
- Bailey, J., & Meyerson, L. (1970). Effect of vibratory stimulation on a retardate's self-injurious behavior. *Psychological Aspects of Disability*, *17*, 133-137.
- Bailey, J. S., Shook, G. L., Iwata, B. A., Reid, D. H., & Repp, A. C. (Eds.). (1986). *Behavior analysis in developmental disabilities 1968-1985 from the Journal of Applied Behavior Analysis, Reprint series, Vol. 1*. Bloomington, IN: Society for the Experimental Analysis of Behavior.
- Barlow, D. H., & Hersen, M. (1984). *Single case experimental designs: Strategies for studying behavior change* (2nd ed.). New York: Pergamon.
- Bates, P., Renzaglia, A., & Wehman, P. (1981). Characteristics of an appropriate education for severely and profoundly handicapped students. *Education and Training of the Mentally Retarded*, *16*, 142-149.
- Berkson, G., & Landesman-Dwyer, S. (1977). Behavioral research on severe and profound mental retardation (1955-1974). *American Journal of Mental Deficiency*, *81*, 428-454.
- Brown, L., Branston-McClean, M. B., Baumgart, D., Vincent, L., Falvey, M., & Schroeder, J. (1979). Using the characteristics of current and subsequent least restrictive environments in the development of curricular content for severely handicapped students. *AAESPH Review*, *4*, 407-424.
- Brownfield, E. D., & Keehn, J. D. (1966). Operant eyelid conditioning in Trisomy-18. *Journal of Abnormal Psychology*, *71*, 413-415.
- Campbell, P. H., McNemey, W. F., & Cooper, M. A. (1984). Therapeutic programming for students with severe hand-

- icaps. *The American Journal of Occupational Therapy*, **38**, 594-602.
- Campbell, P. H., & Stewart, B. (1986). Measuring changes in movement skills with infants and young children with handicaps. *Journal of the Association for Persons with Severe Handicaps*, **11**, 153-161.
- Correa, V. I., Poulson, C. L., & Salzberg, C. L. (1984). Training and generalization of reach-grasp behavior in blind, retarded young children. *Journal of Applied Behavior Analysis*, **17**, 57-69.
- Deiker, T., & Bruno, R. D. (1976). Sensory reinforcement of eyeblink rate in a decorticate human. *American Journal of Mental Deficiency*, **80**, 665-666.
- Dewson, M. R. J., & Whiteley, J. H. (1987). Sensory reinforcement of head turning with nonambulatory, profoundly mentally retarded persons. *Research in Developmental Disabilities*, **8**, 413-426.
- Dyer, K., Schwartz, I. S., & Luce, S. C. (1984). A supervision program for increasing functional activities for severely handicapped students in a residential setting. *Journal of Applied Behavior Analysis*, **17**, 249-259.
- Evans, I. M., & Scotti, J. R. (1989). Defining meaningful outcomes for persons with profound disabilities. In F. Brown & D. Lehr (Eds.), *Persons with profound disabilities: Issues and practices* (pp. 83-107). Baltimore: Paul H. Brookes.
- Fehr, M. J., Wacker, D., Trezise, J., Lennon, R., & Meyerson, L. (1979). Visual, auditory, and vibratory stimulation as reinforcers for profoundly retarded children. *Rehabilitation Psychology*, **26**, 201-209.
- Fernald, C. D. (1986). Changing medicaid and intermediate care facilities for the mentally retarded (ICF/MR): Evaluation of alternatives. *Mental Retardation*, **24**, 36-42.
- Fuller, P. R. (1949). Operant conditioning of a vegetative human organism. *The American Journal of Psychology*, **62**, 587-590.
- Green, C. W., Canipe, V. S., Way, P. J., & Reid, D. H. (1986). Improving the functional utility and effectiveness of classroom services for students with profound multiple handicaps. *Journal of the Association for Persons with Severe Handicaps*, **3**, 162-170.
- 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.
- Grossman, H. J. (Ed.). (1983). *Classification in mental retardation*. Washington, DC: American Association on Mental Deficiency.
- Grove, D. N., Dalke, B. A., Fredericks, H. D., & Crowley, R. F. (1975). Establishing appropriate head positioning with mentally and physically handicapped children. *Behavioral Engineering*, **3**, 53-59.
- Guess, D., Mulligan-Ault, M., Roberts, S., Struth, J., Siegel-Causey, E., Thompson, B., Bronicki, G. J. B., & Guy, B. (1988). Implications of biobehavioral states for the education and treatment of students with the most profoundly handicapping conditions. *Journal of the Association for Persons with Severe Handicaps*, **13**, 163-174.
- Haskett, J., & Hollar, W. D. (1978). Sensory reinforcement and contingency awareness of profoundly retarded children. *American Journal of Mental Deficiency*, **83**, 60-68.
- Hill, J. (1980). Use of an automated recreational device to facilitate independent leisure and motor behavior in a profoundly retarded male. In P. Wehman & J. Hill (Eds.), *Instructional programming for severely handicapped youth*. Richmond, VA: Virginia Commonwealth University.
- Hogg, J. (1983). Sensory and social reinforcement of headturning in a profoundly retarded multiply handicapped child. *British Journal of Clinical Psychology*, **22**, 33-40.
- Horn, E. M., & Warren, S. F. (1987). Facilitating the acquisition of sensorimotor behavior with a microcomputer-mediated teaching system: An experimental analysis. *Journal of the Association for Persons with Severe Handicaps*, **12**, 205-215.
- Ivancic, M. T., & Bailey, J. S. (1986, September). *Assessing operant training potential*. Paper presented at the 6th annual meeting of the Association for Behavior Analysis, Orlando, FL.
- Jones, M. L., Favell, J. E., Lattimore, J., & Riskey, 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.
- Korabek, C. A., Reid, D. H., & Ivancic, M. T. (1981). Improving needed food intake of profoundly handicapped children through effective supervision of institutional staff performance. *Applied Research in Mental Retardation*, **2**, 69-88.
- Kuharski, T., Rues, J., Cook, D., & Guess, D. (1985). Effects of vestibular stimulation on sitting behaviors among preschoolers with severe handicaps. *Journal of the Association for Persons with Severe Handicaps*, **10**, 137-145.
- Landesman-Dwyer, S., & Sackett, G. P. (1978). Behavioral changes in nonambulatory, profoundly mentally retarded individuals. In C. E. Meyers (Ed.), *Quality of life in severely and profoundly mentally retarded people: Research foundations for improvement* (pp. 55-144). Washington, DC: American Association on Mental Deficiency.
- Maloney, F. P., & Kurtz, P. A. (1982). The use of a mercury switch head control device in profoundly retarded, multiply handicapped children. *Physical and Occupational Therapy in Pediatrics*, **2**, 11-17.
- Matson, J. L., & Mulick, J. A. (Eds.). (1983). *Handbook of mental retardation*. New York: Pergamon.
- Meehan, D. M., Mineo, B. A., & Lyon, S. R. (1985). Use of systematic prompting and prompt withdrawal to establish and maintain switch activation in a severely handicapped student. *Journal of Special Education Technology*, **7**, 5-10.
- Murphy, R. J., & Doughty, N. R. (1977). Establishment

- of controlled arm movements in profoundly retarded students using response contingent vibratory stimulation. *American Journal of Mental Deficiency*, **82**, 212-216.
- Murphy, R., Doughty, N., & Nunes, D. (1979). Multielement designs: An alternative to reversal and multiple baseline evaluation strategies. *Mental Retardation*, **17**, 23-27.
- Noonan, M. J. (1984). Teaching postural reactions to students with severe cerebral palsy: An evaluation of theory and technique. *Journal of the Association for Persons with Severe Handicaps*, **9**, 111-122.
- 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.
- Parsons, M. B., Cash, V. B., & Reid, D. H. (1989). Improving residential treatment services: Implementation and norm-referenced evaluation of a comprehensive management system. *Journal of Applied Behavior Analysis*, **2**, 143-156.
- Parsons, M. B., Schepis, M. M., Reid, D. H., McCarn, J. E., & Green, C. W. (1987). Expanding the impact of behavioral staff management: A large-scale, long-term application in schools serving severely handicapped students. *Journal of Applied Behavior Analysis*, **20**, 139-150.
- Piper, T. J., & MacKinnon, R. C. (1969). Operant conditioning of a profoundly retarded individual reinforced via a stomach fistula. *American Journal of Mental Deficiency*, **73**, 627-630.
- Rainforth, B. (1982). Biobehavioral state and orienting: Implications for educating profoundly retarded students. *Journal of the Association for Persons with Severe Handicaps*, **6**, 33-37.
- Ranieri, L., Ford, A., Vincent, L., & Brown, L. (1984). 1:1 versus 1:3 instruction of severely multihandicapped students. *Remedial and Special Education*, **5**, 23-28.
- 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 in Mental Retardation*, **23**, 228-237.
- Realon, R. E., Favell, J. E., & Phillips, J. F. (1989). Adapted leisure materials vs. standard leisure materials: Evaluating several aspects of programming for profoundly handicapped persons. *Education and Training in Mental Retardation*, **24**, 168-177.
- Reid, D. H. (1987). *Developing a research program in human service agencies: A practitioner's guidebook*. Springfield, IL: Charles C. Thomas.
- Reid, D. H., & Favell, J. E. (1984). Group instruction with persons who have severe disabilities: A critical review. *Journal of the Association for Persons with Severe Handicaps*, **9**, 167-177.
- Reid, D. H., & Hurlbut, B. (1977). Teaching nonvocal communication skills to multihandicapped retarded adults. *Journal of Applied Behavior Analysis*, **10**, 591-603.
- Reid, D. H., Parsons, M. B., McCarn, J. M., Green, C. W., Phillips, J. F., & Schepis, M. M. (1985). Providing a more appropriate education for severely handicapped persons: Increasing and validating functional classroom tasks. *Journal of Applied Behavior Analysis*, **18**, 289-301.
- Remington, R. E., Foxen, T., & Hogg, J. (1977). Auditory reinforcement in profoundly retarded multiply handicapped children. *American Journal of Mental Deficiency*, **82**, 299-304.
- Rice, H. K. (1968). Operant behavior in vegetative patients III: Methodological considerations. *Psychological Record*, **18**, 297-302.
- Rice, H. K., & McDaniel, M. W. (1966). Operant behavior in vegetative patients. *Psychological Record*, **16**, 279-281.
- Rice, H. K., McDaniel, M. W., Stallings, V. D., & Gatz, M. J. (1967). Operant behavior in vegetative patients II. *Psychological Record*, **17**, 449-460.
- Riordan, M. M., Iwata, B. A., Finney, J. W., Wohl, M. K., & Stanley, A. E. (1984). Behavioral assessment and treatment of chronic food refusal in handicapped children. *Journal of Applied Behavior Analysis*, **17**, 327-341.
- 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.
- Sobsey, R., & Orelve, F. P. (1984). Neurophysiological facilitation of eating skills in children with severe handicaps. *Journal of the Association for Persons with Severe Handicaps*, **9**, 98-110.
- Spiegel-McGill, P., Bambara, L. M., Shores, R. E., & Fox, J. J. (1984). The effects of proximity on socially oriented behaviors of severely multiply handicapped children. *Education and Treatment of Children*, **7**, 365-378.
- Sternberg, L., McNeerney, C. D., & Pegnatore, L. (1987). Developing primitive signalling behavior of students with profound mental retardation. *Mental Retardation*, **25**, 13-20.
- Sternberg, L., Pegnatore, L., & Hill, C. (1983). Establishing interactive communication behaviors with profoundly mentally handicapped students. *Journal of the Association for Persons with Severe Handicaps*, **8**, 39-46.
- Tarnowski, K. J., & Drabman, R. S. (1985). The effects of ambulation training on the self-stimulatory behavior of a multiply handicapped child. *Behavior Therapy*, **16**, 275-285.
- Thompson, G. A., Jr., Iwata, B. A., & Poynter, H. (1979). Operant control of pathological tongue thrust in spastic cerebral palsy. *Journal of Applied Behavior Analysis*, **12**, 325-333.
- Ulicny, G. R., Thompson, S. K., Favell, J. E., & Thompson, M. S. (1985). The active assessment of educability: A case study. *Journal of the Association for Persons with Severe Handicaps*, **10**, 111-114.
- Ulrey, G., & Schnell, R. R. (1982). Introduction to assessing young children. In G. Ulrey & S. J. Rogers (Eds.),

- Psychological assessment of handicapped infants and young children* (pp. 1-11). New York: Thieme-Stratton.
- 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.
- Walker, R. I., & Vogelsberg, R. T. (1985). Increasing independent mobility skills for a woman who was severely handicapped and nonambulatory. *Applied Research in Mental Retardation*, **6**, 173-183.
- Walmsley, R. P., Crichton, L., & Droog, D. (1981). Music as a feedback mechanism for teaching head control to severely handicapped children: A pilot study. *Developmental Medicine and Child Neurology*, **23**, 739-746.
- Whitman, T. L., Scibak, J. W., & Reid, D. H. (1983). *Behavior modification with the severely and profoundly retarded: Research and application*. New York: Academic Press.
- Wolfe, D. E. (1980). The effect of automated interrupted music on head posturing of cerebral palsied individuals. *Journal of Music Therapy*, **17**, 183-206.
- Zucker, S. H., D'Alonzo, B. J., McMullen, M. R., & Williams, R. L. (1980). Training eye-pointing behavior in a nonambulatory profoundly mentally retarded child using contingent vibratory stimulation. *Education and Training of the Mentally Retarded*, **15**, 4-7.

Received August 14, 1989

Initial editorial decision April 17, 1990

Revision received May 10, 1990

Final acceptance February 8, 1991

Action Editor, Terry J. Page