Therapeutic Programming for Students with Severe Handicaps

(Child development disorders, function movement pattern, occupational therapy, pediatric care, special education)

Philippa H. Campbell  William F. McInerney  Margaret A. Cooper

Therapeutic methods that use facilitation and inhibition to alter dysfunctional patterns of movement were implemented in children with multiple handicaps within educational settings. Desired movement patterns such as reach and manipulation skills were performed by students throughout the classroom day and across a variety of contextual uses. Data collected on several students indicated that more normal patterns of movement were attained at more rapid rates where students were provided the opportunity to practice the desired movement more frequently. Successful contextual programming depends on accurate and consistent implementation of therapeutic methods by all individuals who come in contact with a student. The therapist must identify the targeted movement pattern, determine appropriate intervention procedures, and train others to implement the procedures accurately. While such an approach shows promise as a means of developing function movement patterns with severely handicapped children, the increased opportunities to practice appropriate movement enhance the effectiveness of direct therapy but do not necessarily replace required individual intervention.

Severely multihandicapped students frequently have movement disorders in addition to possible sensory impairments (1). Traditional habilitation programs for these students have included the provision of related services such as physical and occupational therapy on either a consultant or direct therapy model (2). The occupational therapist who functions in the role of a consultant to the teacher/student typically performs an assessment, establishes objectives for gross or fine motor skill development, and subsequently instructs the teacher in methods designed to assist the student in acquiring these motor skills. The therapist in a direct therapy model may provide treatment for individual students on a scheduled basis. Treatment may be provided in an area removed from the classroom (e.g., therapy room) or within the classroom itself. The therapist may also be involved in instruction of the teacher in therapeutic methods that might be used within the classroom.

Traditional therapeutic assessments of motor skills are developmentally oriented and include measures of the presence or absence of such basic skills as crawling, grasping, or upper extremity movement skills (3). These assessment measures alone are not likely to yield age-appropriate or functional skills as therapeutic targets. Instead, basic underlying skills such as righting and equilibrium reactions in combination with procedures to alter postural tone constitute the types of objectives likely to be identified as appropriate for the severely handicapped student. Intervention methods suggested by the therapist (or provided directly) emphasize techniques that must be implemented on a one-to-one basis. That therapeutic methods are traditionally delivered in a one-to-one model is not surprising, because most movement therapy involves an interaction of patient and therapist with direct manipulation of the patient by the therapist as the primary outcome.

Philippa H. Campbell, OTR/L, PhD, is Director of Research and Training, Children's Hospital Medical Center of Akron, Akron, OH 44308; William F. McInerney, PhD, is Assistant Professor, Department of Special Education, University of Toledo, Toledo, OH 43606; and Margaret A. Cooper, MS, is Coordinator, School Age Services Project, Children's Hospital Medical Center of Akron, Akron, OH 44308.
Many therapists and teachers are seeking procedures that will enable students with severe and multiple impairments to acquire functional skills. Standard treatment models that are used by physical and occupational therapists in pediatric treatment focus primarily on the neuromotor component of movement. This article describes the results of therapeutic intervention provided for three multihandicapped students by systematically targeting: 1) consequences of movement (motivation to move); 2) neuromotor procedures; and 3) training context. Application of each of these programming components extends current therapeutic methodology and allows therapists to increase performance of functional skills with severely handicapped students.

Consequences of Movement
There are several general facets of any observed movement. Muscle tone underlies and provides the background against which individual muscle contraction occurs. Significantly atypical muscle tone will influence the resulting movement pattern or may totally preclude the demonstration of a given movement. Initiation of the movement requires muscle contractions and coordinations that are different from those needed to maintain that pattern once initiated. Perhaps the most critical aspect of movement is that it occurs in response to stimuli. This is true in both the global and specific sense that some set of nondirectly observable sensations, such as proprioception, kinesthesia, and tactile stimuli, relate to both the initiation of movement and the maintenance of muscular contractions over time.

However, the initiation of movement is a response to more external environmental stimuli that are interpreted on a variety of cognitive levels ranging from reflexive and sensorimotor to formal operational actions (4). Every movement has both a neuromotor and cognitive component. Both the neuromotor form of the movement and the underlying cognitive function that precipitates the movement must be accounted for to develop effective programming for severely multihandicapped students.

The majority of pediatric therapeutic approaches that have been developed to influence atypical movement (e.g., neurodevelopmental treatment, sensory integration) do not specifically address the underlying motivational or cognitive component of movement (5, 6). These approaches are designed to influence the neuromuscular form of the movement through systematic control of either the sensory (input) or motor (output) aspects of movement. For the most part, “desire” on the part of the child to move is an assumed state rather than a specifically programmed prerequisite for movement. This is a spurious assumption with severely handicapped students who may not accurately receive or encode visual or auditory stimuli and may, in addition, have learned that their actions have no effect on their environment, a phenomenon frequently described as “learned helplessness” (7, 8).

As a result, motivation (or desire) to use movement to interact functionally with persons and objects in the environment may be extremely limited. Application of standard therapeutic methods must be expanded to include systematic manipulation of the outcome(s) of movement to teach the student the motivational component of movement while facilitating efficiency of the neuromotor system.

Programming to enhance functional use of movement patterns through manipulation of consequences to movement can influence the rate of movement, thereby providing a severely handicapped student with more opportunities to practice the required neuromotor movement pattern in various types of environmental interactions.

Figure 1 contrasts the performance of a single student across various types of movement consequences. This 14-year-old student with cerebral palsy used flexion of the shoulder to move the upper extremity forward, bringing the hand into contact with a switch interface which, when activated, produced various types of electronic consequences. The configuration of the switch was selected on the basis of need to practice specific functional movement patterns (9). The mean rate of movement in the third phase in which 8 sec of rock music was the consequence for each switch closure was 5.6 activations per min. This rate was dramatically higher than during the second phase in which different consequences (e.g., music, fan, vibrator) occurred for the same 8-sec time period. However, the combination of increased mean rate of switch activation with an acceleration trend indicates the power of the consequence of the movement as a means of providing practice in upper extremity movement. Such data illustrate the effects of motivation on movement while also providing the therapist with important information to use.
in both assessment and intervention. Acquisition of upper extremity movement by this student would occur more rapidly when movement patterns systematically produce an outcome of activating a tape recorder that produced 8 sec of rock music. Such a programming situation allows practice of a desired neuromotor movement pattern within the context of an age-appropriate, recreational-leisure activity.

Movement that produces a desired outcome is likely to be repeated and practiced, thereby strengthening the movement itself. Many multihandicapped students may have a limited number of outcomes that are desired or interesting. A movement may not occur or may be produced at a very low rate, although the movement is neuromuscularly possible, because of lack of meaningful consequences of the movement. The therapist must not only implement neuromotor facilitation procedures but must also identify potentially motivating outcomes of desired neuromotor movement patterns to improve movement skills.

**Neuromotor Guidance Procedures**

Physically guiding a required movement pattern while gradually decreasing the amount of physical manipulation provided is a common instructional and therapeutic strategy employed with motorically handicapped students. Guidance is typically used either to produce (instate) or initiate movement or to control the form of the movement pattern itself (10, 11). Positioning, handling, and facilitation/inhibition procedures are therapeutic methods that consist of physical guidance of posture and movement. The use of global guidance procedures, however, assumes the integrity of several biological systems that are frequently impaired in populations of severely multihandicapped students. The first assumption is that of a normal neuromuscular system where muscle contractions in various coordinated combinations are possible. The second is that frequent passive repetitions of a particular movement will result in independent performance of the pattern. A third assumption, and perhaps the most important, is that the movement pattern is already present in the repertoire of the individual but needs to be altered with respect to rate and/or form (quality).

Many severely multihandicapped students have extensive problems with posture and movement, making the application of global physical guidance procedures ineffective unless modified to ensure joint mobility and to facilitate desired muscle actions. Most often, these facilitation procedures must also be combined with inhibition methods to prevent activation of atypical muscle contractions (12, 13). The presence of certain pathologies of the body structure, including joint deformities, soft tissue changes, and alterations in muscle length, limits the ability to perform normally executed patterns of movement. Sensory systems of touch and pressure are ac-
tivated when movement is guided. However, as a result of movement dysfunction, many severely handicapped students may also have deficient or inaccurate perceptions of sensory stimuli. This sensory information, designed to provide stimuli that enable the muscles to contract normally, may in fact result in inappropriate and inaccurate movement responses.

The desired outcome of educational and therapeutic programs for multihandicapped students is to use movement functionally to interact within varied environments. Neuromotor guidance procedures must be combined with consequences to the movement itself to instate and subsequently increase the movement pattern while fading the level of guidance necessary.

Figures 2 and 3 illustrate the performance of a 3-year-old multihandicapped child with primary problems of quadraplegic cerebral palsy and visual and hearing impairment. Use of the upper extremities to reach for objects and persons was identified as an objective for this child, who demonstrated no movement of the upper extremities. Table 1 diagrams the procedures developed by the interdisciplinary team and implemented throughout all components of a 3-hour daily preschool program. The guidance methods used included movement facilitation procedures derived from neurodevelopmental treatment. All individuals who came in contact with the child during the preschool program were trained to implement the facilitation procedures consistently and to record results.

Several outcomes can be determined from analysis of these data. Two acceleration lines were calculated using split-middle median procedures (14). Rates of change in behavior (acceleration or deceleration) are seldom calculated on performance data with severely handicapped students, perhaps because the expectations of most professionals is that these students will make slow progress (15). The initial 11 sessions of the reaching intervention program (a total of 380 trials) were used to predict the expected acceleration rate, using stated intervention procedures. The second acceleration line represented in Figure 2 depicts the actual rate of acquisition of reaching over a total of 44 sessions (1,380 trials). Had the guidance procedures been as effective across trials as they were in the initial 11 sessions, acquisition of reaching would have been complete (100% response to all trials) around session 32. Instead, the effect of intervention was not optimal. Performance yielded only approximately 65% competency at the end of 44 sessions. Comparison of the mean percentage of the first and final 11 sessions of 27.18% and 50.82%, respectively, indicates a percentage gain. This change was not statistically significant when subjected to a test for correlated means.

Data in this reaching program were recorded on an activity-by-activity basis, such that daily records were kept for the number of
opportunities to respond (trials) and the number of reaching responses in opening circle, cognitive, music, art, and communication activities. Figure 3 depicts the percent of opportunities where reaching responses occurred during the opening circle activity. The initial 11 sessions (a total of 32 trials) were used to develop the acceleration line for acquisition of reaching competency within the circle activity. This predicted rate of acquisition can be compared with actual performance acceleration based on 41 sessions (160 trials). Comparison of these two rates shows no significant difference between actual and predicted performance, indicating that the guidance procedures used were effective in the circle activity across all training sessions.

The acceleration rates for all activities (total sessions) and for circle activity were represented separately based on subjective assessment that this child was "more motivated" and "alert" during opening circle than during other instructional activities. These data indicate that both overall performance (percent correct) and rate of acceleration were increased significantly in circle when compared with data for performance across all classroom activities. This difference may indicate greater motivation to respond during a more highly preferred activity. The difference in performance between the two conditions cannot be attributed to the facilitation procedures that were used to instate and strengthen the reaching response, because these procedures were in effect in both conditions. Rather, the data illustrate a possible interaction effect between facilitation procedures and movement that produces motivating consequen-

Table 1
Procedures for Training Reaching Response

<table>
<thead>
<tr>
<th>Goal</th>
<th>M will reach for environmental stimuli within 5 sec of presentation when paired with a verbal request.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Procedures</td>
<td>Teacher/therapist/parent presents stimuli approximately 12 in. from M at her midline and says, &quot;M, get the ___.&quot; Tone in both arms and shoulders normalized, head in midline.</td>
</tr>
<tr>
<td>Desired response</td>
<td>M reaches with either hand and contacts the object.</td>
</tr>
<tr>
<td>Consequences</td>
<td>If correct—social reinforcement and interaction with object for 10 sec.</td>
</tr>
<tr>
<td></td>
<td>If M reaches but does not contact object—teacher, therapist, or parent guides response to ensure contact with object and provides social interaction but provides no interaction with the object. Guide by facilitation at shoulder.</td>
</tr>
<tr>
<td></td>
<td>If NR (no response)—object is removed and M receives no interaction for 15 sec.</td>
</tr>
<tr>
<td>Data collection</td>
<td>+ = if response is correct within 5 sec.</td>
</tr>
<tr>
<td></td>
<td>- = if response is incorrect and/or reaches without contact.</td>
</tr>
<tr>
<td></td>
<td>NR = if no response.</td>
</tr>
</tbody>
</table>
ces. Therapists must be attentive to both the neuromotor and motivational components of movement to develop maximally effective treatment programs for severely handicapped children.

**Contextual Programming**

The upper extremity reaching program described in Figures 2 and 3 was carried out across various activities that make up a typical preschool day. The procedures used to facilitate acquisition of reaching were held constant across all activities, but the context surrounding the required response differed. Training therapeutic objectives within functional contexts assumes that skills taught within a variety of situations will not require additional training for generalization to occur (16). Traditional approaches to teaching specific forms of behavior to severely handicapped students have emphasized demonstration of a stated skill under defined antecedent and consequence conditions. An activity such as reaching might be performed under the therapeutic conditions of an adult telling the student to reach for a comb, toy, cup, or other object. Theoretically, a child could acquire the ability to reach only for the cup (but not the other objects) and only when told to do so. This reaching skill would then need to be expanded to generalize the skill to other objects and other cues.

Contextual programming offers an alternative to this situation-specific strategy for skill acquisition. Handicapped children need to acquire movement “concepts” rather than isolated movement skills for a movement pattern to be functional. Repeated opportunities to perform a particular movement pattern allow the child more opportunity to practice the required movement. The overall programming day can become an environment for the acquisition of functional movement patterns and for remediation of physical problems such as shortening in the muscles.

Procedures that are selected for a given child as a means of instating and/or increasing the frequency of a particular movement pattern must be determined by an individual with training in movement assessment and remediation. This individual is most likely to be a physical or occupational therapist. The therapist becomes responsible not only for determination of the appropriate procedures but also for training other individuals. Every individual who has contact with the student must implement the procedures accurately and consistently. Therapeutic programming is thereby extended to include opportunities to perform the desired movement pattern throughout the programming day in functional and age-appropriate activities, increasing the rate of acquisition of a given movement pattern.

Two examples of movement patterns trained within various contexts with a 15-year-old severely multihandicapped student are pictured in Figure 4. This student’s developmental age was calculated at 5 months on the basis of standardized psychological testing (e.g., Bayley Scales of Infant Development). Muscle tone was slightly increased throughout the body but more so in the legs than

![Figure 4](image-url)

**Figure 4**

Acquisition of opening schemes

---

The American Journal of Occupational Therapy 599
in the arms. Functional use of the upper extremities was physically possible. This student, however, did not independently perform any functional movement skill requiring upper extremity reach and/or reach with combined grasp/manipulation within any functional programming domain. As a result, she was unable to feed herself without assistance or to use her arms and hands to manipulate objects for other self-care activities or for vocational or recreation-leisure skills. She was also immobile, unable to transfer, and unable to communicate.

A program was devised to teach this student to use upper extremity reach in combination with finger manipulation movements to open containers. Items that were appropriate for activities conducted throughout the day were used and included objects such as her locker, the microwave oven door, boxes (e.g., mixes used in food preparation), food containers used at lunch, and other related items. Records were maintained of specific items used during any given day, but performance was represented in terms of the number of objects opened with respect to the number of opportunities provided (percent correct). Baseline performance was established over eight sessions and indicated a deceleration trend in acquisition with a mean competence of only 21% correct. Intervention was provided across 31 sessions (872 trials) and included demonstration of partial opening with physical guidance if the required movement to open the object was not independently performed within a specified period of time.

Natural consequences to successful opening including continuing with the activity in progress (e.g., proceeding through an opened door, getting food from the microwave oven) in combination with social interaction with the adult or other students. Analysis of the data indicated a slow but consistent increase in acquisition of opening schemes, although full competence has not been attained. Average performance across the last five sessions resulted in a 36% success rate. While this success rate is above the baseline rate of 21%, there is no statistically significant difference between the baseline and therapeutic intervention conditions.

The graph also illustrates two additional and significant points. The first is that while attainment of competency is proceeding slowly, the rate of performance during intervention is significantly higher than the decelerating rate demonstrated during baseline conditions. This is important information for the therapist, because it shows that without therapeutic procedures, this manipulation scheme would not have been acquired. In addition, the predicted rate of acquisition (based on the initial 11 intervention points) and the actual rate are not significantly different, indicating that the intervention procedures of demonstration and physical guidance have been consistently effective across training sessions. Information concerning performance rate can encourage therapists to continue intervention by providing information that acquisition is indeed occurring.

Ideally, an initially taught movement pattern should subsequently become a component of a more complicated movement act. Intervention designed to facilitate reach and touch, reach and grasp, or, as in the example above, reach and open logically combines two upper extremity movements. Opening various objects and containers is classified as a fine motor-manipulation scheme from a neuromotor perspective.

A critical cognitive function in opening, however, is that of object permanence. The object permanence concept includes two important components, one of which is “memory” that the object (or person) exists even when not fully present. A second aspect of the concept is that of searching for the object when it is not immediately present. Direct observation and assessment to determine whether or not an individual has object permanence is typically based on movement. If an object is presented to a student and then hidden and the student does not search for the object, the inference is drawn that the student does not yet have the concept (17). Therefore, functional use of a fine motor scheme such as opening requires mastery of the object permanence concept. Such training is easily accomplished by teaching reach and search by partially or totally covering objects that are to be reached for. Objects can then be moved between two locations (two-choice paradigm) to train the student to reach to more than one location to search for the missing object.

Figure 5 illustrates performance of the same student where the initial instructional condition was an object partially hidden, the second condition was a fully hidden object, and the third required looking for the object in one of two locations (presented immediately in front of the student). Training opportunities were provided within the context of daily activities that occurred in the classroom.
in two locations. The discrepancy between predicted and actual performance may well be related to uneven motivational outcomes of movement within the training opportunities across the classroom day. For instance, searching for a spoon hidden under a cloth may be more motivating when hungry than searching for a package of mix to use to bake a cake in a group cooking activity.

Implications
Facilitating acquisition of movement patterns within the context of a variety of age-appropriate and functional activities offers an alternative to traditional therapeutic methods. By increasing the number of opportunities (trials) that are available for practicing normal movement patterns, rates of acquisition can be increased. Establishing functional and motivating outcomes of movement also enhances movement acquisition.

Successful contextual programming depends on accurate and consistent implementation of therapeutic methods by all individuals who come in contact with the student. The therapist must identify the targeted movement pattern, develop appropriate procedures, and train others to implement those procedures consistently and accurately. While such an approach shows promise as a means of enabling severely multihandicapped students to acquire functional movement patterns, programming in context does not need to replace direct therapy. Rather, the increased opportunities to practice appropriate movement patterns serves to enhance the effectiveness of direct therapy.

Acknowledgments
This work was supported in part by US Office of Education/Special

Various covers such as cloths, boxes, and other similar items were used to conceal the objects. Functional and age-appropriate objects that were part of ongoing instructional activities were used and included materials necessary for food preparation, leisure activities, and self-help skills. If the student did not attempt to reach and uncover the hidden object, the reaching movement was guided by the instructor using facilitation procedures. Each subsequent condition of cognitive difficulty was included in daily programming after the student had demonstrated two successful sessions of performance above a 65% accuracy level.

The actual rates of acquisition are significantly lower than the predicted rates in both the first and third condition, indicating that the intervention procedures were not consistently effective over training trials. Object permanence/search schemes, however, were attained at all three levels with maximum performance rate observed in the most difficult of the three conditions, searching

Figure 5
Acquisition of search (object permanence) concept

| Condition 1: search for partially hidden objects; mean = 46.39% (464 trials); slope of predicted performance (A) = 1.67; slope of actual performance (B) = 1.19. Condition 2: search for totally hidden objects; mean = 41.41% (400 trials); slope of predicted performance (A) = 1.16; slope of actual performance (B) = 1.27. Condition 3: search for totally hidden object in one of two locations; mean = 48.53% (506 trials); slope of predicted performance (A) = 1.40; slope of actual performance (B) = 2.26. |
Education Program Grants G00-79-03069 and 300-81-0358 to the Children's Hospital Medical Center of Akron, Akron, Ohio.

REFERENCES


