Research Report

Performance Following Ability-Focused Physical Therapy Intervention in Individuals With Severely Limited Physical and Cognitive Abilities

Background and Purpose. Do individuals with severely limited physical and cognitive abilities improve their gross motor abilities when given physical therapy intervention, and does improvement transfer to nontreatment settings? **Subjects.** The subjects were 24 individuals (10 female, 14 male), aged 3 to 30 years ($\bar{X}$=20.1, SD=8.1), who were nonambulatory and had limited adaptive behavior. **Methods.** Change in gross motor ability during 18 weeks of twice-weekly therapy was measured using goal attainment scaling (GAS). Three gross motor goals were developed for each subject based on individual or caregiver needs, with one goal randomly selected as a control. Physical impairments were treated, and behavioral management principles, low-level communication approaches, high-repetition practice of goals, and a progressive reduction of both physical assistance and multisensory cues were used. An independent rater scored goal level from randomly ordered videotapes recorded during therapy and in recess and home settings. **Results.** Mean GAS *T* scores were higher for treatment goals ($\bar{X}$=45.6, SD=10.5) compared with control goals ($\bar{X}$=34.6, SD=11.8). When the expected goal level (50) was met during therapy, mean GAS *T* scores in recess settings ($\bar{X}$=35.9, SD=11.5) and home settings ($\bar{X}$=42.2, SD=12.2) were lower. At the conclusion of therapy, there were no differences in goal levels between treatment and control goals in both the recess and home settings. **Conclusion and Discussion.** The subjects demonstrated improvement of gross motor abilities practiced during therapy. Level of ability during therapy, however, did not consistently transfer to the recess and home settings. [Brown DA, Effgen SK, Palisano RJ. Performance following ability-focused physical therapy intervention in individuals with severely limited physical and cognitive abilities. *Phys Ther.* 1998;78:934–950.]

Key Words: *Ability-focused physical therapy, Generalization, Goal attainment scaling, Motor learning, Severe physical and cognitive disability, Transfer.*

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Gross motor abilities that allow individuals to interact with people and their environment are essential to the development of basic cognitive and communication abilities.[1–3] People who do not move and interact with others, or who are excluded from participation in social opportunities (eg, education, meals, work and recreation with peers without motor impairments), may expect social failure and might not try to move or interact, a learned helplessness.[4,5] Although individuals with severely limited physical and cognitive abilities may learn gross motor abilities that are useful to them, these abilities often will not look like, or develop in the same order as, the skills of peers their age without disabilities.[6] Examples of gross motor abilities that may enhance function include (1) arm and hand movements to activate an environmental control unit (eg, to turn a television or lamp on or off); (2) arm and hand movements to contact objects, signal others, or use an alternative communication system; (3) trunk and limb movements to reposition the body for social interaction and comfort; (4) protective limb movements to prevent or slow a fall; and (5) active movements that oppose forces that could lead to the development of deformities. These abilities may help individuals with severely limited cognitive and physical abilities engage in social interactions in addition to reducing the physical assistance required for their care.

Gains in gross motor ability in individuals with severely limited physical and cognitive abilities have been reported following intervention.[7–11] The gains reported include improved head control,[8,9] improved arm movements[8] and a pattern of sitting,[7] maintenance of a 4-point posture,[8,9] standing up,[11] and maintenance of walking.[10,11] Interventions were administered 2 to 3 times per week, with a duration of 10 to 40 minutes per session. Treatment included high-repetition practice of

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behavioral objectives,[7–11] knowledge of results,[7–11] systematic fading of prompts,[7–11] behavior shaping,[7–9,11] use of minimal physical assistance,[7,11] and adapted positioning.[8,9]

Individuals with severely limited physical and cognitive abilities require high-repetition training and protracted treatment to obtain meaningful gains.[12] Although long-range goals must be focused on meaningful functional outcomes within the individual's environments, short-term objectives may have to focus on achievable components of those long-range outcomes. In contrast to studies of successful approaches that focused on specific abilities and systematic fading of prompts,[7–11] limited progress has been reported following neurodevelopmental physical therapy that focused on acquisition of motor milestones, quality of movement, muscle tone, and postural reactions.[13,14]

Ability-focused physical therapy, as defined in this report, emphasizes teaching gross motor abilities that are important to both the individual and the individual's caregivers. This approach to therapy is a composite that we developed from the aim-oriented approach of Scrutton[15] and from physical therapy, psychology, and special education procedures that have been reported to enhance the learning of individuals with severely limited physical and cognitive abilities (Appendix 1).[2,5,6,15–49] *Ability* is defined as the capability to perform an activity. Ability-focused therapy is designed for use with individuals with severely limited physical and cognitive abilities whose potential to learn the skilled actions typical in the daily routines of their peers without disability is extremely limited. We contend that this is an important distinction for individuals who may not learn typical skills but who may acquire useful gross motor abilities.

The emphasis of ability-focused physical therapy is on simple motor behaviors that are meaningful in the individual's current or future environment. Ability-focused physical therapy is not based on adherence to the motor development sequence or on the expectation that persons with severely limited physical and cognitive abilities will move in a manner similar to people without disability. Rather, this approach is characterized by the therapist's (1) acceptance of individually preferred types and levels of stimulation and ways of moving (eg, the patient may not tolerate normal lighting and sound levels), (2) use of behavior management to enhance motivation, and (3) communication of goals and outcomes to the individual, using strategies designed for persons with severely limited cognitive abilities and sensory impairments. Physical impairments are treated only when they are thought to interfere with attainment of motor skills or may result in the long-range loss of motor ability. During practice, the therapist attempts to gradually and systematically reduce the amount of (1) physical assistance and (2) tactile, visual, and verbal guidance provided to the individual. Therapist feedback and reinforcement are directed primarily at leading to an individual's success in achieving a desired goal, rather than on qualitative aspects of movement. In our view, the emphasis of ability-focused physical therapy on potentially useful, but not necessarily skilled, movements helps to avoid a learned expectation of failure that may occur if the therapist requests normal movement patterns that the individual is not capable of achieving.

Limited transfer of motor behaviors to spontaneous use with other persons, in other places, and at other times of the day has been extensively reported in the literature of psychology and special education, which primarily investigated fine motor and communication abilities, for individuals with severely limited cognitive abilities.[8,16,17] In the few studies of physical therapy for individuals with severely limited physical and cognitive abilities in which transfer of new abilities was examined, there was some, but limited, transfer when the therapist prompted the learner in nontreatment settings.[7,10,11,14,18] There are no studies on transfer of gross motor abilities following physical therapy in which the individual was prompted by persons naturally present in those environments (eg, family, friends, caregivers). The primary purpose of our study was to examine whether individuals aged 3 to 30 years with severely limited physical and cognitive abilities will improve their gross motor ability after receiving 18 weeks of ability-focused physical therapy. The secondary purpose of our study was to examine whether abilities initially attained in the clinical setting would be used when prompting is supplied by a person naturally present in the subjects' recess or home setting.

The primary hypothesis was that, after 18 weeks of physical therapy, the subjects' gross motor level for the treatment goals that were practiced would be higher than the level for control goals. The secondary hypotheses were (1) when the subjects first reach their expected gross motor level for goals treated in the physical therapy setting, their level for the treatment goals would be lower when they are prompted in the recess and home settings and (2) after 18 weeks of physical therapy, when the subjects are prompted in the recess and home settings, their gross motor level for treatment goals would not differ from the level for control goals.

Method

Subjects

A single-group pretest-posttest design was used, with subjects serving as their own controls. The subjects were

24 children and young adults who were nonambulatory, had severely limited physical and cognitive abilities, and resided in Custer County, South Dakota. Only 2 individuals received direct physical therapy services just prior to the study. Guardian consent was sought for all 3- to 30-year-old individuals in Custer County, South Dakota, who met the following inclusion criteria:

1. Received special education services under an individualized education program with the Custer Independent School District 16-1 while living in a family home or received special education or workshop services under an individualized habilitation plan in developmentally grouped classrooms, with on-grounds residence, at the South Dakota Developmental Center at Custer.

2. Did not walk or use a wheelchair independently.

3. Scored below an adaptive behavior achievement age of 20 months on the Preschool Attainment Record (PAR)[50] on their last comprehensive assessment. The PAR is an achievement test with high test-retest and interrater reliability[51,52] that is often used by psychologists to assess adaptive behaviors of individuals of all ages with limited cognitive abilities.

4. Scored below a gross motor age equivalent of 13 months on the Gross Motor Scale of the Peabody Developmental Motor Scales[53] (PDMS-GM) on their last comprehensive assessment.

After receiving approval from the institutional review boards, informed consent was obtained from each subject's guardian. Thirty-three children and young adults met the initial inclusion criteria. Three potential subjects were excluded because they had undergone recent major surgery, and their surgeon prevented their participation. Two potential subjects were excluded because their guardians did not provide consent. Three potential subjects, although scoring low enough on their prior PAR or PDMS-GM assessment (done up to 3 years earlier), scored too high on one of those assessments for study inclusion when retested at the start of the study. Twenty-five subjects started the study. One subject was discontinued due to a femur fracture not associated with physical therapy.

Of the 24 subjects, 10 subjects (42%) were female and 14 subjects (58%) were male. The mean age of the sample was 20.1 years (SD=8.1, range=3–30). The limited abilities of most subjects were attributed to more than one etiology, and only 1 subject had limited ability of unknown etiology. Three subjects (12%) had cerebral palsy, 12 subjects (50%) had microcephaly, 2 subjects (8%) had hydrocephaly, 4 subjects (17%) had other cranial anomalies, 3 subjects (12%) had post-maternal infection, 3 subjects (12%) had post-maternal drug use, 6 subjects (25%) had genetic disorders, 4 subjects (17%) had cerebral anoxia, and 2 subjects (8%) had low birth weight (<2,500 g). Seven subjects (29%) were fed by gastrostomy pumps. Although not controlled, no changes occurred in use of pharmaceutical agents during the study. Subjects had a mean score of 10.5 months (SD=4.1, range=3.4–19.5) on the PAR adaptive behavior assessment and a mean score of 1.5 months (SD=2.8, range=0.0–12.0) on the PDMS-GM.

Table 1.
Types of Goals Selected for Subjects

No. of Goals	Gross Motor Ability Targeted
27	Head control (11 prone/9 pull-to-sit/5 sitting/2 supine)
12	Rolling
8	Propping on forearms and crawl on elbows
8	Protective arm extension and propping on hands
5	Reaching and grasping to midline over chest while supine
5	Sitting (assume and maintain)
2	Stand from floor
2	Stand free of support
2	Walk using walker
1	Attain 4-point posture
72	Total (3 goals per individual)

Selection and Quantification of Goals

Three gross motor goals were selected for each subject. The treating therapist, guardians, caregivers, teachers, and subjects participated in goal selection. In accordance with ability-focused therapy, the goals selected were related to the subjects' needs and preferences instead of therapist-perceived needs. A summary of the types of goals selected is presented in Table 1.

Goals were written in goal attainment scaling (GAS) format. *Goal attainment scaling* is an individualized client-centered outcome measure that incorporates the components of the behavioral objective and includes an ordinal scale that states possible levels of goal attainment following a therapeutic intervention.[54] The GAS format uses 5 possible outcomes, as opposed to only 1 outcome for the behavioral objective. For GAS, the expected level of attainment for each goal is stated, as are the 2 possible levels of attainment that are less favorable and the 2 possible levels of attainment that are more favorable. This format allows the physical therapist to determine whether a patient has made progress despite not achieving the desired goal and whether a patient's progress has surpassed the expected outcome. Another useful and unique feature of GAS is the ability to compute a change score for multiple goals, providing an aggregate measure

of change. The composite change score can be expressed as a T score with a mean equal to 50 and a standard deviation of 10.

In our study, the −2 level of goal attainment was a description of each subject's current abilities based on some element of his or her PAR and PDMS-GM assessments and the judgment of the interdisciplinary team.[55] The 0 level of goal attainment reflected the interdisciplinary team's expectation of the most likely outcome after 18 weeks of physical therapy. The +2 level of goal attainment represented the team's judgment of the best possible outcome after 18 weeks physical therapy. Behaviors representing attainment between these levels were used for the −1 and +1 scores. To illustrate the method of scaling, the 3 goals approved for subject 10 are shown in Appendix 2, along with his case history and the 100-mm-long visual analog scale lines used to assess the content validity of each item. The goals, in our view, were functionally relevant, based on individual needs, and are representative of goals developed for individuals with severely limited physical and cognitive abilities. For most of the subjects, the interdisciplinary team did not anticipate that fully functional skills could be attained in only 18 weeks. Most goals, therefore, represented what we think were components of functional tasks.

After each subject's interdisciplinary team approved the 3 goals, a die was cast to randomly select the 1 control goal. The 2 remaining goals were the treatment goals that were practiced in the physical therapy setting. The team was unaware of which goals were practiced.

Procedure for Measurement of Goal Attainment

Each subject's performance for each goal was videotaped on 4 test days in the physical therapy (at the subject's school), recess, and home settings. The test days were at the study start, after 9 and 18 weeks of physical therapy, and when the treating therapist determined that a subject first reached the expected outcome (0 level of goal attainment) for a treatment goal in the physical therapy setting. Subjects did not receive physical therapy on test days. Prior to beginning each therapy session, the treating therapist prompted the subject to perform each goal to determine when the subject first attained a score of 0. This protocol was modified in 2 instances to keep the number of measurements of each goal constant. If a subject did not achieve the expected outcome for a goal prior to the 16th week of therapy, the subject was videotaped attempting to achieve that goal and the control goal during the 17th week to keep the number of measurements for each goal constant. If a subject first achieved the expected level for a goal in the physical therapy setting after 9 weeks of therapy, a fourth videotaping was not necessary for that goal.

On each test day, subjects were videotaped first in the physical therapy setting during their therapy time, followed by videotaping in their recess setting and then in their home setting. The order of the settings corresponded to each subject's daily routine. Within each setting, the order of goal prompting on the 3 goals was randomized to minimize goal-order effects. For the subjects in public school, the recess setting was their adapted physical education class. For subjects residing at the state developmental center, the recess setting was their recreation class.

An adult (training technician or caregiver) who routinely interacted with the subject prompted goals in the recess or home setting. After assisting the subject to assume the initial position, prompting included cuing the subject to perform the specified gross motor activity using environmentally appropriate subject-specific stimuli, signs, or gestures. For example, a recreation technician might use a promise of activation of a favorite game, verbal or tactile encouragement, and praise in front of peers to motivate a subject. The subject was allowed up to 3 trials per goal per setting, with any spontaneous attempts counted as a trial.

The adult who prompted the subject in each setting remained constant throughout the study. The goals of subjects who attended public school were prompted by the aides who assisted them in adaptive physical education and the family member who was their most consistent caregiver in the home setting. For subjects who resided at the state developmental center, goals in the recess setting were prompted by their recreation technician, and goals in the home setting were prompted by their evening caregiver.

Individuals with severely limited physical and cognitive abilities do not always perform within their capacity when tested. When a subject did not perform even at the −2 level, a score of −3 was given for that test day. The independent rater scored a −3 level on 13.0% of her ratings (112 out of 864 tests). We suggest that, when using GAS, failure to document an individual's actual attainment may result in underestimation of within-group variance, thereby inflating reported effect sizes.

After data collection, the test-day videotapes of each subject were randomly reordered prior to scoring by an independent rater. The independent rater was an experienced pediatric physical therapist who did not provide services to any of these subjects. The rater's experience included the writing and scoring of behavioral objectives similar to those included in the GAS scales and the provision of direct physical therapy services to individuals with severely limited cognitive and physical abilities.

Content validity of measurements related to goals. To assess how meaningful the goals were to the home setting, caregivers were asked to complete a 100-mm-long visual analog scale (Appendix 2). Each caregiver completed the visual analog scale at the beginning of the study and again near the end of the study. All persons who served as caregivers for 20 or more of the prior 100 days were asked to complete survey forms. The caregiver was instructed to mark the point on the scale that reflected his or her judgment of the potential usefulness of the goal for the individual's current and future settings. The term "future settings" was defined as any future living, work, or recreation environments the individual may have access to in the foreseeable future. Responses were measured to the nearest millimeter. There was a 100% return of visual analog scale forms. For the 22 subjects with more than one caregiver, weighted average scores (using the number of days of service provided by each of their 2 caregivers for the weightings) were used to compute the score.

The caregivers' mean ratings of goal usefulness were 75.8 (SD=16.5) at the start of the study and 72.3 (SD=21.3) at the end of the study. The results suggest that the goals were considered of potential use to the subjects. The low correlation (Pearson matched-pair $r=-.09$, n=72, $P>.25$) between the start and end of the study ratings, however, suggests that caregivers changed their opinion of which goals had more usefulness after prompting the subjects to achieve the goals during the test sessions.

Interrater reliability of GAS scores. Interrater reliability was examined by having the treating therapist score each subject's levels of goal attainment in the physical therapy setting from direct observation on the test days. The treating therapist's scores were compared with those of the independent rater who scored the subjects' levels of goal attainment from the videotapes. To examine interrater reliability across all 3 settings, a third physical therapist independently scored the levels of goal attainment of 3 subjects from the videotapes. Those 108 scores (3 subjects × 3 goals × 3 sites × 4 test times) were compared with the independent rater's scores. Pearson r correlation coefficients assess whether scores are associated in a linear pattern. In contrast, the intraclass correlation coefficient (ICC) assesses whether 2 raters obtain similar means. We chose to examine both aspects of reliability.

The Pearson r correlations and interrater ICCs (2,1) between the scores of the treating therapist and the independent raters were $r=.84$ ($P<.0001$, n=360, $r^2=70.9\%$) and ICC=1.00 (between raters: $df=1$, SS=0.01; within raters: $df=695$, SS=1172.65), respectively. The coefficients between scores of the 2 independent raters were $r=.81$ ($P<.0001$, n=135, $r^2=66.2\%$) and ICC=.997 (between raters: $df=1$, SS=1.48; within raters: $df=245$, SS=433.39). The results support acceptable interrater reliability of the scores for the goals in this study.

Treatment Procedure

Each subject received one-on-one direct physical therapy twice a week for 18 weeks. Eighteen weeks was selected based on the first author's clinical experience working with this population, which suggested that a minimum of 4 months was needed to obtain meaningful progress. The therapy sessions lasted 30 minutes, with 10 to 15 minutes per session devoted to practice of each treated goal. The first author provided treatment to all subjects. He had 18 years of experience working with individuals with limited cognitive and physical abilities, he had a master's degree in special education, and he was certified in pediatric physical therapy by the American Board of Physical Therapy Specialties.

The physical therapy intervention consisted of (1) goal-relevant treatment of joint, fascia, and skin contracture in addition to facilitation or inhibition of specific muscle use by application of passive motion, quick or prolonged stretching, tapping, and vibration[19]; (2) preparatory techniques, including positioning, environmental modification, and sensory stimuli to either alert or calm the subject; (3) use of behavior management principles and techniques; (4) communication principles specific to the unique needs of the subject; and (5) high-repetition practice of the 2 targeted gross motor abilities. The specific techniques used are described in Appendix 1. Stretching procedures were done only when tissue tightness or laxity were thought to interfere with an individual's goal-related movement. All prolonged stretching was limited to procedures described by Boehme.[56] The specific procedures and strategies used were based on the therapist's interpretation of each subject's goals and needs.

Individuals with severely limited cognitive ability need high task repetition prior to ability acquisition.[8] Unfortunately, clients, therapists, teachers, aides, and family members may become bored and lose motivation if the same prompts, materials, and rewards are always used. General case instruction,[20,57,58] in which the relevant antecedent stimuli (prompts or materials) are varied, was used in an effort to help maintain subject interest in the task and to increase the likelihood of ability transfer to the subject's recreation and home settings. Reinforcers (consequent stimuli) that proved successful were alternated to avoid subject boredom and eventual lack of response to single reinforcers. Thus, treatment was characterized by individualized variation in both antecedent (cue) and consequent (reinforcer) stimuli, but it

Table 2.
Goal Attainment Scaling (GAS) *T* Score Equivalents for 1-Goal Control and 2-Goal Treatment GAS Raw Scores

GAS *T* Score	1-Goal Control Raw Score	2-Goal Treatment Raw Scores
12.8		−3,−3
19.0		−3,−2
20.0	−3	
25.2		−3,−1 or −2,−2
30.0	−2	
31.4		−3,1 or −2,−1
37.6		−3,1 or −2,0 or −1,−1
40.0	−1	
43.8		−3,2 or −2,1 or −1,0
50.0	0	−2,2 or −1,1 or 0,0
56.2		−1,2 or 0,1
60.0	1	
62.4		0,2 or 1,1
68.6		1,2
70.0	2	
74.8		2,2

was consistent in regard to which abilities the subjects practiced.

Treatment Consistency

The subjects received 82.6% of the planned sessions ($\bar{X}$=14.9, SD=1.1, range=12–17) during the first 9-week period and 84.7% of the planned sessions ($\bar{X}$=15.3, SD=1.1, range=14–18) during the second 9-week period. The missed sessions were due to subject illness and to treatment cancellation on the 4 test days.

Our approach to physical therapy incorporated principles from behavioral psychology and special education. A behavioral psychologist and a special education director observed the therapy sessions of 3 randomly selected subjects and scored checklists on the correct use of behavior management and communication principles, respectively. A second independent physical therapist also observed therapy for 3 randomly selected subjects and scored a checklist related to treatment procedures. All raters were experienced in serving this population. The 3 checklists were developed based on the treatment and management procedures used in this study and were previously published.[59]

Data Analysis

Computerized data entry was done using dBASE IV, version 1.5.* Data were analyzed using the Statistical Package for the Social Sciences (SPSS/PC+, version 3.0).† The required level of significance for all tests was P=.01, instead of the more common level of P=.05. We used this level of significance to avoid the increased chance of a Type I error that occurs with repeat analysis of data.

Two-goal GAS *T* scores were computed for treatment goals, whereas a one-goal GAS *T* score was computed for the control goal. These scores were computed for each preplanned test day (study start, 9 weeks, 18 weeks) and for the at-criterion-level test day, using the formula developed by Kirsuk and Shermann[54]:

$$T = 50 + \frac{(10\Sigma W_i X_i)}{\sqrt{(1-r)\Sigma W_i^2 + r(\Sigma W_i^2)}}$$

where W_i represents the weighting for a particular goal and X_i represents the outcome score for each goal (a value of −2 to +2). The r value in the formula reflects the estimated average intercorrelation for the outcome scores of multiple goals. The formula for computing the *T* score assumes a correlation of .30 between goals. In this study, all goals received equal weight to allow comparison of the mean GAS *T* scores for the treatment goals with the mean GAS *T* scores for the control goals. The relationship between the GAS *T* scores and the GAS raw scores from which they were computed is shown in Table 2.

Goal attainment scaling was designed to simulate parametric-like data distributions, particularly when larger numbers of goals are combined into subject *T* scores. We ran both parametric and nonparametric statistics (Friedman 2-way analyses of variance [ANOVAs] and Wilcoxon matched-pairs signed-rank tests). Because both types of statistics gave the same results and the GAS *T* scores were normally distributed, only the parametric statistics are presented.

A 2-factor (goal type [treatment versus control] × test day) repeated-measures ANOVA was done to determine whether there was a significant goal × test day interaction, indicating a differential change between GAS *T* scores for treatment and control goals across the initial, 9-week, and 18-week test days. A separate analysis was done for each of the 3 test settings (physical therapy, recess, home). For the settings in which the goal type × test day interactions were significant, a Student paired *t* test was run on 18-week GAS *T* scores to test for a treatment effect. The *t* value was based on the mean sums of squares of the error term from the ANOVA.

The mean GAS *T* score for the 27 treatment goals in which the subjects were videotaped when they first attained the 0 level of goal attainment in the physical therapy setting was by definition 50; thus, there was no variance. The between-setting difference in mean GAS *T* scores, therefore, were analyzed using Student *t* tests for matched pairs, with the standard error of the mean of

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Table 3.
Mean Goal Attainment Scaling *T* Scores by Test Day, Treatment or Control Goal, and Setting (N=24)

Test Day and Type of Goal	Setting: Physical Therapy $\bar{X}$	SD	Range	Recess $\bar{X}$	SD	Range	Home $\bar{X}$	SD	Range
At study start									
Treatment[a]	27.0	8.1	12.8–50.0	28.0	8.0	19.0–43.8	27.8	8.8	12.8–56.2
Control[b]	30.4	6.9	20.0–50.0	32.5	9.4	20.0–50.0	30.4	8.1	20.0–50.0
After 9 weeks									
Treatment[a]	37.3	11.8	25.2–62.4	30.6	8.2	12.8–50.0	30.0	9.7	19.0–50.0
Control[b]	32.5	7.9	20.0–60.0	31.7	10.1	20.0–60.0	32.5	9.9	20.0–60.0
After 18 weeks									
Treatment[a]	45.6	10.5	25.2–68.6	31.1	10.3	12.8–62.4	35.5	8.7	19.0–62.4
Control[b]	34.6	11.8	20.0–60.0	32.5	9.9	20.0–50.0	35.0	10.6	20.0–50.0

[a] Two-goal *T* scores.
[b] One-goal *T* scores.

the non–physical therapy setting score used for the usual standard error of the difference between setting scores.

Results

After 18 weeks of therapy in the physical therapy setting, 9 subjects had a level of goal attainment of 0 or higher for both treatment goals, 10 subjects had a score of 0 or higher for one of their treatment goals, and the remaining 5 subjects had levels of goal attainment of +1 or −2 for either treatment goal. Two of the 5 subjects did not demonstrate any change in level of goal attainment after 18 weeks of therapy in the physical therapy setting. Both subjects died within a year after the study, suggesting to us that their potential for change was limited at the time of the study. One of those individuals also had severe opisthotonos, despite use of muscle relaxant medications. Mean GAS *T* scores for treatment and control goals are shown in Table 3. The mean GAS *T* score of 45.6 for treatment goals in the physical therapy setting was close to the expected outcome GAS *T* score of 50.

GAS T Scores for Treatment and Control Goals Measured in Physical Therapy Setting

The subjects' mean GAS *T* scores for treatment goals ($\bar{X}$=45.6, SD=10.5, range=25.2–62.4) compared with control goals ($\bar{X}$=34.6, SD=11.8, range=20.0–60.0) measured in the physical therapy setting are plotted in the Figure (plot A). The results of the 2-way ANOVA indicate a goal type × test day interaction ($F=8$; $df=2,143$; $P<.001$). The results of the matched-pairs *t* test indicated that the mean GAS *T* score for the treatment goals was higher than the mean *T* score for the control goals ($t=4.06$, $df=23$, $P<.001$). The primary hypothesis was accepted. After 18 weeks of physical therapy, the subjects' progress on treatment goals was greater than their progress on the control goals.

GAS T Scores Measured in Recess and Home Settings When Goals Were Attained in Physical Therapy Setting

The independent rater also scored 27 of the treatment goals in the recess and home settings on test days when the therapist stated the subject first achieved the expected level of goal attainment in the physical therapy setting. The results of the *t* tests to compare mean GAS *T* scores for each setting are presented in Table 4. When the subjects first reached their expected outcome in the physical therapy setting, they did not perform as well in the recess and home settings, supporting secondary hypothesis 1. The difference in mean *T* scores between the home setting and the recess setting was not significant.

Comparison of Subjects' GAS T Scores for Recess and Home Settings

Subjects' GAS *T* scores for the recess and home settings are plotted in the Figure (plots B and C, respectively). The results of the 2-way ANOVAs indicate that there was no goal type × test day interaction for either the recess setting ($F=1$; $df=2,143$; $P>.30$) or the home setting ($F=2$; $df=2,143$; $P>.15$). Secondary hypothesis 2 was accepted. The subjects' level of goal attainment on treatment versus control goals did not differ across time in the recess and home settings.

We examined *post hoc* how many subjects demonstrated transfer of gross motor ability from the physical therapy setting to either the recess or home setting after 18 weeks of physical therapy. Compared with their level of goal attainment in the physical therapy setting, the subjects had the same or a higher level of goal attainment for 17 (36%) of their treatment goals in the recess setting and for 22 (46%) of their treatment goals in the home setting.

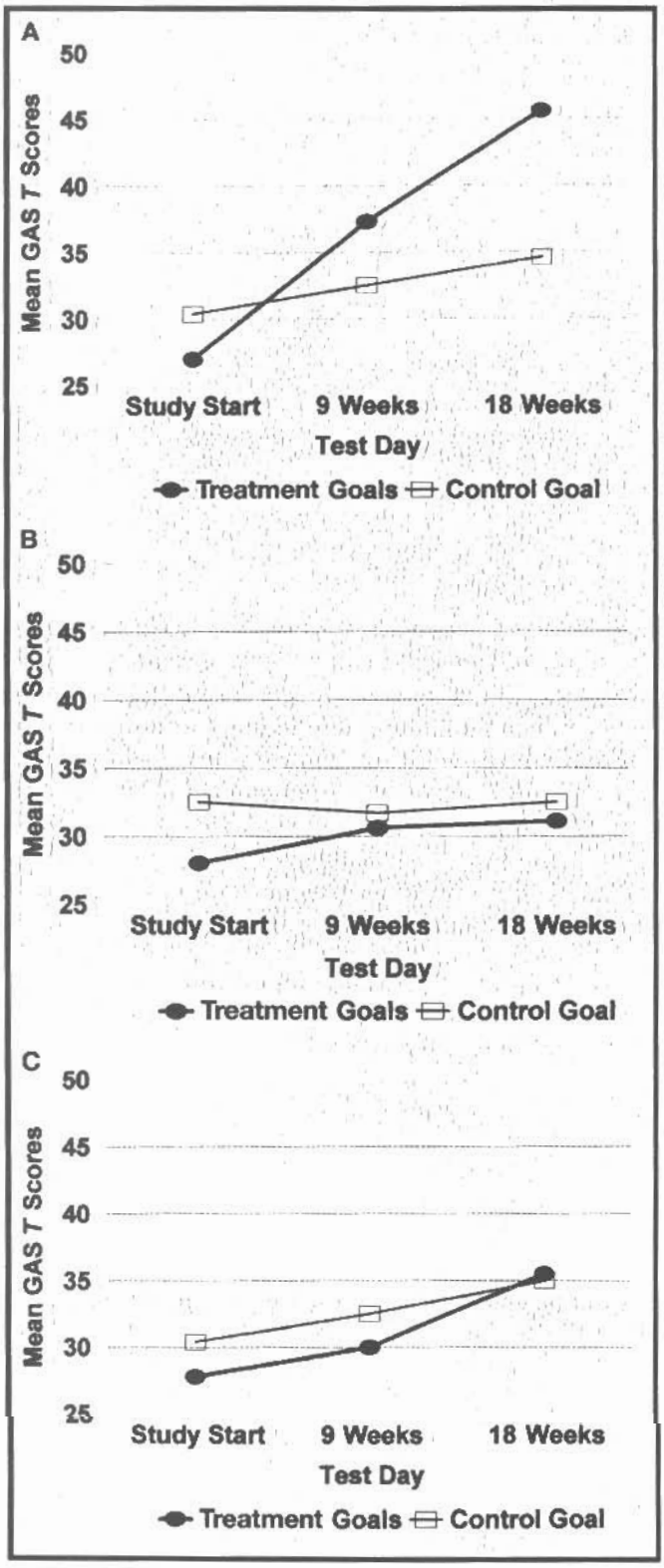

Figure.
Subjects' (N=24) goal attainment scaling (GAS) *T* scores: (A) in the physical therapy setting, (B) in the recess nontreatment setting, and (C) in the home nontreatment setting.

Discussion

Effects of Ability-Focused Physical Therapy

We attributed the subjects' higher GAS *T* scores for treatment goals compared with control goals to the effects of ability-focused physical therapy. The effect size (d=1.69) was large, and the goal type × test day interaction for the ANOVA indicates a differential change between GAS *T* scores for treatment versus control goals across the initial, 9-week, and 18-week test days. Additionally, each subject's control goal was randomly selected, which minimized the probability of differences in difficulty between treatment and control goals. Based on our experience, we suggest that the characteristics of the subjects in this pilot study are representative of the population of individuals with severely limited physical and cognitive abilities. Furthermore, treatment was provided by one physical therapist who had extensive experience and skills working with this population. Future research will need to include other subject samples and treating therapists before the efficacy of ability-focused physical therapy can be asserted for individuals with severely limited physical and cognitive abilities.

The results of our study support the findings of 5 other studies of physical therapy interventions,[7–11] suggesting that the techniques included in our ability-focused approach to providing physical therapy were effective in teaching gross motor abilities to individuals with severely limited physical and cognitive abilities even though there was transfer to the home setting for only 46% of the treatment goals. In contrast, 4 other studies that investigated individuals with severe physical and cognitive disabilities demonstrated little or no improvement in gross motor abilities following neurodevelopmental treatments or vestibular stimulation.[13,14,60,61] Those studies focused treatment on quality of movement patterns and postural reactions based on normal development. This approach is different from our approach, where the focus was on initial learning of simple gross motor tasks that might later be combined with other simple movements to enable performance of a task meaningful to the subjects and their caregivers. We emphasized strategies that we believed were specific to the learning needs of individuals with severely limited physical and cognitive abilities. We think the strength of our approach is that physical therapy procedures were incorporated into strategies commonly used by psychologists and educators to enhance the learning of individuals with severe disabilities.

Maturation probably did not contribute to improved attainment on the control goals, because the mean age of the subjects was 20 years. A training effect from testing of control goals was unlikely, as the testing was sparse. Rather, the tendency for the subjects to make small gains

Table 4.
Matched-Pair *t* Tests of (GAS) *T* Scores for Treatment Goals When Subjects First Reached the Expected Level of Goal Attainment in Physical Therapy, by Setting

GAS *T* Scores for Physical Therapy Setting Versus Recess Setting

Setting	N	$\bar{X}$	SD	SE	Range
Physical therapy	27	50.0	0	0	50.0–50.0
Recess	27	35.9	11.5	2.2	20.0–60.0

Mean difference=14.1 (SD=11.5, SE=2.2)
t value[a]=6.35, *df*=26, 1-tailed $P<.00001$, $d=2.49$

GAS *T* Scores for Physical Therapy Setting Versus Home Setting

Setting	N	$\bar{X}$	SD	SE	Range
Physical therapy	27	50.0	0	0	50.0–50.0
Home	27	42.2	12.0	2.3	20.0–60.0

Mean difference=7.8 (SD=12.2, SE=2.3)
t value[a]=3.31, *df*=26, 1-tailed $P<.005$, $d=1.30$

GAS *T* Scores for Recess Setting Versus Home Setting

Setting	N	$\bar{X}$	SD	SE	Range
Recess	27	35.9	11.5	2.2	20.0–60.0
Home	27	42.2	12.2	2.3	20.0–60.0

Mean difference=6.3 (SD=14.5, SE=2.8)
t value=2.26, *df*=26, 2-tailed $P<.01$, $d=0.89$

[a] Based on the SE of the mean in the non–physical therapy setting.

on control goals most likely reflected the subjects' positive relationship with, and a sense of knowing how to respond to, their therapist. These observations suggest that social interaction and self-initiation may also be important for initial learning of gross motor skills in individuals with severely limited physical and cognitive abilities.

Our primary objective was to examine whether the subjects would demonstrate a small change in the gross motor abilities that were practiced in the physical therapy setting, yet a change that would be meaningful to their caregivers. The gross motor abilities were thought to be functionally relevant and reflected the judgment of each subject's interdisciplinary team on the change expected over an 18-week period. Our study was restricted by limited knowledge of 3 questions that are important for outcome-based research. These questions are: (1) How is *function* defined for this population? (2) What are the changes in gross motor function that individuals with severely limited physical and cognitive abilities are capable of making? and (3) What constitutes change in motor ability that is meaningful to individuals and caregivers? A better understanding of these issues is essential to investigation of the effectiveness of physical therapy for individuals with severely limited physical and cognitive abilities.

Transfer of Gross Motor Ability

As hypothesized, the subjects' improved attainment of goals in the physical therapy setting did not transfer fully to their recess or home settings. Only 4 subjects (17%) demonstrated transfer of gross motor ability to the recess setting for both of their treatment goals. Subjects performed as well in the recess setting as in the physical therapy setting on 36% of the goals practiced in the physical therapy setting. These findings are similar to those reported for transfer of cognitive and language abilities in individuals with severely limited cognitive abilities.[16] Little has been reported on transfer from therapy to home settings.[7,10] In our study, only 4 subjects (17%) also demonstrated transfer of gross motor ability to the home setting for both treatment goals. Subjects performed as well in the home setting as in the physical therapy setting on 46% of the goals practiced in the physical therapy setting.

Three factors, related to the study design and procedures, may have contributed to the lack of transfer of gross motor ability. Constraints imposed by the study design required that each subject's interdisciplinary team be unaware of which goals were practiced in therapy. Staff members and caregivers, therefore, were not permitted to observe and participate in physical therapy, a departure from conventional practice. If the

staff and caregivers who prompted the subjects to perform the goals in the recess and home settings had knowledge of the treatment goals, they may have inadvertently assisted the subjects in practicing the goals. Such knowledge would have confounded investigation of transfer of gross motor ability and potentially biased how the subjects were prompted on test days.

The lack of transfer of gross motor ability also may be related to the higher amount of distracting visual and auditory stimuli present in the recess and home settings. Individuals with visual impairment may be irritated by what is considered proper lighting. All except 2 of the subjects demonstrated a preference for reduced general stimuli, particularly visual stimuli. Therefore, during treatment the amount of lighting was intentionally reduced, although it was not reduced during videotaping in any setting to maintain a balanced comparison among settings.

The greater percentage of goals in which subjects demonstrated transfer of gross motor ability to the home setting compared with the recess setting may reflect differences among the persons who prompted the subjects to exhibit motor behavior in each setting. Recess at the state developmental center consisted primarily of group activities involving limited, short-duration, one-on-one contacts. Two of the 3 recreation technicians never appeared comfortable prompting subjects during test days and repeatedly requested therapist guidance on how to motivate the subjects. In the home setting, although some caregivers initially were uncomfortable when asked to prompt subjects to perform gross motor tasks, they developed confidence as the study progressed.

Although subjects were able to perform new gross motor tasks when prompted by their therapist in the physical therapy setting, their abilities in performing these tasks often did not consistently transfer (the term "generalization" is used in special education[60]) to recess and home settings. Similar setting-specific findings for communication and fine motor skills have been reported for individuals with severely limited physical and cognitive abilities.[58] The partial transfer of ability to other settings suggests that, for this population, providing physical therapy in an isolated setting is not always effective when the goals are to improve function and to reduce the amount of caregiver assistance needed to perform activities as part of daily routines in home, education, and community settings. Further research is needed to determine whether provision of physical therapy in natural environments and use of planned methods to improve transfer will result in more consistent transfer of abilities to other environments and increase spontaneous, unprompted use of these abilities.

Conclusion

The purpose of our study was to examine whether individuals with severely limited physical and cognitive abilities improve gross motor abilities when given ability-focused physical therapy. After 18 weeks of ability-focused physical therapy provided in an isolated setting, 24 subjects aged 3 to 30 years had higher GAS *T* scores for treatment goals compared with control goals. The results are attributed to the emphasis in physical therapy on subject-preferred methods of moving and incorporation of strategies used by psychologists and educators to enhance learning of individuals with severely limited physical and cognitive abilities. The subjects' level of goal attainment in the therapy setting, however, did not transfer to their recess and home settings. The results suggest that physical therapy provided in an isolated setting is only partly effective when the goals are to improve the ability of individuals with severely limited physical and cognitive abilities to perform motor activities as part of daily routines.

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Appendix 1.
Outline of the Ability-Focused Method of Physical Therapy Used in This Study

Service Delivery Components

- Isolated physical therapy area in individual's school (common practice and required by study design, **not** part of ability-focused method)
- Staff and family not informed of individual's progress and did not train gross motor goals (**not** part of ability-focused method, but necessary for control in study)
- Student and family aim-oriented therapy goals[15]
- Task-specific individual physical therapy treatment[21]

Preparatory Physical Therapy Techniques

- Prolong stretching to 2 min per hold[19,22]
- Facilitate low muscle tone by vibrating or tapping the weak agonist muscles[23,24]
- Use reflex-inhibiting movements, slow rocking, or pressure on the tendons to decrease resistance from spastic antagonists to movement[25–27]
- Use environmental changes and positioning to increase the likelihood that the individual will anticipate the varied times and places to use new ability
- Fade above techniques as individual ability and strength improve to avoid a dependence on therapist that will block skill transfer[18]
- Use starting positions that ease the desired motion with gravity or physically block nonuseful options and require the motion[28]
- Use modeling to decrease individual need for verbal guidance[29]

Behavior Management Strategies Used During Practice of Goals

- Use least-to-maximum multimodal antecedent prompts until ability emerges, then decrease verbal and tactile prompts until only natural situational cues signal the need to use the ability[17,30]
- Vary training materials and style of presentation to avoid boredom and satiation
- Reinforce correct responses, improved effort, or approximations of desired responses[31]
- Use individual-specific, age-appropriate reinforcers[32]
- Give continuous reinforcement for approximations of target ability and improved effort until initially learned, then give reinforcement intermittently to maintain ability[33,34]
- Where tasks can be broken into components, practice partial elements and intersperse the component practice with high-probability-of-success, individual-choice-relevant tasks to decrease problem behaviors[35]

Communication Principles Used During Practice of Goals

- Remain sensitive to individual's cues regarding his or her interests and needs[20,36]
- Adjust intensity of sound, lighting, and touch low enough for individual's tolerance, yet high enough to encourage alertness[30,32]
- Set level of challenge between individual's need for both security and risk-taking[5,37]
- Use simple, clear, concise, age-appropriate language
- Allow time for processing of language (eg, respect individual's latency of response by spacing brief requests)[33]
- Use gesture or full-contact deaf-blind signing, as appropriate
- Maintain a positive emphasis; for example, say "Good trying," "Interesting way," or "How clever"[33,38]
- Use the word "No!" only to warn of immediate danger; use "Try another way" to guide[16]
- Allow individual to learn at own pace, through own trials and experiences, providing feedback (knowledge of results)[37,39]
- Initially align your body in direct contact with the individual to ease learning body parts and imitation of desired movements and posture[2,26]
- Respect individual need for nurturing, followed by looking for individual resonance signals to continue a motion passively, followed by co-active action (parallel imitation), then distance (fade) your prompts[2,40]

Physical Therapy Techniques During Practice of the Goals

- For weak agonists, recruit muscles into synergistic contraction patterns by repetition of approximate movement, shaping performance to the desired ability[41]
- Use spaced, brief-massed practice (high repetition of one ability at a time) with rest periods, as needed[42]
- When needed, suggest what the individual moves, and how, while respecting the individual as an active learner and problem solver[43]
- Use adaptive devices (orthoses or equipment) to bypass disabilities that will not change[44]
- Include strengthening and endurance activities in spiral movements (the "diagnosis" of proprioceptive neuromuscular facilitation literature) matching muscle alignment[42]
- Use weight bearing, approximation of joints, and rhythmic stabilization techniques[42,45]
- Select positions that use gravity to initially help, or later resist, movements[25]
- Use head-position-initiated postural reactions to guide movement, when available, until strength, endurance, and awareness adequate to attempt ability without such guidance[6,46]
- Guide movements minimally, allowing the individual to experience the consequences of self-initiated variation in position, timing, and force[47–49]

Appendix 2.

Case Description for Subject 10 and the Visual Analog Scale Used to Assess His Caregiver's Impression of the Potential Usefulness of the Selected Goals[a]

Chris is a 22-year-old man with Pierre Robin syndrome and global profound developmental delay. He is nonverbal and tends to get skin rashes. Complications from left pelvis surgery resulted in left hip joint dislocation 6 years before. Chris' worsening moderate kyphoscoliosis was a major concern for his father and caregivers. Trunk bracing had not slowed the trend toward increasing trunk deformity, thought to be related to the weakness of Chris' postural muscles. His father was also concerned about Chris' lack of protective reactions because Chris spontaneously assumed a sitting position but did not lower himself to the floor or a mat safely. Chris' standardized test scores were: PAR adaptive behavior age=10 months, PAR ambulatory age=0.5 year, PDMS-GM basal/ceiling levels=0/12–14 months, PDMS-GM age equivalent=4 months, PDMS-GM scaled score=389.

Visual Analog Scales Completed by Student Caregivers Functional Movement and Posture Training Study

The 3 training goals identified by our study for Chris and approved for his IEP are listed below. We are told you provide at least 20% of Chris' care. We want to know how important these objectives are to Chris. We will ask only 4 questions. You will not have to give us your name.

Please place a vertical mark across the line below between the arrows showing how useful Chris might find the ability described, both now and in future settings. Do this for each goal:

Goal L3: Chris will improve his neck and upper back strength to counteract his trunk deformity. When placed on his stomach on a mat with his elbows by his sides and given a novel object to obtain, Chris will, on 1 of 3 trials in physical therapy:

−2 attempt holding his head erect (baseline)
−1 raise his head to midline, chin touching mat
0 clear his chin from the mat, head in midline
+1 raise his head to vertical midline
+2 raise his head to vertical midline, then extend a hand above shoulder level to get object

Of No Help >———————————< Very Useful

Goal L4: Chris will improve his posture and propping reactions for safety. When placed on his back on a mat with his left side blocked and given a novel object to obtain, Chris will, on 1 of 3 trials in physical therapy:

−2 roll to his left side to sit up, if not blocked (baseline)
−1 roll to his right side to attain partial side-sitting, propped on right elbow
0 roll to right side to attain full side-sitting
+1 push himself to right side-sitting using both hands
+2 roll to right side using counterrotation, prior to coming to sitting

Of No Help >———————————< Very Useful

Goal L5: Chris will develop an ability to protect himself during falls. When supported by his waist, with his head tipped toward the floor mat, Chris will, on 1 of 3 trials in physical therapy:

−2 over a padded barrel, take no weight on both hands (baseline)
−1 over a padded barrel, actively extend both hands, touching mat
0 over a barrel, maintain weight on hands for 2 seconds
+1 when placed in 4-point posture without barrel, maintain weight on hands and knees for 2 seconds
+2 when placed in 4-point posture without barrel, maintain weight on hands and knees for 5 seconds

Of No Help >———————————< Very Useful

On about how many of the upcoming 100 days do you expect to be Chris' primary caregiver?

_____ days.

Today's Date: _____.

Please let us know the names of, and how to contact, any other caregiver(s) who may be doing over 20 days of Chris' care during the next 100 days below:

_____

YOU DO NOT NEED TO SIGN THIS FORM

When completed, please put this questionnaire in the enclosed envelope and drop in the mail.
Thank you for your time and help! Subject 10

[a] PAR=Preschool Attainment Record,[50] PDMS-GM=Gross Motor Scale of the Peabody Developmental Motor Scales,[53] IEP=individualized education program.

Invited Commentary

Upon initially reading the article by Brown and colleagues, I was enthusiastic about a study focusing on issues facing children, youth, and young adults with severe physical and cognitive disabilities. The study involved a substantial sample for this population (ie, 24 people), and the authors described a well-designed and well-executed study. Of particular interest to me was the seemingly eclectic approach introduced by the authors: ability-focused therapy. Brown et al described this approach as being designed for use with people with limited ability to learn skilled actions, with the emphasis focusing on instruction of "simple motor behaviors that are meaningful in the . . . current or future environment." The authors' description of ability-focused therapy denoted that normal movement was not the end result, but functional movement that was meaningful for the person was the intended outcome. The concept of ability-focused therapy embraces long-standing strategies well supported in other fields, particularly in the areas of special education and psychology. I have concerns, however, relative to the philosophical basis for 3 aspects of the study: (1) generalization or transfer of learning, (2) functional outcomes, and (3) age and experiences of the learner.

Understanding learning characteristics and matching learner needs to instruction is a primary skill for effective teaching and successful learning to occur. When the learner has a disability, particularly a cognitive impairment, understanding learning traits is even more crucial. We know that students with severe disabilities: (1) need increased time and increased repetitions to learn, (2) have the ability to learn a limited number of skills, (3) have a decreased ability to learn complex skills, (4) will forget a skill if they are not given the chance to use the skill within a functional context, (5) have decreased ability to generalize information or transfer skills learned in one environment to a different environment or different situation, and (6) have decreased ability to synthesize information and utilize new information in a new or uncommon situation.[1] The authors report that no studies exist on the transfer of gross motor abilities following physical therapy in which the individual was also prompted by people present in natural environments. We do have information, however, to support the notion that pull-out, isolated therapeutic intervention in simulated environments is not an effective means for students with disabilities to learn and retain new motor skills.[2–6] Given this information, I question the rationale for conducting this study. I believe adequate information currently exists for us to expect that the subjects in this study would not successfully transfer the targeted skills to the natural environments when the instruction occurred in an unnatural, artificial one (ie, physical therapy setting).

My additional concerns with this study revolve around the notion of functional learner outcomes and the age and experiences of the learner. Some studies[7–9] have identified key factors that affect generalization. Selecting skills that are likely to be naturally reinforced and that are used frequently and in many situations is a key factor in successful generalization. Although intervention has historically focused on deficient skills with the assumption that isolated skills must be learned and then eventually transferred to functional activities,[10] we now know that for learners with severe disabilities, task-specific instruction must take place in the natural environment for retention to occur.[1,7–10] Although I support the authors' use of goal attainment scaling (GAS) as an effective method for measuring outcomes for people who may not make substantial or rapid progress, I question the types of goals chosen for the subjects in the study, such as head control, propping on forearms, protective extension, and reaching and grasping to midline over the chest while positioned supine. Furthermore, in the example provided for Chris, a 22-year-old young man with severe delays, the goal was to improve his neck and upper back strength to counteract his trunk deformity. The GAS then involved rating Chris' performance on a prone propping activity, which is not a functional goal or an appropriate activity for most 22-year-old men. Another concern is that even if the activity were appropriate, it is difficult to imagine how opportunities for prone propping could be easily incorporated into Chris' daily routine. This goal obviously was derived from a philosophical approach that embraces a more developmental model. For example, this type of goal would be appropriate for an infant 4 to 6 months of age.

Considering Chris' age, past experiences, and level of disabilities, it is also difficult to believe that meaningful gains will be made in the area of head control. The example states that the progressive trunk deformity is a family concern. I would want to know how the kyphoscoliosis interferes with Chris' daily routine. We also, however, must consider available evidence on the effectiveness of bracing and exercise to prevent further structural deformity. What we know is not very promising regarding counteracting Chris' present structural problems.[11] If Chris' family wants him to hold up his head, he must be provided with ample opportunities and motivating stimuli to do so throughout the day while in his wheelchair. Therefore, goals involving using a computer, social interaction, eating, or grooming would be appropriate avenues to explore for Chris. For youth and young adults with severe disabilities, the literature is quite sparse regarding effective intervention strategies, especially in the area of physical therapy. Incorporating evidence we know to be true regarding systematic

instruction and using common sense, however, should assist us in developing an appropriate research agenda regarding therapeutic intervention for youth and young adults with severe disabilities.

To quote Rothstein, "Evidence is what is published in credible and respected journals. We should practice based on evidence that tells us what works. We also should stop doing what *doesn't* work, based on evidence. But the biggest challenge is to do our best in the uncertain world that exists between those two extremes."[12(p800)] Learning is learning. It is time for us to embrace the evidence we know to be true, whether we like it or not. Yes, it means giving up therapy rooms and vacating clinical settings so that instruction occurs in typical life settings with naturally occurring prompts and consequences. Our research should be leading the way, investigating how to best use the evidence we have. The process in which information is presented to students with disabilities is as crucial as the actual content. We must shift the focus of our intervention planning to encompass not only what to do, but also where and how to do it.

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Author Response

We appreciate Dr Shelden's thoughtful comments and agree with her perspective that evaluation of the effectiveness of physical therapy requires evidence that intervention improves function in contexts that are meaningful to individuals with limited physical and cognitive abilities, their families, and others who interact with them on a regular basis. Our study was not designed to address this question. Our aim was to begin to examine a model of physical therapy for individuals with limited physical and cognitive abilities. *Research models* have been defined as "idealized constructs that typically incorporate a number of variables and are used by scientists both to visualize and to test theories."[1] Transfer of learning, functional outcome, and relevance of age and experience of the learner are constructs within the ability-focused intervention model that require critical examination.

We believe that a better understanding of 3 issues is essential to investigation of the effectiveness of physical therapy for individuals with limited physical and cognitive abilities. As stated in the discussion, these issues are: (1) How is function defined for this population? (2) What changes in gross motor function are individuals with severely limited physical and cognitive abilities capable of making? and (3) What constitutes change in motor ability that is meaningful to individuals and caregivers? We have attempted to address these issues as well as fill a gap in the literature on transfer of learning. The subjects in our study had a mean age of 20 years, chronic and severe cognitive and physical limitations, and multiple diagnoses. Most of the studies cited by Dr Shelden included children with cerebral palsy or Down syndrome and preterm infants. Furthermore, transfer of skills in individuals with severe cognitive and physical limitations has focused on the c! ommunication, behavior, and fine motor domains.[2]

We agree with Dr Shelden that "understanding learning characteristics and matching learner needs" are essen-

tial. That is precisely why the goals reflected outcomes that were judged to have a high probability of being achieved within 18 weeks. The goal-setting teams agreed that the selected abilities were components necessary for eventual acquisition of functional outcomes. Thus, the term "gross motor ability" was used instead of "function." Our contention that the goals were meaningful is supported by the feedback provided by the caregivers. Had functional outcomes been selected that exceeded what the subjects were capable of achieving in 18 weeks, we would not have been able to investigate transfer of ability in the home and recess settings.

Although many of the subjects' goals involved postures and movements associated with the motor development sequence, our rationale for selection was not based on a developmental perspective. Rather, the focus was on postures and movements that might provide a means to perform a task, reduce the need for caregiver assistance, or prevent secondary impairments. For Chris, the subject described in Appendix 2, the goal of prone propping was selected to counteract a flexible, but severe, kyphosis. The rationale was to prevent further cardiopulmonary dysfunction and pain. We believe that, for individuals with severe physical and cognitive limitations, consideration should be given not only to improved motor function but also to prevention of secondary complications that could compromise quality of life.

In conclusion, as noted by Dr Shelden, physical therapists need to consider goals that reflect abilities that will be "used frequently and in many situations" and "are likely to be naturally reinforced." Our study presents a model that we hope will prove useful in investigating how to maximize function and minimize disability for individuals with limited physical and cognitive abilities. We encourage others to critically examine the model in attempts to provide evidence of what constitutes high-quality services for individuals with limited physical and cognitive abilities.

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