One of the major themes during the 2005 III STEP (Linking Movement Science and Intervention) conference was the use of the World Health Organization’s (WHO) *International Classification of Functioning, Disability and Health* (ICF)\(^1\) to delineate the “components of health”\(^2\)\(^3\) of people with neurological conditions.\(^2\) The ICF synthesizes earlier disablement models,\(^3\) such as the WHO *International Classification of Impairments, Disabilities, and Handicaps* (ICIDH)\(^4\) and the Nagi model,\(^4\) which was used in the *Guide to Physical Therapist Practice*\(^5\) and is intended to provide a common language for discussion of function, disability, and health in research, clinical practice, health policy, and other arenas.

The ICF views health and disability as the result of the interaction between a health condition (eg, spinal cord injury) and contextual factors, including those related to the person and the environment. A health condition can be classified by 3 interrelated domains: body structures and functions, activities, and participation. The spinal cord is an example of a body structure; muscle contraction is an example of a body function. Activities are specific tasks or actions, such as rising from a chair, walking, and climbing stairs. Participation is “involvement in a life situation,”\(^6\) such as situations in kindergarten, home, and community. The ICF also considers environmental and personal factors that contribute to each domain and to the health condition.

An aspect of the ICF that Behrman et al\(^6\) illustrated well is that the components of the model are not necessarily linear. With some models, an assumption would be that the child’s ability to walk would depend on improvement in his lower-extremity muscle function. In this case, the child’s Lower Extremity Motor Score did not change, and the score continued to predict he would not walk—but he did.

The change in the child’s ability to walk, from being unable to stand or take a step to walking without assistance with a walker, is impressive. Measurements of his walking ability included his gait speed, the average number of steps he took during a day, and his score on the Walking Index for Spinal Cord Injury II (WISCI-II) scale.\(^7\) His self-selected gait speed averaged 0.41 m/s, he walked an average of 2,844 steps per day, and his WISCI-II score indicated he was able to walk 10 m using a walker without assistance or braces. All of these measurements clearly showed improvement in his activity. Clinicians, however, are likely to also want to know about the child’s activity and participation in the context of his daily life, such as school, home, and the community.

The report by Behrman et al gave an indication when it stated, “Four months after completion of [locomotor training], he attended kindergarten walking independently with full-time use of a walker.” It also stated that he could walk on level ground and “could not stand without external support or independently move from a sit-to-stand position.” This information raises more questions. Was the child able to assume a standing position in his walker by himself? Was he able to keep up with his classmates when walking in a line? Was he able to walk as far as the playground and play once he was there? Was he able to use the toilet by himself? The answers to these and other questions require both comparison of the child’s abilities with those of children of the same age who are developing typically and measurement of the child’s activity and participation in his own environments.

The fastest speed that the child could walk was 0.48 m/s, and at the 1-month follow-up, his usual self-selected walking speed was 0.41 m/s. Without a context, however, the numbers are relatively meaningless. Readers can see that his speed increased, but was he able to keep up with his kindergarten peers? David and Sullivan\(^8\) measured the walking speeds of children in elementary schools and identified the slowest speed that teachers considered “good enough.” For children in kindergarten, the mean speed while walking 15.24 m (50 ft) was 1.13 m/s, and 95% of the children walked between 0.81 and 1.88 m/s. Kindergarten teachers reported a mean “good enough” time of 0.78 m/s.

Waters and colleagues\(^9\) reported similar data. They asked children aged 6 to 12 years to walk at their usual normal, slow, and fast speeds. Although the children were older than the child in the report by Behrman and colleagues, their normal walking speed was 1.16 m/s, similar to the 1.13 m/s that David and Sullivan\(^8\) measured as the mean walking speed of kindergarten children. The children’s mean slow speed was 0.92 m/s and their mean fast speed was 1.47 m/s, which were similar to the mean speed of 0.94 m/s (SD=1.41) in the study by David and Sullivan.\(^8\)

Comparison of the speed of walking of the child in this report with average speeds of children who were developing typically in the other 2 studies\(^8,9\) indicates his walking probably was far slower than the average speed of his kindergarten classmates.
This suggests that the child most likely was left behind at least part of the time. A comparison of the number of steps per day that the child took with the number of steps that children who are developing typically take also would have helped readers to understand his activity compared with his peers. The report states that the child walked an average of 2,844 steps per day, but what does this mean? I was not able to find data specific to kindergarten age boys, but 3- to 4-year-old children in Japan whose teachers judged them to be “inactive” walked an average of 10,038 steps per day. Other studies found that boys with a mean age of 9.6 years averaged 12,709 steps per day and boys aged 6 to 12 years averaged between 12,300 and 13,989 steps per day. The child in the current report walked many fewer steps per day than the children in those studies, again suggesting that his mobility was limited and that he probably was not participating fully in his school, home, and community environments.

Two measures that would have helped to describe the child’s activity and participation in school and at home are the Pediatric Evaluation of Disability Inventory (PEDI) and the School Function Assessment (SFA). The PEDI measures the self-care, mobility, and social function of children with disabilities. It addresses not only function (activity) in each of the areas, but also the amount of caregiver assistance and modifications needed in daily self-care, mobility, and social activities (participation). The SFA also was designed for children with disabilities and measures children’s participation and performance in kindergarten and elementary school activities and documents the supports that a child needs to participate and perform in those activities. Use of these or similar measures would have given readers a much better picture of the child’s functioning. Clinicians also are likely to want to know how much energy the child required to walk. Reporting of energy expenditure, such as by use of an energy cost index, with comparison to children of the same age who are developing typically, would have helped to complete the picture. Qualitative information about the perceptions of the child and family also would have been informative. They probably were pleased with the child’s ability to walk, but what did they perceive as the benefits and the difficulties?

The supplemental video (available online at www.ptjournal.org), which shows the child walking at various times during the training, is an excellent addition to the report. It raises another question, however, that clinicians are likely to ask: Why did the researchers choose to not have the child use orthoses to help him achieve a more plantigrade gait? The video suggests that he had difficulty clearing his toes during the swing phase, which probably decreased his speed and increased his energy expenditure.

The ICF is intended to promote communication about function, disability, and health. Research that measures not only body function and activity in a laboratory setting but also activity and participation in participants’ real-life environments will do much to improve communication among researchers and clinicians, who ultimately are most interested in whether patients are able to do what they want and need to do in their own environments. Based on comparison of the child’s speed and step data with data of children who were developing typically from previous research and based on information that he could not independently stand from a sitting position, I suspect that his walking was somewhat less than functional in at least some settings and that ultimately he and his family would decide that other means of mobility, perhaps as a supplement to walking, would yield more independence at less energy cost. Longer-term follow-up would be informative.

References
We thank Dr McEwen and Dr Edgerton for their thoughtful commentaries on our study.1 It is extremely helpful to receive input on our study of a child following spinal cord injury (SCI) and locomotor training (LT) from clinical and translational perspectives. The contrast between the 2 commentaries shows the striking differences that exist between the past and current cultures of general clinical thinking and the evolving science of rehabilitation and vision for the future. This investigation, among many others, exemplifies the important connection between the basic sciences and the clinic, in particular, the link between LT studies in cats and the human condition after SCI envisioned by Edgerton and others at least 15 years ago.2,3

As McEwen stated, “The change in the child’s ability to walk, from being unable to stand or take a step to walking without assistance with a walker, is impressive.” However, the impact of his ambulatory status on his ability to keep up with others, integrate socially, and participate in his environment is an important consideration identified by McEwen. An evaluation tool that she suggested to describe a child’s activity and participation is the Pediatric Evaluation of Disability Inventory (PEDI). Although not reported in the article, this evaluation was done (Table). The overall score of interest for locomotion is the functional skills—mobility category score. Within this category, item scores changed from 0 (unable) before LT to 1 (capable) after LT. Specifically, improvements were noted in the following subcategories: indoor locomotion methods, indoor locomotion distance and speed, outdoor locomotion distance and speed, and outdoor locomotion surfaces. For caregiver-assisted mobility, a change was seen from total assistance before LT to supervision for indoor and outdoor locomotion and independent bed mobility and transfers after LT.

We agree with McEwen’s comment that “qualitative information about the perceptions of the child and family also would [be] informative.” Therefore, we asked the child’s mother to provide a response to this and other points of interest raised by McEwen (mother’s response available online only at www.ptjournal.org). The mother’s summary reflects the multiple benefits of walking even when performance does not meet age-matched norms. Thus, while examining outcomes relative to the norm is always an important consideration, perfection and normalcy are typically not reasonable goals after a central nervous system injury. The greater focus should be on the value of functional change that results in even incremental improvements in a person’s quality of life. We believe more valid reference points are the child’s performance level prior to training and his progress and benefit relative to nonambulatory children with SCI. Because the mother’s summary is so illustrative, we will not comment further on this aspect.

One of the most common clinical approaches in the absence of active dorsiflexion is the use of ankle-foot orthoses (AFOs). In the current study, even though dorsiflexion was absent bilaterally (as shown by manual muscle testing), AFOs were not used during training because they were...

Table.

Pediatric Evaluation of Disability Inventory (PEDI) Scores Before and After Locomotor Training (LT)

<table>
<thead>
<tr>
<th>PEDI Category</th>
<th>Before LT</th>
<th>After LT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional skills</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-care</td>
<td>40/73</td>
<td>54/73</td>
</tr>
<tr>
<td>Mobility</td>
<td>14/59</td>
<td>25/59</td>
</tr>
<tr>
<td>Social function</td>
<td>62/65</td>
<td>64/65</td>
</tr>
<tr>
<td>Caregiver assistance and modification (caregiver assistance scored)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-care</td>
<td>19/40</td>
<td>23/40</td>
</tr>
<tr>
<td>Mobility</td>
<td>0/35</td>
<td>15/35</td>
</tr>
<tr>
<td>Social function</td>
<td>25/25</td>
<td>25/25</td>
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</tbody>
</table>