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KEY WORDS
• cognition disorders
• learning
• teaching
• user-computer interface
• wheelchairs

The Driving to Learn project explored ways to help people with profound cognitive disabilities practice operating a joystick-operated powered wheelchair. The project used a grounded theory approach with constant comparative analysis and was carried out over 12 yr. The participants were 45 children and adults with profound cognitive disabilities. Reference groups included 17 typically developing infants and 64 participants with lesser degrees of cognitive disability. The data sources included video recordings, field notes, open interviews, and a rich mixture of literature. The findings that emerged yielded strategies for facilitating achievements, an 8-phase learning process, an assessment tool, and a grounded theory of deplateauing explaining the properties necessary for participants to exceed expected limitations and plateaus. Eight participants with profound cognitive disabilities reached goal-directed driving or higher. Participants were empowered by attaining increased control over tool use, improving their autonomy and quality of life.


Cognitive disabilities result from mental retardation, developmental dis-
abilities, brain injury, cerebrovascular accidents, the aging process, and severe mental illness (C. Lewis, 2006). People with profound cognitive disabilities (PCD) often have combinations of physical disabilities, sensory impairments, and health problems, and the exact degree of cognitive function can be difficult to assess reliably because of their reduced cognitive, physical, and communicative capacity (Nakken & Vlaskamp, 2007). People with PCD have limited or no ability to reach, grasp, hold, or manipulate most objects; little or no understanding of verbal language; no evident symbolic interaction with objects; and very limited or no ability for self-support (Nakken & Vlaskamp, 2007; Ross & Bachner, 1998). They have an IQ of 20 or below, a low sense of cause–effect relationships, and a limited awareness of the impact their own actions can have on the environment (Ross & Bachner, 1998). Thus, they may be extremely difficult to assess, keep alert, and engage in any purposeful activity (Ivancic & Bailey, 1996; Nakken & Vlaskamp, 2007). The search for appropriate activities or methods to enhance their abilities to react, act, and interact is a challenge for all professionals working with this population (Ivancic & Bailey, 1996; Nakken & Vlaskamp, 2007).

People with PCD are not thought of as powered wheelchair learners (C. Lewis, 2006; Ross & Bachner, 1998). A search for descriptions of powered mobility interventions for this population in the occupational therapy and assistive technology literatures was unsuccessful, although it is well known that in children with severe physical disabilities who have lesser degrees of cognitive impairment, powered mobility training may increase initiation of movement, provide a general idea of movement, and improve independence and power mobility skills.
Occupational therapy has three core purposes: (1) enabling ability; (2) enhancing quality of life through pleasurable experiences, relationships, and activities; and (3) empowering people by providing autonomy-increasing means (Hagedorn, 1995, p. 33). To attain these purposes for people with PCD, it is necessary to increase professionals’ knowledge of the processes underlying achievements in this population and their ability to give the just-right challenge during individual interventions (Ayres, 1987; Yerxa, 1998). In this article, we explain the significance of using a powered wheelchair intervention with people who have PCD and describe how to use the just-right challenge with this population.

A research project called Driving to Learn explored whether people with PCD could benefit from using a powered wheelchair. The project started in a rural area in Norrbotten, Sweden, with two preschool children with PCD and additional severe physical disabilities, severe visual impairments, and no speech. Their practice in powered wheelchairs was videorecorded, and old and new tapes were repeatedly compared. After 1 yr of practice, the two children displayed increased wakefulness and alertness, the beginning of goal-directed hand use, and an incipient sense of the simple relationship between their action on the joystick and the motion of the chair (Nilsson, 1996, 2007; Nilsson & Nyberg, 2003). The positive achievements of these two children confirmed the importance of continued development of the project.

The aim of the Driving to Learn project was to explore ways to give people with PCD the opportunity to practice using a joystick-operated powered wheelchair. We present strategies for facilitating achievements, an eight-phase learning process, a tool for assessment of joystick use, and a grounded theory of deplateauing.

Method

The Driving to Learn project used a Glaserian classic grounded theory approach (Glaser, 1978; Glaser & Strauss, 1967). The grounded theory principle of theoretical sampling (Glaser, 1978) guided the inclusion of participants and data collection. The project was repeatedly extended to include more participants with PCD of different etiologies, of different ages, with multiple combinations of additional disabilities, and with walking ability, as well as two reference groups of participants with lesser degrees of cognitive disability and typically developing infants. The collection and analysis of data were halted when the pattern of categories, codes, and indicators related to achievements stabilized and reappeared repeatedly in the analyses of new data (Glaser, 1978, 1998). The project was approved by the ethical committee of Umeå University.

Participants

Study participants consisted of children and adults with PCD, a reference group of typically developing infants, a reference group of children and adults with lesser degrees of cognitive disability, and facilitators.

Forty-five children and adults with PCD were included progressively in the project over a 12-yr period. The age at inclusion was between 12 mo and 52 yr, distributed as follows: 14 preschool children (1–6 yr), 18 schoolchildren (7–20 yr), and 13 adults (21–52 yr). Length of participation varied from 1 mo to >6 yr: 9 participated <1 yr, 11 participated between 1 and 2 yr, and 25 participated for >2 yr. At the time they entered the project, 40 participants were assessed as having PCD. Five participants were younger than 2 yr but were assessed to be at high risk of developing PCD. The 45 participants were nonverbal and had, in addition to their cognitive disabilities, combinations of physical disabilities, sensory impairments, and health problems.

A reference group of 17 typically developing infants aged 3–12 mo was formed 5 yr after the project started. Data from participants with PCD were difficult to interpret and sort into a pattern. Infant development is well researched; thus, infant performance provided a stable framework for comparison. We compared observations of how the infants used a joystick (Nilsson & Nyberg, 1998) with indicators of achievement in joystick use of the participants with PCD.

Later in the project, 64 participants between ages 16 mo and 86 years with lesser degrees of cognitive disability formed another reference group (Nilsson, 2007). They were recruited via the pediatric rehabilitation clinic (6), special schools (20), day centers for adults with developmental disabilities (12), and primary health day care centers (26). Thirty-six of the participants had diagnoses of mental retardation, neurodevelopmental disabilities, or both, and 28 had diagnoses of stroke, brain tumor, traumatic brain injury, or dementia. Twenty-four participants were able to walk with or without assistive devices. Project findings indicated that practice in a powered wheelchair can benefit people with lesser degrees of cognitive disability and walking ability. We compared observations of this group with observations of participants with PCD and indicators of achievements in joystick use.

Lisbeth Nilsson—referred to in this article as the researcher—and parents, siblings, other relatives, personal assistants, day care staff, occupational therapists, physical therapists, teachers, and teaching assistants shared the role...
of facilitator. As facilitators, they modulated their interaction to nurture the participant’s curiosity and drive to act on and act with the joystick to explore its function and use. None of the facilitators was employed by the research project; some attended as relatives, and others attended as part of their regular work. The researcher continuously tutored the other facilitators in data collection and the emerging method during repeated follow-up visits or through telephone contacts.

**Joystick-Operated Powered Wheelchairs**

The powered wheelchairs were fitted with specially programmed proportional joysticks. Each wheelchair had a transparent tray with a semicircular recess for the upper body that was attached to the armrests. The control box was mounted in the center of the tray about 5–7 cm from the semicircular recess for the upper body, and only the joystick was above the surface of the tray. The central placement of the joystick close to the body positioned hand movements in midline of the body. This position made accidental activation more likely and gave the participants the choice to use the joystick with both hands. The tray supported the participants’ forearms and offered stabilization of their trunk and head. Protection of the participants was provided by specific programming of the joystick and the use of mechanical buffers. Findings regarding the characteristics of an appropriate powered wheelchair are more thoroughly described and explained in Nilsson and Eklund (2006).

**Procedures**

The procedures emerged slowly as the researcher’s insights grew through explorative interaction with the participants, reading of literature from many fields, and constant comparisons of data. It was an iterative process that gradually developed as an increasing number of participants and facilitators became involved in the project.

The participants practiced free driving in the powered wheelchair, and the facilitators used the constantly developing strategies to stimulate each participant’s curiosity, mutual interaction, and initiative to explore and experiment with joystick and powered wheelchair functions.

**Locations.** Practice in a powered wheelchair took place in pediatric clinics, special schools, day care centers for adults with developmental disabilities, primary health day care centers, and participants’ homes. The first trial was always carried out in a furnished room of <30 m². The smaller size and the furniture provided a pleasant level of sound and possibilities to recognize objects in the close vicinity.

**Length and Frequency of Sessions.** An hour was scheduled for each session, but the actual length depended on the participant’s endurance and level of alertness at the time. Accordingly, sessions lasted from 15 to 90 min. The frequency of sessions varied according to the participant’s health status, the facilitator’s motivation to continue, the availability of an appropriate powered wheelchair, and any important changes in the participant’s circumstances.

In total, 45 participants with PCD took part in >1,000 practice sessions. The number of sessions per participant varied from a minimum of 5 to a maximum of 60. Twenty-three participants took part in >20 sessions. The time intervals between the sessions varied according to each participant’s needs. Typically, participants needed sessions once or twice per week to maintain their latest performance at the beginning of the following session.

**Participants in the Reference Groups.** In general, the procedures for the participants in the two reference groups were similar to those for the participants with PCD but were adjusted to each participant’s level of understanding and ability to interact. The researcher carried out a total of 40 sessions with the 17 typically developing infants. Most of the infants participated in 1 session, although a few completed >1 (once per month to a maximum of 6 sessions). The researcher and other facilitators carried out from 1 to >30 sessions with the 64 participants with lesser degrees of cognitive disability. The number of sessions depended on the participant’s joystick operation skill, access to an appropriate powered wheelchair, access to school or day care activity, motivation to practice, and parent or staff motivation to provide access to practice.

**Collection and Analysis of Data**

Data collection involved videotaping sessions with the participants with PCD supplemented by taking field notes and conducting open interviews with facilitators and other people acquainted with the participants. The videotapes were frequently made with a wide-angle camera lens mounted on a tripod and placed to give the best possible view of the location. The recordings were continuous and of the same length as the session. If a participant grew more conscious of the steering pattern and used a wider environment for driving, a handheld video camera was used, and the recordings became shorter than the length of the session. Approximately 390 sessions were videotaped, providing a total of 280 hr of videos for analysis.

All facilitators made field notes on their observations of changes in participants’ reactions, behaviors, or activities during the sessions. Additionally, the researcher wrote field notes on utterances, comments, reflections,
and reactions by facilitators and other people within the participants’ social context.

The open interviews with the facilitators and other people acquainted with the participants focused on their view of the participants’ experiences during practice, their own experiences of being facilitators, and whether they could recognize any changes in the participants’ behavior over time.

**Constant Comparative Analysis of Data.** The collection and constant comparative analysis of data were focused on indicators of achievement in the participants’ reactions, behaviors, acts, and interactions during the powered wheelchair practice. The researcher paid special attention to small signs of novelty and change in the participants’ approaches to joystick use and attitudes toward the practice context. She repeatedly viewed, rewound, and re-viewed the first 20 hr of videotapes in short sections (from seconds to a couple of minutes) to achieve a detailed description of what she was observing. This procedure is necessary in constant comparative analysis to become more acquainted with and attuned to detection of small deviations in the participants’ diverse activity repertoires. The researcher viewed the remaining 260 hr of videotapes at least twice to check for changes in participants’ behaviors, actions, and interactions with the powered wheelchair over time. She observed novel behaviors in participants’ activities and interaction approaches and in facilitators’ attitudes in the videotapes, and she constantly compared her observations with data from field notes and open interviews. She invited parents, relatives, teachers, and caregiving staff acquainted with the participants to observe video clips of core situations that she interpreted as possible achievements to gather further possible interpretations of the events she observed.

Repeated constant comparisons of new and old observations of novel behaviors or changes in the participants’ acts or interactions with the facilitators enabled the detection of small deviations in participants’ activity. The detected deviations were key to providing reflections on interrelationships between participant activity and changes interpreted as achievements after practice in a powered wheelchair.

**Comparisons With Reference Groups and Literature.** The researcher compared participant activity interpreted as novel behaviors or changes with the joystick use of the typically developing infants and the participants with lesser degrees of cognitive disability. These procedures led to the identification of a hierarchical incremental pattern in the 45 participants’ development of joystick use. Finally, she compared the results with each reference group’s higher-level achievements to confirm such indicators of development, which were found in only a few of the 45 participants. She read a rich mixture of literature from other areas and fields (e.g., activity theory, motor control, psychology, cognition, pedagogy, emotion theory) to inform the emerging theoretical framework throughout the project (Glaser, 1978, 1998).

**Interrelationships.** Parallel to the emergence of a pattern in the 45 participants’ achievements, the constant comparison focused on interrelationships between the participants’ possible achievements and the physical and social context of the practice. This part of the analysis focused on data from segments of the videotapes and written notes that concerned the facilitators’ and others’ approaches to stimulate the participants’ joystick use and attitudes toward the participants’ potential benefits from the practice. Thus, this analysis concentrated on interrelationships between the participants’ achievements and aspects of the physical and social context, which provided the key to understanding and interpreting what could be identified as facilitating or hindering strategies for people with cognitive disabilities practicing in powered wheelchairs.

**Findings**

The 45 participants with PCD all, to some extent, benefited from practicing joystick use in powered wheelchairs. Typical powered wheelchair intervention strategies with tests, directing instructions, and training programs were not relevant for this group of people. During the first years of the project, it was difficult to sort different indicators of possible achievements in a systematic way to detect whether they had a special order of appearance and whether they were related to each other. As the project developed, the researcher and other facilitators became more attuned to recognizing and interpreting the participants’ behaviors, acts, and interactions.

**Growing Awareness of Facilitating Strategies**

Awareness of which strategies facilitated joystick use grew slowly as the researcher practiced with more participants, cooperated with more facilitators, and engaged in constant comparisons of data. The facilitating strategies were distinguished in parallel with the emerging understanding of the achievement patterns. The researcher identified the following strategies as most important for nurturing participant attainments:

- Using reassuring, calming interaction to build a reliable and mutual relationship
- Coupling cause–effect relationships (i.e., the participant’s own activity on the joystick set the chair in
motion; thus, the chair should move only when the participant was involved in the joystick activation)

- Providing manual guidance to show functions and facilitate activity or to demonstrate possible joystick use and problem solving
- Directing attention to the consequences of activity and interaction
- Emphasizing effects from the participant’s own activity to stimulate development of a sense of self and agency
- Using meaning-making language with descriptions, interpretations, explanations, and questions to enhance understanding of effects and consequences
- Allowing long time sequences for responses and initiative to act and interact
- Allowing collisions to provide bodily experiences of bumping into things
- Offering contact and interaction to facilitate object manipulation
- Encouraging reflection, touch, manipulation, exploration, experimentation, turn taking, and choice making
- Using verbal encouragement, prompting, and single words or very short sentences imperatively to instill words with meaning
- Connecting doing (i.e., the act) with language by verbal labeling of body parts, objects, acts, and interactions
- Avoiding isolated judging comments or loud expressions that might cause anxiety, passivity, fright, or shame
- Stimulating mutual interaction, discourse, and dialogic inquiry
- Inspiring the participant’s own initiative to act on or act with the joystick to drive or navigate
- Deciding on options, proposals, exercises, and setting of rules in cooperation.

The facilitator’s level of knowledge and the participant’s degree of cognitive disability, current state, and needs influenced the choice, order, and combinations of strategies used in a session. The facilitators’ gradually growing consciousness of facilitating strategies was associated with an increasing ability to differentiate the participants’ individual needs for interaction.

### Mutual Interactions Among Actors in the Process

Mutual interactions between the researcher and other facilitators took place in the continuous exploration of possible facilitating strategies and in experimentation to determine what stimulated the participants’ attainments. The interrelationships the facilitators discovered between the facilitating strategies and the participants’ achievement patterns assisted in the development of mutual interactions between facilitators and participants. It was a strongly motivating experience for the facilitators to grow conscious of how they could stimulate the participants to attain small achievements. This consciousness made the facilitators more engaged and interested in investing time and energy in the practice. By becoming more attuned to recognizing participants’ achievements, the facilitators grew more conscious of the strategies’ potential and of their own abilities to facilitate the participants’ growing consciousness. Facilitators observed that the successes achieved using the strategies during practice sessions positively influenced their expectations of the participants’ progress. The facilitators also articulated that successful experiences during practice sessions influenced their approaches to and attitudes toward interaction with the participants in other activities.

### Growing Consciousness of Joystick Use

The facilitators’ increased awareness of facilitating strategies led to demonstrations by the participants of increasingly complex attainments in joystick use. The participants’ patterns of achievements, ranging from very simple to more complex, showed in their emergent abilities to manipulate, explore, experiment with, and use the joystick. Their growing consciousness of how the functions of the joystick and ways to use it was found to be the keystone for their achievements. Participants’ growing consciousness of how to act on the joystick to set the chair in motion, how to use different actions on the joystick to cause different directions and speed, and how to order and time the acts composing goal-directed steering stimulated their tool use endeavors.

### Identification of Phases in Learning Tool Use

The identified patterns of achievement formed 8 characteristic phases in learning joystick use, accompanied by phase-specific facilitating strategies. The 8 phases reflected different levels of consciousness of joystick use, revealing growth from unconsciousness of cause–effect relationships related to joystick use to consciousness of how to use the joystick for safe and functional driving.

The first phases were the most difficult ones in which to recognize and interpret behaviors that could be understood as meaningful or purposeful. The comparisons with infants’ joystick use facilitated the recognition of activities that could be interpreted as achievements in participants with PCD and enhanced the uncovering of the incremental order of the identified indicators of achievement. The 45 participants’ trajectory of learning joystick use was also authenticated by comparisons from the literature on infant development.
Table 1. Eight Phases of Growing Consciousness of Joystick Use to Operate a Powered Wheelchair

<table>
<thead>
<tr>
<th>Phase</th>
<th>Activity Form</th>
<th>Behavior or Activity</th>
<th>Hand and Arm Movement</th>
<th>Consciousness of Joystick Use</th>
<th>Alertness</th>
<th>Motive</th>
<th>Driving Style</th>
<th>Expression</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>Occupation, composed of two or more activities</td>
<td>Drives as a part of the occupation, as a means for doing other activities</td>
<td>Smooth and precise movements</td>
<td>Conscious of other parts of the occupation; driving more or less subconscious</td>
<td>Relaxed, active, not tense</td>
<td>Plan</td>
<td>Secure, skilled navigation</td>
<td>Appropriate to the activity, occupation</td>
</tr>
<tr>
<td>7</td>
<td>Occupation for its own sake</td>
<td>Drives as the solo activity; drives for pleasure</td>
<td>Well-adjusted and -timed movements</td>
<td>Aware of consequences and conscious of how to control steering with the joystick</td>
<td>Generally focused</td>
<td>General goal</td>
<td>Mastery of steering</td>
<td>Happy, satisfied</td>
</tr>
<tr>
<td>6</td>
<td>Activity</td>
<td>Drives in a desired direction or to a goal</td>
<td>Goal-directed but coarse movements</td>
<td>Conscious of the need to sequence acts in a certain order to reach a desired point or place</td>
<td>Focused on goal</td>
<td>Special goal</td>
<td>Goal directed but unskilled</td>
<td>Serious, contented, laughing, excited</td>
</tr>
<tr>
<td>5</td>
<td>Sequences of chains of acts</td>
<td>Experiments with the joystick; drives here, there, forward, backward</td>
<td>Intentional, more eager or violent movements</td>
<td>Conscious of ability to cause many different effects, of motion in different directions while searching the steering pattern</td>
<td>Active, concentrated</td>
<td>Exploration of choices of effects</td>
<td>Experimental, explorative</td>
<td>Eager, smiling, serious, frustrated</td>
</tr>
<tr>
<td>4</td>
<td>Chains of acts</td>
<td>Investigates more effects; drives–stops–drives; tests different grips</td>
<td>Intentional but cautious, careful movements</td>
<td>Conscious of more than one effect, of motion in different directions depending on how acts are combined</td>
<td>Attentive</td>
<td>Intention</td>
<td>Intentional, intended, destined</td>
<td>Serious, smiling, sometimes laughing</td>
</tr>
<tr>
<td>3</td>
<td>Acts</td>
<td>Activates joystick; gets the effect of motion</td>
<td>Distinct, aimed movements</td>
<td>Conscious of how one act can cause one effect (act starts motion)</td>
<td>Alert</td>
<td>Exploration of cause and effect</td>
<td>Self-initiated, voluntary</td>
<td>Serious, contented, smiling</td>
</tr>
<tr>
<td>2</td>
<td>Preactions</td>
<td>Touches or hits different parts of the chair; in between, is sitting still</td>
<td>Diffuse, vague multidirected movements</td>
<td>Preconscious of how a self-initiated act can cause the effect of setting the chair in motion</td>
<td>Passive; at times more alert</td>
<td>Anticipation of an effect</td>
<td>Able to keep on driving after release of guidance</td>
<td>Contented, curious, anxious, angry</td>
</tr>
<tr>
<td>1</td>
<td>Reflexes, behaviors</td>
<td>May accidentally activate the joystick; is still for long periods</td>
<td>No aim with movements</td>
<td>Unconscious of how own activity can cause an effect</td>
<td>Passive</td>
<td>Excitement, anxiety</td>
<td>Guided or accidental</td>
<td>Neutral</td>
</tr>
</tbody>
</table>

Participants in the reference group with lesser degrees of cognitive disability followed a trajectory similar to that of the 45 participants with PCD, although less slowly. The comparisons with the attainments of participants in this group led to confirmation of the higher phases in the learning process and the facilitating strategies accompanying those phases.

Assessment Tool. The most prominent indicators of each of the 8 phases were categorized and put into a simplified scheme to offer the facilitators a tool to assess the participants’ phase of growing consciousness of joystick use (Table 1). This tool identified strategies appropriate for stimulating growth to the next phase at each phase in the learning process. The assessment of actual phase guided facilitators’ choice of individually appropriate facilitating strategies. The assessment tool was developed and tested in clinical practice, and a test for interrater reliability resulted in a weighted κ of .85 (Nilsson, 2007; Nilsson, Eklund, & Nyberg, 2011).

Oscillation Between Phases. Growing consciousness involved oscillation between phases influenced by a participant’s health status, level of energy, position in the learning process, complexity of joystick use, physical and social interactions, and practice context. Each participant had a special dynamic in the pace and pattern of oscillation between phases.

Attainments in Joystick Use

The 45 participants with PCD attained the following levels of joystick use (see Table 1): 8 participants reached
Deplateauing Through Growing Consciousness of Tool Use

The researcher’s constant comparisons of interaction and communication between facilitators and participants led to the discovery of a grounded theory of deplateauing to explain achievements exceeding expected limitations. People are often expected to reach a limit—a plateau or a ceiling for their development, growth, and learning—so when they unexpectedly exceed their own or others’ expectations of achievements, they are deplateauing. The repeated analyses uncovered an interdependency among approaches, attitudes, responses, and learning of tool use (either participants’ learning of joystick use or facilitators’ learning of facilitating strategy use). The participants’ achievements were dependent on the facilitators’ motivation, endurance, responsiveness, adaptability, and understanding of the participants’ current position in the learning process. The facilitators’ achievements were similarly dependent on the participants’ signs of a drive to explore, endurance, responsiveness to facilitating strategies, and adaptability to invitations to interact. The achievements were also contingent on access to useful and predictable resources such as an appropriate powered wheelchair (Nilsson & Eklund, 2006) and on facilitators’ knowledge of and experience in powered wheelchair intervention with the participant population. Facilitators whose strategy use was stimulated by participant responses could facilitate a growing consciousness of joystick use to surprising levels, exceeding expected limitations and plateaus. Thus, when the necessary prerequisites of motivation, endurance, responsiveness, adaptability, and appropriate resources were mutually present, the facilitator’s and the participant’s tool use improved, and they both deplateaued.

Discussion

The Driving to Learn project explored ways to help people with PCD practice operating a joystick-operated powered wheelchair. The focus of the project was to explore this population’s possible achievements in such practice. Indicators of achievement were compared with reference groups composed of typically developing infants and people with lesser degrees of cognitive disability. Eight of the 45 participants with PCD reached goal-directed driving or higher. The findings yielded a set of facilitating strategies, an 8-phase learning process, a tool for assessing growing consciousness of joystick use, and a grounded theory of deplateauing (Nilsson, 2007).

Driving to Learn Method

The method used in the intervention involved mutual interaction, dialogue, and facilitation of participants’ understanding of tool functions and their own initiative to explore and implement tool use. They could move and manipulate the joystick even though it was attached, and it stayed in place despite their coarse, imprecise movements. Effects of accidental or voluntary activation influenced their whole body and their relationship to the environment. In the first phases of the learning process, circular movements with the chair dominated, which provided vestibular stimulation that increased alertness (Ayres, 1987). Bodily experiences of collisions naturally informed participants about properties of the chair and the nature of the environment and nurtured an internal desire to avoid the unpleasant experience of colliding. Repeated intervals of manual guidance and waiting for responses, together with practice in tool use, facilitated concept formation, meaning making, and curiosity, nurturing participants’ motivation to explore, experiment with, and master tool functions and tool use. This methodological knowledge was necessary for facilitators to provide the just-right challenge to enhance each participant’s growing consciousness of joystick use.

Tool Use Learning

Human tool use is related to complicated cortical networks affecting skilled manipulation and conceptual knowledge of tools and the actions involved in their use (J. W. Lewis, 2006). Acting on a tool includes manipulation and handling without knowledge of its use, and acting with a tool includes understanding and knowledgeable use of tool...
functions (Menz, Blangero, Kunze, & Binkofski, 2010). Tool use learning also involves development of a body scheme and an action scheme with timing and sequencing of actions and movement (J. W. Lewis, 2006). Brain activity research has indicated an important relationship between the cerebral cortex and cerebellum in the acquisition and storing of representations (internal models) of new tool use skills (Johnson-Frey, 2004).

The findings from tool use research provide evidence for the usefulness of the emerged facilitating strategies and the Driving to Learn method. The strategies affected the participants’ manipulation skills as well as their understanding of the effects and consequences of joystick use, conceptualization of tool use activity, and retrieval of internal models of the developing skills for tool use. Identification of the learning process and the assessment tool made it possible for facilitators to distinguish a participant’s position in the learning process and choose appropriate strategies to promote growing consciousness of joystick use.

**Generic Value for Occupational Therapy**

The three core purposes of occupational therapy described earlier can be fulfilled using the Driving to Learn method because the achievements from practicing joystick use may extend individual abilities and skills and provide a means to become more autonomous (Hagedorn, 1995; Nilsson, 2007). As Yerxa (1998) and Ayres (1987) argued, the occupational therapy field has a need for increased knowledge of the development of adaptive skills, rules, and habits that can facilitate capability and of ways to create individually adjusted challenges to stimulate adaptive responses. The identified process of learning joystick use and accompanying facilitating strategies may help professionals enable people with PCD to become doers, to enhance their capability to interact, and to gain empowerment and well-being (Lancioni, Singh, O’Reilly, Oliva, & Basili, 2005; Tengland, 2007; Wilcock, 1998). The findings can also be useful for occupational therapists attempting to use powered mobility intervention with people who have lesser degrees of cognitive disability.

**Grounded Theory Approach**

Videotapes were an indispensable tool for the study of people not able to directly communicate their experiences or use verbal language. The videotapes enabled recognition, interpretation, and comparison of the participants’ activities and gradual development (Nilsson, 2011).

An advantage of the grounded theory approach was that it allowed for repeated extensions of participant recruitment and data gathering. The great variation among participants enabled the discovery of comparable codes, indicators, categories, and properties of possible achievements. The disadvantage of the approach was the amount of time needed for repeated comparisons, analyses, and sorting to ensure the trustworthiness and relevance of the emerging learning process and the theory of deplateauing.

An unexpected benefit of conducting the project in a rural area and of focusing on a small population with slow development and diverse reference groups was that the practice was performed in many different contexts and by different facilitators. This variation elucidated facilitating and hindering aspects of the context and enhanced identification of the 8-phase learning process.

A potential limitation is that the researcher acted as both facilitator and researcher. The researcher sought to minimize this limitation by engaging in recurrent discussions and inspections of video clips from special core situations during sessions with parents, related people, and professionals not involved in the project. She also increased the number of facilitators and participated in critical discussions with the coauthors.

**Conclusion**

The Driving to Learn project provides evidence of the benefits of practice operating a joystick-operated powered wheelchair for people with PCD. Their achievement patterns formed an 8-phase process of learning joystick use with an oscillating progress pattern. The Driving to Learn method combined the use of an appropriate powered wheelchair, facilitating strategies, a description of the learning process, and an assessment tool to promote growing consciousness of joystick use. These tools made it possible to detect, assess, and facilitate participant progress to levels of joystick use exceeding expected limitations and plateaus.

The findings from the project have important implications for people with PCD. Because they are hard to engage in any purposeful activity, people with PCD require assistance to reach higher levels of constructive activity. Attaining control of tool-mediated mobility is an empowering experience for the participant, and successfully using facilitating strategies is an empowering experience for the facilitator. As the participant becomes more conscious and more able to explore the vicinity, he or she becomes a *doer*—that is, a person with the desire and ability to learn how to actively influence and interact with the environment. To become a tool user increases individual autonomy, which in turn improves quality of life. ▲
References


