REHAB CASE STUDY

POWERED MOBILITY READINESS: A CASE STUDY

WRITTEN BY: JAN FURUMASU, PT ATP

Independent mobility is important in the development of a number of cognitive and psychosocial skills, including spatial relations, verbal skills and play skills with peers. For a young child with mobility impairments, the opportunity for early powered mobility enhances the development of skills that may otherwise develop more slowly or not at all *(Jones, 2012, 2003; Lynch, 2009; Guerette, 2013; Tefft, 2011; Livingstone, 2013).* How early is a child ready for powered mobility? Chronological age and IQ are not good determinants of a child's ability to operate a powered wheelchair. Children as young as 7 months have experienced self-initiated mobility in a mobile robotic-type device *(Galloway, 2007).* Children as young as 18 months have learned to functionally use a powered wheelchair within a period of two to four weeks *(Butler, Okamoto, McKay, 1983, 1984, 1986; Jones, 2003; Tefft, 1999).* A child's ability to learn to use a powered wheelchair is influenced by a number of factors, including consistent accurate physical access to control the wheelchair, cognitive developmental abilities, coping styles (e.g., attentiveness, persistence, motivation) and dynamic sensorimotor integration. Cognitive skills was the number one reason given in a national survey of providers for not recommending a powered wheelchair *(Guerette, Tefft, Furumasu, 2005).*

PEDIATRIC POWERED WHEELCHAIR SCREENING TEST (PPWST)
Donita Tefft, CCC-SP; Paula Guerette, PhD; Jan Furumasu, PT
Los Amigos Research and Education Institute, Inc.
Rancho Los Amigos Medical Center, Downey, CA

RESPONSE FORM
Name:**__________________ *Age:*____*Diagnosis:***
***Date of screening:*____________ *Examiner.*_______**
Spatial Relations Last Item Correct:______Problem Solving Last Item Correct:________

SPATIAL RELATIONS SCALE **YES/NO**
(Check if Y/N method used)

1. _____ Nine piece formboard
2. _____Three piece formboard-in order
3. **_____Three piece formboard - reversed order**
4A. _____ Train of blocks - horizontal combination
4B. _____Train of blocks - with chimney
5A. _____ House of blocks - imitation
6. _____ Sequencing toys - two out of three
5B. _____ House of blocks – copy

PROBLEM SOLVING SCALE

1. _____Two supports and a toy
2. ____ One support and a toy
3. _____Stick as a tool
4. **_____Broken doll**
5A. ____Fixes two toys of four toys - marginal repair
5B. ____Fixes two toys of four toys - approximate repair
5C. ____ Fixes two toys of four toys - exact repair

MEASURING READINESS

Researchers have developed and validated a screening tool, the Pediatric Powered Wheelchair Screening Test, a short assessment of specific cognitive skills found to be related to powered wheelchair driving ability *(Guerette, Tefft, Furumasu & Moy, 1999).* The PPWST was developed using children ages 20 to 36 months with orthopedic disabilities who had minimal to no cognitive delays and who used a proportional joystick to control their wheelchair. The intent was not a pass/fail "test," but a tool to allow clinicians to tease out whether a very young child had the cognitive developmental skills needed to learn powered mobility versus whether sensory motor processing was the interfering factor in learning powered mobility skills. Cognitive developmental skills include cause and effect, directional concepts, problem solving and spatial relationships. Sensorimotor abilities include perception, processing, motor planning and reacting in a timely manner. Coping abilities include attention span, motivation and persistence. The screening test checks a child's understanding of spatial relations and problem solving. Spatial relations at a 25-month level, in combination with problem solving at a 20-month level, demonstrated the ability to learn basic powered wheelchair skills (intentional directional control, starting and stopping to play games and speed control of a proportional joystick). Learning specific skills to negotiate community type terrain like ramps, sidewalks and curb cuts required a slightly higher understanding of problem solving seen at 30 months in combination with a 25-month level of understanding spatial awareness *(Tefft, 1999).*

The second multicenter study found that the screening test was appropriate for use in a population of children with cerebral palsy who use joysticks to drive their wheelchair. Problem solving and spatial relations were significant factors and accounted for 82.4 percent of the variance in basic driving skills and 74.1 percent for overall driving skills.

Pediatric Powered Mobility
Donita Tefft, CCC-SP, Jan Furumasu, PT, Paula Guerette, PhD
RERC on Technology for Children with Orthopedic Disabilities
Rancho Los Amigos National Rehabilitation Center, Downey, CA

MOBILITY RATING SCALE

0 - Task not attempted - The task is not introduced because prerequisite basic skills are still at levels 1-2.

1 - Maximum assist of joystick with verbal cueing - Child attempts task but requires complete assistance in order to execute task. Indicated by instructor providing continual (50 - 100% of time) hands-on assistance of wheelchair control to direct and guide wheelchair in order to complete task safely. Continuous verbal and/or gestural instructions are provided.

2 - Minimal assist of joystick with verbal cueing - Child able to perform basic components of task 'independently but needs some assistance in order to complete the entire task safely. The instructor provides intermittent (10 - 50% of time) hands-on assist of wheelchair control only to correct a particular deviation from course, not to direct or guide wheelchair in a continual manner. Continuous verbal and/or gestural instructions are provided.

3 - Stand-by physical assist with verbal cueing - Child able to perform entire task independently but needs guarding for safety. The instructor stands directly next to wheelchair on joystick side in order to assist if child begins to maneuver unsafely (<10% of time). Continuous verbal and for gestural instructions are provided.

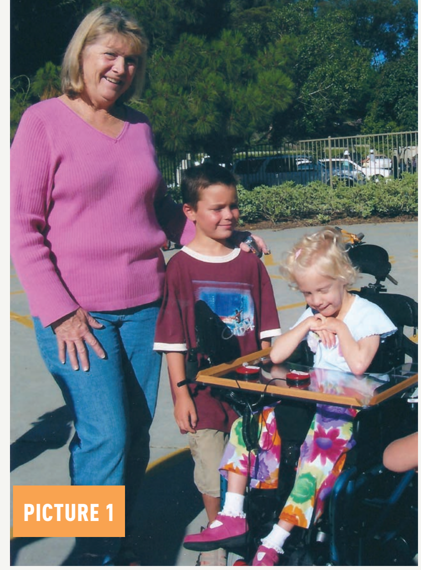
4 - Verbal cueing only - Child able to perform task independently without immediate stand-by assistance but with frequent verbal cueing. The instructor stands away from the joystick (5 feet or less) and does not provide any hands-on assistance to the child. Continuous (>25% of time) verbal and for gestural instructions are provided to the child for safety purposes and to remind or redirect the child.

5 - Age-appropriate supervision - Child able to complete task independently with age-appropriate visual supervision and infrequent (<25% to time) verbal cueing. The instructor stands away from the joystick (5 - 10 feet) and does not provide any hands-on assistance to the child. Verbal cueing provided to the 'child intermittently and only to direct child's attention to maneuver in a certain direction (e.g., towards parent, away from curb).

ALEXA

Alexa has cerebral palsy and had been part of the pediatric powered wheelchair mobility project *(Furumasu, Guerette, and Tefft, 2004).* At 3 and one-half years, she did not yet have the understanding of spatial relations at a 25-month level, although she did demonstrate problem-solving skills at a 20-month level. She worked on her spatial relations skills with her mother using puzzles, stacking cups and looking on, under or around objects for toys. She eventually passed the 25-month cut-off level which, in combination with the 20-month understanding of problem solving, demonstrated readiness to learn powered wheelchair skills. Alexa began practice in a pediatric powered wheelchair. Although she demonstrated cognitive developmental understanding of problem solving and spatial relations, Alexa demonstrated cognitive processing problems when she was trying to maneuver the wheelchair. She was physically able to manipulate a proportional joystick well (she already used a mouse on a computer), but this seemed confusing to her when she tried to maneuver the wheelchair. Dynamically she was able to understand the direction the switches represented when the proportionality of the joystick was eliminated. Initially, she understood the directionality of single switches better than the proportionality of the joystick.

After six months of inconsistent practice at home, her powered wheelchair was ordered with a proportional joystick through her father's insistence. When the power wheelchair was received, Alexa had difficulty learning to drive the proportional joystick controller. She attempted the joystick, but after 15 minutes she would "shut down," become frustrated and was not motivated to continue to attempt to use the wheelchair. The joystick was temporarily exchanged for switches (See Picture 1). Alexa gradually was introduced to a single switch to move forward, starting and stopping successfully. Within two weeks, right and left directional switches were added. After two months of practicing with switches, she



Picture 1: Alexa at age 6 using switches

Picture 2: Alexa at age 7 using a proportional joystick

demonstrated directional understanding and the proportional joystick was tried again successfully (See Picture 2). The switches were used to help her learn the dynamics of moving her wheelchair and transition her to using a joystick controller. Her mother provided the close stand-by assistance and supervision Alexa needed until she was ready to use the powered wheelchair at school, which took another year of practice at home. She has been using a powered wheelchair for all mobility at home, school and in the community for the last seven years. For Alexa, motor access and developmental readiness were not limiting success in maneuvering a power wheelchair. The

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dynamic sensory motor processing – perceiving her environment, motor planning and physically coordinating the movement – was the component she needed to work on. So for her, dynamic practice was important to develop those skills.

COMPLEX CHILDREN

Children with complex developmental delays and cognitive limitations have also successfully developed independent power mobility skills, but with longer training times *(Bottos 2001, Dietz 2002, Huhn 2007)* or use of additional technologies, such as SMART wheelchairs or robotic mobility devices *(Nilsson 2003, Galloway, 2007)*. These children may also require a longer training period to learn skills if they have difficulties with sensory-motor integration or other factors that influence the progression of learning such as distractibility and poor frustration tolerance. Thorpe & Valvano (2002) found that children with cerebral palsy can benefit from increased practice with motor tasks. Specifically, for these kids, it is important to provide a trial powered wheelchair for an extended dynamic practice period and to be able to see a learning curve.

MATT

At age 7, Matt, who has cerebral palsy, was determined to be in the early exploratory stage of powered mobility skills. Those exploratory skills included exploring with movement, starting and stopping, turning, but not necessarily intentionally being able to use the wheelchair functionally. For 10 years, he practiced on and off through school. His mother was very frustrated, angry and disappointed because she thought more practice was needed in order for him to be able to use a powered wheelchair as his means of mobility in the home and community. At age 17, Matt was given the Pediatric Powered Wheelchair Screening Test, which was then valid for children with cerebral palsy *(Furumasu, Guerette, Tefft, 2004)*. Matt could not pass the first skill in the spatial relations test, which consists of putting six of nine squares and circles in a puzzle. We explained the results of the research and how important understanding spatial relations and problem solving are in being able to successfully maneuver a power wheelchair and this was eye-opening for his mother. Her expectations changed as she had a better understanding of her son's capabilities.

The Pediatric Powered Wheelchair Screening Test is an assessment tool designed to help clinicians determine whether a child, who would use a joystick controller, has specific cognitive skills found to be related to powered wheelchair driving, but is not intended to be used exclusively to determine whether or not a child is ultimately a candidate for powered mobility.
Clinical judgment is also essential.

CONTACT THE AUTHOR

Jan may be reached at
jfurumasu@dhs.lacounty.gov.

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Powered Mobility Program (PMP)

Furumasu, Guerette, Tefft
Los Amigos Research and Education Institute, Inc,
Rancho Los Amigos Medical Center, Downey, CA

CLIENT NAME:________________________________

I. Basic Mobility Skills	Practice Sessions – Date								Final Session
BEGINNING SKILLS									
Turns wheelchair power on and off.									
Maintains contact with the joystick for a minimum of 5 seconds.									
Pushes joystick to engage w/c in motion for 5 sec. and stops.									
Moves w/c in forward direction for 10 sec. and stops on command.									
Attends and looks in the direction of wheelchair movement.									
Stops spontaneously to avoid stationary objects.									
DIRECTIONAL CONTROL									
Moves w/c in forward direction for 10 feet.									
Moves w/c in forward direction for 35 feet.									
Turns w/c to the right starting from a stationery position.									
Turns w/c to the left starting from a stationery position.									
Moves w/c backward on command (minimum 2').									
Moves w/c forward making right and left curving turns following a person over a distance of 50 feet.									
Veers spontaneously to avoid a stationery object.									
SPEED CONTROL									
Moves w/c forward maintaining a very slow speed.									
Understands difference between fast and slow.									
Stops at a door with footrests within 12″ without hitting the door.									
Stops at a line with front casters within 12″ and not going over the line.									

Powered Mobility Program – Furumasu, Guerette, Tefft

II. Integration of Basic Skills for Functional Mobility – Structured Environment									Final Session
Maneuvers w/c through a doorway without hitting the door frame.									
Moving along a hallway, self correcting movement to avoid the wall for a minimum of 50 feet.									
Maneuvers w/c along a curving pathway with two turns.									
NEGOTIATING A RAMP									
Moves w/c up a ramp, staying in between the rails and turns a corner.									
Backs up far enough to negotiate a turn between the rails of a ramp.									
Turns w/c within a 5' by 5' space.									
Moves w/c down a ramp staying in between the rails.									
Stops w/c when driving down a ramp.									
Slows speed down when moving w/c down a ramp.									
NEGOTIATING A SIDEWALK									
Moves w/c along a narrow 28″ wide sidewalk, w/o curb for a distance of 35' without veering off the sidewalk with supervision within 5'.									
Moves w/c along a 36″ wide sidewalk with an unmarked 6″ curb for a distance of 35″ without veering off the sidewalk with supervision within 5'.									
III. Integration of Basic Skills for Functional Mobility – Unstructured Environment									
COMMUNITY MOBILITY									
Follows "rules of the road", e.g. stays on one side of a hallway, avoiding people and objects, looking at intersections of hallways.									
Moves w/c in an open, busy area maneuvering around multiple objects and moving people.									
Moves w/c along a sidewalk and down a ramp and stops before entering a parking lot.									
Recognizes difference between curb and curb cut.									
Moves w/c in and out of small rooms.									
Avoids potholes/hazards									

Final Evaluation Raw Score _______ divided by 34 =
Average Level of Assistance _______

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APPENDIX C – TASKS REPRESENTING POWERED MOBILITY SKILLS

1. BASIC MOBILITY SKILLS

A. Basic Cause and Effect Association

1. Turns wheelchair power on and off.

2. Maintains contact with the joystick for minimum of 5 seconds.

3. Pushes joystick to engage wheelchair in motion for 5 seconds. and stops

4. Navigates wheelchair in forward direction for 10 seconds and stops on command

5. Looks in the direction of movement.

6. Stops spontaneously to avoid stationary objects.

B. Directional Control

1. Navigates in forward direction for 10 feet.

2. Navigates in forward direction for 35 feet.

3. Turns to the right starting from a stationary position.

4. Turns to the left starting from a stationary position.

5. Navigates backward (minimum 2 feet).

6. Navigates forward making right and left curving turns following a person over a distance of 50 feet.

7. Veers spontaneously to avoid stationary object.

C. Speed Control

1. Navigates forward maintaining a very slow speed for 15 feet.

2. Changes speed in response to commands –"Slow down" or "Let's go faster."

3. Stops at a door with footrests within 12 inches without hitting the door.

4. Stops at a line with front casters within 12 inches without going over the line.

II. INTEGRATION OF BASIC SKILLS FOR FUNCTIONAL MOBILITY - STRUCTURED ENVIRONMENT

A. Negotiates Doors, Paths, Walls

1. Navigates a doorway without hitting the door frame.

2. Self corrects direction of forward motion when moving parallel along a wall for minimum of 50 feet.

3. Navigates a pathway with two turns.

B. Negotiates Ramps

1. Navigates up a ramp, staying between the rails and turning a corner.

2. Backs up to negotiate a turn between the rails of a ramp.

3. Executes a turn within a 5 by 5 foot space.

4. Drives down a ramp staying between the rails.

5. Stops on command when navigating down a ramp.

6. Slows speed on command when navigating down a ramp.

C. Negotiates Sidewalks

1. Navigates a narrow 28 inch wide sidewalk for a distance of 35 feet without veering off the sidewalk (supervision within 5 feet).

2. Navigates a 36 inch wide sidewalk with an unmarked 6 inch curb for distance of 36 feet without veering off the sidewalk (supervision within 5 feet).

III. INTEGRATION OF BASIC SKILLS FOR FUNCTIONAL MOBILITY - UNSTRUCTURED ENVIRONXENT

A. Community Mobility

1. Navigates along one side of a hallway, avoiding people and stationary objects for a distance of 100 feet.

2. Navigates in an open, busy area around multiple objects and people who are moving in a random pattern.

3. Navigates a sidewalk, down a ramp, and stops before entering a parking lot area.

4. Recognizes difference between a curb and curb cut.

5. Navigates in and out of a small room.

6. Avoids irregularities in ground surface (e.g.; cracks, gratings).