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Hot Topics in Pediatrics

Guest Editor: Lisa Kenyon, PT, DPT, PhD, PCS

11/5: Evidence Based Physical Therapy Management of Idiopathic Toe Walking
Sally P. LeCras, PT, DPT, PCS

11/6: What Are We Waiting For? The Power of Early Mobility
Lisa Kenyon, PT, DPT, PhD, PCS

11/7: Meeting the Sensory Needs of Children with Autism Spectrum Disorder(ASD): A Primer for Therapy Professionals
Melissa Tovin, PT, MA, PhD, PCS, CEEAA

11/8: Keys to Physical Literacy and Fundamental Movement Skills for Children Who Use Wheelchairs: Consideration for Adapted Sport and Inclusive Physical Education
Krista Best, PhD

11/9: Clinical Application of the Congenital Muscular Torticollis Clinical Practice Guideline
Micah Huegel, PT, DPT

CONTINUED

What Are We Waiting For? The Power of Early Mobility

Lisa K. Kenyon PT, DPT, PhD, PCS

PhysicalTherapy.com Webinar

November 6, 2018

CONTINUED™

Learning Outcomes

As a result of this course, participants will be able to:

- List 3 ways in which early mobility positively impacts overall development in a typically developing infant or toddler.
- Describe 3 benefits of early power mobility use for infants and toddlers with mobility delays.
- Identify 3 different types of power mobility learners reflecting the range of expectations for power mobility use in infants and toddlers with mobility delays

3

Learning Outcomes

As a result of this course, participants will be able to:

- Outline a power mobility training plan to promote early mobility experiences for infants and toddlers with mobility delays.
- List 3 outcome measures to assess the impact of power mobility training in infants and toddlers with mobility delays.

4

Developmental Benefits of Early Mobility in the Typically Developing Child

5

Mobility in Typical Development

Self-generated mobility patterns (e.g., crawling, walking) substantially impact development in a child[1,2]

6

Mobility in Typical Development

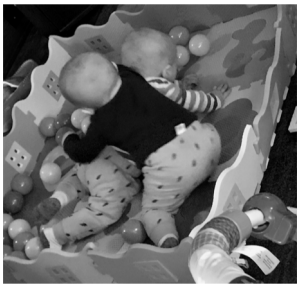
This independent mobility catapults the infant into a new paradigm[3,4]

- The infant is free to explore
- The infant is no longer dependent on others to move from one place to another

7

Mobility in Typical Development

Self-generated mobility is more than just a way to get from Point A to Point B



8

Mobility in Typical Development

- Piaget:[5] Self-generated mobility is the basis for intelligence
- Gibson:[3] Self-generated mobility provides the early exploratory activities that make up a child's cognitive foundation

9

Mobility in Typical Development

- Pallas:[6] Exploring the environment through self-generated mobility shapes and molds the cortical connectivity and function of a child's brain

10

Mobility in Typical Development

- Self-generated mobility provides the typically developing infant a plethora of novel experiences and opportunities[1,2,4]
  - Learning
  - Problem solving
  - Making choices and decisions
  - Development of spatial-cognitive skills

11

When You Were a Baby…

12

When You Were a Baby…

13

Typically Developing Older Infants & Toddlers Are Very Mobile

- Adolph et al[7] explored spontaneous locomotion during free play in 12-19 month-olds
  - Walking infants averaged
    - 2367.6 steps/hour
    - Traveled 701.2 meters/hour
    - Fell 17.4 times/hour

14

Typically Developing Older Infants & Toddlers Are Very Mobile

- Adolph et al:[7] Walking 701.2 meters in an hour = the length of 7.7 American football fields.[7]

15

Typically Developing Older Infants & Toddlers Are Very Mobile

- Adolph et al:[7] If these children were free to move about for just 6 hours a day, their daily practice "dose" would be
  - 14,000 steps over the length of 46 football fields.[7]
    - An incredible amount of practice!

16

CONTINUED

But What if Self-Generated Mobility Is Delayed?

17

CONTINUED

But What if Self-Generated Mobility Is Delayed?

What if the Infant/Toddler Is Unable to Crawl or Walk?

18

The Developmental Impact of Delayed Mobility and Mobility Limitations

19

The Impact of Mobility Limitations

Children with mobility delays or mobility limitations are unable to reap the developmental and functional benefits of independent mobility[8,9]

20

CONTINUED

The Impact of Mobility Limitations

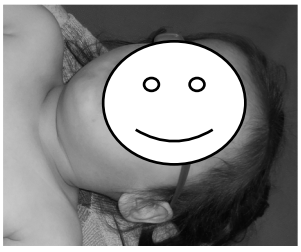
- Children with mobility delays or mobility limitations may experience secondary impairments[1,8,9]
  - Spatial cognition
  - Communication
  - Social development
  - Other developmental domains

21

CONTINUED

The Impact of Mobility Limitations

- Children who are unable to actively move and interact with their environment may exhibit passive, dependent behaviors[8,9]
  - This may lead to learned helplessness[10,11]



22

The Impact of Mobility Limitations

- Ongoing feelings of lack of control may result in[11,12]
  - A negative affect
  - Difficulties with problem solving
  - Poor task mastery (especially with more challenging tasks)
  - Other issues related to executive function

23

The Impact of Mobility Limitations

Passive mobility **does not** provide the same experiences as independent mobility[4]

24

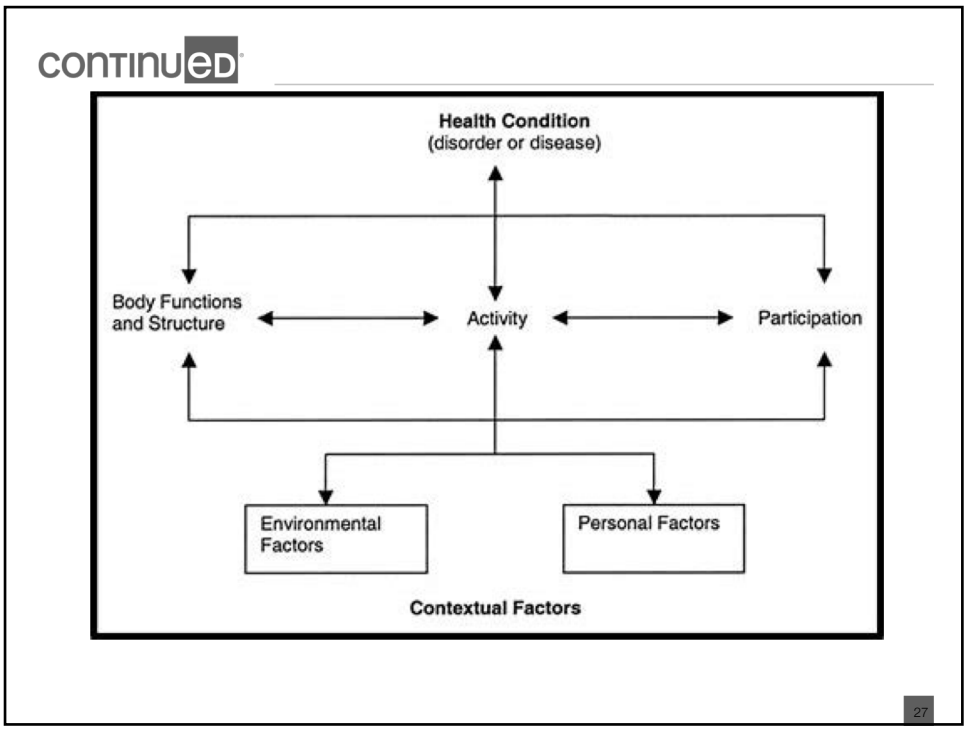
The Impact of Mobility Limitations

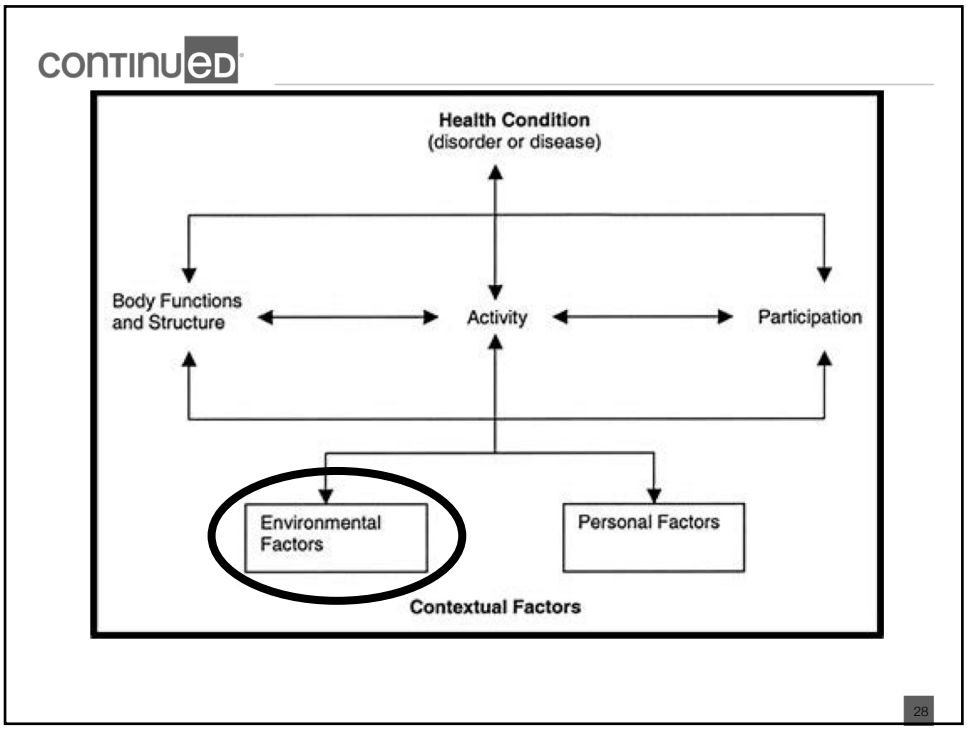
Being pushed in a stroller or a wheelchair **does not** promote the development of the spatial-cognitive skills necessary to understand the relationship between oneself and the environment[4]

25

What Does the Evidence Say?

26


Health Condition
(disorder or disease)
Body Functions
and Structure
Activity
Participation
Environmental
Factors
Personal Factors
Contextual Factors
27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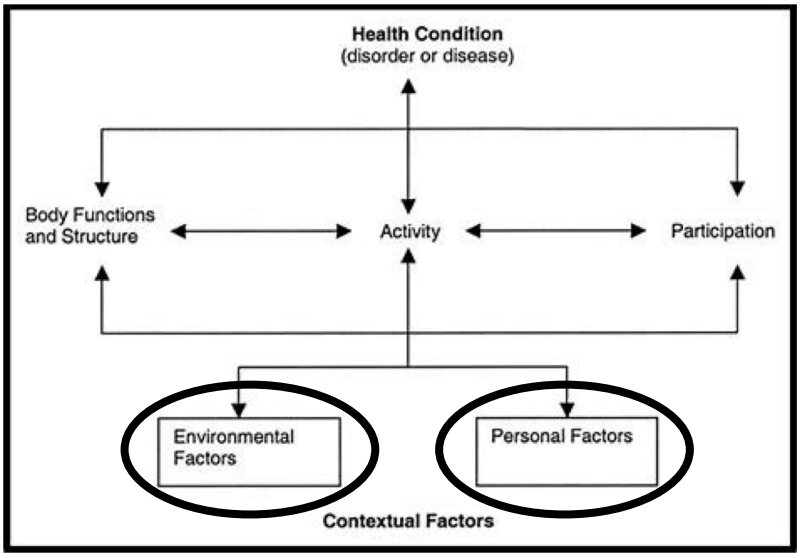


29

Early Power Mobility is Beneficial For…



30

Mobility is a Human Right

Mobility devices enable people who have mobility limitations the opportunity to achieve mobility, benefit from human rights, and live with dignity.[13,14]

31

Mobility is a Human Right

The 2006 United Nations Convention on the Rights of Persons with Disabilities[14] asserts that nations have a responsibility to ensure access to mobility devices that provide the greatest possible level of independence for people with mobility limitations.

32

CONTINUED

Benefits of Early Power Mobility

- May help prevent the development of learned helplessness[10]
  - Provides children who have mobility limitations with opportunities for self-generated mobility and a degree of independence

33

CONTINUED

SR by Livingstone & Field 2014[8]

Systematic review of power mobility outcomes in children from infancy to 18 years of age

34

CONTINUED

SR by Livingstone & Field 2014[8]

- **One randomized controlled trial:** Strong Level II Evidence
  - Supported positive impact of power mobility on
    - Overall development
    - Independent mobility
- **A Single-subject research design:** Moderate Level III Evidence
  - Supported positive impact on self-initiated movement

35

CONTINUED

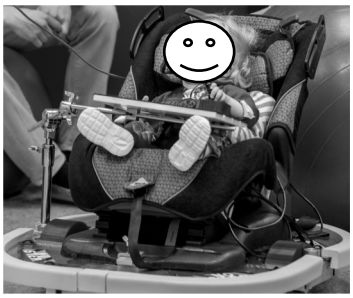
SR by Livingstone & Field 2014[8]

- 26 Remaining studies: Level IV or V evidence
  - Supported positive impacts on a broad range of outcomes from the ICF
    - Body structure and function
    - Activity
    - Participation

36

SR by Livingstone & Field 2014[8]

- Body structure and function
  - Developmental change
  - Intelligence quotient
  - Affect
  - Engagement
  - Sleep/wake pattern
  - Psychological growth
- Activity
- Participation



37

SR by Livingstone & Field 2014[8]

- Body structure and function
- Activity
  - Power wheelchair & power mobility skills
  - Self-generated mobility
  - Communication
  - Interaction with objects
  - Independence
- Participation

38

SR by Livingstone & Field 2014[8]

- Body structure and function
- Activity
- Participation
  - Social skills & interaction
  - Play
  - Peer interaction & participation

39

Livingstone & Paleg 2014[9]

- A Delphi study exploring practice considerations related to power mobility introduction and use in children
  - 9 transferrable practice messages – many of which apply to early power mobility use

40

Livingstone & Paleg 2014[9]

1. Using specialized power mobility devices, infants can participate in power mobility experiences as young as 8 months
2. Infants and toddlers can learn to maneuver a power mobility device by about 14 months
3. Those who have the physical ability to use a joystick can demonstrate competent control as young as 18 months

41

Livingstone & Paleg 2014 [9]

4. Power mobility use promotes functional mobility, enhances overall development, provides independence, and increases participation in children who have mobility limitations
5. With sufficient practice and support, power mobility may augment self-initiated behavior and learning in children who also have severe intellectual or sensory impairments

42

Livingstone & Paleg 2014[9]

Although not every child will become a competent driver, all children with mobility limitations can benefit from power mobility use

43

Different Types of Power Mobility Learners

44

Power Mobility Learner Groups

- Field & Livingstone[15] define 3 groups of power mobility learners
  - Exploratory learners
  - Operational learners
  - Functional learners

45

Power Mobility Learner Groups[15]

- Gauge expectations for power mobility use based on where a child falls within the continuum of these 3 learner groups
- Can provide insights into the power mobility device and training methods used

46

CONTINUED

Power Mobility Learner Groups[15]

- Exploratory learners
  - Most young children begin as exploratory learners and need assistance and close adult supervision
  - May benefit from ongoing training in familiar, predictable environments
  - May benefit from using modified battery-operated toy cars or shared/loaned power mobility devices

47

CONTINUED

Exploratory Learner – Video

48

Power Mobility Learner Groups[15]

- Operational learners
  - Focused on learning basic power mobility skills
  - Benefit from continuing training
  - May be ready to drive in less-restrictive environments and participate in specific activities to advance understanding of the power mobility device

49

Operational Learner – Video

50

CONTINUED

Operational Learner – Videos

51

CONTINUED

Power Mobility Learner Groups[15]

- Functional learners
  - Often meet criteria for purchase of an individually prescribed power wheelchair.

52

CONTINUED

Functional Learner – Video

53

CONTINUED

Power Mobility Learner Groups[15]

Some children may quickly progress from one group to another, while other children may remain at exploratory or operational levels and may not be considered for purchase of an individually prescribed power wheelchair.[15]

54

Introducing Power Mobility to Infants & Toddlers with Mobility Delays

55

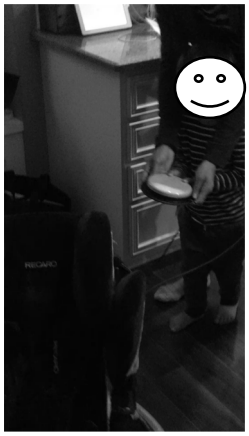
Videos- First Time Driving

56

Video-
After a few sessions….

57

Video –
On A Side Note……



58

Video-Modified Battery-operated Toy Car

59

Video - Modified Battery-operated Toy Car

60

Driver #2

61

Videos - First Time Driving

62

Driver #3

63

Video – 1st day of Training

64

Video – Later in Same Training Period

65

66

When Should We Introduce Power Mobility?

67

High school age is best – high schools are larger and the student must be able to go from one class to the other easily, whereas before that, the child is more likely to stay in one place

68

Survey Says[16]

2 years, 3 months

Average age power mobility considered

7-10 months

Average age a child starts crawling

69

2017 RESNA Application of Power Mobility Devices for Pediatric Users[17]

Age should not be factor in the decision to use a power mobility device

70

2017 RESNA Application of Power Mobility Devices for Pediatric Users[17]

Age should not be factor in the decision to use a power mobility device

Mobility experiences provided thru power mobility provide a means for exploration and learning which may affect later perceptual, cognitive and social quality of life outcomes

71

2017 RESNA Application of Power Mobility Devices for Pediatric Users[17]

Age should not be factor in the decision to use a power mobility device

This applies both to children who need mobility assistance only in early childhood and children who may never walk

72

Myth Buster!!!

Therapists and families may be concerned that early use of power mobility may negatively impact gross motor skills acquisition in young children

73

Myth Buster!!!

Therapists and families may be concerned that early use of power mobility may negatively impact gross motor skills acquisition in young children

This is not supported by the evidence!!!!

74

Myth Buster!!!

Therapists and families may be concerned that early use of power mobility may negatively impact gross motor skills acquisition in young children

This is not supported by the evidence!!!!

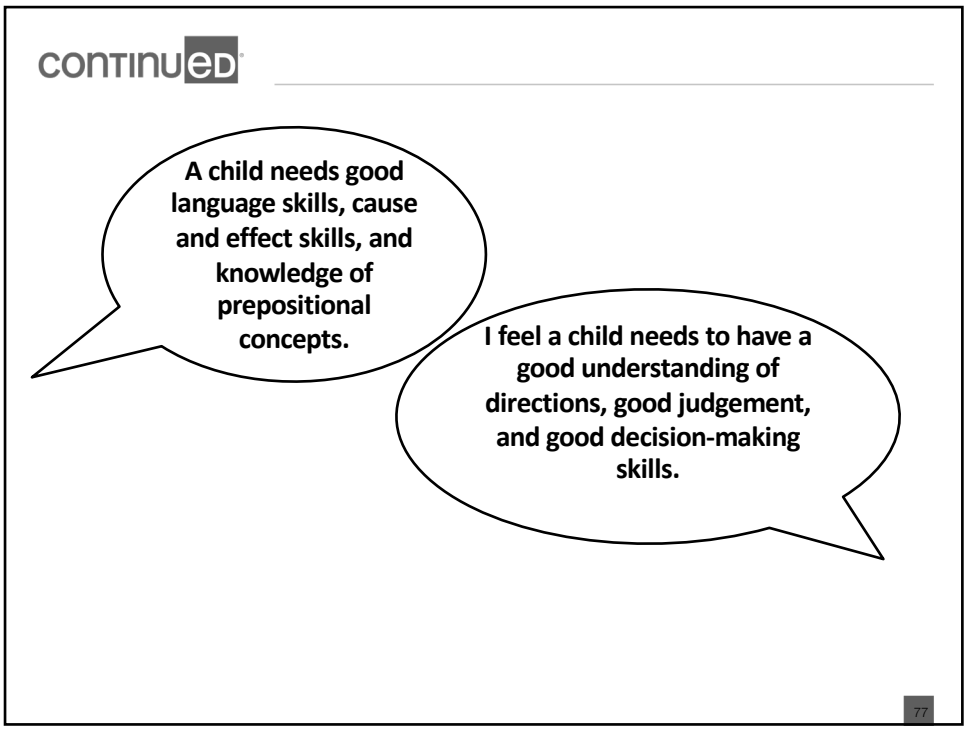
In fact, the opposite is true!!! Mobility breeds mobility!!!

75

Cognitive Pre-requisites

How much does cognition really matter?

76


A child needs good language skills, cause and effect skills, and knowledge of prepositional concepts.
I feel a child needs to have a good understanding of directions, good judgement, and good decision-making skills.
77


Developing a Power Mobility Training Plan for Infants & Toddlers
78

Power Mobility Training Methods

- Limited research
  - Especially related to this specific population
- Power mobility training methods for children in general mostly based on expert opinion
  - Research detailing the best methods has yet to be conducted

79

Foundational Concepts: Durkin[18]

- Responsive partner
- We shouldn't "teach" power mobility skills
- Create an engaging, playful environment
- Designed to elicit driving behaviors and mimic opportunities to promote mobility

80

Foundational Concepts

- For infants and toddlers, accidental activation[19] of a joystick or switch may lead to the development of
  - Cause and effect skills
    - A huge benefit for Exploratory learners!!!
  - Intentional, purposeful driving behaviors

81

SR by Kenyon et al[20]

- Critical review of power mobility training methods

82

SR by Kenyon et al[20]

- Critical review of power mobility training methods
- The Evidence Alert Traffic Light Grading System (EATLS) = Yellow
  - Indicating that caution is needed when providing power mobility training
  - Measure outcomes related to established goals

83

SR by Kenyon et al[20]

- Most commonly used approach
  - Incorporating play
- Other approaches with implications for early power mobility
  - Natural environments
  - Goal directed mobility
  - Self-exploration

84

Foundational Concepts

- Contemporary theories of motor control and neural plasticity
  - Specificity of training
  - Repetition
  - Individually engaging environment
  - Individually meaningful activities

85

Driver #4

86

Video –Introducing Power Mobility

- Start slow
- Single switch
- Start with spinning?
- Let the parent interact with the child
- Power mobility training approaches
  - Incorporating play
  - Goal directed mobility
  - Self-exploration

87

Video – Promoting Mobility

- Create opportunities for success
- Familiar adult interacting with the child
- Power mobility training approaches[20]
  - Incorporating play
  - Goal directed mobility
  - Self-exploration

88

CONTINUED

Other Helpful Hints in Developing Power Mobility Training Methods

1. Identifying motivational and reinforcement factors
2. The Power Mobility Training Tool[21]
3. Create an engaging environment
4. Responsive use of an attendant control unit

89

CONTINUED

Other Helpful Hints in Developing Power Mobility Training Methods

1. **Identifying motivational and reinforcement factors**
2. The Power Mobility Training Tool[21]
3. Create an engaging environment
4. Responsive use of an attendant control unit

90

Reinforcement Assessment for Individuals with Severe Disabilities (RAISD)[22]

- Gathers information related to potentially reinforcing stimuli and activities for each child
  - Parent/Caregiver interview
    - Focused and brief
  - Identifies a child's likes and dislikes

91

Other Helpful Hints in Developing Power Mobility Training Methods

1. Identifying motivational and reinforcement factors
2. The Power Mobility Training Tool[21]
3. Create an engaging environment
4. Responsive use of an attendant control unit

92

The PMTT[21]

- Used to identify basic power mobility skills in children
  - Can be used with children who use **switches** or other alternative access methods
- **Guides the development of power mobility training programs** to promote basic power mobility skills

93

The PMTT[21]

- **Not intended to determine who "qualifies" for power mobility**
- Not intended to be used as an outcome measure
- Consists of
  - 12 items scored on a 5 point scale
    - 4 non-motor items and 8 motor items
  - 1 non-scored item
  - 2 items that are scored dichotomously

94

The PMTT[22]

Provided by the authors free of charge

kenyonli@gvsu.edu

95

Other Helpful Hints in Developing Power Mobility Training Methods

1. Identifying motivational and reinforcement factors
2. The Power Mobility Training Tool[21]
3. **Create an engaging environment**
4. Responsive use of an attendant control unit

96

Create an Individualized & Engaging Environment

- Based on
  - The findings from the RAISD[22]
  - The findings of the PMTT[21]

97

Example - Driver #5

98

Findings from the RAISD[22]

- Likes her pacifier
- Enjoys children's songs
- Loves playing with her brother

99

Initial Findings on the PMTT[21]

- Using only one switch
- Fairly consistent switch activation
  - Appears to understand the connection between pressing the switch and moving the power mobility device
  - Activates a switch to move the power mobility device in any direction
  - Difficulty activating the switch to move the power mobility device for >5 seconds

100

Initial Driving "Goals"

- (Child) will activate the switch to move the power mobility device for >5 seconds.
- (Child) will drive the power mobility device 5 feet to obtain a desired object or to interact with a preferred person.

101

Video - 1st day of Training

102

Subsequent Findings – PMTT[21]

- Still using only one switch – ?motor ability to use more switches
- Consistent switch activation
  - Activates a switch to move the power mobility device in any direction
  - Sustains activation of the switch to move the power mobility device for >5 seconds
- Difficulties with stopping - ?motor ability

103

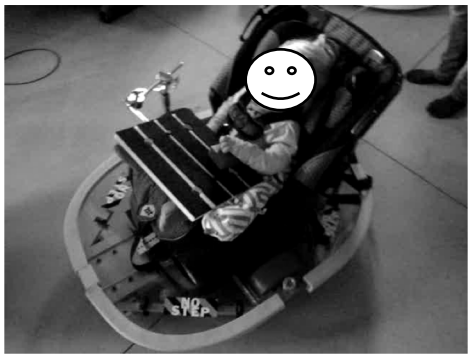
Progression "Goals"

- (Child) will progress to using a joystick to drive the power mobility device
  - Use the joystick to move the device forward, right, left, and in reverse
  - Stopping
- (Child) will drive the power mobility device 25 feet to obtain a desired object or to interact with a preferred person

104

CONTINUED

Video



105

CONTINUED

Success!!!

106

Other Helpful Hints

1. Identifying motivational and reinforcement factors
2. The Power Mobility Training Tool
3. Create an engaging environment
4. **Responsive use of an attendant control unit**

107

Responsive Use of Attendant Control

- Used for
  - Safety
  - Maneuvering
  - Encouraging problem solving

108

Responsive Use of Attendant Control

- Used for
  - Safety
  - Maneuvering
  - Encouraging problem solving

Achieved through shared control

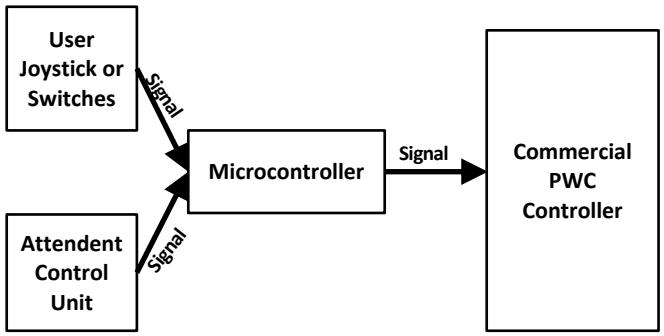
109

Shared Control

The electronic capability to modify the direction and motion of the power mobility device by combining inputs from both the user and attendant control units without having to stop or interrupt the child's driving

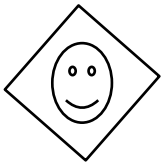
110

Shared Control Schematic



11

Shared Control Output Example



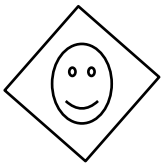
No Shared Control

Glass Wall

12

Shared Control Output Example

No Shared Control



Glass Wall

Shared Control Output Example

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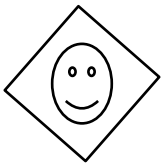
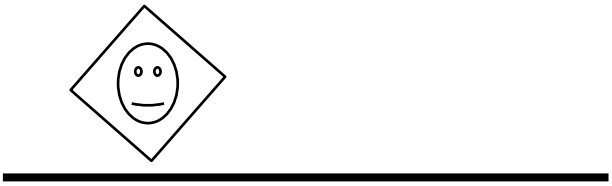


Glass Wall

Shared Control Output Example

No Shared Control

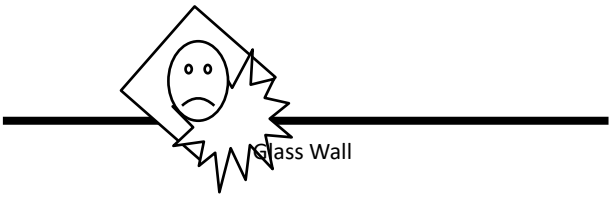


Glass Wall

115

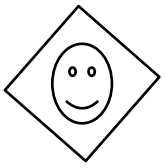
Shared Control Output Example

No Shared Control



116

Shared Control Output Example



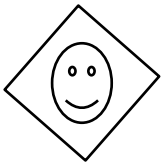
Shared Control

Glass Wall

117

Shared Control Output Example

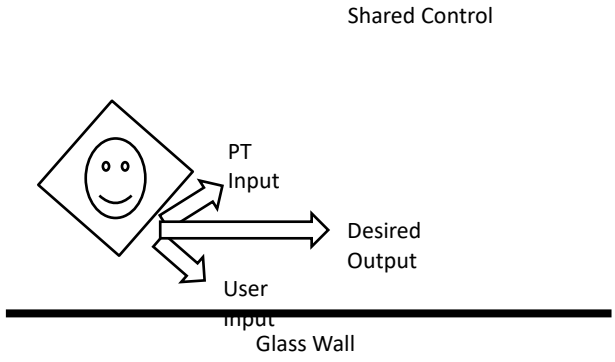
Shared Control



Glass Wall

118

Shared Control Output Example



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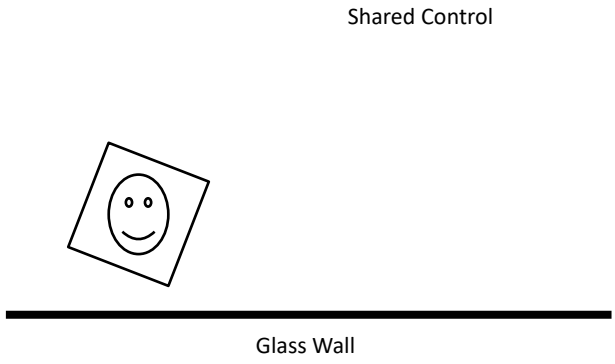
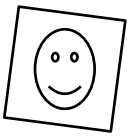
Shared Control Output Example



20

Shared Control Output Example

Shared Control



Glass Wall

121

Shared Control Output Example

Shared Control

Glass Wall

122

Shared Control Output Example

Shared Control

Glass Wall

123

Shared Control Output Example

Shared Control

Glass Wall

124

Shared Control Output Example

Shared Control

Glass Wall

Shared Control Output Example

Shared Control

Glass Wall

Video - Shared Control

127

Shared Control

- When to use & when not to use
  - When is it best for the attendant to take over driving?
    - Safety
    - Other situations?
  - When is allowing a “safe” collision most beneficial?
    - We all learn from our errors!

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Shared Control

- Appears to be most helpful for children
  - Learning cause and effect concepts
  - Who become easily frustrated or discouraged
- Appears most helpful in the early/exploratory stages of learning
- Great for minimizing safety concerns

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Shared Control

- Accompanying verbiage
  - Letting the child know who is driving
    - "I stopped you"
    - "I am driving now"

130

Select Outcome Measures to Assess the Impact of Power Mobility Training in Infants & Toddlers

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SR by Kenyon et al[20]

- Critical review of power mobility training methods
- The Evidence Alert Traffic Light Grading System (EATLS) = Yellow [23]
  - Indicating that caution is needed when providing power mobility training
  - Measure outcomes related to established goals

Kenyon LK, Hostnik L, PT, McElroy R, Peterson C, Farris JP. Power mobility training methods for children: a critical review. Pediatr Phys Ther. 2018;30(1):2–8.

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Measuring Outcomes of Power Mobility Training

- Measurement tool depends on goals
  - Looking for improvements in
    - Development?
    - Functional skills?
    - Power mobility skills?
    - Other areas?

134

Measuring Outcomes of Power Mobility Training

- Outcome tools focused on power mobility skills
  - Power Mobility Training Tool[21]
  - Assessment of Learning Power mobility use[24]
  - Canadian Occupational Performance Measure[25]
  - The Wheelchair Outcome Measure – Young People (WhOM-YP)[26]

135

Measuring Outcomes of Power Mobility Training

- Outcome tools focused on power mobility skills
  - Wheelchair Skills Checklist[27]
    - 7 skills - some combine power mobility skills with the ability to follow adult commands

136

Expectations

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2017 RESNA Application of Power Mobility Devices for Pediatric Users[17]

- In typical development, mobility skills are not suddenly present
  - Mobility emerges over a prolonged learning period and with high variability

138

2017 RESNA Application of Power Mobility Devices for Pediatric Users[17]

- In typical development, mobility skills are not suddenly present
  - Crawling, rolling, and walking are attained over time with frequent "failures" and falls

139

2017 RESNA Application of Power Mobility Devices for Pediatric Users[17]

- In typical development, mobility skills are not suddenly present
  - Crawling, rolling, and walking are attained over time with frequent "failures" and fallsC
    - Remember: Ambulatory infants 12-19 months of age fall 17 times per hour[7]

140

How Long Does It Take?

- Learning to use a power mobility device is a developmental process

141

How Long Does It Take?

- Durkin[18] identified 3 developmental stages in learning to use a power mobility device

1. Learning the idea of movement
2. Learning how to operate the device
3. Learning how to use the device in everyday life

142

How Long Does It Take

Butler et al[27,28] conducted the seminal studies in power mobility use more than three decades ago

143

How Long Does It Take

- In Butler's first study,[28] 9 children ages 20-39 months with age appropriate cognition were provided with power wheelchairs for use in their homes.
- Competence was defined using the Wheelchair Skills Checklist

144

How Long Does It Take[28]

- 7 of 9 children became competent drivers in less than 3 weeks
- An 8th child, who was 24 months-old, achieved competence in 7 weeks
- The 9th child reportedly experienced repeated illness and hospitalizations during the 4 month period in which she had access to the power wheelchair

145

How Long Does It Take

- Butler's 2nd study[27] involved 13 children ages 20 - 37 months with age appropriate cognitive skills
- Competence was defined via the WSC[27]
- 12 of 13 children achieved competency within an average of 16.3 days of driving (range 3 to 50 days)
  - Mean cumulative practice time = 34.4 hours (range 6.6 to 168 hours).

146

How Long Does It Take

All of the children in these two early studies were physically able to use a joystick.[27,28]

147

How Long Does It Take

More recent work by Huhn et al[29] and Mockler et al[30] suggests that children who are unable to use a joystick and require alternate access methods, may require longer periods of time to learn to drive a power wheelchair.

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What About the Different Power Types of Mobility Learners[15]?

- Exploratory leaners
- Operational learners
- Functional learners

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Total Mobility Concepts

How Power Mobility Fits into the Overall Mobility Goals and Plan for Infants & Toddlers

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Typically Developing Children and Adult Use Many Different Forms of Mobility

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Typically Developing Children and Adult Use Many Different Forms of Mobility

Why Should Children With Mobility Limitations Be Any Different?

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Multiple Mobility Options

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Multiple Mobility Options

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Summary

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Questions?

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