MOBILITY DRIVES COGNITION
- The ability to move from one place to another independently appears to play a pivotal role in social development and psychological function (Anderson, 2013).
- Children with cerebral palsy or complex developmental delays are often less mobile and interactive than their peers (Palisano, 2003).
- This lack of mobility and dependent positioning can have a negative impact on overall development, social interaction and social status (Lancioni, 2009 and McEwen, 1992).
- Leading to contractures, scoliosis and hip subluxation.
- Causing poor cardiopulmonary function.
- Giving our kids metabolic syndrome.
- Compounding intellectual disability.
- Killing them....

LOBO, 2013
- Grounded perceptual motor experience forms cognition.
- Exploration through early behaviors facilitate development.
- Infants and children with limited exploration are at risk for global development impairments.
- Gait trainer use targets exploratory behaviors and is a feasible and effective way to advance a range of abilities across developmental domains and time.

AGING
- We have lots of evidence that exercise improves brain function, memory and decreases the onset and severity of dementia.
- We also know that going out and interacting with others has the same result.
- Can this data be applied directly to the young developing brain?
- Is using a gait trainer or other mobility devices exercise? Exploration? Both? Even more powerful?

UCHIYAMA, 2008
- Locomotion is not merely a maturational antecedent to these psychological changes, but instead plays a causal role in their genesis.
WHY DO GAIT TRAINERS HELP?
ANDERSON, 2013
1) Shifts from egocentric to allocentric coding strategies
2) New attentional strategies and improved discrimination of task-relevant information
3) Improvements in means-ends behaviors and greater tolerance of delays in goal attainment
4) Refined understanding of others’ intentions

WHAT IS IT?
• Gait Trainer?
• Support Walker?
• Dynamic Mobility Device?
• Stepping System?
• Activity? Participation? Environmental Factor?

DEFINITION
(PALEG AND LIVINGSTONE, 2016)
• A supported walking device that provides trunk and pelvic support.
• There is some confusion about the term gait trainers as they are not always used to ‘train gait’ or develop independent, unsupported walking, but as a means to enhance activity and participation.
• I use the term gait trainer since it has been established by US coding, is familiar to clinicians, and appears to be longest standing in the literature

DEFINITION
(PALEG AND LIVINGSTONE, 2016)
• Gait trainers commonly unweight the body through a solid or fabric ‘seat’, stabilize the trunk and support the pelvis.
• Survey data suggests that therapists hope to influence body structure and function components such as hip structure, cardiorespiratory function and bone mineral density through gait trainer use (Low, 2011)

Models Available in US and Canada
9. Hart 17. Pony

RESEARCH ON GAIT TRAINERS
1. Don’t care
2. Tell me just a little
3. Give me the main point
4. Tell me most of it
5. Share every detail
SYSTEMATIC REVIEW OF GAIT TRAINER OUTCOMES FOR CHILDREN WITH MOTOR IMPAIRMENTS

Why?

- Lots of people (teachers, parents, therapists, children etc.) use gait trainers
- We didn’t know of more than a handful of studies
- Gait Trainers were considered “experimental”
- This was resulting in a lack of access for children in the US and Canada

Methods:

- 7 electronic databases - search updated to November 2014
- Included studies - gait trainer intervention in home or school setting and child up to age 18 years
- Level of evidence AACPDM intervention in home or school setting and child up to age 18 years
- AACPDM Quality assessment of Evidence Level I-III studies.

Paleg and Livingstone

- 17 studies included.
- Two level II studies supported impact on walking distance and number of steps taken.
- Two level III studies supported impact on mobility level with one of these suggesting impact on bowel function and bone mineral density.
- Level IV and V studies support positive impact on a range of activity outcomes, some supporting impact on affect, motivation and participation.

Level II (weak)

- Overground vs treadmill the same at school for distance with positive trend in increased endurance in over ground group (Willoughby, 2011)
- MOVE helps students increase # of steps taken N=3 (Barnes, 2003)

Level III
(Eisenberg, 2009)

- N=22 children with severe cerebral palsy, 11 used a Hart Walker (HW) device, and 11 had a passive standing program.
- Gait Trainer use makes you poop!

Level III
van der Putten, 2005

- N=44 GMFCS Level IV and V
- Taught to “step” using MOVE
- The level of independence of the experimental group increased significantly in performing movement skills; the control group did not increase significantly
- At an individual level, 20 children (63%) of the experimental group improved in comparison with the control group, in which four children (33%) improved.
Conclusions

- There is Level II Evidence for gait trainers in children with CP
- We recommend beginning use at 9-12 months
- For children at GMFCS levels II-V
- Children at Level V ≤50th percentile may need adult to push devices to activate CPG/Stepping (THIS IS OK WITH BC/BS ANTHEM!)
- Children at Level IV should be independent indoors
- Children at Level III <50th percentile may benefit from use outdoors

Clinical messages

- Gait trainers may assist development of independent stepping and walking distance for some children who are unable to walk without support.
- Observational evidence suggests that gait trainers may have a positive impact on body structure and function, activity and participation outcomes.

Gait trainer evidence – what’s missing?

- Selection of gait trainers often depends on therapist familiarity or availability rather than a clear decision making process (Low et al. 2011)
- SR did not identify any studies evaluating
  - Gait trainer types or features
  - Effectiveness with different populations
  - Comparison of different gait trainers with individual children
- No evidence-based clinical guidelines
  Until Sept 2016…

What we published

- Systematic Review
- Comparison of three models in a lab (no kids)
- Clinical Considerations
- Outcome Measures

Step 1: Inertial properties

- Paleg et al. 2016 Assistive Technology
- Georgia Tech Laboratory

Results

- Footprint similar for all gait trainers
- KidWalk heaviest, Pacer lightest
- KidWalk most growth for height
- Pacer most growth for weight
- On a smooth tile surface, initiation forces were equivalent KidWalk and Pacer; Mustang had the highest initiation force (hardest to move)
- On carpet – the KidWalk had the lowest initiation forces (easiest to move)
- KidWalk kept going best once you started it
Step 2 – compare with a real kid

- Attempt 1
- 5 children
- ‘Gait-Rite’ pad
- Rifton Pacer and Prime Engineering KidWalk
- Results – raw data too high – software failure

CHOOSING THE RIGHT GAIT TRAINERS
PALEG AND LIVINGSTONE, 2016

- We reviewed the evidence and clinical considerations influencing selection of gait trainer features for children with cerebral palsy.
- A scoping methodology was used to identify any relevant research and clinical literature supporting selection of different gait trainer features.
- Conclusions: Evidence supporting selection of gait trainer styles and features for children with cerebral palsy is very limited.
- Further research is needed in all aspects of gait trainer assessment, selection and implementation.
- Clinical consensus may be helpful in providing guidance in decision-making around prescription and use of gait trainers and features for children with cerebral palsy who have differing clinical profiles and needs.

SEPT, 2016
LIVINGSTONE AND PALEG

- Outcome Measures for use with Gait Trainers
- PEDI was best in all categories
- But so far it doesn’t pick up clinically meaningful changes..
- Stay tuned...

SURVEY OF SCHOOL PTS
(LOW, 2011)

- Several support walkers (gait trainers) were reported as used most often to improve gait, mobility, participation at school, and interaction with peers.
- Use commonly included a month trial before purchase and 9 sessions of physical therapy to train a child for use in school.
- Reasons given for the use of gait trainers were improving impairments, functional limitations, and participation with peers.

WILLOUGHBY, 2010

- RCT N=34 GMFCS III or IV
- 9 wks walking training 2x/wk
- PBWSTT vs. overground walking practice

RESULTS

- The over ground training group showed a trend for an increase in the distance walked over 10 minutes.
- No difference in self-selected walking speed over 10 meters or in walking function in the school environment on the SFA
RESULTS

- Willoughby concluded that PBWSTT may be no more effective than over ground training (including use of gait trainers) for improving walking speed and endurance for children with CP.
- Some say her BWSGT intervention was not rigorous enough.

GROSS MOTOR FUNCTION CLASSIFICATION SYSTEM (GMFCS)

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Level I: Walks Without Restrictions; limitations are present in more advanced motor skills.</td>
</tr>
<tr>
<td>II</td>
<td>Level II: Walks Without Assistive Devices; limitations are present in walking outdoors and in the community.</td>
</tr>
<tr>
<td>III</td>
<td>Level III: Walks With Assistive Mobility Devices; limitations are present in walking outdoors and in the community.</td>
</tr>
<tr>
<td>IV</td>
<td>Level IV: Self Mobility With Limitations; children are transported or use power mobility outdoors and in the community.</td>
</tr>
<tr>
<td>V</td>
<td>Level V: Self Mobility Is Severely Limited; even with use of assistive technology.</td>
</tr>
</tbody>
</table>


WHO NEEDS A GAIT TRAINER?

- Children at GMFCS levels IV and V are unable to use typical hand-held walkers due to impaired trunk control, strength, balance and range of motion.
- Children with complex developmental delays also benefit from walkers that provide additional trunk and pelvic support.
- Children with visual impairment or profound cognitive limitations may lack motivation to explore due to limited ability to engage in functional or stimulating activities.
- Supportive walking devices or gait trainers may be used with these populations to influence different types of outcomes as defined by the International Classification of Functioning, Disability and Health (ICF).

GMFCS EXPANDED AND REVISED

- http://canchild.ca/system/tenon/assets/attachments/000/000/058/origna/ GMFCS-ER_English.pdf

BEFORE AGE 2 YEARS

- LEVEL I: Infants move in and out of sitting and floor sit with both hands free to manipulate objects. Infants crawl on hands and knees, pull to stand and take steps holding on to furniture. Infants walk between 18 months and 2 years of age without the need for any assistive mobility device.
Before Age 2 Years

- **LEVEL II:** Infants maintain floor sitting but may need to use their hands for support to maintain balance. Infants creep on their stomach or crawl on hands and knees. Infants may pull to stand and take steps holding on to furniture.

- **LEVEL III:** Infants maintain floor sitting when the low back is supported. Infants roll and creep forward on their stomachs.

- **LEVEL IV:** Infants have head control but trunk support is required for floor sitting. Infants can roll to supine and may roll to prone.

- **LEVEL V:** Physical impairments limit voluntary control of movement. Infants are unable to maintain antigravity head and trunk postures in prone and sitting. Infants require adult assistance to roll.

- **LEVEL I:** Children floor sit with both hands free to manipulate objects. Movements in and out of floor sitting and standing are performed without adult assistance. Children walk as the preferred method of mobility without the need for any assistive mobility device.
LEVEL II: Children floor sit but may have difficulty with balance when both hands are free to manipulate objects. Movements in and out of sitting are performed without adult assistance. Children pull to stand on a stable surface. Children crawl on hands and knees with a reciprocal pattern, cruise holding onto furniture and walk using an assistive mobility device as preferred methods of mobility.

LEVEL III: Children maintain floor sitting often by "W" sitting (sitting between flexed and internally rotated hips and knees) and may require adult assistance to assume sitting. Children creep on their stomach or crawl on hands and knees (often without reciprocal leg movements) as their primary methods of self-mobility. Children may pull to stand on a stable surface and cruise short distances. Children may walk short distances indoors using a handheld mobility device (walker) and adult assistance for steering and turning.

LEVEL IV: Children floor sit when placed, but are unable to maintain alignment and balance without use of their hands for support. Children frequently require adaptive equipment for sitting and standing. Self-mobility for short distances (within a room) is achieved through rolling, creeping on stomach, or crawling on hands and knees without reciprocal leg movement.

LEVEL V: Physical impairments restrict voluntary control of movement and the ability to maintain antigravity head and trunk postures. All areas of motor function are limited. Functional limitations in sitting and standing are not fully compensated for through the use of adaptive equipment and assistive technology. At Level V, children have no means of independent movement and are transported. Some children achieve self-mobility using a powered wheelchair with extensive adaptations.

LEVEL I: Children get into and out of, and sit in, a chair without the need for hand support. Children move from the floor and from chair sitting to standing without the need for objects for support. Children walk indoors and outdoors, and climb stairs. Emerging ability to run and jump.

LEVEL II: Children sit in a chair with both hands free to manipulate objects. Children move from the floor to standing and from chair sitting to standing but often require a stable surface to push or pull up on with their arms. Children walk without the need for a handheld mobility device indoors and for short distances on level surfaces outdoors. Children climb stairs holding onto a railing but are unable to run or jump.
LEVEL III: Children sit on a regular chair but may require pelvic or trunk support to maximize hand function. Children move in and out of chair sitting using a stable surface to push on or pull up with their arms. Children walk with a hand-held mobility device on level surfaces and climb stairs with assistance from an adult. Children frequently are transported when traveling for long distances or outdoors on uneven terrain.

LEVEL IV: Children sit on a chair but need adaptive seating for trunk control and to maximize hand function. Children move in and out of chair sitting with assistance from an adult or a stable surface to push or pull up on with their arms. Children may at best walk short distances with a walker and adult supervision but have difficulty turning and maintaining balance on uneven surfaces. Children are transported in the community. Children may achieve self-mobility using a powered wheelchair.

LEVEL V: Physical impairments restrict voluntary control of movement and the ability to maintain antigravity head and trunk postures. All areas of motor function are limited. Functional limitations in sitting and standing are not fully compensated for through the use of adaptive equipment and assistive technology. At Level V, children have no means of independent movement and are transported. Some children achieve self-mobility using a powered wheelchair with extensive adaptations.

BETWEEN AGES 4-6 YEARS

BETWEEN 6-12 YEARS OF AGE

LEVEL I: Children walk at home, school, outdoors, and in the community. Children are able to walk up and down curbs without physical assistance and stairs without the use of a railing. Children perform gross motor skills such as running and jumping but speed, balance, and coordination are limited. Children may participate in physical activities and sports depending on personal choices and environmental factors.

LEVEL II: Children walk in most settings. Children may experience difficulty walking long distances and balancing on uneven terrain, inclines, in crowded areas, confined spaces or when carrying objects. Children walk up and down stairs holding onto a railing or with physical assistance if there is no railing. Outdoors and in the community, children may walk with physical assistance, a hand-held mobility device, or use wheeled mobility when traveling long distances. Children have at best only minimal ability to perform gross motor skills such as running and jumping. Limitations in performance of gross motor skills may necessitate adaptations to enable participation in physical activities and sports.

LEVEL III: Children walk using a hand-held mobility device in most indoor settings. When seated, children may require a seat belt for pelvic alignment and balance. Sit-to-stand and floor-to-stand transfers require physical assistance of a person or support surface. When traveling long distances, children use some form of wheeled mobility. Children may walk up and down stairs holding onto a railing with supervision or physical assistance. Limitations in walking may necessitate adaptations to enable participation in physical activities and sports including self-propelling a manual wheelchair or powered mobility.
**BETWEEN 6-12 YEARS OF AGE**

- **Level IV:** Children use methods of mobility that require physical assistance or powered mobility in most settings. Children require adaptive seating for trunk and pelvic control and physical assistance for most transfers. At home, children use floor mobility (roll, creep, or crawl), walk short distances with physical assistance, or use powered mobility. When positioned, children may use a body support walker at home or school. At school, outdoors, and in the community, children are transported in a manual wheelchair or use powered mobility. Limitations in mobility necessitate adaptations to enable participation in physical activities and sports, including physical assistance and/or powered mobility.

- **Level V:** Children are transported in a manual wheelchair in all settings. Children are limited in their ability to maintain antigravity head and trunk postures and control arm and leg movements. Assistive technology is used to improve head alignment, seating, standing, and/or mobility but limitations are not fully compensated by equipment. Transfers require complete physical assistance of an adult. At home, children may move short distances on the floor or may be carried by an adult. Children may achieve self-mobility using powered mobility with extensive adaptations for seating and control access. Limitations in mobility necessitate adaptations to enable participation in physical activities and sports including physical assistance and using powered mobility.

**BETWEEN AGES 12-18 YEARS**

- **Level I:** Youth walk at home, school, outdoors, and in the community. Youth are able to walk up and down curbs without physical assistance and stairs without the use of a railing. Youth perform gross motor skills such as running and jumping but speed, balance, and coordination are limited. Youth may participate in physical activities and sports depending on personal choices and environmental factors.

- **Level II:** Youth walk in most settings. Environmental factors (such as uneven terrain, inclines, long distances, time demands, weather, and peer acceptability) and personal preference influence mobility choices. At school or work, youth may walk using a handheld mobility device for safety. Outdoors and in the community, youth may use wheeled mobility when traveling long distances. Youth walk up and down stairs holding a railing or with physical assistance if there is no railing. Limitations in performance of gross motor skills may necessitate adaptations to enable participation in physical activities and sports.

- **Level III:** Youth are capable of walking using a handheld mobility device. Compared to individuals in other levels, youth in Level III demonstrate more variability in methods of mobility depending on physical ability and environmental and personal factors. When seated, youth may require a seat belt for pelvic alignment and balance. Sit-to-stand and floor-to-stand transfers require physical assistance from a person or support surface. At school, youth may self-propel a manual wheelchair or use powered mobility. Outdoors and in the community, youth are transported in a wheelchair or use powered mobility. Youth may walk up and down stairs holding onto a railing with supervision or physical assistance. Limitations in walking may necessitate adaptations to enable participation in physical activities and sports including self-propelling a manual wheelchair or powered mobility.

- **Level IV:** Youth use wheeled mobility in most settings. Youth require adaptive seating for pelvic and trunk control. Physical assistance from 1 or 2 persons is required for transfers. Youth may support weight with their legs to assist with standing transfers. Indoors, youth may walk short distances with physical assistance, use wheeled mobility, or, when positioned, use a body support walker. Youth are physically capable of operating a powered wheelchair. When a powered wheelchair is not feasible or available, youth are transported in a manual wheelchair. Limitations in mobility necessitate adaptations to enable participation in physical activities and sports, including physical assistance and/or powered mobility.

- **Level V:** Youth are transported in a manual wheelchair in all settings. Youth are limited in their ability to maintain antigravity head and trunk postures and control arm and leg movements. Assistive technology is used to improve head alignment, seating, standing, and mobility but limitations are not fully compensated by equipment. Physical assistance from 1 or 2 persons or a mechanical lift is required for transfers. Youth may achieve self-mobility using powered mobility with extensive adaptations for seating and control access. Limitations in mobility necessitate adaptations to enable participation in physical activities and sports including physical assistance and using powered mobility.
GMFM

- You need the book
- You need the software (it's free) GMAE-2
- Set up a folder
- Make sure you have the “right” JAVA version
- Pray, make friend with the IT person, try try try

NEED TO CHEAT?

- Give the 66
- Change the “formula box”
- Download the charts
- Calculate by “hand”
- You’ll be 10-15% off

CHEAT

For A: 4 items x3 pts = 12
B= 15x3=45
C= 30
D= 33
E= 39

NOW YOU NEED THE CHARTS

- Google “GMFM Percentiles”
- Click on PDF version
- Scroll through for charts
- https://canchild.ca/system/tenon/assets/attachments/000/000/222/original/tabulated_gmfm66_percentiles.pdf
GMFM

- 66 for CP (no braces or assistive devices, has percentiles)
- 88 for DS you CAN use orthotics but there will NOT be percentiles
- 88 more sensitive to change for kids at levels IV and V, but then you won’t have percentiles

BARTLETT, 2014

- N=429
- 58% and 75% of the variance in motor function explained by:
  - Primary impairments (spasticity, quality of movement, postural stability, and distribution of involvement)
  - Secondary impairments (strength, range of motion limitations, and reduced endurance)

- NOTE* Postural stability contributed most to primary impairments and strength to secondary impairments. (Jefferies, 2015)
WHO IS GMFM/GMFCS VALID FOR?

- Lymphoblastic leukemia (Wright et al. 1998)
- Children with osteogenesis imperfecta (Ruck-Gibis, 2001)
- Hereditary spastic paraplegia and other childhood neurological conditions (Adair, 2012)
- Down syndrome (Palisano, 2001) *only two curves
- Severe acquired brain injury (Kelly, 2014)
- SMA
- Rett syndrome
I. Handles objects easily and successfully. At most limitations in the ease of performing manual tasks requiring speed and accuracy. However, any limitations in manual abilities do not restrict independence in daily activities.

II. Handles most objects but with somewhat reduced quality and/or speed of achievement. Certain activities may be avoided or be achieved with some difficulty; alternative ways of performance might be used but manual abilities do not usually restrict independence in daily activities.

III. Handles objects with difficulty; needs help to prepare and/or modify activities. The performance is slow and achieved with limited success regarding quality and quantity. Activities are performed independently if they have been set up or adapted.

IV. Handles a limited selection of easily managed objects in adapted situations. Performs parts of activities with effort and with limited success. Requires continuous support and assistance and/or adapted equipment, for even partial achievement of the activity.

V. Does not handle objects and has severely limited ability to perform even simple actions. Requires total assistance.

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EATING AND DRINKING ABILITY

- EDACS

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CVI FROM ROMAN·LANTZY

- CVI Range 1-2: Student functions with minimal visual response
- CVI Range 3-4: Student functions with more consistent visual response
- CVI Range 5-6: Student uses vision for functional tasks
- CVI Range 7-8: Student demonstrates visual curiosity
- CVI Range 9-10: Student spontaneously uses vision for most functional activities