Mobility Matters
Imbedding Hands-free Locomotion Experiences into the Preschool and Elementary Curricula for Students with Severe Speech and Motor Impairment:
The Bridge School Experience

Self-Initiated Mobility

Children who achieve self-initiated locomotion decide how, when and where to move, allowing endless opportunities to explore, discover and interact with objects and people in their environment. As typically developing infants transition from crawling to walking, their world becomes a perpetual state of upright mobility, traveling more than 39 football fields a day and accumulating an average of 17 falls an hour (Adolph 2009). Independent locomotion is then followed by a constellation of developmental changes in sensory motor, spatial cognition, memory and social and emotional domains (Raine 2002, Clearfield 2004, Damiano 2006, Berger 2007, Uchiyama 2008, Clearfield 2011, Anderson 2013). Campos and colleagues (2000) found a relation between infants' responses to referential gestural communication (pointing to a distant object) and the onset of and experience with locomotion, concluding that locomotor activity, distal perception and social cognitive development are developmentally intertwined. Recent studies have also associated the acquisition of locomotion with a significant increase in both receptive and productive language, independent of age (Oudgenoeg 2012, Walle 2014).

Impaired Mobility

Children with a physical disability such as cerebral palsy have limited opportunities to experience self-initiated mobility and exercise without the use of assistive technology devices. Palisano and colleagues (2003) found few children ages 4-12 years, who had moderate to severe cerebral palsy (CP), had a means for self-initiated mobility. Zwier (2010) concluded that physical activity is low in young children with CP and needs to be promoted at an early age. Several studies have concluded that self-initiated mobility has a positive impact on development, particularly in the areas of problem-solving and spatial cognition and that the lack of mobility will have a negative impact on development (Berentahl, B. 1984; Freeman 1993, Butler, C. 1996; Kermoian 1997; Campos, J. 2000; Dietz 2002; Reine 2002; Clearfield 2004; Campos 2008; Foreman 1990). Stanton (2002) noted that restricted mobility during early childhood has a diffuse and lasting impact on development, and if a child's mobility continues to be one of a passive nature, never active or self-initiated early in life, the child is further disadvantaged in his or her development. He concluded that early exploration is important for the development of spatial knowledge and that teenagers with disabilities who received mobility later in childhood scored more poorly on spatial tasks than did those younger children who acquired independent mobility earlier in life.

Support Walkers for Self-Initiated Mobility

A variety of mobility devices, such as support walkers, also referred to as gait trainers, are available for even the youngest and most severely disabled child to independently stand, move and explore (Wright 2002). Support walkers are typically designed to be hands-free and include a seat and pads to support the pelvis, trunk and head.

Hand-held push walkers are also mobility devices. Support walkers differ from hand-held push walkers, which are intended for individuals who have sitting and a moderate degree of standing balance, as physical requirements depend on their ability to hold the walker's handles for support to push it along. Push walkers are difficult and tenuous to use over uneven outdoor surfaces such as playgrounds due to the small caster design. The lack of hands free mobility, because the child must balance by holding on to the handles, limits access to participate in physical activities at school or to use their hands for communicating. Hand-held push walkers (Fig. 1) include the Kaye and Crocodile Walkers. Children with more complex physical needs cannot use a hand-held push walker. Unable to sit and stand independently, these children require a support walker which is designed with a seat, pads around the pelvis and chest and sometimes the head. Support walkers are typically designed with larger wheels which make them more maneuverable over outdoor uneven surfaces. Examples of hands-free support walkers include the WalkAbout (Fig. 2) and GaitMaster by Mulholland Inc., the KidWalk by Prime Engineering (Fig. 3), the FCI Walker by Freedom Concepts (Fig.4) and the Pacer by Rifton (Fig. 5) (Wright-Ott 2015).

The KidWalk, designed with a large mid wheel and front anti tips, is specifically designed to work more efficiently over surfaces which are typically difficult to negotiate with a four caster walker, such as carpeted areas, thresholds and outdoor uneven surfaces like sidewalks, blacktops and even fields. The greatest advantage to support walkers is that the child has hands-free mobility to explore, touch, and participate in playground activities with peers.

Fig 1. A hand-held push walker provides mobility but not access to a variety of recess activities.

Fig. 2. A support walker (WalkAbout) allows the hands to be free for physical activities and peer interaction.

Fig. 3. Arman carries some favorite objects while exploring in his KidWalk.

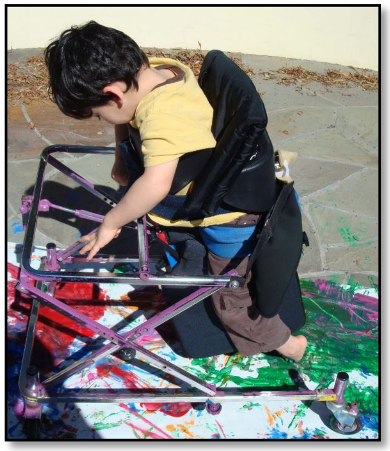

Fig 4. Aidan paints with his feet in a FCI walker.

Fig. 5. Drew walks with a friend in her Pacer.

The Bridge School Mobility Approach

The Bridge School in Hillsborough, California is a private school for preschool and elementary children with severe speech and motor impairment, located on one of the Hillsborough City School District's elementary school campuses. The school is dedicated to ensuring that children with speech and motor impairments, primarily those with CP, achieve full participation in their communities through the use of augmentative and alternative means of communication (AAC) and assistive technology (AT). The environment is designed to foster language development, communication, school readiness-to-learn, mobility, exploration, sensory motor development, learning, peer interaction, self determination and access to core curriculum. The majority of students at the Bridge School have cerebral palsy (CP), classified on the Gross Motor Function Classification System (GMFCS) as levels IV-V. Students range in age from 3 to 10 years and attend either preschool, kindergarten or elementary classrooms. Elementary students may also participate in inclusion classes.

Educators at the Bridge School have recognized the developmental, physical and educational benefits of imbedding self-produced locomotion into the curricula by providing students with opportunities to use hands-free support walkers for self-produced locomotion throughout the school day. Increased motor activity has also been shown to lead to better physical and mental health and to augment other aspects of functioning such as cognitive performance (Raine, et al, 2002; Campos & Bertenthal, 1987; Pelligrini & Smith, 1998; Rendeli, et al. 2002; Bottos, et al. 2001). Several times a day, students are offered the opportunity to transfer from their wheelchairs into a hands-free support walker to participate in classroom activities (Fig. 6) and to access recess activities (Fig.7).

Fig. 6. Preschoolers participate in music group while standing and moving in their support walkers.

Fig. 7. An elementary student uses a KidWalk at recess to play soccer with a friend.

Evaluation, Equipment and Funding

Students participate in an evaluation which may include comparative trials of various hands-free support walkers to determine which walker is appropriate, including adaptations to improve function, such as a wider and longer seat to reduce leg adduction or crossing of the legs. The support walker evaluation is conducted by an Occupational Therapist and Assistive Technology Professional with input from the teacher and the child's community therapists. The evaluation begins by deciding the purpose for using a support walker and identifying the environment(s) where the student will be using it. If the purpose is for the student to access recess activities such as kicking, throwing or catching a ball, reaching and interacting with peers, then hands-free walkers designed with minimal hardware in front of the child are preferred. Since the activities will occur outdoors on the playground, a support walker with features that provide maneuverability over uneven surfaces should be considered (large tires rather than small casters are more efficient and accessible over outdoor, uneven surfaces). It is ideal to evaluate use of the mobility device in the child's natural environment(s), particularly since most support walkers may work efficiently on smooth hard surfaces commonly found in a clinic, but not on other surfaces like playgrounds, sidewalks and fields.

Mobility devices for evaluation and trials at the Bridge School have been acquired through several means. Equipment has been loaned by manufacturers and vendors for use during student evaluations. Funding was acquired through grants to purchase several types of support walkers for long term trial purposes. Authorization for a mobility device may be pursued through the student's school district if the Individual Education Plan (IEP) has a mobility goal, such as inclusion in Physical Education or accessing recess. A family's medical insurance may purchase a support walker for home use, which is transported to school by the family. Cost of a support walker can range from US$1800.00 to $4500.00 depending on the need for specific features and modifications.

Mobility for Preschool Students

Once in their support walkers, the preschool students are able to engage in exploration of the classroom to choose an activity center, which has a component that ties into a weekly classroom theme such as transportation, community helpers, cooking, animals, shopping, construction and to participate in music and outdoor play. Popular activities include kitchen play, ball play (Fig. 8), toy cars (Fig. 9), dress up, gardening with tools and pushing a toy lawn mower (Fig. 10), interacting with peers during imaginary play with an inflatable toy car or a pop up school bus placed over the child and walker, hide and seek, moving in and out of a cardboard play house, discovering favorite activities like looking in the mirror or walking to the book display, carrying toys and objects to different locations and to peers, knocking down a tower of boxes, counting steps and art activities like painting on a wall (Fig. 10) or floor canvas with feet (Fig. 11). Standing in a support walker during music group allows the student to imitate movements and dance to songs like "The Hokey Pokey," "Head Fingers Nose and Toes" and "Red Light Green Light" (Fig. 12) . Students may have access to a Step by Step mounted to the walker for interaction with others and communication opportunities (Fig. 13). In their support walkers, students make independent choices as to areas of the classroom and the activities they want to explore.

Fig. 8. In his walker, Niels plays an adapted baseball game.

Fig. 9. Joey uses a support walker to play auto mechanic.

Fig. 10. Cannon can rake and mow in his walker.

Fig. 10 & Fig. 11. Adam and Jet participate in art activities in preschool.

Fig. 12. Phoebe and Niels walk and dance during music.

Fig. 13. Joey uses a Step by Step (behind his elbow) to ask Abigail to cook with him.

Fig. 14. Arman walks to the post office and places his order on a speech generating device.

Fig. 15. Cannon chooses to work at the computer station during centers time.

Mobility for Elementary Students

Elementary classroom students use support walkers to access recess, physical education, mobile math/science and a mobility sports group. Popular activities for the elementary students include activities at recess like chase and tag, jumping, drawing with chalk on the blacktop with a chalk marker mounted on the frame of the support walker (Fig. 16), ball play, finding and meeting peers, searching in a scavenger hunt and dancing. Students participate in Mobility Sports Group by using their support walkers to learn about and play team sports like soccer, softball, football and ice hockey. Mobility Math/Science activities vary weekly and include comparative measurements, counting by taking steps and interactive number games, science experiments like finding an object in class and hooking it onto a pulley to predict which object is heavier, all while students actively participate by moving in their walkers (Fig.17) or rolling objects down a ramp and predicting which object will travel the furthest (Fig. 18). The support walkers are also utilized on field trips which have included taking public transit, exploring a children's museum, skating in the support walker at the ice skating rink, walking through the aisles of the toy store to choose and buy a toy to give to the toy drive, visiting a bakery and the fire department.

Fig. 16. Drew enjoys drawing with a sidewalk chalk toy attached to her KidWalk at recess.

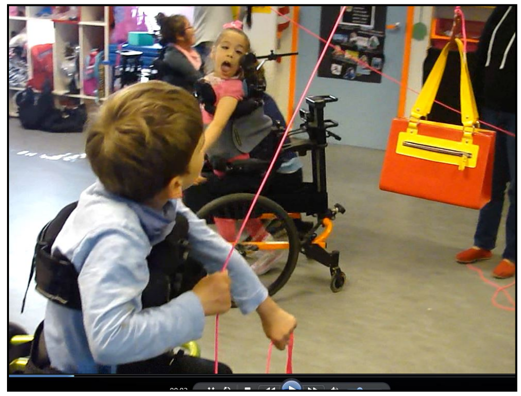

Fig. 17. Fletcher experiments with pulleys and weight of objects during Mobility Science/Math in walkers.

Fig. 18. In their KidWalks during Mobility Math, Savannah and Jet choose an object to roll down the ramp and predict which object will roll the furthest.

Observed Impact of Students Experiencing Self-initiated Mobility at Bridge School
From 2006 to 2015, 29 students enrolled in the Bridge School (22 boys and 7 girls; 3-10 years) participated in self-produced locomotion activities at school throughout the school day, using hands-free support walkers. Diagnoses of these children included 26 with cerebral palsy (CP), classified as Gross Motor Function Classification System (GMFCS); Palisano, et al., 2008) level III (n=1), IV (n=5), V (n=20) and a diagnosis of cortical vision impairment (CVI) (n=15). Three of the 29 students had a diagnosis related to a non-specific genetic disorder. All students had a severe speech and language impairment. Preschool students spent a minimum of 30 minutes daily up to an hour depending on their physical abilities. Elementary students participated in a 15 minute daily recess while in their support walkers and a minimum of 30 minutes three times per week for sports and math/science group. Over time the impacts observed by teachers, family members and therapists when children were in their walkers included:

- An increase in peer interaction and touching. In their walkers, students actively seek out their friends and touch each other to gain attention, to greet one another, to express affection by hugging and to jointly engage in an activity. (Figures 19 A-C).

Fig. 19A. Drew and Collin greet each other with a "high-five".

Fig. 19B. Collin and Drew are dance partners during a music activity.

Fig. 19C. In their walkers, it's easy for Trevor and Will to give each other a hug.

- An increase in self-initiated activities. Example: A preschooler who had no means for independent mobility while seated in her wheelchair, was transferred to her support walker. While looking around the room, she saw her teacher sitting on a stool facing away from her. The preschooler slowly walked towards her teacher, while giggling in anticipation of sneaking up and surprising her teacher. She tried to reach out and touch the teacher's back but was not close enough. After realizing she needed to move closer she carefully took a few more steps, reached her arm out and touched her teacher with a gentle pat. The teacher's surprised reaction was followed by an abundance of joy, laughter and vocalizations from the student, as she attempted to carry on a conversation with her during the interaction that followed (Fig. 20). An elementary student walked by the light switch and reached for it with his index finger to discover after several attempts, he could turn it on/off (Fig. 21) .

Fig. 20. Her walker lets Abigail sneak up to surprise her teacher.

Fig. 21. Alex is delighted when he discovers that, in his walker, he can reach and operate the light switch independently.

- An increase in demonstrating a preference for objects and favorite activities. A preschool boy with CVI, when in his support walker, would walk over to the mirror getting up close to watch his mouth as he vocalized (Fig. 22) then over to his computer desk to interact with his favorite program (Fig. 23).

Fig. 22. Will loves to see himself in the mirror and vocalizes while looking at himself.

Fig. 23. Will walks to his computer, one of his favorite activities.

- An increase in engagement with typically developing peers at recess and inclusion. An elementary female student had no independent mobility at recess in her wheelchair. Once she got her support walker she could independently walk from her classroom to the playground. As she walked onto the playground her friends gave her a high five greeting and were amazed she could walk with them, having never seen her do this previously. She was able to participate in inclusive physical education enjoying relay races and exercises she could do with a peer buddy (Fig. 24) and run at recess on the accessible playground (Fig. 25).

Fig. 24. Drew uses her KidWalk to participate in an inclusive PE activity.

Fig. 25. In her KidWalk, Drew can independently run and explore the accessible playground.

- An increase in engagement with objects, materials and peers in the classroom. A preschooler watched as a fellow student was pushed through the door in his wheelchair as he arrived late for music group. The preschooler turned around and saw his classmate being pushed into class so he walked over and helped bring his fellow student to music group by pulling him in his wheelchair (Fig. 26). A support walker enables children to gaze around their surroundings and locate objects and people. Students can configure their own grouping for an activity in their walkers (Fig. 27).

Fig. 26. Arman helps Niels join the music group by pulling his wheelchair into place.

Fig. 27. Aidan, Abigail and Jackie choose to work together on an activity.

- Increased engagement during dramatic play. A preschool student slowly walked over in her support walker to the costume area. The teacher gave her choices of what she could wear for dress up and she chose a pink princess dress. The costumes are adapted to fit over the child when they are standing in their walker (Fig. 28). Students take turns while in their walkers to stand inside a pop up bus or car and be the driver, a favorite activity. (Fig. 29A-B). A preschool girl who has no mobility in her wheelchair chooses to push a toy car while in her KidWalk (Fig. 30).

Fig. 28. Princess Phoebe loves to walk around in her pink gown.

Fig. 29A. Driver and passenger enjoy being in the bus in their walkers.

Fig. 29B. Aidan's walker lets him speed around in his race car at his own pace.

Fig. 30. In her KidWalk, Phoebe chooses to push a toy car around the garden during recess.

- More frequent use and greater range of active movement of the upper extremities as children reached out for objects and people. A student took responsibility for using his support walker to walk to the kitchen, open the refrigerator with an adapted extension handle and assist staff in bringing lunches to the table by pushing the lunchboxes in a cart (Fig. 31). Another student was never able to catch a ball with both hands, because he had to hold on to the handles of his push walker. A support walker was loaned to him and after practicing at recess for several months he proudly learned to catch and toss a ball with a peer (Fig. 32). Students also have an opportunity to carry objects while walking because the support walkers like the KidWalk are steered with the pelvis rather than the hands (Fig. 33).

Fig. 31. Jet can walk to the kitchen in his KidWalk and open the refrigerator to get the lunches.

Fig. 32. In his hands-free walker, Jack can toss and catch a ball with his friends.

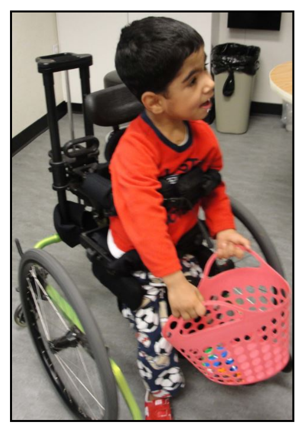

Fig. 33. With his hands free, Arman can find and carry objects during dramatic play.

- Increased use of vision and improvement in the ability to use head movements to visually search locations in the room beyond their immediate surroundings. Distant vision became meaningful for the students as they could seek out objects and people beyond their wheelchairs. When students were asked to find a person or object in hide and seek, they could rotate their body in the walker to orient themselves to their surroundings, contributing to their visual search skills (Fig. 34).

Fig. 34. Arman identifies his classmates by pointing and moving over to them during attendance.

- A decrease in muscle tone and stiffness. One child with CP, spastic quadriplegia, who did not have a support walker to use at school, but sat in her wheelchair, became tight in her hip flexors with general high tone throughout her body. When she was first evaluated for a support walker she was able to walk all around the room and reach for toys on tables, smiling and enjoying herself. However, unable to acquire a support walker, she became stiff and muscle tone remained high. A male student with CP, spastic quadriplegia, was able to take a few steps in his support walker, but the longer he was standing and moving in it the more he was able to take quicker steps with a longer stride and was more relaxed when he returned to his wheelchair.

- Increased opportunities for problem solving. Two students were using their support walkers during Mobile Math and bumped into each other, preventing them from moving any further. The young girl vocalized her frustration. After being alerted by the student of the problem, the teacher told her to "push her legs forward" and physically demonstrated how to do it. She tried for several minutes to problem solve how to move her legs to back away. Then suddenly, for the first time, she was able to push herself backwards and giggled at her accomplishment. On a field trip, a preschool boy was walking around the hallways of the mall and saw a water fountain. He walked up to the fountain, having never experienced one before. Standing at the right height for exploring it, he watched as the adult pushed the button to get water to flow. He was able to press the button with his hands and brought both hands up to the water, which abruptly stopped the water flow. It took him several minutes of experimenting, but he finally figured out how to keep one hand on the button and the other at the fountain to feel the cold water (Fig. 35).

Fig. 35. Arman discovers a water fountain during a field trip and experiments until he learns how it works.

- Increased motor control and ability to self regulate. A preschool student who had been hospitalized the first 3 years of his life was introduced to using a support walker. When he came to school, he sat in a dependent manual wheelchair with full supports (Fig 36). He was rather weak, but within 6 weeks of using the KidWalk at school, his head and trunk control improved and by 10 weeks he had mastered maneuverability such that he could walk along a curved pathway outside. During music group, he would decide to leave the group, walk to another part of the room, spin himself and jump in his KidWalk, then return to the group activity (Fig. 37). The sensory motor experiences from the vestibular, proprioceptive and kinesthetic input he was able to attain for himself, allowed him to rejoin the group, focus and attend. After 7 months of using the KidWalk he gained enough trunk and head control that he no longer required use of the upper body supports, relying on only the seat and pelvic unit (Fig. 38). When he graduated from the Bridge School and moved to a local kindergarten class, there was a delay in bringing his KidWalk to the new school, where he could only sit on the floor by leaning onto his hands. He had no means for mobility in his new class or outdoors with his peers, other than being pushed in his wheelchair by the adults. He had invented a sign for his walker, one hand tapping the palm of his other hand, calling it his "jumper". Upon seeing his walker brought into his new classroom, he signed "jumper", pointed to his chest and his eyes filled up with tears. He was so happy to stand and move with his peers, he wanted to stay in his walker during most of the school day.

Fig. 36. Arman sits in his dependent wheelchair with no means for hands-free self produced mobility.

Fig. 37. Arman enjoys the sensory input from spinning and jumping in his walker.

Fig. 38. Arman's motor control of his trunk and head improved so sufficiently after using his KidWalk for 6 months, he was able to transition to using only the seat and hip pad unit, no longer needing the upper body supports.

Summary

Currently, the links empirically observed in this article between young children with significant physical disabilities who use hands free support walkers and increases in interaction, engagement, self-initiation, problem solving, physical motor control, upper extremity use and peer interaction are mostly indirect, descriptive and correlational. However, they consistently point to the importance of independent locomotion and self-produced locomotion. This article has sought to raise awareness of relationships that exist between self-produced locomotion and development. We have argued that children as young as 3 years, who have severe mobility and sensory impairments can and should have access to hands-free mobility devices as a key component of their assistive technology supports. We have provided a theoretical framework and longitudinal observations for 29 students, ages 3 to 10 years. There is a need to examine the observed relationships at the empirical level to ascertain and refine the impacts of using upright, hands-free walkers in school settings. Children who have participated in the Bridge School support walker mobility program have had a positive observed benefit in their physical, sensory motor, visual, emotional, social, language and cognitive abilities.

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