



Evidence and Outcomes for Power Mobility Intervention with Young Children

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Abstract

This *CASEmaker* bibliography includes selected references and information about evidence for the use of power mobility to assist young children with disabilities to participate in everyday learning opportunities. The source material in this bibliography provides a foundation for provision of power mobility as an effective accommodation for young children with motor impairments that limit other forms of self-initiated mobility. This bibliography primarily includes articles published in peer reviewed journals or texts. For additional references, including case studies published in non-peer reviewed journals, the reader is referred to Magnuson (1995).

From infancy, children learn through their everyday activities (Bronfenbrenner, 1992). Children with severe motor impairments have more limited opportunities to explore their environment; therefore, they are considered to be at risk for secondary impairments such as cognitive, spatial-perceptual, and social-emotional delays (Peganoff-O'Brian, 1993; Tefft, Guerette, & Furumasu, 1999). Power mobility has been advocated for those who are dependent in all mobility, but also for children with limited manual wheelchair or walking ability (McEwen & Hansen, 2006; Olney & Wright, 2006; Warren & Gazdag, 1990), and for those who lose mobility, such as children with muscular dystrophy or spinal muscular atrophy (Stuberg, 2006). The provision of power mobility for young children is congruent with a strengths-based, promotional model of building child competence and functioning. A promotional approach is one that focuses on enhancing competence and function while a strengths-based approach helps children use the abilities they have to develop new competencies (Dunst, 2005). For young children who are not learning to walk at the same age as peers, power mobility affords opportunities to engage in more independent exploration of their environment, as compared with focusing exclusively on remediation of limited mobility, which can delay independent exploration. Power mobility offers the opportunity for preschoolers who lose the ability to walk and those with limited walking or manual wheelchair proficiency to participate similarly to typically developing same-age peers during home, preschool, and community activities. Power mobility allows all children who are unable to walk opportunities to express cognitive as well as social and adaptive abilities they do have and

to develop new abilities. This bibliography is divided into two areas: (1) evidence for the role of mobility for spatial-cognitive and social-emotional development; and (2) evidence for successful use of power mobility among children under age 5 with delayed motor development and motor-related disabilities. Further, articles addressing assessment and training, and research results examining parents' perceptions of power mobility for young children are included.

Role of Movement on Child Development

The use of power mobility has been justified over the years by studies that have examined the association between social-emotional, cognitive, and spatial-perceptual development and locomotion. Widespread agreement now exists to support the notion that locomotion is associated with a range of beneficial developmental

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Rx Prescription for Practice Rx

Improve your understanding of the benefits of power mobility and how to help children learn to use power mobility by reading the following:

Jones, M. A., McEwen, I. R., & Hansen, L. (2003). Use of power mobility for a young child with spinal muscular atrophy. *Physical Therapy, 83*, 253-262.

Bottos, M., Bolcati, C., Sciuto, L., Ruggeri, C., & Feliciangeli, A. (2001). Powered wheelchairs and independence in young children with tetraplegia. *Developmental Medicine and Child Neurology, 43*, 769-777.

Kangas, K. M. (1997). Clinical assessment and training strategies for the child's mastery of independent powered mobility. In J. Furumasu (Ed.), *Pediatric powered mobility: Developmental perspectives, technical issues, clinical approaches* (pp. 33-47). Arlington, VA: RESNA/Rehabilitation Engineering and Assistive Technology Society of North America.

Wiat, L., Darrah, J., Hollis, V., Cook, L., & May, L. (2004). Mothers' perceptions of their children's use of powered mobility. *Physical and Occupational Therapy in Pediatrics, 24*(4), 3-21.

changes, such as spatial problem-solving, visual tracking, and positive pro-social interactions with others (Butler, 1997; Yan, Thomas, & Downing, 1998). The following articles include research studies examining the effects of mobility on either typically developing children or children with developmental delays.

Acredolo, L. P., Adams, A., & Goodwyn, S. W. (1984). The role of self-produced movement and visual tracking in infant spatial orientation. *Journal of Experimental Child Psychology, 38*, 312-327.

Bai, D. L., & Bertenthal, B. I. (1992). Locomotor status and the development of spatial search skills. *Child Development, 63*, 215-226.

Benson, J. B., & Uzgiris, I. C. (1985). Effect of self-initiated locomotion on infant search activity. *Developmental Psychology, 21*, 923-931.

Butler, C. (1986). Effects of powered mobility on self-initiated behaviors of very young children with lo-

comotor disability. *Developmental Medicine and Child Neurology, 28*, 325-332.

Gustafson, G. E. (1984). Effects of the ability to locomote on infants' social and exploratory behaviors: An experimental study. *Developmental Psychology, 20*, 397-405.

Horobin, K. & Acredolo, L. (1986). The role of attentiveness, mobility history and separation of hiding sites on stage IV search behavior. *Journal of Experimental Psychology, 41*, 114-127.

Kermoian, R., & Campos, J. J. (1988). Locomotor experience: A facilitator of spatial cognitive development. *Child Development, 59*, 908-917.

Poag, C. K., Cohen, R., & Weatherford, D. L. (1983). Spatial representations of young children: The role of self-versus adult-directed movement and viewing. *Journal of Experimental Child Psychology, 35*, 172-179.

Yan, J.H., Thomas, J.R., & Downing, J. H. (1998). Locomotion improves children's spatial search: A meta-analytic review. *Perceptual and Motor Skills, 87*, 67-82.

Self-Produced Mobility for Children with Motor Impairments

Research on self-produced mobility has focused on the ability of young children to learn to use power mobility devices. Some of these studies additionally sought to describe the developmental benefits afforded to children with motor delays who used power mobility devices. While no conclusive statement can be made about the developmental benefits of using power mobility, multiple studies have demonstrated that children less than 2 years of age can learn to use power mobility (Butler, Okamoto, & McKay, 1984; Jones, McEwen, & Hansen, 2003; Kangas, 1997; Zazula & Foulds, 1983). Another research group, however, found that two preschool-aged children with severe cognitive disabilities were unable to become independent in using power mobility after 12 months of training (Nilsson & Nyberg, 2003). These authors concluded that practice driving was a feasible method to promote learning for individuals with cognitive disability. They also noted that both children demonstrated increased alertness, increased understanding of cause and effect, and increased the use of their arms despite lack of achieving independence using power wheelchairs. These findings also highlight the importance of practice for young children when considering prescribing power mobility for mobility impairments. Of further importance is that none of the research has substantiated a commonly held fear that children will regress in motor skills due to use of power mobility (Bottos, Bolcati, Sciuto, Ruggeri, & Feliciangeli, 2001). The following references include research studies that examined use of power mobility among young children 13 months to 8 years of age.

- Bottos, M., Bolcati, C., Sciuto, L., Ruggeri, C., & Feliciangeli, A. (2001). Powered wheelchairs and independence in young children with tetraplegia. *Developmental Medicine and Child Neurology*, 43, 769-777.
- Butler, C., Okamoto, G. A., & McKay, T. M. (1983). Powered mobility for very young disabled children. *Developmental Medicine and Child Neurology*, 25, 472-474.
- Butler, C., Okamoto, G. A., & McKay, T. M. (1984). Motorized wheelchair driving by disabled children. *Archives of Physical Medicine and Child Neurology*, 25(4), 472-474.
- Deitz, J., Swinith, Y., & White, O. (2002). Powered mobility and preschoolers with complex developmental delays. *American Journal of Occupational Therapy*, 56, 86-96.
- Jones, M. A., McEwen, I. R., & Hansen, L. (2003). Use of power mobility for a young child with spinal muscular atrophy. *Physical Therapy*, 83, 253-262.
- McEwen I.R., Jones M.A., Neas B.R. (2006). Effects of power wheelchairs on the development of children aged 14-30 months with severe motor-related functional limitations. *Developmental Medicine & Child Neurology Supplement*, 106, 29.
- Nilsson, L. M., & Nyberg, P. J. (2003). Driving to learn: A new concept for training children with profound cognitive disabilities in a powered wheelchair. *American Journal of Occupational Therapy*, 57, 229-233.
- Tefft, D., Guerette, P., & Furumasu, J. (1999). Cognitive predictors of young children's readiness for powered mobility. *Developmental Medicine and Child Neurology*, 41, 665-670.
- Zazula, J. L., & Foulds, R. A. (1983). Mobility device for a child with phocomelia. *Archives of Physical Medicine and Rehabilitation*, 64, 137-139.
- Assessment and Training to Use Power Mobility**
- Different opinions exist about how to assess a child's readiness for and to provide training for the use of a power mobility device (Butler, 1997; Furumasu, Guerette, & Tefft, 1996; Kangas, 1997; Wright-Ott & Egilson, 2001). One research group attempted to develop a tool to assess the potential for successful power mobility devices for young children (Furumasu et al., 1996; Guerette, Tefft, Furumasu, & Moy, 1996; Tefft et al., 1999). Others based assessment and training strategies on clinical experience (Janeschild, 1997; Kangas, 1997). Still other researchers created guidelines (Bottos & Gericke, 2003) based on studies of prognosis for ambulation among children with cerebral palsy, suggesting power mobility should be considered for all children who have poor prognosis for independent walking or manual wheelchair use. Clarke (1988) created a checklist to evaluate whether considered mobility devices, including but not limited to power wheelchairs, meet the needs of the child. Kangas recommended considering all children who can't ambulate by the time typically-developing peers are walking as candidates for powered mobility, while Tefft et al.'s (1999) tool contained specific cognitive indicators. These indicators included some spatial-perceptual and spatial-cognitive skills that were previously associated with locomotion (see Yan et al., 1998). Presence of these skills was found to predict those children with orthopedic or neuromuscular disabilities or cerebral palsy (CP) who were later successful accessing power mobility using joystick controls within their protocol for introducing devices in a clinic setting over six visits. The screening test was not found to help predict successful wheelchair use among children with CP who were able to use a standard joystick and required any alternative access devices (Furumasu, Guerette, & Tefft, 2004; Kangas, 1997). Kangas (1997), in contrast, recommended practice in familiar, natural environments, stating that practice in meaningful activities and familiar routines promotes child learning better than block practice in an unfamiliar setting. Janeschild (1997) recommended gradual introduction of a power wheelchair for young children, progressing through stages of exploration moving toward purposeful use of mobility in ways similar to observed patterns of ambulation acquisition among typically developing infants. The following resources describe the alternative approaches:
- Bottos, M., & Gericke, C. (2003). Ambulatory capacity in cerebral palsy: Prognostic criteria and consequences for intervention. *Developmental Medicine and Child Neurology*, 45, 786-790.
- Clarke, K. L. (1988). Barriers or enablers? Mobility devices for visually impaired and multihandicapped infants and preschoolers. *Education of the Visually Handicapped*, 20, 115-132.
- Furumasu, J., Guerette, P., & Tefft, D. (2004). Relevance of the pediatric powered wheelchair screening test for children with cerebral palsy. *Developmental Medicine and Child Neurology*, 46, 468-474.
- Janeschild, M. (1997). Early power mobility: Evaluation and training guidelines. In J. Furumasu (Ed.), *Pediatric powered mobility: Developmental perspectives, technical issues, clinical approaches* (pp. 48-57). Arlington, VA: RESNA/Rehabilitation Engineering and Assistive Technology Society of North America
- Kangas, K. M. (1997). Clinical assessment and training strategies for the child's mastery of independent powered mobility. In J. Furumasu (Ed.), *Pediatric powered mobility: Developmental perspectives, technical issues, clinical approaches* (pp. 33-47). Arlington, VA: RESNA/Rehabilitation Engineering and Assistive Technology Society of North America.

Tefft, D., Guerette, P., & Furumasu, J. (1999). Cognitive predictors of young children's readiness for powered mobility. *Developmental Medicine and Child Neurology*, *41*, 665-670.

Parents' Opinions of Power Mobility Use Among Young Children

Therapists may be hesitant to suggest power mobility due to cost, environmental requirements, wondering whether parents will be receptive to the idea for a young child, and whether it actually increases participation in typical child and family routines. Addressing this concern, several researchers designed studies asking parents their perspectives about various aspects of their children's power wheelchair use (Berry, McLaurin, & Sparling, 1996; Home & Ham, 2003; Wiart, Darrah, Cook, Hollis, & May, 2003). Berry et al. asked parents about the extent of power mobility use and parent perspectives about the child's power wheelchair. Wiart et al. also interviewed parents and identified five themes based upon their replies. Themes included sadness over the child's disabilities and difficulties with environmental barriers, but also increased child independence and personal control, increased child engagement in meaningful life experiences, and positive effect on others' attitudes toward the child. Finally, Home and Ham (2003) sent a paper questionnaire to parents asking them about their experiences with a charity that assisted them in getting power mobility for their children. Among the questions were a series that asked parents' opinions of the effects for the child of having a power wheelchair. Among these parents, the majority agreed or strongly agreed that the use of the power wheelchair increased their child's confidence, motivation, and happiness and reduced frustration.

Berry, E. T., McLaurin, S. E., & Sparling, J. W. (1996). Parent/caregiver perspectives on the use of power wheelchairs. *Pediatric Physical Therapy*, *8*, 146-150.

Home, A. M., & Ham, R. (2003). Provision of powered mobility equipment to young children: The Whizz-Kidz experience. *International Journal of Therapy and Rehabilitation*, *10*, 511-518.

Wiart, L., Darrah, J., Hollis, V., Cook, L., & May, L. (2004). Mothers' perceptions of their children's use of powered mobility. *Physical and Occupational Therapy in Pediatrics*, *24*(4), 3-21.

Conclusion

Considering power mobility for all young children with motor delays or disabilities who are not walking when typically-developing children walk is congruent with a natural learning environments approach to intervention. No evidence exists to suggest children with mobility restrictions regress in motor skills when provided

with power mobility (Bottos et al., 2001; Jones et al., 2003). The available evidence does suggest that mobility is positively associated with other areas of development in all infants and toddlers (Yan et al., 1998), and that power mobility can be associated with positive development in children with motor impairments (Bottos et al., 2001; Butler, 1986; Jones et al., 2003).

References

- Berry, E. T., McLaurin, S. E., & Sparling, J. W. (1996). Parent/caregiver perspectives on the use of power wheelchairs. *Pediatric Physical Therapy*, *8*, 146-150.
- Bottos, M., Bolcati, C., Sciuto, L., Ruggeri, C., & Feliciangeli, A. (2001). Powered wheelchairs and independence in young children with tetraplegia. *Developmental Medicine and Child Neurology*, *43*, 769-777.
- Bottos, M., & Gericke, C. (2003). Ambulatory capacity in cerebral palsy: Prognostic criteria and consequences for intervention. *Developmental Medicine and Child Neurology*, *45*, 786-790.
- Bronfenbrenner, U. (1992). Ecological systems theory. In R. Vasta (Ed.), *Six theories of child development: Revised formulations and current issues* (pp. 187-248). Philadelphia: Jessica Kingsley.
- Butler, C. (1997). Wheelchair toddlers. In J. Furumasu (Ed.), *Pediatric powered mobility: Developmental perspectives, technical issues, clinical approaches* (pp. 1-6). Arlington, VA: RESNA/Rehabilitation Engineering and Assistive Technology Society of North America.
- Butler, C., Okamoto, G. A., & McKay, T. M. (1984). Motorized wheelchair driving by disabled children. *Archives of Physical Medicine and Child Neurology*, *25*, 472-474.
- Dunst, C. J. (2005). Framework for practicing evidence-based early childhood intervention and family support. *CASEinPoint*, *1*(1), 1-11. Available at http://www.fippcase.org/caseinpoint/caseinpoint_voll_no1.pdf
- Furumasu, J., Guerette, P., & Tefft, D. (1996). The development of powered wheelchair mobility programs for young children. *Technology and Disability*, *5*(1), 41-48.
- Furumasu, J., Guerette, P., & Tefft, D. (2004). Relevance of the pediatric powered wheelchair screening test for children with cerebral palsy. *Developmental Medicine and Child Neurology*, *46*, 468-474.
- Guerette, P., Tefft, D., Furumasu, J., & Moy, F. (1996). Development of a cognitive assessment battery for children with physical impairments. *Infant Toddler Intervention*, *9*, 169-184.
- Home, A. M., & Ham, R. (2003). Provision of powered mobility equipment to young children: The Whizz-

- Kidz experience. *International Journal of Therapy and Rehabilitation*, 10(11), 511-518.
- Janeschild, M. (1997). Early power mobility: Evaluation and training guidelines. In J. Furumasu (Ed.), *Pediatric powered mobility: Developmental perspectives, technical issues, clinical approaches* (pp. 48-57). Arlington, VA: RESNA/Rehabilitation Engineering and Assistive Technology Society of North America
- Jones, M. A., McEwen, I. R., & Hansen, L. (2003). Use of power mobility for a young child with spinal muscular atrophy. *Physical Therapy*, 83, 253-262.
- Kangas, K. M. (1997). Clinical assessment and training strategies for the child's mastery of independent powered mobility. In J. Furumasu (Ed.), *Pediatric powered mobility: Developmental perspectives, technical issues, clinical approaches* (pp. 33-47). Arlington, VA: RESNA/Rehabilitation Engineering and Assistive Technology Society of North America.
- Magnuson, S. (1995). Annotated bibliography: Powered mobility for young children with physical disabilities. *Physical and Occupational Therapy in Pediatrics*, 15(3), 71-79.
- McEwen, I. R., & Hansen, L. R. (2006). Children with motor and cognitive impairments. In S. K. Campbell, D. W. VanderLinden, & R. J. Palisano (Eds.), *Physical therapy for children* (3rd ed., pp. 591-624). St. Louis: Saunders.
- Nilsson, L. M., & Nyberg, P. J. (2003). Driving to learn: A new concept for training children with profound cognitive disabilities in a powered wheelchair. *American Journal of Occupational Therapy*, 57, 229-233.
- Olney, S. J., & Wright, M. J. (2006). Cerebral palsy. In S. K. Campbell, D. W. VanderLinden, & R. J. Palisano (Eds.), *Physical therapy for children* (3rd ed., pp. 625-664). St. Louis: Saunders.
- Peganoff-O'Brian, S. (1993). Human occupation frame of reference. In P. Kramer & J. Hinojosa (Eds.), *Frames of reference for pediatric occupational therapy* (pp. 307-350). Baltimore, MC: Williams & Wilkins.
- Stuberg, W. A. (2006). Muscular dystrophy and spinal muscular atrophy. In S. K. Campbell, D. W. VanderLinden, & R. J. Palisano (Eds.), *Physical therapy for children* (3rd ed., pp. 421-451). St. Louis: Saunders.
- Tefft, D., Guerette, P., & Furumasu, J. (1999). Cognitive predictors of young children's readiness for powered mobility. *Developmental Medicine and Child Neurology*, 41, 665-670.
- Warren, S. F., & Gazdag, G. (1990). Facilitating early language development with milieu intervention procedures. *Journal of Early Intervention*, 14, 62-86.
- Wiat, L., Darrah, J., Cook, A., Hollis, V., & May, L. (2003). Evaluation of powered mobility use in home and community environments. *Physical and Occupational Therapy in Pediatrics*, 23(2), 59-75.
- Wright-Ott, C., & Egilson, S. (2001). Mobility. In J. Case-Smith (Ed.), *Occupational therapy for children* (4th ed., pp. 609-633). St. Louis: Mosby.
- Yan, J. H., Thomas, J. R., & Downing, J. H. (1998). Locomotion improves children's spatial search: A meta-analytic review. *Perceptual and Motor Skills*, 87, 67-82.
- Zazula, J. L., & Foulds, R. A. (1983). Mobility device for a child with Phocomelia. *Archives of Physical Medicine and Rehabilitation*, 64, 137-139.

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