ITHACA COLLEGE

# The Effect of Robotic Powered Locomotion on the Adaptability to Switch Attention in Pre-Crawling Infants

**Isabella Badagliacca, Tatiana Mark, & Adrienne Story**
**N. Rader (Faculty Sponsor), J. Pena-Shaff, L. Muscalu, C. Dennis, S. Stansfield, H. Larin**

**Background:** Executive functioning involves neurocognitive and regulatory processes associated with inhibitory control and cognitive flexibility (Diamond, 2013). Some researchers (e.g., Diamond, 2000; Koziol, Budding, & Chidekel, 2011; Rakison & Woodward, 2008) have suggested self-guided locomotion contributes to the development of executive function. Attempts to study the effects of locomotion on cognitive development have been hampered by the use of a correlational design, comparing groups of crawling and non-crawling infants (e.g., Campos & Anderson, 2000; Kermoian & Campos, 1988). Furthermore, these studies have not focused on executive functioning. We use an experimental design to examine the relationship between self-guided locomotion and the development of executive function.

**Methods:** Five-month-old typically developing infants were randomly assigned to either a locomotor (experimental group) or non-locomotor (control group) condition. Infants in both conditions participated in 12 play sessions. Participants in the locomotor condition learned to navigate using a robotic-assisted device fitted with a Wii balance board, developed by Larin, Dennis, and Stansfield (2012). This allowed them to self-navigate through their environment by leaning in the direction they want to go. Infants in the non-locomotor condition sat on a stationary seat, following a protocol similar to the locomotor condition.

Following the 12 play sessions, at 7 months of age, participants viewed a series of videos on a plasma screen designed to test executive functioning. The infants sat in a car seat with a head-tracking sensor. They viewed five novel tasks, during which pupil diameter and eye gaze were recorded. We are reporting on the switch task, based on the research of Kovacs and Mehler (2009). From research on adults using the Wisconsin Card Sorting Task, researchers found, the ability to respond to a shift in rules is associated with executive functioning (Diamond, 2013). Using the same notion as the Wisconsin Card Sorting Task, Kovacs and Mehler (2009) designed but adapted it for 7-month-old infants. An image of a puppet was used as a reward for nine trials. After this training, nine more trials occurred on the opposite side. Eye tracking was used to measure the latency to look to the side the puppet appeared on. Kovacs and Mehler (2009) argued better executive functioning would allow infants to disengage faster from the learned response.
The switch task consists of 18 trials in which a puppet appears on the screen – nine times to the right side and nine times to the left. We measured the number of times the infant made an anticipatory look to the correct side. Looks were scored in the following way: -2 if the infant looked to the incorrect side, -1 if the infant looked to both sides, 0 if the infant did not look at either side, and 2 if the infant looked at the correct side.

ITHACA COLLEGE

**Results**: Presented here are results for 25 infants (13 in the locomotor condition and 12 in the non-locomotor condition). There were 14 male and 11 female participants; 19 of the participants were identified as Caucasian by their parents, while 6 were identified as other than Caucasian. All participants were recruited from the Ithaca area. Independent Sample t-tests showed a statistically significant difference between the experimental and control groups, $t$ (21.2) = 2.07, $p$ =.025. As predicted, infants in the experimental group showed better anticipatory attention to the puppet's location ($M$ = 12.77, $SD$ = 7.02) than did the control group ($M$ = 7.83, $SD$ = 4.76).

**Discussion and Conclusion**: The switch task results suggest that self-guided locomotion experience provided by the robotic-assisted device led to enhanced cognitive function as shown by better learning and more flexible attention in the locomotor group. While the data presented here are from a limited sample and part of continuing research, if these results hold, there will be implications for interventions using such devices with motorically impaired young children, who would not have the ability to self locomotion until four or five years of age. Moreover, this research will contribute to the growing understanding of the development of executive functioning.

## References


Campos, J. J., & Anderson, D. (2000). Travel broadens the mind. *Infancy, 1*, 149-219.

Diamond, A. (2000). The interrelation of motor development and cognitive development and of the cerebellum and prefrontal cortex. *Child Development, 71,* 44-56.

Diamond, A. (2013). Executive functions. *Annual Review of Psychology, 64*, 135-168.

Kermoian, R., & Campos, J. J. (1988). Locomotor experience: A facilitator of spatial cognitive development. *Child Development, 59,* 906-917.

Kovacs, A. & Mehler, J. (2009). Cognitive gains in 7-month-old bilingual infants. *Proceedings of the National Academy of Sciences*, *106*(16), 6556-6560.

Koziol, L. F., Budding, D. E., & Chidekel, D. (2012). From movement to thought: Executive function, embodied cognition, and the cerebellum. C*erebellum, 11,* 505-25.

Rakison, D. H., & Woodward, A. L. (2008). New perspectives on the effects of action on perceptual and cognitive development. *Developmental Psychology, 44,* 1209-1213.