EFFECT OF PROVIDING POWERED MOBILITY ON INFANTS' SOCIAL BEHAVIOR AND VOCALIZATION: TWO CASE STUDIES

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ABSTRACT

Lack of autonomous mobility in infants with motor impairment can lead to delays in development and cognition, as well as delayed socialization skills due to limited opportunities to interact with their environment, caregivers, and peers. Clinicians and researchers advocate for providing powered mobility as early as is feasible for young children with motor impairment. Previous research has shown that both typically developing infants and infants with motor impairment can learn to drive the WeeBot, a robotic mobility device controlled by the child shifting his/her weight in an upright, seated position. This study investigated the effect of gaining mobility using the WeeBot on the social behavior and vocalizations of two infants (10 months and 22 months of age) with motor impairment. Over twelve 20-minute sessions, both children learned to drive the WeeBot. As the children gained independent mobility during these sessions, their interactions with the environment, caregivers, and the investigators increased, while their spontaneous vocalizations decreased. The results provide support for increasing active social participation by providing early powered mobility technologies to young children with motor impairment.

BACKGROUND

Research indicates that in typically developing infants, independent mobility is associated with the development of skills in domains such as perception (Anderson et al., 2001), cognition (Campos et al., 2012), social/emotional skills (Guerette, Furumasu, & Tefft, 2013), and language (Iverson, 2010). Clinicians and researchers emphasize the need to provide independent mobility to children with motor impairments at as early an age as is feasible (Feldner, Logan, & Galloway, 2016; Rosen et al., 2009), with the goal of reducing or preventing associated delays. In particular, children with disabilities that impact mobility often have reduced opportunities for play and limited participation in social activities (Palisano et al., 2009; Ullenhag, Krumlinde-Sundholm, Granlund, & Almqvist, 2014). The ability to independently explore through the use of powered mobility has been found to facilitate child development and engagement in social relationships (Livingstone & Field, 2014). Most of the research exploring the effect on socialization of providing powered mobility to young children with motor impairment has used case studies, rather than controlled experiments. In addition, studies of the effect of powered mobility on the social behavior of children with motor impairment have used different definitions of *participation* and *socialization*. For example, Field, et al. (2015) used the ICF-CY definition -- "involvement in a life situation" (World Health Organization, 2007, p. 17), when performing a survey to identify the important elements in measuring participation of children using powered mobility. Wiart, Darrah, Hollis, Cook, and May, (2004) identified mothers' perceptions of opportunities for their children with motor impairment to "engage in meaningful life experiences" (p. 13) in a study to address the same question. In the case study done by Ragonesi, et al. (2010) both verbal and physical interaction were included as social behavior. Several studies have demonstrated an apparent relationship between independent mobility and increased socialization (Huang, Ragonesi, Stoner, Peffley, & Galloway, 2014; Logan, Huang, Stahlin, & Galloway, 2014; Ragonesi, Chen, Agrawal, & Galloway, 2010, 2011).

The results of previous studies on the effect of mobility on communication have been mixed. Butler (1986), in a study of six children with motor impairment between the ages of 23 and 38 months, found that four had increased vocalizations with powered mobility, while two had decreased vocalizations. Huang, et al. (2014) also found increased vocalization with the ability to move independently for a 21-month old with cerebral palsy.

Our research team has found that typically developing infants as young as 5 months of age are able to learn to drive the WeeBot, a robotic mobility device that uses weight shift to control movement and direction (Stansfield, Dennis, & Larin, 2012). Of five children with motor impairment who had experience using the WeeBot, only one child, a seven-month old boy with Down's syndrome, was not successful in learning to drive. During driver training, this child demonstrated little interest in the toys offered and did not, in general, respond to prompts intended to teach him to drive successfully (Dennis, Larin, & Stansfield, 2015; Larin, Dennis, & Stansfield, 2012).

PURPOSE

The purpose of this case study research was to examine the effect of independent mobility using the WeeBot on the social behavior and vocalizations of children with motor impairment.

METHOD

Participants

Two children with motor impairment were recruited from the regional early intervention program. Kelley, a 10-month old female, presented with severe undifferentiated hypotonia. She had no independent mobility, was not able to sit without support, and showed little interest in objects within her environment. Kelley could recognize two familiar words, produce repetitive consonant-vowel sounds, and jabber with expression, but did not use any word approximations. Mikaela, a 24-month old female, with a corrected age of 22 months, was diagnosed with spastic diplegia cerebral palsy, GMFCS level 4 (Palisano, Rosenbaum, Bartlett, & Livingston, 2007). She was able to commando crawl with great effort at the initiation of the study, and could sit briefly without support. Mikaela could identify parts of the body and clothing items, name simple objects, answer yes or no to questions, and imitate two-word sentences.

Equipment

The WeeBot is a robotic mobility device assembled from commercially-available components: A wheeled, aluminum frame is attached to a Pioneer 3DX mobile robot. Attached to this frame is a Nintendo® Wii Balance Board with an infant seat mounted on top of it. Custom software analyzes the data from the balance board to determine if the child is sitting upright (as measured during an initial calibration phase) or is leaning forward or to the left or right. If the child is determined to be leaning, the robot is sent commands to move in the desired direction (forward, left, or right). Sonar on the robot are monitored to determine if the robot is in close proximity to an obstacle and the software stops the robot accordingly. The WeeBot is shown in Figure 1.

Figure 1. The WeeBot mobility device

Procedure

The procedure used for this study is similar to that described in Larin, Dennis, and Stansfield (2012). Each child participated in twelve 20-minute robotic mobility experiences over a period of eight weeks. Each experience consisted of an initial 3-minute free-play period, a 10-minute driver-training period, and a final 3-minute free-play period. During free play, the child was free to move about the study space using the WeeBot. Figure 2 shows a diagram of the space: Two adults sat opposite the child and three shelves containing toys were placed against three of the walls. The study was approved by the Ithaca College IRB. All robot sessions took place on the Ithaca College campus and were videotaped.

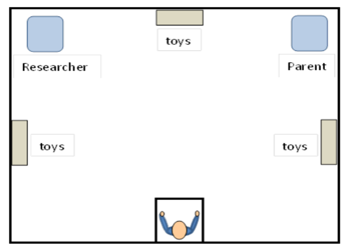

Figure 2: Setup of the study space.

Measures

The Bayley III developmental assessment (Bayley, 2006) was administered before the first robot session and after the last session. Videotapes of free-play sessions were analyzed using the ELAN annotation software (Sloetjes & Wittenburg, 2008) to quantify time engaged in vocalizing and in social behavior (or driving to socialize), which we define as periods when the infant is driving to a person, with a resulting social interaction. Vocalization and social driving were measured in seconds. Reliability was established with 2 examiners coding 20 percent of the videotapes: ICCs were 0.90.

RESULTS

During the experiment both children scored well on driver training – each learned to control the robot in all three directions and could move to get a desired object within the first five weeks of the study. Both children showed similar trends in social behavior and vocalization. Time engaged in driving to people increased, while time spent vocalizing decreased. The nature of the social interaction also changed; the children took more initiative to maintain proximity with adults. In the last several sessions, Mikaela picked up toys and carried them to her parents, (e.g., encouraging them to read a book to her). Figure 3 shows the results of driving to socialize over the 24 free-play periods for both children. Figure 4 shows the results of vocalizations for both.

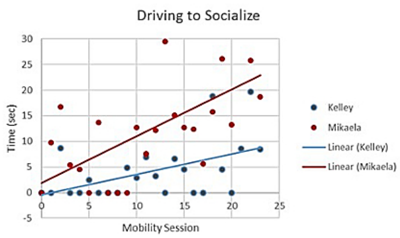

Figure 3 Time spent driving to socialize.

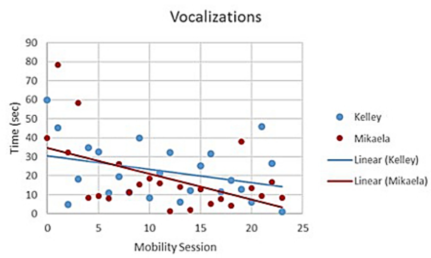

Figure 4. Time spent vocalizing.

In addition, both children showed an increase in Bailey III scaled scores and percentile ranking from pretest to posttest for expressive and receptive language (communication).

DISCUSSION

The results of these case studies support research that indicates that powered mobility may increase social interaction in children with motor impairment (Guerette et al., 2013; Huang et al., 2014, Ragonesi et al., 2010, 2011). However, since all data was recorded during driving experiences in our laboratory, we do not know if this increased social behavior would have occurred in the natural environment.

As noted above, the decrease in vocalizations for both children is not unique. Butler (1986) suggested that the decrease in vocalizations in two children in her study, when they received powered mobility, may have reflected a diminished need for control using speech. We suspect that, in this study, the children's engagement in mobility, which allowed for independent environmental exploration and increased opportunity to interact with others, may have resulted in less need to vocalize.

CONCLUSION

This case study research supports providing assistive technology to permit independent mobility at a very young age, both for children who are delayed in the acquisition of mobility skills and for those children who will likely need assisted mobility. Independent mobility may foster the development of motivation to move, cognition, socialization, and communication.

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