Babies Driving Robots
Advances in Infant Mobility

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Babies Driving Robots
Mobility at Younger Ages Speeds Development

Photo courtesy of The News Journal/Robert Craig
At about 19 weeks into her pregnancy, Terri Peffley of Wilmington, Del., arrived at her doctor’s office for a routine ultrasound. Hoping to learn whether her fourth child was a boy or a girl, she was shocked at the news that her unborn son had Spina Bifida.

A part-time occupational therapist at her older son’s school, it was natural for Terri to begin planning for her new role as mother to Andrew. She knew that mobility would be key to his involvement in life and his self-esteem.

**Andrew Gets Wheels**

Terri discovered that researchers at the University of Delaware (UD) were exploring ways in which enhanced mobility could stimulate development in infants with special needs. At 7 months, Andrew became the first case study for the Pediatric Mobility Project at UD, aka “Babies Driving Robots.” The UD research team currently driving this project consists of Associate Professor of Physical Therapy James C. Galloway, PhD, and Professor of Mechanical Engineering Sunil Agrawal, PhD, as well as Xi Chen and Christina Ragonesi, graduate students in Mechanical Engineering and Biomechanics and Movement Science, respectively.

The infant-sized robotic wheelchair Andrew took for its first spin is known as UD1, designed by Dr. Agrawal and his team of graduate students. Equipped with sonar and infrared sensors, the robot senses obstacles in its path and takes over control for the baby if need be. The UD1 can navigate around an obstacle or stop altogether. Infants as young as 7 months can learn to drive the robot using a joystick. This allows young infants to have independent mobility important for traveling about freely. Mobility is critical to motor, social, language, cognitive, and perceptual development.

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To be honest,” said Dr. Galloway, “this has become an emotional issue for the members of our research team. We are each now part advocate and part clinical scientist.” Dr. Galloway is the director of the Infant Motor Lab at the University and heads up the research projects that train babies to drive. He is particularly driven to minimize the age at which children with mobility impairments can obtain independent mobility experiences.

“Mobility provides infants with the ability to explore the environment, to play with distant objects and people, and to begin to understand cause and effect of their actions,” continued Dr. Galloway. “Often an infant’s personality will become more pronounced with the new abilities of expression that mobility affords. With mobility comes empowerment and responsibility.”

Andrew’s mom agrees. “To see his face light up when he drove was amazing,” she said. “For him to move across the room—his eyes got really big and he really enjoyed it.”

“It’s about living life to the fullest,” says Terri of her son Andrew, pictured here with his dad, Mike, and siblings Jake, Abbi, and Michael.

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*Dr. James Galloway*
By the time Andrew was just a 1-year-old toddler, the robot was too slow for his driving ambitions. For safety reasons related to ability to control the equipment, most children are not fitted with a motorized power chair until they are 3-5 years of age. But Dr. Galloway wanted to keep Andrew moving, so his team designed a refurbished pediatric power wheelchair, complete with a baby seat to keep Andrew strapped in.

**Mobility Drives Development**

Terri credits the use of the robot early in Andrew's development with helping him to learn and exercise the skills needed to have his own form of mobility and independence. That independence has translated into a determination to move on his own. Encouraged by his parents and physical therapists, Andrew, who turned 2 in June, is learning to crawl. He is ahead of the typical schedule for a child with his diagnosis.

Terri has seen improvement in Andrew's social interactions now that he is no longer "trapped" or "confined to the patio" to play. "He wants to be in the middle of what's going on with his three older siblings," said his mother. On the day the family brought his power chair home, Andrew made a point to go to each of his siblings and pay a visit to each one. Amazed at his determination, Terri said, "He didn't just want to joyride, he wanted to go and interact with somebody right away."

The differences in social interaction haven't been limited to Andrew's side of relationships. Terri has also seen a change in how others approach him. "I noticed it first with adults," she said. "When people saw Andrew being carried in his braces they would often react with pity or sympathy. But when they see him driving on his own, their response is much more optimistic and encouraging. There's a perception that if you can move on your own you are more capable."

From the moment Terri learned of Andrew's disability she wanted him "to be able to fully participate—to be a go-getter." With the chair becoming "his legs," the family's activities are not so limited by Andrew's mobility. "Andrew not only participates in family activities, but he also has the chance to lead. He can initiate with the other kids," Terri said. "He's just an equal part of what we do."

**Looking to the Future**

In late 2008, the Pediatric Mobility Project was awarded a two-year National Science Foundation grant to fund improvements to the robot design. The new UD2 prototype features the same robotics but now has indoor and outdoor wheels, plus a colorful baby seat, felt decorations, and a neon green tray, according to Christina Ragonesi. "It's designed to be kid-friendly and an attractive piece of equipment within the classroom," she said. "We want it to be used from now on specifically within the classroom by kids with mobility impairments and for the other kids in the classroom to view it as just another flashy tricycle." Christina explains that their present and future studies are focusing on having "mobility training" be immersed in daily life (ie: within a preschool classroom). That is, training to drive will be similar to how a typically developing infant learns to crawl and walk: not in the lab, but on the floor of his or her house or daycare infant classroom.

With recent funding from the National Institutes of Health, the current research continues to explore how infants and toddlers with mobility impairments use newfound mobility to interact with others and to increase their own sense of empowerment and independence. "We are specifically interested in studying the link between mobility experience and socialization development," said Christina. The team has been working with children at the Early Learning Center of Newark, Del., which is associated with the University of Delaware. Within five years the team hopes to have a commercial device available that can be used indoors and out. By then, the team dreams of having enough funding and mobility devices to send them home with families, to use out in the community, and to pilot in other daycare centers around Delaware.

Meanwhile, the Peffley's are continuing their journey as they pursue intensive physical therapy with the goal that Andrew will learn to walk. Terri's expectations for her youngest son are the same as for all of her children—"That he is happy and successful in what he wants to do. That he makes a difference in this world."

**Babies Needed for Driver's Training**

The Pediatric Mobility Project is currently recruiting infants for participation in a new group study for the UD2. Researchers are looking for infants aged 4-6 months who will not be expected to learn to crawl or walk within the first year of life.

The research team will work with each infant three times per week to train the child to drive the new mobility robots. Sessions will last one hour each, with the training continuing for up to four months. Training will take place at the University of Delaware in Newark, Del., but families from across the country are encouraged to apply, if they can participate in at least a one-month study.

Those who meet the qualifications and would like more information are asked to contact one of the following individuals: Christina Ragonesi at 302-831-3214 or CLBR@udel.edu; Dr. Galloway at 302-831-3697 or jacgallo@udel.edu; or Dr. Agrawal at 302-831-8049 or agrawal@udel.edu.