Interactive Technologies for Autism

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CHI 2007, April 28 - May 3, 2007, San Jose, California, USA.
ACM 978-1-59593-642-4/07/0004.

Abstract
In meeting health, education, and lifestyle goals, technology can both assist individuals with autism, and support those who live and work with them, such as family, caregivers, coworkers, and friends. The uniqueness of each individual with autism and the context of their lives provide interesting design challenges for the successful creation and adoption of technologies for this domain. This Special Interest Group (SIG) aims to bring together those who study the use of technology by and for individuals with autism, those who design and develop new technologies, and those who are curious about getting involved. Areas that this SIG will consider include assistive technologies; tools for data collection and analysis; educational software; virtual reality rehabilitation environments; identifying users; need finding; user-centered collaborative design processes that include individuals who cannot speak or write; and product assessment. This SIG will provide opportunities for participants to join together and share their own projects, design challenges, and lessons learned while focusing on directions for future development. Those with experience and newcomers to the field are both equally encouraged to attend.

Keywords
Health, education, children, autism, ubiquitous computing, assistive technology, design methodology

ACM Classification Keywords
K.3.1 Computers and Education: Computers uses in Education; K.4.2 Computers and Society: Social Issues; H.4 Information Systems Applications; H.5.2 Information Interfaces and Presentation

Introduction

Autism spectrum disorder (ASD) is a developmental disability characterized by impairment in communication, social interaction, and creative or imaginative play. Additionally, sensory and motor impairments are common. Individuals with autism may exhibit self-stimulatory behaviors, such as rocking, hand flapping, or vocalizations. Although autism typically presents itself in some common ways, it is a highly idiosyncratic disorder, making each case unique and giving rise to the anecdote, "If you've seen one child with autism, you've seen one child with autism," highlights some of the challenges of design for autism.

Autism presents in early childhood and is typically diagnosed at that time, though it is not uncommon for individuals to be diagnosed as late as adulthood. Current estimates from the Autism Society of America are that 1 in 167 children will be diagnosed with some form of autism and 1.5 million Americans today are considered to have autism. Meeting the lifelong needs of people with autism can be a complex and dynamic challenge. Individuals with autism, their families, assistants, teachers, and consulting specialists struggle to find therapies and support systems for developmental growth and the achievement of life goals.

Some of the challenges of autism that technology shows promise in mediating include: rehabilitation, education, gaining access to social situations, identifying appropriate therapies, tracking progress, maintaining consistency for an intervention that involve a large assistance network, and providing opportunities for work and play. Although there has been significant progress in recent years in the understanding and development of innovative interactive technologies for autism, we are still only in the early stages of what can and needs to be accomplished. This SIG provides an opportunity for the CHI community to come together to address the challenges autism poses and brainstorm what new directions the field can take in autism technological research and development.

Topics to be Covered

Some of the topics that will be covered include:

- Methods for understanding the requirements of cultures that include individuals with autism and how to design solutions that meet those needs
- Social-emotional technologies
- Record-keeping and decision-support for caregivers
- Achieving generalization in the real world of skills gained in educational and rehabilitative software environments
- New therapeutic uses of VR, augmented reality, and ubiquitous computing systems
- Use of collaborative technologies by individuals with autism and their caregivers
- Best practices for working with the ASD population and gaining entrée into cultures that include individuals with autism

Process

To achieve the goals of the SIG, we will employ the following process:

1. To quickly establish common ground and shared understanding among SIG participants, some of the SIG organizers will provide a brief overview of their work
2. SIG participants will be invited to briefly describe their own relevant work
3. Break-out discussion groups facilitated by the organizers to explore next steps for the CHI community to pursue in the autism domain
4. Break-out group presentations
5. Group brainstorm: What next?

CHI Projects and Career Paths in Autism

Exploring the diverse backgrounds and projects of the organizers of this SIG provides examples of the many directions a CHI researcher can take in the field of autism, and also the breadth of project that can be explored. What follows is a brief description of some of the projects on which the organizers work.

Dan Gillette has a background in educational psychology and is chair of the Innovative Technology for Autism Initiative at Cure Autism Now (CAN-ITA). He is also the director of the Education and Behavioral Healthcare department at the Greenleaf Institute, and a lead designer at Greenleaf Medical. In the past, Mr. Gillette worked on the development of a voice output communication device for children with severe autism, where he developed user-centered design methods for collaborating with users who cannot speak. He has also developed and taught classes in product design and autism at Stanford University (with David Law), and UC Berkeley. Mr. Gillette is currently designing and testing a virtual reality environment that supports social skills group therapy for teens with high functioning autism.

Gregory D. Abowd leads the Autism Research Group at Georgia Tech, an inter-disciplinary research program including researchers in HCI, Design, Artificial Intelligence, Machine Learning, and Mobile and Wearable Computing. He is also the director of the Aware Home Research Initiative, dedicated to exploring the ways technology can support home activities, including amongst other things, technologies for home therapies for children with autism and sensing platforms and applications for early detection of developmental delay. Dr. Abowd and his group are working to understand and to develop new technologies for individuals with autism throughout the lifespan.

Gillian R. Hayes, a PhD candidate working with Dr. Abowd, designs, develops, and studies ubiquitous computing technologies to support educational and behavioral interventions for children with autism. She has studied multiple interventions and designed the CareLog system for supporting functional behavior assessments of children with severe emotional and behavior disorder in schools. She is currently working with Dr. Abowd and Caring Technologies to design and develop a more widely available product similar CareLog.

Justine Cassell is the director of the Center for Technology and Social Behavior at Northwestern University, and a full professor in the departments of Communication Studies and Computer Science, with a background in linguistics and psychology. After having spent ten years studying verbal and non-verbal aspects of human

communication through microanalysis of videotaped data she began to bring her knowledge of human conversation to the design of computational systems. Dr. Cassell and her team are currently developing virtual peers (VPs) -- 3D life-size animated characters that look like children and are capable of interacting, sharing real toys, and responding to children's input. With graduate student Andrea Tartaro, Cassell has shown that children with autism engage in more developed contingent social interaction with virtual peers than with real children.

Rana el Kaliouby is a postdoctoral associate at MIT's Media Laboratory, where she is developing *in situ* wearable social-emotional technologies that help individuals with high-functioning autism and/or Asperger's syndrome acquire an affinity for the social domain and improve their overall social abilities. The device is a wearable camera system capable of perceiving and visualizing social-emotional information in real-time human interaction and aims to facilitate learning and systemizing of social-emotional cues for individuals with autism, promote self-reflection and perspective-taking and enable wearers to share experiences with peers, family members, and caregivers.

Computer Scientist **Dorothy Strickland** is a pioneer in virtual reality and video games for children. She is currently president and CEO of Virtual Reality Aids. Since beginning in the early 90's using virtual reality to customize virtual practice worlds for children with autism, Dr. Strickland and her team's methods have evolved into a combination of commercial computer games and web delivered training modules that combine practice with computer directed action controls to mold behavior. Through close analysis of learning goals and user behavior, Dr. Strickland's group has managed to create games that not only teach children in the virtual gaming environment, but show generalization to the real world.

Tamar Weiss is an occupational therapist with a background in kinesiology, physiology, and biomedical engineering. Dr. Weiss and colleagues, in one of the projects in the Trento IRST-University of Haifa Agreement, co-directed by Olivieor Stock and Martin Golumbic, are working on a co-located interface where pairs of children interact to construct a common story, called the Story Table. Central to the Story Table is MERL's DiamondTouch, a multi-user, touch-and-gesture-activated, table-like device designed to support small-group collaboration. The Story Table was explicitly designed to enforce collaboration by requiring that some activities be performed together by the children. Collaboration on the Story Table is carried out with a peer in a real situation, rather than in a virtual environment, yet technology remains available to mediate the interaction, making the intervention less stressful and more ecologically valid. Forcing some tasks to be done collaboratively (as in the case of multiple-user GUI actions in Story Table) appears to foster the recognition of the presence of the partner and stimulate collaborative behavior. Results from a pilot study suggest that co-located interfaces like the Story Table may be well suited to support positive social behaviors and some core language skills of children with high functioning autism.

Acknowledgements

This SIG was made possible by support from Innovative Technology for Autism Initiative at the Cure Autism Now Foundation.