Authorable Virtual Peers for Children with Autism

Andrea Tartaro

Center for Technology and

Social Behavior

Northwestern University

2240 Campus Drive

Evanston, IL 60208 USA

andrea@cs.northwestern.edu

Abstract

For my dissertation, I am designing, implementing and evaluating the use of a new kind of "authorable" virtual peer that allows children with autism to learn about reciprocal social interaction by building their own virtual humans. This work has three stages: (1) Study the verbal and nonverbal reciprocal social interaction behaviors of children with autism; (2) Use the results of the study to design and implement an authorable virtual peer for children with autism; and (3) Evaluate the effectiveness of the system in improving reciprocal social interaction behaviors of children with autism.

Keywords

Assistive technology, autism, embodied conversational agents, collaborative virtual peers, social interaction

ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Introduction

Figure 1 is a picture of Sam (on the screen), Emily[1] (standing up) and Jane (sitting down) playing together

[1] All children's names have been changed.

during a shared storytelling task. Sam is a virtual peer – a 3-D, life-sized, animated character that looks like a child and is capable of interacting with children by collaborating to tell stories. Emily is telling stories with Sam, an activity that has been shown to help children learn to use literate language and develop literacy skills [1, 5]. Sam uses language and nonverbal behavior to help children develop critical discourse skills.

Figure 1. Two girls playing with Sam.

But what about children who don't have the pragmatics and discourse skills of storytelling? Children with Autism Spectrum Disorders (ASD) are not capable of engaging in reciprocal social interaction and appropriate verbal and nonverbal behavior in conversation. This seriously limits their access to learning opportunities because of the important role social interaction plays in learning. For these children, collaborative narrative with Sam is an ideal task for investigating these pragmatic deficits. Storytelling enables children with ASD to practice turn-taking behaviors, address the beliefs of their peers, take on conversational roles, and

invent narrative content. However, storytelling between children with autism and typically-developing children is hard because typically-developing children don't have a lot of patience for it. In addition, while children with autism avoid social interaction, we know anecdotally from parents and teachers, as well as empirically from research, that children with autism love interacting with computers [2].

For my dissertation, I am designing, developing and evaluating a new kind of virtual peer to help children with ASD develop reciprocal social interaction and communication skills. In addition to interacting with virtual peers by storytelling, my research proposes that *controlling* a virtual peer (as Jane, the second child in Figure 1, is doing), combined with *authoring* a virtual peer – creating new stories for the virtual peer by specifying verbal and nonverbal behaviors, will further help children with ASD develop reciprocal social interaction skills. My initial results demonstrate that children with ASD enthusiastically engage with virtual peers, both in storytelling interactions and controlling the virtual peer for someone else [7].

Background
Autism is a developmental disorder that affects a person's ability to communicate and interact with others. People with autism experience difficulty in three main areas, known as the triad of impairments: reciprocal social interaction (for example, they may appear indifferent to other people), social communication (such as not understanding common gestures, facial expressions or affective responses), and imagination (difficulty developing interpersonal play and telling stories) [4]. My work focuses on children with high-functioning autism (HFA), and other

related developmental disorders such as Asperger syndrome. Children with HFA have functional language, but their pragmatics – the appropriate use of language for a communicative context – is often seriously impaired [6]. My work investigates how the pragmatic deficits are reflected in a collaborative narrative task, and how storytelling with a virtual peer can be used to address the autism triad of impairments.

Research Method

My dissertation research has three components: (1) study the verbal and nonverbal collaborative storytelling behaviors of children with autism; (2) Use the results of the study to design and implement an authorable virtual peer for children with autism; and (3) Evaluate the effectiveness of the AVP in improving reciprocal social interaction behaviors of children with autism.

Toward the first goal, I am conducting structured observations of children telling stories with a human peer and with a virtual peer. I want to understand how children with HFA differ from typically-developing children in their collaborative storytelling, how children with HFA tell stories with real and virtual collaborators, and how these results suggest that we help children through the use of virtual peers. I have collected several participants with autism telling stories with human peers and a virtual peer, and am analyzing this data for features of collaborative narrative. Preliminary analysis of one participant with Asperger syndrome demonstrates that the child actively engages in collaborative narrative with both his sister and the virtual peer. He uses narrative gestures with the props in his stories, and is able to take on the role of a

character in the story. However, he has difficulty with reciprocal social interaction and narrative construction, including collaborative eye-gaze, language that makes meaning to an audience, and developing narrative content. He practices some of the skills more in a narrative task with a virtual peer than with his human peer.

Toward the second goal, I hypothesize that virtual peer technology can be applied to enable children with ASD to understand the function of the behaviors involved in reciprocal social interaction. To do this, I propose an "authorable" virtual peer (AVP) that can be used in three interaction modes. First, children interact with the virtual peer by telling stories with the system, and thereby rehearse verbal and nonverbal interaction skills with an indefatigable peer. In a second mode, children control the virtual peer by using a "Wizard of Oz" interface to select predefined responses. They can select head and body gestures, utterances and story segments for the virtual peer to perform, and observe the outcomes of the interaction. Third, children can use authoring tools to create new behaviors and responses, and construct their own interaction examples. The AVP has its roots in research on instructional technology systems and extends the constructionist tradition in education – the use of technology as "objects to think with" [3] – to learning about language and social interaction through building communicating virtual humans, as elaborated in [7].

Toward the final goal, I will evaluate the effectiveness of the AVP by examining the effects of this technology on the reciprocal social interaction skills of the children who interact with it. In this process, I will study how children with autism control a virtual peer, use

authoring systems to create a virtual storytelling peer, and finally interact with the virtual peer that they have created.

Impact for HCI

My research advances the study of human-computer interaction by proposing a novel application of dialogue-based agent interactions to help children develop social skills. I am building a system that functions in three interaction modes: face-to-face interactions with a full-bodied agent enable children to practice both verbal and nonverbal behaviors, while new tools for controlling and authoring the agent allow children to experiment with social interaction by observing and constructing their own interaction examples.

At a theoretical level, my work contributes to an improved understanding of autism and how to incorporate what we learn about the deficits and strengths of children with ASD into the design of technologies that help them learn. These technologies can then be used as a platform to iteratively study the theoretical descriptions of autism deficits. Ultimately, my research aims to create technology that can demonstrate social interactions, imagination and communication skills, and empower children with ASD to develop these skills.

Acknowledgements

References

[1] Cassell, J. Towards a model of technology and literacy development: Story listening systems. Applied Developmental Psychology, 25. 75-105.

[2] Goldsmith, T.R. and LeBlanc, L.A. Use of Technology in Interventions for Children with Autism. Journal of Early and Intensive Behavior Intervention, 1 (2). 166-178.

[3] Harel, I. and Papert, S. Constructionism : research reports and essays, 1985-1990. Ablex Pub. Corp., Norwood, N.J., 1991.

[4] NAS. National Autistic Society, www.nas.org.uk, 2005.

[5] Ryokai, K., Vaucelle, C. and Cassell, J., Literacy Learning by Storytelling with a Virtual Peer. in Computer Support for Collaborative Learning (CSCL), (Boulder, CO., 2002).

[6] Tager-Flusberg, H. Current Theory and Research on Language and Communication in Autism. Journal of Autism and Developmental Disorders, 26 (2). 169-172.

[7] Tartaro, A. and Cassell, J., Authorable Virtual Peers for Autism Spectrum Disorders. in Combined Workshop on Language-Enabled Educational Technology and Development and Evaluation fo Robust Spoken Dialogue Systems at the 17th European Conference on Artificial Intelligence (ECAI06), (Riva del Garda, Italy, 2006).