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Abstract

We present an overview of the approach we used and the challenges we encountered while designing software for smartphones to facilitate communication and improve social skills of children with severe autism spectrum disorder (ASD). We employed participatory design, using special education teachers of children with ASD as proxies for our target population.

Keywords

Assisted cognition, autism, health informatics, design with proxies

ACM Classification Keywords

K.4.2 Computers and Society: Social Issues—Assistive technologies for persons with disabilities; H.5.2 [Information Interfaces and Presentation]: User Interfaces - Evaluation/ methodology, graphical user interfaces, prototyping, user-centered design.

Introduction

Autism spectrum disorder (ASD) is one of the most prevalent neurodevelopment disorders and its incidence

continues to grow. It currently affects 1 in every 150 American children [1]. The main symptoms of ASD are impairments in reciprocal social interaction and communication, and restricted and stereotyped patterns of interests [2]. Functional communication and forming social relationships are the most difficult and dominant problems in ASD [3]. About a third to half of individuals with autism never develop sufficient natural speech to meet their daily communication needs [4].

One of the most popular treatment approaches among special education teachers is to teach children with ASD to communicate and interact with others using images. The most commonly system used is the Picture Exchange Communication System (PECS) [5-7].

Software can be developed to help people with severe autism communicate. However, since good software design requires good communication with users, designing for children with ASD requires a special approach. Since we can not engage the final user (the children with ASD) in the design process due to communication barriers, we involve special education teachers in the design in two ways: they help design the product in their role as teachers, allowing us to do participatory design, and they act as proxy users for autistic children. This ensures that the software will be nearly optimal before testing with autistic persons.

Picture Exchange Communication System (PECS)

PECS utilizes printed and laminated pictures and applied behavior analysis is commonly used to teach the picture exchange. There are several phases which increasingly encourage independent communication. Although very popular, low-tech approaches such as PECS are cumbersome, time-consuming, and inefficient. Teachers with multiple ASD children in their classrooms spend a significant amount of time printing, cutting, and laminating pictures for all of their students. It becomes increasingly difficult to customize the set of pictures based on personal desire, interests, and the communication skills of each child. For a child, the length of time needed to find a picture and then show it may discourage the expression of emotions, such as happiness, which can rise after an activity the child enjoyed.

Existing Technical Solutions

Existing electronic communication devices such as DynaVox [8], Palmtop Impact [8] and Cyrano Communicator [9] have been designed for high functioning learners. Other devices such as Visual Assistant, Pocket Reader, Pocket Coach, and Pocket Compass [10] have been designed to provide multi-modal assistance to individuals with moderately impaired intellectual performance. The electronic communication devices available on the market have three primary problems: 1) not easily customized to the needs of each child (no possibility to use personal or *ad hoc* images), 2) no qualitative and quantitative usage data for teachers, 3) and no analysis tools to measure the effects on child development.

Our Smartphone Solution

We have designed and developed software for smartphones that offers a new media for communicating and socializing while overcoming the shortcomings with paper pictures. There are two modes that the smartphone can be in: operational and display mode. In operational mode, users can form a message (Figure 1a) by touching images with their finger. The

selected images are combined. Then, clicking a button places the message in the middle of the screen and the handheld device goes into display mode. In display mode, the images are enlarged as much as possible (Figure 1b) and the touch-screen does not respond to touch anymore, allowing others to hold the device without changing the message.

Figure 1a: Operational mode. Selection of image/images

Figure 1b: Display mode. Visualization of image or sentences

Figure 1: Smatphone application

Our solution provides two augmentations that may have an enormous impact on therapy. First, we can track how often the child uses the smartphone to form messages. Today there are no convenient and systematic approaches to gather data for these very

young children with ASD. It has been impractical and very difficult to do when using PECS. The second enhancement is that images shown using the smartphone can be easily customized based on the needs, interests, and preferences of each child, but also for groups of children without extra effort. It is possible to use comic based pictures with and without text on the top, real-life photos of items such as an apple, as well as personal images such as the child's house, parents, and family members. Our solution can be easily adapted to children with other communication impairments. As of March 2008, a first functional prototype has been developed and its evaluation is in progress.

Participatory Design and Designing by Proxy

Because the final users of our smartphone are the children with severe ASD, we employed participatory design using special education teachers as proxies to our target population. We work with special education teachers in multiple public and private schools in North America. We are expecting enrolling in the study 10 teachers.

Initial design insights are based on interviews with therapists, parents, and teachers in Southern California and Arizona. Then, a first low-end prototype was developed at Claremont Graduate University and compared with paper-images [11]. We continued refining the design for message forming and tracking in interaction with special education teachers by means of semi-structured interviews.

The teachers adopt two roles in the design. First, they help design the software from a teacher perspective so that the software optimizes their use of time when

teaching children. They do not want to spend extra time preparing images for multiple children but are eager to be able to monitor and analyze image usage. Second, teachers also serve as proxy users for autistic children and help design the software keeping in mind strengths and limitations of the children they work with. They spend time with children with autism on a daily basis and are familiar with the specific problems that will be encountered.

Conclusion

Designing health informatics system for a vulnerable group such children with ASD has additional difficulties. We propose to overcome these barriers by having teacher assuming different roles: they are participants in the design but also serve as proxy users. We are currently pursuing additional funding to test our smarphone software with children with ASD in controlled clinical trials.

Acknowledgements

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