SMARTSign: A Different Flavor of Accessibility

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ABSTRACT
We present SMARTSign, an application for helping hearing parents with deaf children learn American Sign Language (ASL) on their mobile phones. Unlike the traditional view of accessibility, which involves enabling individuals with disabilities or special needs to use a particular technology, SMARTSign provides a different form of accessibility. By teaching parents with young deaf children sign language, the children gain the ability to understand the world through a language that is more accessible to them.

Author Keywords
American Sign Language, hearing parents with deaf children, mobile language learning

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General Terms
Design, Human Factors, Theory

INTRODUCTION
The traditional view of designing for access is to design a system that enables a broad set of individuals to use the system. Sometimes this use occurs through “indirect access” in which individuals with disabilities or special needs use an assistive device such as a screen reader to gain access to the technology. When no assistive devices is needed, then a technology is said to be designed for universal access. SMARTSign is a mobile application that helps hearing parents learn American Sign Language (ASL) so that they can provide opportunities for accessible communication to their deaf children. As such, it belongs in a third class of accessibility which provides access to individuals who would not normally have access, but not by providing a technology to those individuals.

In the United States, approximately ninety-five percent of deaf children are born to hearing parents [10]. These parents have little experience with American Sign Language (ASL) or deafness in general. The deaf child’s limited opportunities to communicate cause a delay in linguistic development in comparison with deaf children born to deaf parents and hearing children born to hearing parents [12, 15]. When acquisition of a child’s first language is delayed, children are not only less capable of fully learning their first language, they will have more difficulty learning throughout life [8]. Some technology interventions have been designed to help deaf children overcome their linguistic delay [1, 3], but a more ideal situation would be to help parents learn sign language so that they can be better language models for their children. Teaching ASL to hearing parents with deaf children provides deaf children with better access to the world around them. The goal of SMARTSign is to assist parents learning ASL by providing access to learning tools on their mobile phones which can be used throughout the day. SMARTSign’s role resembles indirect accessibility, because is a tool that provides enhanced access to deaf children. SMARTSign differs in that it is not meant for the deaf children directly, but is instead intended for their parents.

RELATED WORK
There are a few instances of research involving technology for educating novice signers. However, this research rarely evaluates how these technologies affect the novices’ ability to learn. Karpouzis et al. incorporated animations of virtual characters performing Greek Sign Language into an educational system for Greek elementary school students [7]. Sagawa and Takeuchi investigated a teaching system for helping novice signers learn Japanese Sign Language [11]. This system used avatars in two ways: as an exemplar of what the person should sign and as a reflection tool showing learners what they actually signed. Participants viewed the avatars performing the exemplar and their own sign simultaneously to help with self evaluation. This paper did not report measures of the participants’ actual sign performance. Johnson and Caird [6] investigated the effect of frame rate and video presentation (normal versus point light video) on novices ability to match signs with their English equivalent. Frame rate affected the time the novices needed to learn the signs and the video presentation affected recognition rates. All of the above projects involved laboratory or classroom research and do not provide insight on how learning changes when self-motivated and incorporated into daily life.

Henderson-Summet showed that learning sign language vocabulary on a mobile device is more efficient than learning...
on a computer [2]. When investigating how Japanese students learned English on their mobile phones, Thornton and Houser found that students wait until they have free time such as a commute home to look at lessons [13]. Students who studied on their mobile phones did learn better than those who were just reminded to study once a week during class time.

UNDERSTANDING PARENT MOTIVATION
The main problem addressed by SMARTSign is the communication barrier between hearing parents and their deaf children. To achieve better communication, there are a two potential research directions. The first direction is to provide a tool for parents to receive ASL video from English input that they can show to their children when they wanted to communicate, paired with an ASL-to-English recognition system to understand their children. The other direction is to provide a system for parents to learn ASL so they can sign with their children directly. However, hearing parents of deaf children may not want to learn ASL. We heard this opinion from social workers and educators who worked with deaf children. The deployment of an English-to-ASL dictionary device provided evidence to the contrary. Instead of showing the device to their children, the parents would practice signing the phrase in the video until they could sign to their children themselves. This deployment provided evidence that parents would rather learn ASL than use a device for communication.

ASL is a difficult language that is thought to be as hard for an English speaker to learn as Japanese or Chinese [5]. English and ASL differ on a variety of linguistic aspects. One of these aspects is how English and ASL use morphemes. In English, morphemes are combined sequentially. In ASL, morphemes are frequently expressed simultaneously so that one multimorphemic sign in ASL could be used to represent an entire sentence in English. Fingerspelling, which many people expect to be easier for English speakers due to the direct mapping between finger shape and letters in the English, is really one of the most difficult components of ASL to learn. It takes a long time to become skilled at recognizing fingerspelling at normal conversational speed.

Given that ASL is so difficult to learn, how can we best assist parents attempting to learn? It can be hard to find time to learn while caring for a child with special needs, which can be equivalent to caring for two or three children without special needs [4]. Institutional support for different methods of communication also varies by geographical location [9]. In order to better understand the motivations and barriers parents face while learning ASL, we performed an interview study with hearing parents of deaf children from around the country [14]. Because this research question required the unique knowledge of our target population, we recruited participants from a national conference, rather than limiting the potential for future results from the local population. We found that even parents with children who have cochlear implants want to learn ASL. Parents described the advantages and disadvantages of their current methods for learning. The interview study also provided us with the first opportunity to deploy SMARTSign with members of our target population.

SYSTEM DESIGN
The SMARTSign application was designed for smartphones with front-facing cameras running the Android operating system. We have designed three components to accommodate the needs of hearing parents attempting to learn sign for the purposes of communicating with their deaf children. These components will be described in the following paragraphs.

Because SMARTSign is a tool to emphasize parent child communication. It is essential to provide parents with easy access to all of the vocabulary available in the application. We provide a search interface which auto-suggests words as the parents are typing so that they can quickly see whether or not a desired word is in the dictionary (Figure 1). Parents can also search for words via speech recognition for situations where typing is not feasible. The search component is useful when parents need to communicate with their child but don’t know a particular sign yet. During the interview study, parents mentioned that this functionality also helps them become more of an authority. Currently when parents do not know a sign, they either have to look it up in a paper dictionary with static images which can be difficult to decipher or ask their child. Asking their child is problematic because parents are not always certain their children are telling the truth on what a sign means or how to produce a specific sign. This reliance on their children can shift the balance of power within the family. An early user of our application employed SMARTSign when helping her 7-year-old son complete his math homework. He had to do word problems and the mom didn’t know how to sign one of the words. She asked her son and he signed something. The mother looked up the sign in SMARTSign and found out that her son had told her the wrong sign. Children are unreliable sources for signs whether through ignorance, desire to have their parents sign incorrectly and look stupid, or as we assume in the previous situation, because he just wanted to do his homework and did not care whether his mother knew the sign or not.

In the interviews, parents reported being self conscious when signing in public or to their child. The recorder component was created to provide parents with the opportunity to practice signing without being judged by others. The record component can be activated in order to practice a specific sign or for more general sign practice. When activated for a particular sign, the recorder allows parents to compare their recorded
Figure 2. Emphasizing sign production

Figure 3. Expanding vocabulary

sign with the video of an expert signer (Figure 2). According to one parent who has taken sign classes at a university, recording sign was valuable for learning to monitor the different components of sign.

To help parents gain independence from SMARTSign, the final component was created to help parents learn and practice new signs outside of their context of use. The study component helps parents improve both their recognition and production skills. Parents improve sign recognition through a quiz interface (Figure 3). A video plays and parents are then shown four possible responses as well as a fifth “Show me the answer” response. Through this simple quiz, parents can take advantage of small moments throughout the day to learn new vocabulary. Parents use the quiz to learn a set number of new signs every day. Accessing the study component after the daily list has been learned allows parents to review previously learned signs. When reviewing a word, parents will either be directed to the quiz or to the recorder ensuring production and recognition practice.

FUTURE DIRECTIONS

The design of the SMARTSign application is now mature enough to support a long-term deployment to members of our target population, hearing parents with young deaf children. We are planning a study to evaluate the impact of using SMARTSign for a 4-week period on parents’ ability to recognize and produce ASL vocabulary. Through this study, we will gain an understanding of how parents integrate the application into their everyday lives. We will collect information on what components parents use when, location of access, situations that may have prompted its use, and if they are using the application with anyone else.

One aspect mentioned by some of our parents in interviews that is not addressed by our current implementation of SMARTSign is the sense of community that can arise in an ASL classroom for parents with deaf children. We made the decision not to focus on social network formation in our design due to privacy concerns, but we are interested to see how the application may integrate into parents’ current social networks. Hearing mothers with deaf children tend to learn ASL more frequently and more thoroughly than hearing fathers [9]. Do mothers use SMARTSign differently from fathers? How does SMARTSign use change based on whether one or two parents in a household have it installed on their phone? According to our interview study, it is not common for extended family to learn ASL. This situation means that at family gatherings, deaf children are frequently isolated due to the language barrier between them and their family. SMARTSign, if successful with parents, may also prove useful in teaching ASL to the deaf child’s extended family. If the entire extended family learns ASL, then the parents and the deaf child will have more conversational partners.

CONCLUSION

In this paper, we have presented the SMARTSign application for helping hearing parents with deaf children learn American Sign Language on their mobile phones. As a tool which indirectly helps deaf children gain access to language and the world, SMARTSign resembles indirect accessibility interventions. However because it is designed for the parents instead of the children, SMARTSign belongs in a third class of accessibility along with universal access and indirect accessibility.

REFERENCES


