SignBright: A Storytelling Application to Connect Deaf Children and Hearing Parents

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Abstract

Deaf children of hearing parents face many unique challenges that have been shown to adversely impact their interpersonal interactions and development. Contemporary research indicates that many of these challenges stem from environmental factors, including a lack of exposure to language concepts during early developmental stages. In this paper, we will present an innovative solution to foster connection and understanding between deaf children and hearing parents, SignBright. In addition, SignBright promotes acquisition of sign language skills by hearing parents and deaf children, providing greater opportunities for interfamilial dialogue and bonding, and promoting development of social and linguistic competencies.

Keywords

Deaf, Children, Parent-Child Interaction, Communication, Sign Language, Educational Technology, Attachment, Child Development

ACM Classification Keywords

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

General Terms

Design, Human Computer Interaction, Human Factors

Introduction

In the United States, 2 to 3 out of 1000 children are born deaf, and 90% or more of children with present-at-birth deafness are born into families where both parents are hearing [1]. While some hearing parents have adopted non-auditory means of communication, the vast majority lack the skills to communicate effectively with their children [2]. As a result, deaf children with hearing parents do not commonly receive essential exposure to language-driven interaction during early developmental stages. In addition, hearing parents often express feelings of failure or sorrow related to a child's deafness, which they may view as a handicap [3].

Based on these factors, deaf children of hearing parents face many difficult challenges related to interfamilial perceptions and limited social engagement [5]. These challenges include socio-emotional, cognitive, and linguistic impairments, and relative emotional immaturity and dependence compared to hearing peers with hearing parents and deaf peers with deaf parents [4]. Furthermore, average deaf or hard-of-hearing students have been shown to exhibit low language-related competency levels compared to hearing peers [2].

Relative performance of deaf children with hearing parents compared to deaf children with deaf parents is particularly enlightening, since it points to a fundamental difference in familial environmental conditions. As an example, Deaf parents commonly dialogue with their deaf children using sign language from a very early age, which has been shown to increase their linguistic aptitude and understanding of appropriate social cues [5].

As an illustration of the frustrations that are often faced by deaf people in relation to their hearing families, one deaf student in our initial interviews stated, "*It's terrible, I can barely talk [with] my parents. […] We primarily talk on e-mail and [there are] so many misunderstandings because we can't talk to each other. They don't even know me well or my deaf friends. […] Home is stressful, so many problems, and it sucks but we can't do anything about it since talking is hard.*"

Hearing parents also face a number of challenges in raising their deaf or hard-of-hearing children, as indicated by the responses of another interviewee, a mother of a hearing-impaired child. She stated that "*raising a deaf or hard-of-hearing child is difficult early on. Nobody expects or plans for the child to be deaf and the family has to make a lot of changes and adjustments. [...] There were so many obstacles and frustrations through the process of learning sign language […] trying to help our child at school with making friends was tough and heartbreaking. [...] This was not easy and I wish there was something that could have helped us learn and teach sign language to our child. That would have made things so much easier*".

Various technologies have been employed to good effect as educational tools for deaf and hard-of-hearing children, though many are limited in capability and rudimentary in form. However, technological solutions that adequately address the social needs of deaf children are nearly non-existent. An appropriate solution is required to connect deaf children and hearing parents and promote mutual understanding, provide deaf children with an effective means of
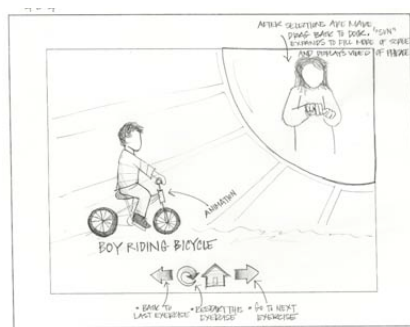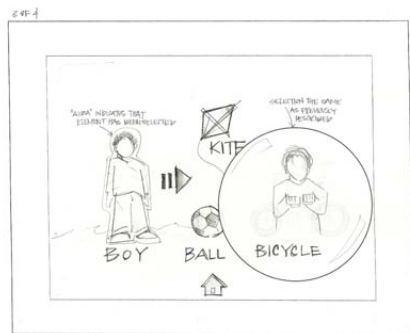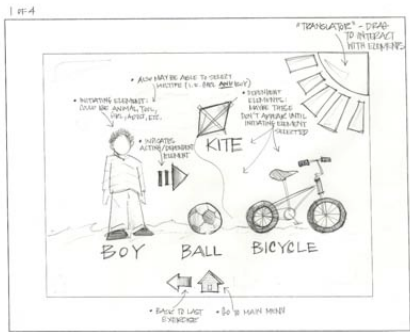
Figure 1: Preliminary interface sketches.

expression, and foster cognitive development and language competency.

Problem Identification

After identifying our target audience, deaf children ages 2-5 with hearing parents, we conducted a thorough literature review to determine relevant issues that impact this unique group. Our investigation involved analysis of current people with hearing parents and hearing parents with deaf children. Research revealed that the quality of early parent-child relationships can strongly influence academic and professional success, cognitive development, and feelings of social adjustment of deaf individuals, and that these impacts extend well into adulthood. Exposure to language and meaningful forms of expression were also identified as primary factors contributing to higher performance and socio-emotional well-being among the deaf [7]. Furthermore, our research indicated that interventions are most effective when they take place during early pre-verbal developmental stages, when children are typically learning proper responses to verbal cues and basic vocabulary through direct immersion [3,6,7,8].

In framing the design problem, we determined that an appropriate solution should expose children to relevant and multi-modal forms of language, including sign language and written English, during early developmental stages [12]. Additionally, the solution should give guidance and encouragement that is relevant to the specific child. The solution should also incorporate various techniques to promote acquisition of language skills in a clear and engaging manner, since the language-learning process is unique to each user and can be frustrating [9].

In considering forms for a solution, storytelling emerged as a particularly impactful and familiar mechanism to promote parent-child bonding, language development, and other social skills. Numerous child-centered studies demonstrate the importance of storytelling and shared reading with parents. In early childhood (e.g., at kindergarten or at home), storytelling is well recognized as a means to support a child's development and to help the child express and assign meaning to the world, to develop communication, recognition, and recall skills, and to enforce relationships with peers and adults [10].

Furthermore, storytelling can be an important and intimate shared experience between a parent and child, and one which fosters personal familiarity and understanding. A storytelling solution designed primarily for hearing parents and deaf children may help to fill a crucial gap in interpersonal interaction between members of the target group, since many hearing parents are unequipped to engage in active, shared reading or storytelling with their children.

Proposed Solution

Our proposed solution, SignBright, is a storytelling application designed to promote connection between parents and deaf or hard-of-hearing children ages 2-5. SignBright allows parents and deaf or hard-of-hearing children to engage in the activity of storytelling, which promotes mutual growth and understanding, teaches language skills, and enhances parent-child bonds [10]. With the additional goal of providing a common language for children with hearing difficulties to communicate with caregivers, the SignBright application enables users to learn and practice

Figure 2: Avatar customization.

Figure 3: Color identification / selection using SignFinder tool.

American Sign Language (ASL) and Signed English (SE) forms of sign language [11,12].

SignBright is intended for use on multi-touch tablet devices, such as the Apple iPad. After experimenting with a number of form-factors, we believe that this format provides an experience that is most comparable to reading from a book, allowing parent and child to interact with the application while sitting in close physical proximity which results in interpersonal bonding between parent and child.

Vibrant colors and patterns were chosen to actively engage users and address the "visual" nature of deaf perception. Primary interactive elements are emphasized through the use of bold forms and contrast, while secondary elements such as menus are allowed to fade to the back during engagement in learning activities.

Primary interaction with elements is conducted through use of the SignFinder, a tool which docks in the top right-hand corner of the screen and expands to create a viewport when undocked. As users hover over elements with the viewport, they are presented with video depicting appropriate signing gestures for that element, accompanied with text.

As users view the corresponding video for various elements, these videos will be added to a video collection that can be viewed at any time for practicing. By using a device that features a facing camera, users can record their own representation of the signed gestures and save them to the device to view in conjunction with the standard videos. In this way, users

can visually analyze their gestures and refine technique as needed.

In typical signing e-books with video, a stationary window is presented along with several lines of text. While this format is appropriate for some applications, stationary windows that do not strongly correlate to individual elements can lead to confusion as users attempt to determine which element is being signed at any given time. The SignFinder was employed to mitigate confusion by creating proximity between individual elements and associated signs. In addition, the SignFinder provides a novel tool with which to select individual elements while forming a story (Fig. 5), adding characteristics to a character (Fig. 3), or practicing signs (Fig. 7). In addition to input via the SignFinder, users will be able to navigate frames of a story or menus through a familiar directional "swiping" gesture, which is common to many popular multi-touch applications. Other common multi-touch gestures, such as two-finger zooming of the SignFinder viewport, may be integrated, as well.

Parents will begin by entering a child's age and other pertinent data, which will allow for a customized user experience. Children will then create a character, or avatar, to represent themselves in stories (Fig. 2,3). SignBright provides many customizable options to make the application more personal. For instance, the avatar is intended to give children a greater sense of involvement in stories, and empower them to interact more readily with the world around them, and can be modified indefinitely as a child's interests and self identity change.

Figure 4: Storytelling interface. User presented with objects.

Figure 5: User views/selects objects using SignFinder tool.

Figure 6: Animation of interaction with signed phrase.

Regardless of age, children differ in their cognitive and linguistic abilities. For instance, 2-year-old children have more limited vocabulary than older children and are commonly limited to expression through very short phrases and sentences. However, infants are also more attentive to objects in their environment [3,6]. SignBright will initially address early language learning through presentation of simple objects in correlation with text (Fig. 4). These objects are selected based on relevance to a particular age. Parents can interact with the elements via the SignFinder tool, which will present them with video of related signed gestures. In this way, parents and children can begin to build a vocabulary that allows them to communicate freely and understand each other's needs.

As children continue to grow in age and ability, SignBright will adapt to their changing needs. At 3-4 years of age, children typically have increased ability to communicate. They are able to express their ideas clearly and tell some short stories [13]. At this level, children can begin to create their own stories by repeating the method described in figures 4 through 6. The content of this level focuses more on describing daily activities than simple objects. The higher level is designed for children who have an excellent grasp of sign language appropriate for 4-5 year old children. The content can range from humorous stories to more detailed fairy tales, with many joining segments. At this stage, SignFinder interaction will be used in conjunction with stationary video depictions to handle longer phrases.

Children and families can benefit tremendously from acquisition of a shared language, to support proper child development and to strengthen shared interpersonal connections [5]. SignBright addresses both of these goals in an intuitive and innovative application that a child and parent can enjoy together. Furthermore, SignBright grows with users, making it an integral tool to encourage children and parents to keep developing their sign language abilities.

Future Work
We believe that SignBright has significant potential to impact development of future applications that cater to deaf or hard-of-hearing children. As an example, research has shown that virtual reality can be a highly effective tool for teaching concepts to deaf or hard-of-hearing students [14]. SignBright could be combined with virtual reality and incorporate enhanced features that employ mathematics and science concepts for older students [15].

With additional features SignBright could be adapted for users of various ages and with a wide range of cognitive abilities. SignBright may also be useful as an educational and collaborative tool for teachers or students in a classroom setting or used in sign language courses at a high school or college level that are geared to hearing and hearing impaired students. Furthermore SignBright could be modified for use with deaf populations of differing ethnic and cultural backgrounds.

Based on time constraints related to necessary IRB approval, user testing of prototypes was not conducted prior to submission of this paper. As a next step, the group will test a working prototype with caregivers and children and revise the concept as needed, based on responses from test subjects.

Figure 7: Object collection screen for review and practice.

Conclusion

Children and parents can benefit tremendously from acquisition of a shared language, to support proper child development and to strengthen shared interpersonal connections [5]. SignBright addresses both of these goals in an intuitive and innovative application that a child and parent can enjoy together. Furthermore, SignBright grows with users, making it an integral tool to encourage children and parents to keep developing their sign language abilities. We are confident that this application will be successful with improving the connection, communication, and interpersonal growth between the parent and child.

Acknowledgements

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