Design With the Deaf: Do Deaf Children Need Their Own Approach When Designing Technology?

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ABSTRACT

In this paper, we focus on the question of design of technology for Deaf children, and whether the needs of these children are different from their hearing counterparts in a technology design setting. We present findings from literature together with our own observations to determine if there are distinguishing characteristics for Deaf children that may influence design sessions with them. We found that Deaf children generally have reduced literacy and slower academic progress, reduced social and emotional development, reduced empathy and a level of nervousness in novel situations, delayed language development, and limited or delayed spoken language. We also found that Deaf children are active and innovative in approaching communication, have sensitive visual attention in their peripheral vision, enhanced attention to small visual changes, and a capacity for visual learning. Finally, cultural issues within the Deaf community mean that Deaf children should be free to interact on their own terms in a design situation. We suggest that these differences merit the development of a design approach specific to the needs of Deaf children.

Categories and Subject Descriptors

H.5.2 User Interfaces (User-centered design)

General Terms

Design, Human Factors

Keywords

Child Computer Interaction; Deaf Children; Prototyping

1. INTRODUCTION

The study of the interaction between children and information technology has gradually emerged as a distinct research area - Child Computer Interaction - within the broader Human Computer Interaction community [15]. The area is concerned with how children use interactive products [11] and includes (but is not limited to) research in design, participation, and evaluation techniques specific to children and technology. We are specifically interested in developing an approach that will work well for Deaf children. Recently we have been asked why we would look to develop an approach in this area specifically for Deaf children – why not simply use design best practice? This paper endeavours to answer the question "Do Deaf children need a special approach when designing technology?"

This paper discusses preliminary work in progress within the Seek and Sign project, which was established to develop technologies to enhance the communication environments of very young Deaf and hard of hearing children and explore the issues in design with that client group. The focus for this paper is the element of design of technology for Deaf children, and whether the needs of these children are different from their hearing counterparts.

In order to answer this question, we will look first to the literature to determine if there are distinguishing characteristics for Deaf children. We will also present our own observations from working with Deaf children. In doing so we will outline the characteristics of Deaf children that have been identified or observed that may affect their ability to participate in the design of technology.

2. A NOTE ON LANGUAGE AND CULTURE

Deaf Australia provides definitions for terminology to describe people with hearing loss as follows:

"deaf (with a small letter, d) is a general term used to describe people who have a physical condition of hearing loss of varying degrees irrespective of which communication mode they use such as Auslan and lip reading for example. Deaf (with a capital D) is used to describe those people who use Auslan (Australian Sign Language) to communicate, and identify themselves as members of the signing Deaf community. These people may also identify themselves as "Culturally Deaf." They are more likely to have been born deaf or become deaf early in life, are pre-lingually deaf and use sign language as a primary or preferred mode of communication.

Hard of hearing is the term used to describe those who have a hearing loss, usually acquired post-lingually and whose communication mode is usually by speech. This term also covers those people who have become deafened later in their life" [17].

This paper will follow the conventions of Deaf Australia and use the term ""deaf" when referring to all Deaf and hard of hearing groups at once."

3. HOW ARE DEAF CHILDREN DESCRIBED IN LITERATURE?

A range of design techniques have been used for design with children generally, including observations, questionnaires, surveys, storytelling, workshops, roleplaying, and prototyping [21], and many approaches for working with children have been developed, such as the cooperative inquiry approach [6], co-design sessions [15], and Guha, Druin, and Fails [9] inclusionary model for children with special needs. The choice of method for a design session is dependent on the skills of the specific design session participants, the aims of the session, and the attributes of the product to be designed. We contend that when the children who will be involved in the design session are deaf, the nature of their abilities requires the consideration of additional factors. In order to answer whether that contention is true, we need to explore the actual characteristics of Deaf children and identify the additional factors for consideration.

As with any child the skills possessed will depend on the individual participating. However some more general attributes have been identified specific to deaf children. A large percentage of deaf children are born to hearing parents, with statistics reported ranging from 70% to 90% [8]. In Australia, that figure is reported at 95% [5]. While the deaf children of deaf signing parents acquire sign language at a comparable rate and with similar milestones as hearing children acquire verbal language, deaf children of hearing parents acquire language more slowly, leading to ongoing learning difficulties [12]. These children go on to experience reduced levels of literacy as compared to their hearing counterparts [20, 23]. This suggests that when designing for these children, a design team needs to establish the development level of the child and be prepared to use tools and techniques that are suitable for that level.

The importance of cultural characteristics is clear from the definition for Deaf people provided by Deaf Australia. It is critical that a design approach for Deaf children engages them 'on their own terms', allowing them to express themselves in the way that is most comfortable for them.

Intellectually, deaf children have similar characteristics for perception, learning and memory to hearing children [22]. Despite this, deaf children frequently lag behind hearing children in academic areas, including reading, comprehension, written language, mathematics, and speech and language [22]. The delay in language development then leads to reduced levels of literacy [14], however deaf children can be active and innovative in approaching communication by incorporating drawing and writing to communicate when they do not have spoken or signed language [24]. This suggests that a design approach for these children needs to be flexible and tangible allowing the children to engage innovatively.

In addition to potential literacy delays, general and spoken language may be limited or delayed for Deaf children [13]. Not all deaf children can communicate verbally, however they do use facial expression and body movement, which can provide valuable feedback. The structure of design sessions involving deaf children should be flexible and communication support should be available [4]. Participatory approaches involving deaf children also require flexibility [1]. Any design approach for working with Deaf children must be focused beyond the written or spoken word. Tactile and visual interaction may be a means for facilitating communication in design. The approach must allow for the general communication challenges that will exist when working with the children.

Many Deaf children of hearing parents experience elevated levels of behavioural and attention problems, with these problems occurring both at home and at school [16]. Barker, Quittner, Fink, Eisenberg, Tobey and Niparko [2] suggest that this may be in part due to language difficulties and to the challenges and frustrations involved in communication between a hearing parent and Deaf child. They found a link between language skills and the ability of the child to sustain attention to a task. This suggest that a design approach for Deaf children would need to facilitate communication between the children and the design team and operate with a language that the children are comfortable with in order to maintain the attention of the child.

Deaf children may exhibit reduced social and emotional development in terms of communication, understanding of both situations and other people, and flexibility [3, 20]. For these reasons, Deaf children must be given the scope and opportunity to express themselves freely, without the expectation of typical social mores or niceties, and any design process must facilitate this.

People who are Deaf progressively develop more sensitive visual attention in their peripheral vision than their hearing counterparts as they get older [10], and this change to visual attention starts in childhood. Mitchell and Quittner [16] suggested a connection between the attention difficulties they observed in Deaf children with "distracting or "competing" visual stimulation in the environment". Hirschorn (2011) suggests that classrooms need to be designed to suit this through smaller class sizes, arranged seating, and predictability within the environment. She also suggests that the characteristic may affect the way Deaf children deal with written information, as words in their periphery vision may attract their attention instead of words in their main field of focus. These same considerations for visual attention should be supported within a design approach.

Deaf children use visual-spatial cognitive perception and processing [7]. Parasnis [18] suggests that the acquisition of sign language is a critical factor for the further development of visual spatial skills for these children. These skills provide an opportunity for developing an innovative design approach that would capitalize on the visual nature of Deaf children.

4. OUR OBSERVATIONS OF DEAF CHILDREN

The Seek and Sign project is focused on the use of technology to support young Deaf children as they acquire sign language [19]. The project has used a number of different techniques, including separate observations of both Deaf and hearing children's interactions with applications, discussions with parents and teachers of Deaf children, cooperative design prototyping sessions with Deaf children for the development of game based applications to help children learn signs in Australian Sign Language, or Auslan, and exploration of technologies that may be suitable for recognition of sign language gestures. The key participants in the project are the children themselves and a decision was made early in the development of Seek and Sign to actively involve children in the design process. There is "recognition of the fact that children's views differ from those of adults" (Rabiee et al. 2005), and when developing technology for children we feel that it is important to gather the child's ideas, not only those of the supervising adult. The importance of

recognizing the child's view is made more critical in an area where different methods of communication may be used, and where there is potential for distortions from interpretation and reinterpretation between children, carers, and the design team [5].

We have observed hearing and Deaf children as they have interacted with the applications developed as part of the project, as well as observing Deaf children's interactions with technology more generally. Early design sessions with Deaf children have involved a child-as-informant approach to requirements elicitation, as described within the Cooperative Inquiry approach [6]. These sessions are informing the development of an approach that will facilitate the participation of Deaf children as design partners.

In the course of the cooperative design prototyping and observation sessions that have been conducted across the life of the Seek and Sign project with Deaf children, we have observed a range of characteristics that the children displayed. While we encountered several issues that could be general to all children, there were some challenges that were specific to their needs as Deaf children. We have observed many of the characteristics that are reported in literature, including language and literacy delays (which affect the use of written language when working with the children), attention problems, and differences with visual processing. It is perhaps unsurprising that the primary challenge in dealing with Deaf children was around communication.

Communication is arguably one of the most important facets in a participative design process, and when the participants are essentially speaking different languages challenges are inevitable. This is compounded when dealing with Deaf children who have a communication deficit through a lack of mastery of language. When working with the children we experienced difficulties with feedback during prototype design sessions, both with the children providing feedback and with the designer eliciting input and feedback. Initially, some children were reluctant to speak during early sessions, and would not share thoughts at all unless prompted. There also appeared to be contradictions in their interaction, such as one example where a child's behavior of singing and making noises for elements within the interface, seemed contrary to his stated opinion, that he didn't want the interface to make sounds. Design techniques for working with Deaf children need to be flexible enough to support communication in whatever medium is most comfortable for the child.

We observed a degree of initial nervousness in Deaf children when they were introduced to the prototyping sessions. Whereas hearing children were comfortable with interacting with the game, the Deaf children were hesitant to explore the game to its fullest, as evidenced by their reluctance to click on buttons during the early part of the sessions. This seems to be due to overall nervousness due to being placed in an unfamiliar situation, rather than a reluctance to play, and applied to both introverted and extroverted participants. With increased familiarity (with the game and prototyping approach) they demonstrated the same confident and animated approach as their hearing counterparts. This may suggest the need for a technique within a design approach that bridges hesitancy.

We observed examples of attention and behavioural issues with some of the children, such as sessions when children would fight over who had control of a computer mouse, or an instance when a child displayed hyperactive behavior and was more interested in clicking on everything in the prototype and making up stories

about the items on screen than trying to learn the signs. While it could be argued that this is typical of many children regardless of their hearing, it has been found that Deaf children have a higher level of behavioural and attention problems and a design approach must be flexible in order to deal with this. In the example above, the child's story telling provides an opportunity for a designer to capture the child's thoughts in a novel way, and a flexible design approach needs to allow for this in a fluid way.

We found that working with the children in pairs when developing a computer based prototype was effective for dealing with potential behavioural problems as this minimised fighting between the children and made it easier to direct their efforts and attention. In pairs, the children tended to support each other in a constructive fashion, as evidenced by the children answering one another's questions relating to the technology in use, or in pointing out interaction options to each other. A design approach that can facilitate team or small group settings could capitalize on these benefits.

The Deaf children were generally visually acute. Even very minor changes, such as the addition of a button to a screen or a minor change to the background, were very obvious to them and were noticed immediately. Such changes caused the children to fixate on the change itself, rather than the expressed goal of the prototyping session. A design approach should allow for this, both in terms of capitalizing on the potential opportunities offered by their level of observation, and in minimizing any potential negative impact of minor changes.

A second aspect of their visual attention that affected their interaction with designers was their ability to be distracted by their surroundings – a finding commonly reported in parent forums and consistent with findings related to visual attention in literature. Changes occurring in their peripheral vision will catch their attention and distract them, such as movements seen through windows. They can also be distracted by someone sitting near them if their position is such that they are in the child's peripheral vision. Clearly these aspects must be included within a design approach for Deaf children. The children were also observed to delight in animated graphics and buttons within the prototypes. This is perhaps unsurprising given the nature of their visual attention.

In addition to their visual nature, they often seemed to learn visually. The grandmother of one participant commented that her grandson from "a very early age could easily find objects and find his way around shopping centres, even after having been there only once." She also noted that he was "much more attentive to the environment than other children who probably cruise through on the basis of what they hear."

5. CONCLUSION

Within this paper we have looked at the characteristics of Deaf children reported in literature that may influence their ability to be active participants in a design process, and presented our own observations from working with Deaf children. We were seeking to answer the question "Do Deaf children need a special approach when designing technology?" The findings in literature and our observations suggest that Deaf children differ from their hearing counterparts in several areas, and that the combination of these differences warrants an approach that is tailored to their needs.

The characteristics discussed in this paper relate to the development of Deaf children. Academic development characteristics are represented in reduced literacy and slower

academic progress. Emotional and social characteristics are represented in reduced social and emotional development, reduced empathy, and a level of nervousness in novel situations. Deaf children demonstrate delayed language development, and limited or delayed general or spoken language, however Deaf children are also active and innovative in approaching communication. Deaf children have sensitive visual attention in their peripheral vision, enhanced attention to small visual changes, and a capacity for visual learning. Finally, cultural issues within the Deaf community mean that Deaf children should be free to interact on their own terms in a design situation.

The choice of methods for the design of a new technology should be based on the skills of the participants. The characteristics of Deaf children that have been identified suggest that a design approach specific to the needs of Deaf children is warranted. We intend to develop a design approach that will support communication between all parties in the design process. This approach must support Deaf children independent of their level of literacy, facilitate language support appropriate for them, capitalise on their visual abilities, and allow creative expression.

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