We Need to Communicate! Helping Hearing Parents of Deaf Children Learn American Sign Language

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ABSTRACT

Language immersion from birth is crucial to a child's language development. However, language immersion can be particularly challenging for hearing parents of deaf children to provide as they may have to overcome many difficulties while learning American Sign Language (ASL). We are in the process of creating a mobile application to help hearing parents learn ASL. To this end, we have interviewed members of our target population to gain understanding of their motivations and needs when learning sign language. We found that the most common motivation for parents learning ASL is better communication with their children. Parents are most interested in acquiring grammar knowledge through learning to read stories to their children.

Categories and Subject Descriptors

K.3.1 [**Computers and Education**]: Computer Uses in Education—*Computer-assisted instruction*

General Terms

Human factors

Keywords

American Sign Language, mobile devices, computer assisted language learning

1. INTRODUCTION

In the United States, from 90 to 95 percent of deaf children are born to hearing parents [6]. Typically, these parents have had no exposure to American Sign Language (ASL), the most accessible language to deaf Americans, before the birth of their deaf child. Parental involvement plays a large role in a deaf child's language development. Maternal communication in particular, is a significant indicator of language development, early reading skills, and social-emotional development [1]. The better the language skills of the parents,

the higher chance deaf children will have of succeeding in school and beyond. The language skills of deaf children with hearing parents lag far behind those of hearing children with hearing parents and deaf children with deaf parents [11, 7]. The slower development of deaf children of hearing parents has been attributed both to incomplete language models and less parent-child interaction [8, 2].

In order to improve parental language ability in ASL, we have been developing SMARTSign. The goal of SMART-Sign is to provide parents with ASL practice via the mobile phone. Prior research has been focused on validating the viability of a mobile phone as the content delivery system [3, 10]. Henderson-Summet demonstrated that novice sign language learners can learn to recognize more vocabulary when using a mobile phone as the content delivery system as opposed to a computer. However, participants had difficulty across both platforms in producing the signs they learned [3]. Weaver et al. demonstrated that a modern mobile phone display possesses a sufficiently large screen area to enable novices to reproduce signs from example videos with high accuracy [10].

To ensure that SMARTSign is providing appropriate types of assistance to hearing parents attempting to learn ASL for their young deaf children, we have conducted interviews with members of our target population. These interviews were focused on understanding parents' motivation for learning ASL, existing methods and support for learning, reactions to the SMARTSign prototype, and current mobile technology usage.

2. RELATED WORK

Two similar interview studies have been carried out with parents of deaf children on a number of relevant topics [4, 5]. No one has explicitly interviewed parents about their learning habits to understand difficulties when learning sign language.

Jackson et al. carried out interviews with nine parents of eight children [4]. The children's ages ranged from one to to nineteen. The goal of the interview was to make recommendations to service providers on how best to serve families with deaf children in early interventions. Parents' reliance on oral methods and their child's hearing ability had the most impact on parental willingness to learn ASL as a communication method. One key finding from the interviews was that parents said time demands from caring for their deaf child was "equivalent to caring for two to three children." We had already assumed that demand on parent time was one reason why it was difficult for them to learn

ASL. Managing the doctor and therapist meetings for their deaf child can also put a significant limit on parental free time.

Meadow-Orlans et al.'s data comes from a mixed methods approach including surveys, individual interviews and focus group interviews [5]. The purpose of their study was to gain basic understanding of the experiences of parents of young deaf children. They focused on reactions to identification, communication method decisions and reactions to care providers. Parents sometimes had no choice over what communication methods they used. Instead they were limited by the opportunities available to them based on their place of residence. Two reasons for parents deciding to sign included giving their children any chance they could to communicate and leaving as much choice in the hands of their children when they were older. Mothers rated their skills in sign language better than the fathers 95 percent of the time. An interesting area for investigation could be exploring the opportunities for supporting fathers' learning ASL using SMARTSign.

Vaccari and Marshark wrote a summary paper on the impact of parental communication ability on a deaf child's development [9]. They found that the deaf children who are most competent in social and linguistic development are those whose parents engaged them actively in linguistic interaction from a young age. Linguistic interaction is difficult for hearing parents with deaf children who have so little formal sign training that they cannot use it for daily needs, feel uncomfortable signing, and only sign when directly addressing their child. The goal of my interview study is to determine how to address these three problems.

3. METHOD

The study took the form of a semi-structured interview with hearing parents of deaf children. The interview topics followed four categories: family, ASL learning, prototype reactions, and phone ownership. The goal of the family topic was to understand basic background information about the parents and their deaf children to determine the level of support parent and child had for learning ASL. Conversation about ASL learning was directed towards uncovering current difficulties parents experience while learning ASL in order to determine if SMARTSign can be designed to alleviate those difficulties. Parents were shown the prototype SMARTSign system to gauge reactions and determine utility and desirabilty of the existing functions. Because the ultimate goal of this research project is to deploy a working system longterm to parents, the phone ownership topic was important for understanding what devices were favored by parents and availability of data plans.

3.1 Parental Recruitment

Parents were recruited through a number of methods. E-mails were sent both to the SKI-HI (Sensory [Kids] Impaired Home Intervention) coordinator at Georgia PINES, the state-wide early intervention program for Georgia and to the social worker at the Atlanta Area School for the Deaf. Parents were also recruited from the 10th Annual Early Hearing Detection and Intervention Conference (EHDI 2011) in Atlanta, Georgia. EHDI is a national conference with tracks for both practitioners and parents. Only one parent was already acquainted with the SMARTSign project before participating in the interview. She is a regular user of an early web-based iteration.

3.2 Participant Demographics

Eleven parents were recruited for the interview study, nine mothers and two fathers, representing ten different families. One of the participants is currently a single parent and one of the other participants was a single parent when her child was born but is now married. The other eight families represented two-parent households. Due to recruitment at a national conference, participants represented eight different states from three geographic regions of the United States, the Southeast, Northeast, and Midwest. A summary of the participant demographics is shown in Table 1.

The parents interviewed had between one and seven children ($\mu = 2.5$, $\sigma = 1.84$). All of the participants were the parents of at least one deaf or hard of hearing child. One mother had two children who were hard of hearing. Three of the parents only had one child.

The ten families included eleven deaf or hard of hearing children. Their ages varied between 10 months and 16 years ($\mu = 5.26$ years, $\sigma = 4.04$ years). The age of their child's hearing loss identification also varied between birth and 3 years ($\mu = 11.18$ months, $\sigma = 12.65$ months). Four of the children were identified at birth. Many of the parents reported that their children had initially failed their neonatal hearing tests, but passed on follow up tests which lead to delayed diagnosis. Despite the late identification of deafness for some of the children, only one child's deafness was not congenital or acquired shortly after birth. This child became deaf after suffering from meningitis at 13 months. Three of the eleven children had other serious medical conditions. This ratio is consistent with the findings of Meadow-Orlans et al. [5]. The two deaf siblings have cystic leukoencephalopathy which is a progressive degeneration of the brain's white matter. Another child is autistic. One child is adopted, and the birth mother abused drugs: high levels of bilirubin (extreme jaundice) caused the deafness which was not diagnosed until the child was 3 years old.

All of the children possessed some form of sensory device: hearing aid or cochlear implant. Five of the children had at least one ear with a cochlear implant although two parents reported that their children did not like to wear their implants. Five of the children wore hearing aids. One of the children wore a cochlear implant and a hearing aid.

4. MOTIVATION FOR LEARNING ASL

Discussions with educators and social workers early in the SMARTSign development process indicated that parents had no interest in learning ASL. In our interviews, we learned parents had a number of reasons for deciding to learn ASL. The primary reason was communication with their child which is consistent with previous parent interview studies. Some parents also expressed an interest in providing their children with a bilingual education and access to the deaf community. Parents also related some negatives that made their decision more difficult.

4.1 Communication

Eight of the ten families said that a desire for communication with their child was a reason for their decision to learn ASL. One mother said that when her parent mentor came to her home and told her all of the potential options

Table 1: Summary of participating family demographics

Family	Interviewed	Region	Children (Hearing:Deaf)	Child Age	Identified	Sensory Device	Medical Issues	Learning Duration
1	mother	Southeast	(0:1)	8 yrs	2 yrs	cochlear implant		6 yrs
2	mother	Northeast	(2:1)	3.5 yrs	3 mos	hearing aid		2.5 yrs
3	mother	Southeast	(1:1)	16 yrs	13 mos	cochlear implant (does not use)	meningitis	13 yrs
4	mother	Southeast	(2:2)	3.5 yrs & 2 yrs	18 mos & birth	hearing aids	cystic leukoen-cephalopathy	1.5 yrs
5	mother	Northeast	(6:1)	6 yrs	2 yrs	cochlear implant (does not like)		4 yrs
6	mother	Northeast	(1:1)	4 yrs	birth	cochlear implant		3 yrs
7	mother	Southeast	(1:1)	5 yrs	birth	cochlear implant & hearing aid	autistic	5 yrs
8	mother	Midwest	(0:1)	10 mos	5 mos	hearing aid		4 yrs
9	father	Midwest	(1:1)	5 yrs	birth	hearing aid		3 mos
10	mother & father	Southeast	(0:1)	4 yrs	3 yrs	cochlear implant	maternal drug usage, adopted	2 yrs

her decision was based on how her son could learn language the fastest. Other parents felt like they had no choice. For others it was less of a conscious decision and more the only option they had. Communication was not happening by any other method, and they "had to do something."

One mother realized that she had to work harder to learn after an experience at an amusement park. Her son was four and playing in the pool so was not wearing his cochlear implant. The lifeguard was whistling at him to tell him not to climb over the edge. Without his implant, the son couldn't hear the whistle. The mother had no idea how to attract her son's attention and she felt embarrassed when all the other families turned to stare at her. When she tried to take her son away, he could not understand her.

The Baby Sign movement is having a positive effect on parents' willingness to learn sign language. Two mothers stated that they had already planned on using sign language with their child before identification as deaf. One mother had already used Baby Sign successfully with her two older children. She said it didn't feel as "scary" as she feels it might be for others because of her prior exposure. Another mother said that she had always wanted to teach her children sign language and her husband pointed that desire out when they learned their child was deaf. Her reaction was to say "that's not the point." Familiarity is not everything, there is a difference between learning a handful of vocabulary as a temporary measure while a child is young by choice and learning a new language as a primary means of communication.

Some parents treat sign language as a temporary measure until their child gets implanted, their hearing aids allow them to learn language, or their hearing gets better. In some cases a transition to oral communication might be possible. One mother related how as her son masters a spoken word, he will drop the use of the relevant sign. This viewpoint can also backfire. One mother said they had started learning ASL and then they stopped when he was implanted. At age three, their son had behavioral problems due to lack of communication. They then decided to start signing again and have been doing so for 13 years.

In two other cases, this lack of communication became so apparent that their child became very frustrated. One

family said that they and their son were frustrated because they didn't know what he wanted, and they didn't know how to respond to him. Another mother said that knowing single words wasn't enough to ease the communication barrier.

If parents wait too long to learn ASL, then they find they have to play catch up with their child's language abilities. One mother reported experiencing this situation. The child became the language model for the parent. This situation becomes frustrating not just for the child but for the parent as well.

4.2 Linguistic and Cultural Benefits

Parents also made the decision to learn ASL for more than just communication. Three parents expressed interest in ASL as a way to provide their children with a bilingual education. One mother said "we always considered it an option because if nothing else, we figured he'd be bilingual." This sentiment is evidence that old ideas of learning one language impairing the ability to learn a second language are becoming less prevalent. Bilingualism is now thought of as an advantage rather than a disadvantage. Another parent said a bilingual education would help her child "learn as much as possible." One father took his son to Gallaudet (the university for the Deaf) in Washington DC shortly after his child was identified. Despite pressure from those in his community who wanted him to focus on one communication method, either oral or signing, the father said that they wanted to "empower him [their son] with choices." The father said that their son would then have the opportunity to choose his desired communication method later.

Two families mentioned the role of the Deaf Community in their decision process. One parent said that he wanted to learn ASL because it was the language of choice for the Deaf Community. Another parent said the experiences of a Deaf friend who learned sign first and then started learning oral convinced them to learn sign language. In the first example the father is learning ASL to help his child gain access to the Deaf Community. In the second example, the Deaf adult served as proof that sign language did not hurt a child's chances to eventually learn to speak.

ASL has one other benefit for parents as expressed by one of the fathers. In this father's state, the dominant language

promoted by early education providers is Signed Exact English (SEE). SEE is another visual language but is based on English grammar. SEE goes farther than just sign language in English word order and also includes signs for word endings such as "-ed" and "-ing." The father said that SEE was unnatural, too difficult to learn, and his son had given up using it. The feeling of dislike for SEE's difficulty and appreciation for ASL was shared by another mother.

Two of the parents made a point to emphasize how their children were normal, though deaf. These parents focused not just on communication with their child but inclusion in family life. One mother, after listening to stories by a deaf individuals who spent childhoods sitting at the dinner table not being engaged by their family and not knowing the names of their aunts and uncles, resolved that her child's experience would not be the same. Another father went to visit Gallaudet to make sure he explored all of the opportunities his son could have and to ensure that all possible avenues were open for his child to choose. Both of these parents are working to make sure to find ways to make their children's childhood "the best possible experience" as one mother expressed.

4.3 Disincentives

There are a number of disincentives which make the decision to learn ASL difficult. One mother related her annoyance of going out and having people stare at them. Kids would come up to her and ask what was wrong with her son. Using a visual language automatically singles you out as being different which can be uncomfortable for parents.

Lack of prior experience with deafness can make it difficult to embrace a new language and culture for their child. Only one parent had prior experience with Deaf individuals before their own child's identification. One mother was a special education teacher even before her child was identified. She said that all she was taught about deafness in school was "deaf is bad."

ASL is not an easy language to learn. Even parents who have been learning ASL for many years are hesitant to say they know or use ASL. A mother claimed that the sign they used in the house was more of a pidgin of ASL. One mother, who works in her son's school, says that she is uncomfortable when she is asked to read "aloud" at school because she is constantly worrying about whether she is signing correctly. She also said that when she first started signing she was afraid to sign in the grocery store for fear that people might see her doing it wrong. One father stopped signing because his child said his signing was bad and was embarrassing. Now the father doesn't have the confidence to use ASL with his Deaf friends.

Treating sign language as if it is a temporary language before oral English is acquired can be another disincentive to learning ASL fully. As technology for hearing aids and cochlear implants advances there are some who are able to gain enough ability to interact in society without the need for sign language. Religion can also play a role in the belief that ASL knowledge is only a temporary necessity. None of the parents expressed this belief personally but one father related an experience he had with his father. The grandfather quoted how Jesus healed the deaf, the blind, and the mute implying that faith could heal his grandson as well. The father's reply was "My son is not broken. He is whole. He just happens to be whole and not hearing." This attitude

Table 2: Summary of Learning Tools

Learning Tool	Positive	Neutral	Negative	Total
Early Intervention Services	4	1	1	6
DVDs	4	2	2	8
Websites	2	6	1	9
Classes	3	1	3	7
Mobile Phone	0	2	0	2
Books	1	2	4	7

is more likely to help his child develop the skills necessary to succeed in a hearing society.

Another barrier to learning sign language is lack of opportunities to practice. Two mothers talked about this. One mother has experienced frustration because her son is autistic. She feels that the response from her son is not enough. Later on she did state that he does surprise her sometimes when he uses a sign that she was unaware he knew. The mother whose child is still an infant talks about how difficult it is when she cannot use her sign language every day. Her child does not yet have the capacity to learn more complex language, so she has to work and focus on learning so she is ready to teach when her child is ready.

5. LEARNING TOOLS

Participants were asked about the tools they used to learn and practice their sign language skills. While most parents agreed that classes were the most beneficial, they reported using a wide range of tools including books, DVDs, and websites. Some parents even talked about tools they used while they were mobile. Many states provide services for parents where an educator will come into the home to help parents and family members. Table 2 shows a summary of participant use of and reaction to a number of different tools for learning ASL. We will start by investigating characteristics of the tools which had the most positive reactions (Early Intervention Services) and the most negative reactions (books).

5.1 Interventions

Early Intervention Services received the most positive comments of any of the other learning tools. Of the ten families, six had access to early intervention services. These services are typically provided for the family while the child is between the ages of zero and three and can provide many different forms of assistance. One parent was matched with a deaf mentor. The mentor played a significant role in helping the mother with her confidence in learning sign language and with helping her feel comfortable interacting with the Deaf community. Other home providers help parents by teaching them ASL in their homes. One home provider taught the extended family as well as the parents in their home once a week. Home providers can also help parents learn event-specific vocabulary. One mother whose home provider visits twice a month talked about looking ahead at the calendar and asking her to help with vocabulary related to visiting the dentist office so that her son would not be nervous. Another service can be helping parents keep pace with vocabulary related to the topics their child is learning in school. A third way home providers can assist parents is by helping them with the transition to communicating in a more

visual language. One parent talked about how his early childhood educator did a good job of teaching about communication and turn-taking to help them understand how to convey the significance of the signs to their child. Interventions are largely positive experiences for parents because they are largely customized to the family, providing relevant and timely information.

Not all reactions to the home providers were positive. One parent commented about the wide range of potential personalities and styles. She commented that one home provider will argue with parents about the proper way to perform signs. Given that parents are already experiencing low confidence with their sign language skills, this confrontational style could discourage them further. Parents may also feel overwhelmed by the amount of information provided by their home providers at once. Despite these problems, the parent admitted that she knew the home providers meant well and that it was better than not having any support like those who lived in more rural regions of her state. The disadvantage of Early Intervention Services then lies in the variability of the home providers.

5.2 Books

Parents reacted to books the most negatively. Seven of the ten families reported using books to help them learn sign language. Of those seven families, four of the parents were not happy with the books they had. Parents found them difficult to understand. Because motion plays a large role in the meaning of a sign, it can be difficult to convey a complete sign through static images. One mother said it was difficult to look at a single picture with lots of arrows pointing in "seemingly random" directions and figuring out what to do. One father said that he does not know the sign for FOREVER because of the two dimensional representation. He knows how the sign ends but cannot figure out how to start the sign.

Parents reported owning big ASL dictionaries, pocket dictionaries for quick reference while mobile, text books, and other reference books. All of these books are focused on vocabulary acquisition. One parent who reported not owning any books lamented the lack of real books in ASL to enable her to tell stories to her child.

5.3 DVDs

DVDs, while still focusing primarily on vocabulary, do have an advantage over books in their ability to present signs in a more understandable format. DVDs were employed by eight of the ten families. The Signing Time series was the most popular with five of the families reporting its use. Signing Time is targeted at helping children learn signs, but many of the parents felt they learned a lot from them as well. One mother said that the fact that the videos had sound with them helped because she could put the DVD on and then when the DVD said a word she was interested in learning she could pay attention. With DVDs without an auditory component it was easy to start playing one and then get distracted and realize an hour later they were supposed to be learning. Parents liked DVDs because they were able to see the whole sign and how it was performed, unlike with the books.

Parents sometimes became frustrated with the DVDs because they were mostly focused on vocabulary. The songs provided a little bit of flow, but for the most part the signs were not being presented together to create full phrases. One parent said there was too much extra in the DVDs and they just wished they could get to the vocabulary. Another disadvantage with the DVDs is that there was no assistance if you had difficulty learning a sign. You just had to watch the section of the DVD over and over again until you understood. DVDs are meant to be played and watched for a duration, they are not as useful for quick referencing.

One parent reported having an ASL story DVD and said he could follow the signs generally word for word, but when the video showed a classifier it would make him confused. Classifiers are signs that represent a general category of objects. Classifiers in ASL are similar to pronouns in English in that what they are referring to depends on their context of use. They can be used to represent an object, how it moves, or how it relates to other objects. This ambiguity is understandable for parents who have had a largely vocabulary-based ASL education.

5.4 Websites

Websites are becoming more popular with parents. Only one family reported not using websites to help them learn sign language. Most families use dedicated sites for ASL such as ASL Pro, lifeprint.com or SigningOnline. All of the websites provide a dictionary. Some are not browsable without acquiring a login which may cost money. Lifeprint.com provides different workbooks and practice tools. SigningOnline provides access to course material for a fee. Two families reported using generic search strategies for finding sign videos online. One family uses YouTube. Another family searches for signs using Yahoo! and the search terms "sign language for" to find vocabulary. The problem with the Yahoo! strategy is that sometimes she gets videos that are not what she is looking for. It can be a very slow process to weed out the inappropriate videos.

The advantages and disadvantages of the websites are similar to those of the DVDs. Parents like seeing the videos of the actual signs instead of the illustrations they find in books. But they also feel like they want to see more than just vocabulary. Support for more connected speech is limited. Websites have one advantage over DVDs in that they can immediately find the sign they are looking for. Some parents felt that it was difficult to spend a lot of time online.

5.5 Classes

Classes received the most divided responses of all of the tools discussed. Seven of the families have attended formal classes at some point in their attempts to learn ASL. Classes are typically offered through three different sources: higher education institutions, schools for the deaf, and churches. Two families attended classes at higher education institutions. One mother took ASL 1 at the University of Georgia while she was a student. Unfortunately ASL was not considered a language by the university so it did not fulfill her language requirement. Another family took ASL 1 at the local community college. This mother talked about the expense of taking the class when they were not interested in the course credit. Three families attended classes at their local school for the deaf. Reactions to these classes were largely positive. Parents talked about the fun games they played, the camaraderie they gained from learning with other parents in similar situations. One mother said she took ASL 1 and

2 multiple times each because every time she experienced learning from different deaf adults. One family attended classes at their church. They felt that there was too much information at once. They were more interested in learning the basics.

Another mother who did not specify the location of her classes said that she registered for ASL classes twice but dropped them. She felt that the class took too much time. The teacher spent most of the time talking and the mother felt that she just was not learning enough to justify the amount of time spent. Over all it appears that the classes at the school were the most accessible to the parents. More general classes were frustrating to parents who were most interested in immediate communication needs with their children.

5.6 Mobile

Five of the parents talked about using some form of language learning tool while outside of their homes or classroom. Two mothers had small dictionaries they would carry with them to look up unknown signs. Another mother reported that every time they were in the car, she would play one of the SigningTime DVDs. Two families reported using a mobile phone for looking up new signs. One mother used the SMARTSign website on her smart phone to look up vocabulary. Another mother would search for words on the ASL Pro website. No parents mentioned using any of the applications available for the Android or iOS operating systems. All of the parents were very interested in an all-in-one application for learning ASL such as SMARTSign.

5.7 Other Sources

Other people also provide support for parents attempting to learn sign language: their deaf children, church community, deaf adults, and other professionals. Three parents talked about acquaintances with adults. The advantage of being around deaf adults is that parents are able to gain experience with full conversations. As one mother said, talking with a deaf adult is much different than a conversation with their child. Two of the parents mentioned the importance of immersion in acquiring their language skills. Both of these mothers have become involved with their child's school in order to improve their language.

One mother who has struggled with learning ASL says that now the family is mostly learning from their child. They are now playing catch up with his language skills. The family is not always sure that the signs he is teaching them are correct.

Parents will frequently ask others around them if they are unsure of a word. Two mothers talk about asking deaf adults they know. One mother said she will talk to the speech pathologist at the school if she is unsure of a sign. The church community can also be helpful for parents learning sign language. One father said that three people from his church immediately started learning ASL when his son was identified. Two of them are training to become interpreters. He is now learning ASL from one of those individuals.

6. SYSTEM PROTOTYPE RESPONSE

During the interview, parents were presented with a prototype of the SMARTSign system. They were asked for reactions to the current components as well as suggestions for improvement. Possible expansions of the system were de-
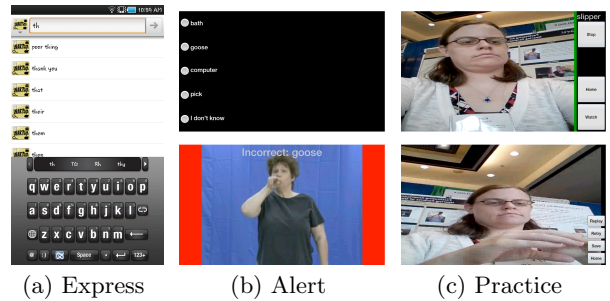

| (a) Express | (b) Alert | (c) Practice |

Figure 1: The three SMARTSign components

scribed and parents reflected on the impact or importance of the proposed additions to their own learning.

6.1 Current Components

The prototype of SMARTSign has three components focused on ASL vocabulary acquisition. These components are shown in Figure 1. The system is designed to function without the need for an active Internet connection as much as possible. The first component, *Express*, allows parents to search for and watch ASL videos by typing or saying the associated English word. The second component, *Alert*, gives parents the chance to learn new vocabulary through a quiz-based interface. The final component, *Practice*, takes advantage of a device's front-facing camera to provide parents with the ability to record themselves signing and compare with the source video.

Parents reacted positively to all three components and to the system as a whole. Parents saw the system not just as a tool for them to learn sign language, but something their whole family including siblings and extended family could use to learn. Two parents talked about how the interface was easy for them to use and understand. Two parents commented on the quality of the videos and how easy it was to see the motion in them. One mother said it was a good system for people without access to classes. Two parents expressed the sentiment that it would have been good for them when they started learning "and now too."

Although nothing negative was said about the *Express* component, the search functionality had the least amount of positive reactions (six of the ten families). This lack of reaction may be due to the fact that basic search functionality is something that parents are familiar with on the Internet and with books. One mother mentioned the desire to incorporate English phrases. She noted that sometimes only "one sign is needed to convey four English words" as in English idioms and some negated signs like DON'T-LIKE. The mother who used Yahoo! as her primary source for new sign information liked *Express* because it was a lot faster than using the Internet and because you could just type in a few letters to get the sign instead of the whole word.

The first participant made a number of useful suggestions that led to the positive reception of the *Alert* component by the rest of the participants. Her original impression was that *Alert* was useful for practicing vocabulary that had been learned elsewhere but did not have value in discovering new vocabulary. She suggested that when parents selected an incorrect English word they should be shown the video of the sign they selected. This modification to the original system was appreciated by two of the later participants. One of the

participants said that guessing the signs would help them learn. One of the parents appreciated the *Alert* component because reception of signs was the hardest thing for him to master.

Parents seemed the most impressed with the *Practice* component of SMARTSign. One mother said that in her class they were asked to record themselves signing so it was really useful to incorporate the recording mode to help people perfect what they are doing. Another parent was impressed with the opportunity to compare his signs with the example sign. He did stipulate that he tended towards being over-exacting. One mother thought that the *Practice* component might be useful for her child as well who liked to act out movies. A number of interesting applications were discussed. Because it is possible to record anything, other suggestions that arose from the interviews included recording stories for their children in sign and leaving messages. One parent asked if the system could evaluate the signs. Although a desirable addition, sign recognition is beyond the current capabilities of the system.

6.2 Proposed Additions

Four potential extensions were described to the parents to obtain feedback. These extensions are aimed at helping parents advance past simple vocabulary acquisition and help them to learn grammar and fluency.

The extension that seemed most exciting to parents involved teaching vocabulary and grammar with the goal of learning how to read a story to their children. All ten parents expressed interest in this capability. Two parents also suggested nursery rhymes. One mother talked about wanting to read Bible stories to her child but not having access to anything at the appropriate level. Another mother said that a dialogue with someone talking and asking you to answer a question which you could record might be useful as well. Parents were very interested in a system that would help them with their production skills and improve fluency.

Small grammar lessons were less interesting to the parents. One mother said that they are important, but she did not feel parents would use them because it might make it feel too much like school. Others said it would be great to know or be useful information.

Deaf Culture lessons received even more mixed reactions. Two parents stated explicitly that they were not interested in Deaf culture tips. One said it would be more useful for Deaf families. A third person was unsure of their usefulness. She was not interested in general Deaf culture, but she was interested in information about politeness when interacting with Deaf adults. She wondered whether it was rude to approach two signing adults you did not know and whether it was rude to watch people signing in the same way it would be rude to listen in on someone else's conversation.

Five parents were in favor of Deaf culture lessons. Three of them said that they did not know anything so any information was good. One parent said as long what was being shown was understandable, the Deaf culture lessons would be interesting. The comment about understandability led to a discussion of how to present information. Parents liked the idea of signed video lessons with subtitles, but wanted to see more than just a direct English translation in the subtitles. Parents liked the idea of subtitles with a literal transcription from the sign glosses so they could understand the grammar and vocabulary in the videos. One mother

provided suggestions for these lessons. She thought it would be interesting to give information about technology for the Deaf such as lights that flash when the doorbell rings. She emphasized that for these tips to be useful they needed to be really "parent friendly."

Parents were also asked about their interest in lessons aimed at helping them interact with their child. Half of the parents were interested in these lessons. Two parents said that they've known for many years about their child's hearing status and they still did not know anything. Another parent said that this would especially be useful for parents whose children had recently been diagnosed. One parent said that he was not interested in interaction lessons because early intervention had done a good job telling him the information he needed. Two parents suggested potential lessons. One mother talked about getting her child's attention, and another talked about reminding herself to sign.

7. PHONE OWNERSHIP

The next phase of the SMARTSign project will involve deploying software for parents to use in their daily life, therefore the last portion of the interview was intended to learn about current technology ownership. Four of the parents already owned smart phones. Five parents also paid for monthly data plans. All of the parents were willing to switch phones in order to be able to use the SMARTSign system.

Parents provided valuable information about what was important to them in a phone. Two mothers were really interested in the devices with front-facing cameras. One mother said that since her son is getting older, he will start going out alone to play with friends. If she wants to be able to communicate with him, sign language would be the most convenient. Phones also serve an added bonus as entertainment for their children while waiting. Doctors' offices don't usually activate captioning on their TV, so mothers can give their phones to their children to play games as entertainment. Parents are also excited about potential educational opportunities for their child that can be provided by smart phones. Parents noted the convenience of having access to SMARTSign on a mobile phone. As one mother said she would be able to use the software anywhere: "public, home, library, shopping." She said she would probably be on the phone all of the time.

8. DISCUSSION

In this paper we interviewed hearing parents from ten different families who had deaf children to better understand their needs when learning ASL. Based on what we learned about parental motivation, the main aim of our tool should be providing assistance to increase parent-child communication.

8.1 Creating an Ideal Learning Tool

Looking at the reactions to the various learning tools discussed in the interviews, we can gain an impression of the characteristics that make a successful or unsuccessful learning tool. Classes and Early Interventions share the traits of being regularly scheduled and interactive, but Early Interventions received more positive reactions. One reason for the positive comments is the fact that Early Interventions are more individualized than classes and very specific to the needs of an individual parent and child. A successful inter-

vention should focus on the specific needs of hearing parents and should not focus on general sign language learning. This aim is also reflected in comments parents made about classes not focusing on what was important for them to learn to satisfy their immediate needs. Learning material needs to be as relevant as possible to reducing the communication gap.

Another characteristic of learning tools that lead to more positive reactions is dynamic presentation of signs in the form of videos instead of static images. DVDs, websites, and mobile phones all shared this trait. Websites and mobile phone users had similar response patterns which is consistent with the fact that parents used their mobile phones to access the websites and not standalone applications. DVDs had more positive reactions, perhaps due to the fact that they are usually designed around themes and accessible to whole family. Books, which present static images, are not desirable.

A learning tool should not focus on vocabulary. The vocabulary focus was a commonly stated negative of many of the learning tools: DVDs, websites, and books. While the current version of SMARTSign does only focus on vocabulary, we hope that with the addition of some of our proposed components we can help parents improve not only their vocabulary ability but also their fluency and understanding of the ASL language as a whole.

8.2 Improving SMARTSign

Parents were generally satisfied with all three of the existing SMARTSign components, so the discussion here will focus mainly on the four suggested additions. The parents we interviewed were unanimously in favor of a tool that focused on providing grammar and vocabulary associated with reading a story to their children. This desire aligns with a number of characteristics noted in the previous section. One of the biggest advantages is the focus on more than just vocabulary. Story telling would also be, by definition, interactive because it would require the parents to produce the signs in order to tell the story to their child. It also fulfills an immediate need that parents said they had. Many parents talked about their desire to read stories to their children, and the lack of opportunities to do so even before this addition was mentioned.

The remaining three additions: lessons on grammar, Deaf culture, and interaction strategies received equally mixed reactions. The varying responses towards these additions creates an opportunity for parents to customize their experience. Parents will be able to adjust their preferences for receiving these lessons so they can get the information that is most relevant to them.

9. CONCLUSION

Hearing parents' desire to learn ASL is based not on mastery of the language for its own sake, but to fulfill a specific need of improving communication with their child. The parents we interviewed expressed strong motivation to learn and use ASL more, but they still only experience limited success. The focus of SMARTSign will not be on convincing parents of the necessity to learn ASL, but in providing parents with the appropriate tools to help them gain more experience with a difficult language.

Initial reactions to the prototype system aimed at vocabulary acquisition were positive. The next step in this research will be to evaluate a method for presenting vocabulary lessons to parents on their mobile phones through an in-the-wild study. This evaluation will help inform a second study which will incorporate both vocabulary and grammar lessons. These lessons will be based on aiding parents in learning to read stories in ASL to their children, which was found to be the most compelling motivator for increasing fluency and grammar ability. Through this research we hope to increase hearing parents' ASL language skills and communication ability with their child. With hearing parents better able to communicate with their child in an accessible language, we hope to reduce the linguistic gap between deaf children of hearing parents and other children their age.

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