

# Designing for the deaf: The potential of technology supported social skills training interventions for d/Deaf and Hard of Hearing students

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## ABSTRACT

Technology-supported social communication and pragmatics training for d/Deaf and Hard of Hearing (DHH) students is an important avenue of research. In this paper we describe some key challenges that DHH students face, the human centered design process used to uncover insights with stakeholders, and the potential of technology-based interventions to support development of social pragmatic skills. We further describe user experience considerations for DHH students, identified through discussions with subject matter experts, from a review of the literature, and identified through ongoing interviews with educators and parents, in addition to focus groups with teachers of the deaf.

## 1. INTRODUCTION

Deaf and Hard of Hearing (DHH) students face several challenges in the acquisition and development of effective communication and social skills. Over the past 30 years, the development of hearing device technology such as cochlear implants and early detection of deafness have contributed to significant progress in enabling DHH students to access sound. However accessing spoken communication is one step in developing effective interpersonal communication. Further steps include understanding the nuances of conversations and social interactions, which require considerable learning about self and others, and is a well-documented challenge for DHH students (Peterson & Siegal, 2000). The design, development and use of technology-based interventions to support social skill development in DHH students in an area of practice that has received limited research attention.

Increasingly sophisticated hearing technology has contributed to a majority of DHH students learning oral language and attending mainstream education settings. A key to success in these settings is having effective social-pragmatic skills (Luckner & Muir, 2001). Delays in language development are relatively common for DHH students compared to their hearing peers, particularly when the deaf or hard of hearing student is born to hearing parents. These delays in language acquisition have a substantial impact on theory of mind development and executive functioning; areas associated with the ability to attribute mental states to others, consider multiple perspectives and communicate with others effectively (Peterson & Siegal, 2000). These are also areas that students on the Autism spectrum experience significant challenges with.

Practical teaching of social pragmatic and communication skills is often needed, and strategies such as role-play are occasionally utilised by subject matter experts (SMEs) such as resource teachers of the deaf (Marschark & Spencer, 2003). However, due to finite time and resources available to each deaf student, technological support that students can access in a flexible way could provide valuable learning opportunities and reinforcement mechanisms. Such interventions could create a safe place for students in which to learn effective communication strategies, building their resilience in a way that also prepares them for meaningful engagement and more active involvement in social interactions within and outside the classroom. The potential of serious games to offer valuable learning opportunities in an intrinsically motivating way is discussed in detail by several authors (e.g. McGonigal, 2011; Walz et al., 2015) who conceptualise them as engaging mediums that can employ highly motivating strategies and mechanics such as choice, autonomy, rewards and feedback for effort and persistence, flexible identities and clear goals.

In this paper, we first present our findings from a literature search and formative consultations with subject matter experts. We then describe areas of social communication identified as important for consideration in the intervention, and discuss preliminary findings arising from primary data collected in interviews, and the implications for user experience design of the intervention. Finally, we suggest future evaluation through an iterative human-centered design process with resource teachers, teachers of the deaf and DHH students.

## 2. BACKGROUND

We conducted a structured literature search to provide an overview of the current state of the art in technology-supported social skill interventions for DHH children and young people. Due to a lack of results, we extended the search strategy to include interventions for students on the autism spectrum where the nature of the intervention was identified as being potentially relevant to DHH students. For example interventions dealing with Theory of Mind, executive function and effective social communication. Including this secondary user group of ASD students was theorised to be relevant due to studies, which have demonstrated that DHH students can have delays in these areas akin to autistic children (Peterson & Siegal, 2000).

The final search strategy was then specific to include in the search a game or AR/VR application(s) that had the primary goal of providing a social skills intervention for deaf or hard of hearing students under 21 years of age or people with an autism spectrum disorder. The search was carried out on the following databases: COMPENDEX (which indexes IEEE and ACM), EMBASE, MEDLINE, ICDVRAT archive, PsycINFO, Scopus and Web of Science. A detailed outline of the search strategy including the specified inclusion and exclusion criteria is available in Prospero using CRD42018092708 as the ID (Platt-Young & Hoermann, 2018).

Searching the seven databases and initial screening to remove duplicates and irrelevant papers resulted in 92 possible papers that met the inclusion and exclusion criteria specified in the search strategy (ibid.). The majority of the studies were found to have an ASD focus; very few are primarily focused on interventions for deaf or hard of hearing students. This suggests a paucity in the research into how technology-based interventions can best be designed for DHH students.

Necessitated by the relatively sparse information provided in the literature regarding guidelines for the design of technological social-skill and pragmatics interventions for DHH students, we consulted with subject matter experts including teachers of the deaf in mainstream school settings. SME feedback has identified several areas for exploration, which will be further researched in interviews and focus groups with resource teachers of the deaf, speech language therapists and parents. These areas are: conversational repair strategies, contextual barriers, self-advocacy, self-efficacy, and stigma. In addition peripheral areas such as: theory of mind, executive function, scaffolding and role-modelling, were also identified.

**Stigma** was identified as a reason for why low functioning students may be struggling in social pragmatic areas, due to a perceived lack of family acceptance of their hearing status and hearing accommodation usage. Family acceptance of the hearing status of a deaf child appears to be of critical importance in counteracting stigma. This is also reflected in the previous work of researchers who have investigated factors for DHH student success and resilience (Ahlert & Greeff, 2012; Luckner & Muir, 2001), and has been further confirmed in recent interviews and focus groups. An insidious form of stigma can also be low expectations of the DHH student to succeed in education settings.

**Contextual barriers** describe environmental factors impacting DHH students' ability to communicate effectively and participate in social interaction. Examples identified by resource teachers are visual stimulus and noisy outdoor environments which present significant challenges and can lead to frustrations. Pre-teaching clear communication strategies for dealing with interactions that occur outside the classroom was identified as important by teachers of the deaf, and one Resource Teacher of the Deaf (RTD) described a strategy where they would record the DHH student playing outside and discuss with the student behaviours that had occurred, in an effort to provide feedback relevant to the communication context and associated barriers.

**Conversational repair strategies** describe strategies that students take to correct a misunderstanding, provide someone with clarification, or to request clarification, for example by asking another to repeat or rephrase a question. One RTD referred to question skill training being of high importance in his work with DHH students. A lack of questioning and repair skills can significantly impact interactions with peers and DHH students are often specifically delayed in these areas (Yoshinaga-Itano, 2015).

**Self Advocacy** describes acting and speaking on one's behalf, and in discussions with educators regarding possible goals DHH students may have, a lack of goals or demonstrating self advocacy skills was attributed to language deficiencies. Self advocacy appears significantly linked to students' language and communicative skills, which has been demonstrated in research investigating self advocacy differences between hard of hearing (HH) students and hearing peers (Michael & Zidan, 2018).

**Self-Efficacy** is one's belief in oneself to accomplish a task and to take actions towards goals (Bandura, 1982). In primary data collected to date, educators have drawn attention to expectations of DHH students being too high or too low as being a possible factor for how attainable goals are for students, describing incremental learning as an optimal strategy for students. This would presumably be well accomplished through a game-based learning model that breaks larger goals down into manageable

Cawthon et al. describe in their review of research into the social skill development of deaf youth two main theoretical frameworks when considering social skills research: *socioemotional perspectives* that focus on behaviours and interactions, and *humanistic ones* that focus on personal qualities such as self-concept (Cawthon,

Fink, Schoffstall, & Wendel, 2018). It is probable that near equal focus on both is needed in the intervention, as opportunities to practice communication skills and behaviours could reinforce a student's self-concept and belief in future success in social interactions. Both frameworks are important when considering a game-based learning approach, as game mechanics focus on behaviours and games additionally offer the opportunity to role-play and take on alternate identities.

The acceptance and feasibility of interactive video games in addressing pragmatics areas has confirmed by teachers and parents to be worthwhile. Respondents have their DHH students/children find games to be highly engaging, especially if they include rewarding feedback to provide the motivation needed to persevere if success was not forthcoming. Such mechanics could support self-efficacy development by providing an achievable goal. Captions and language modality considerations are also a recommendation for further research and implementation efforts.

### 3. FRAMEWORK

Human-centered and goal-directed design processes (Cooper, 2014) are employed in this project in addition to a Grounded Theory framework to define themes for the development of personas. Interviews are in progress with teachers of the deaf, resource teachers of the deaf, mainstream teachers and parents of DHH students. For reasons of privacy and anonymity, interviews with parents were deemed a more adequate method when compared with other methods. The plan is for interviews to continue until saturation can be achieved (Corbin & Strauss, 2008).

A variety of hearing accommodations and needs, different language and cultural backgrounds, varying reading ages, and different affinities with technology and abilities means that developing a first version of the game needs to be well thought out. For this reason, a continual and incremental development process is used in partnership with teachers of the deaf, some of whom are DHH themselves, offering valued input at various stages of the process.

**Interviews and Focus Groups:** Semi-structured interviews were identified as a primary method (Silverman, 2009) to gather SME input regarding social skills, social communication, user experience and technology considerations. These interviews focus on topics identified in SME consultations and include device use, gameplay and interface preferences, scenarios and general user experience considerations. Emergent themes are identified by coding interview transcripts, which further defines questions for future enquiry until saturation is achieved (Corbin & Strauss, 2008). The strategy implemented in the focus groups is the pursuit of a combination of reflective and ideation questions with teachers to elicit accurate personas and develop scenarios that are appropriate for student learning. Focus groups with resource teachers of the deaf, teachers of the deaf, mainstream teachers and speech language therapists are ongoing, and two focus groups, one with two teachers of the deaf in a satellite class within a mainstream school (both hearing), and one involving three RTDs (one hearing and two deaf) have been conducted. Initial findings highlight the importance of role play, explicit teaching of repair strategies, d/Deaf role models, interactivity and language skill development for pragmatic interventions.

**Personas and Scenarios:** Personas are employed to translate abstract information into a tangible research tool for the design effort and are particularly useful in an area such as this, where there may not be an established paradigm and in an effort to limit design assumptions and bias (Cooper, 2014; Pruitt & Grudin, 2003). Scenarios are two-fold in the project, describing interaction scenarios between end users of the game and the interface, and scenes that users can role-play that are illustrative of communication situations that provide valuable learning experiences. An example of a possible scenario is that of sports activity, as this was identified in interviews with parents and teachers as a common example of where communication breakdowns regularly occur. Personas and scenarios will be validated with resource teachers, as these individuals are highly knowledgeable about the target users and several are DHH themselves so they have a unique perspective that will assist in with the refinement.

**User Experience Workshop:** Low-fidelity concepts will be evaluated with DHH students between ages 6-12 in a user experience workshop, as this is the hypothesised age group most likely to benefit from the intervention given the expectation for students to be independent learners during secondary school. The idea is to view DHH students as co-design partners by their inclusion as testers (Guha, Druin, & Fails, 2008) using the user experience workshop as an opportunity to collect their recommendations and perspectives.

### 4. CONCLUSIONS

In this paper we have provided background information regarding pertinent areas of effective social communication and outlined the potential of technology-supported pragmatics training for DHH students. Through consultations with subject matter experts including teachers and parents we have identified key domains where technology could play a role in fostering social skills development. Focus groups and continued interviews with teachers of the deaf are suggested as a next step to prepare personas and scenarios in order to establish a design framework that further informs the development of effective technological interventions.

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