Expanding Designing for One to Invite Others Through Reverse Inclusion

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ABSTRACT

This research aims to explore how tangible technology created through co-design can be designed in a way that invites social interaction for people with intellectual disability. We conducted co-design sessions with one participant to create a sensory musical blanket. As the trials were run in a collective environment, their peers were drawn to the developing design. The design method and unique interactions are key contributions of this research.

CCS CONCEPTS

• **Human-centered computing** → **Empirical studies in interaction design**; **Participatory design**; **Accessibility**.

KEYWORDS

Intellectual Disability, Co-design, Social Devices, Tangible Technology, Reverse Inclusion

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1 INTRODUCTION

Many people with intellectual disability crave to make social connections with their peers, family and community [6]. Methods of initiating and forming social connections familiar to neurotypical people are difficult for many people with intellectual disability [2]. It can be further isolating for those who are minimally-verbal and do not have means to reliably connect with others through mainstream means of communication. Loneliness has a profound impact on people with intellectual disability's mental health and well being, and it has been linked to low self-worth and increased anxiety [10].

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Designing technology for one participant ensures engagement with assistive technology [9], but not necessarily inclusive technology.

This paper contributes towards new approaches to co-design that considers social invitation. We contribute insights based on a case study of co-designing a tangible technology with one participant, which initially embraced alternative methods of connecting with others through tangible technology [4, 9, 15], which have been shown to ease social friction.

1.1 Tangible User Interfaces

Tangible user interfaces (TUI) tie the physical world to the virtual world, revealing new opportunities for creative alternatives to interact with computer systems [12]. Hornecker and Buur put forward a tangible interaction framework that can also inform design of tangibles for use by people with intellectual disability. It describes four entangled themes of tangible interaction: tangible manipulation; spatial interaction; embodied facilitation; and expressive representation [8]. Creating objects that can be tangibly manipulated can appeal to unique sensory needs for people with intellectual disability and create diverse access points to interact with the design. Spatial interaction creates meaning through bodily movement or configuring your space which often times is not in the control of people with intellectual disability. Expressive representation is how a user expresses themselves through the outputs of the tangible technologies in ways that are meaningful to them. Designing with this framework, and prioritising idiosyncratic interests and strengths, creates valuable design requirements. Having a customised TUI for people with intellectual disability provides an opportunity for them to communicate on their own terms and feel safe to "speak" in [16].

1.2 Co-designing for One

Typically, the principal goal of technology design is to maximise the size of the user group by attempting to create universal designs, those that can be used by most or all people. Hornof discusses how the concept of universal design is not useful when designing for people with profound disabilities who have distinct needs [9]. He suggests they would benefit from highly customised systems through designing for one. A notable example of the design for one is the creation of the Assistive Context Aware Toolkit (ACAT) for Stephen Hawking [7]. This device was designed for one particular

individual in mind but is now open source for many people with disabilities to use and customise.

2 SENSORY MUSICAL BLANKET: A CASE STUDY

This study reflects on the co-design of a tangible device that provided entertainment and opportunities for social engagement to one non-verbal adult participant with intellectual disability. The participant will be referred to from hereon in as John and attends an adult learning and lifestyle centre during the day, where he is surrounded by others who also have intellectual disability. The case study in Section 2 is presented from the perspective of the first author, who co-designed closely with John for almost a year, learning the unique mannerisms he uses to express himself.

2.1 Design Process

John was selected for this research due to his minimal participation in group activities and the limited availability of engaging activities for him outside of using his iPad. When I first met John, he would curl up on a couch with his head in his hands while everyone else would partake in group exercises or he would be rapidly navigating the YouTube application to play his favourite song, despite being unable to read. John had no interest in the social activities that the group partook in. Therefore, the goal of the research was to co-design with John to create a tangible device that was engaging to him which could be used to create opportunities for social engagement.

The first phase of the design process was exploratory in nature to gauge John's needs, strengths and interests. An iterative co-design process was used where John was considered a co-designer. John's input to the design was included by observing his interactions with people, sensory stimuli and prototypes [3]. This involved creating simple prototypes and presenting him with commercially available toys to determine what his preferences and needs were based on activities that John was already enjoying. Note that commercially available toys were used because they provided access to a variety of tangible features. Principles of self expression by design, flexible interactions and playfulness were applied to the design [16].

Firstly, John was invited to pass a ball back and forth with me. John was able to do this with ease, which confirmed his ability to take turns and exercise joint attention skills. This particular ball lit up with blue LED lights when it was shaken and John was able to learn this was the case by watching me do it, this demonstrated imitation skills. Turn taking, joint attention, and imitation are all pre-verbal social skills and are key to socialising with others. John participated in co-design by interacting with concrete prototypes and materials, expressing interest, and through using pre-verbal social skills [5].

John's interest in auditory and tactile stimuli was then explored. John loves music and there was one particular song that John would always play on YouTube, so I started there. By playing this song, I was able to determine John's baseline reaction to songs he loved. He would become overly excited, giggle, make noises, smile and be unable to sit still. When I played other songs to John, I compared his reaction to the baseline to gauge his enjoyment. This process allowed me to create a list of songs I knew John enjoyed to be used in future prototypes. Next a few prototypes were made with different tactile stimuli such as a talking pillow and an electronic stuffed elephant. It was found that he enjoyed the tactile stimulation of different fabrics including sequins and soft blankets.

Finally, a working sensory musical blanket exploratory prototype was created that had custom pressure-sensitive pads as seen in Appendix A. The top layer of the pads were made from different materials that John had a tactile interest in. When a pad was pressed (a form of tangible manipulation), it played a corresponding short snippet of a song through a speaker (a form of expressive representation) next to the blanket. All pads were disabled until the end of the song.

2.2 Trials of the Working Prototype

Focusing on John's specific interest in music, the blanket was loaded with songs which I knew John enjoyed. He required minimal instruction to understand how to use the blanket and happily played by himself; smiling and dancing to the music. There were a few times when the prototype stopped working but John kept pressing the buttons, then he would leave and come back to see if the blanket was working again. This shows how keen John was to interact with the blanket. Two of John's peers then became curious about the blanket and joined in. One of them jumped on the mat using the blanket as a dance floor while the other sat on the side watching and listening to the music. This was the first time I had witnessed someone else join John voluntarily in an activity and engage in parallel spatial interaction with him. This prompted me to encourage further social interactions by adding songs that others may enjoy too.

The second iteration of the blanket was loaded with new Christmas songs. On his own at first, John remembered the blanket and how to use it even though two months had passed since the first trial. He explored the new songs that were available to him and demonstrated that Jingle Bells was his favourite, pressing the button for that song more often than others. He played for a total of 45 minutes with two short 10 minute breaks. A support worker helped him remove his shoes, so that he could feel the tactile buttons with his feet. He particularly enjoyed the feathered pads which he stroked with his feet.

The blanket was moved into a big common area to open access to a large group of John's peers. There were 9 people engaged with the blanket, 4 of whom were using the blanket directly and others standing around it. Some liked to stay on the same button and listen to the same song. Others preferred to dance alongside the blanket or stand next to others that were operating the blanket. Some people were demonstrating to others how to use the blanket. Additionally, games were silently and organically created by the participants. The participants began to realise quickly that the person who pressed the button first would get their favourite song snippet played in its entirety. They began to compete to see who could press their button first and would cheer when their song was selected. This is a key example of embodied facilitation through tangible interactions.

3 DISCUSSION

Often, initiatives to be more inclusive of people with intellectual disability start with mainstream spaces or technology being adjusted

to suit people with intellectual disability. For example, sensory sensitive events at places such as cinemas are created to be more inclusive by having soft lighting, reducing the volume of audio, and not restricting people to their seat for the duration of the activity [1]. However, when inclusion initiatives are designed in this way, there is an assumption that inclusion of a person with intellectual disability is achieved by fitting them into mainstream environments [13]. The design process undertaken for this research was reversed, focusing on creating technology for the person with intellectual disability first and adjusting it to invite others to join in that space or activity afterwards.

To describe the design process in this research we expand on the term *reverse inclusion*. This is traditionally defined as the inclusion of children without intellectual disabilities in environments for children with intellectual disabilities [11]. However, in this research, reverse inclusion is generalised to include anyone (including those with or without intellectual disability) being invited by the person with intellectual disability to connect socially through a prototype created for their specific needs. It makes the user the centre of the design and works outwards to include wider and wider social circles. Firstly, the blanket prototype was tested with John, then his peers were considered. This method of design is more inclusive because it makes others conform to expectations derived from John's lived experience rather than John having to constantly conform to everyone else's social expectations [13].

John's involvement in the design of the blanket enhanced his inclusion amongst his peers. Every time we came to test any prototype, everyone at the centre knew we were making something special for John. They began to associate the fun prototypes with John. This point accomplishes two things: through the co-design process, John participated in designing interactions with the blanket, and he was a perceived gate keeper of the blanket. People were intrigued by the blanket and as they wanted to interact with it, they were drawn to interacting with John on his own terms. Being recognised and known throughout the centre via interesting prototypes, John builds social capital that can be used to kindle social connections [14].

The benefit of co-designed reverse inclusion is that the prototype was created for John, with John, and prioritises John first. To include others, John's favourite music was replaced with popular songs. This slight change to the output appealed to a wider social circle. By testing this change with John as well, we can gauge if he is still interested in the interactions that the blanket offers. This change had minimal impact on John's engagement with the prototype and successfully included more people without compromising how John wanted to interact. Note that it could not be determined whether being socially included was something that John wanted. When other people joined him on the blanket, he did not reject them but also did not directly seek to interact with them. A long-term study could reveal more information about John's intentions but the process can lead to insights about how social inclusion can be initiated.

The blanket was designed to be deliberately playful and provide expressive representation through music. Additionally, it was designed to be ambiguous enough to foster flexible interactions which was useful in progressing the design and gave opportunity to participants to generate new interaction scenarios. Flexibility in play is key because everyone was still able to interact with the blanket in a way they preferred and were able to. When more participants also played with the blanket, it became like a dance floor and they organically created their own games. This type of appropriation nurtures creativity and social connections. When the blanket was tested, the interactions between the blanket and the participants were flexible, pushing both John's and his peers' ideas of how the device should be used. Ultimately, this created opportunities for social interaction and negotiation.

This research has contributed insights about how the co-design of tangible technologies for one can be extended to invite others to join in social interaction. This places the burden on others to meet people with intellectual disability in their own domain.

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A SENSORY MUSICAL BLANKET

Figure 1: Assembled Sensory Musical Blanket