Figure 1: The Strummi in guitar form (top) and tabletop form (bottom)

The Strummi: design and construction

The Strummi was originally conceived and developed for a previous study concerned with the effects of global form and interaction modality [8, 10].

Two enclosures for the Strummi were built: a tabletop enclosure and a guitar-body enclosure. The guitar form was designed by Ailish Underwood (instagram.com/ailishmu_)

The Strummi features six short, dampened lengths of bass guitar string, held to tension over individual bridge pieces with integrated piezo pickups. A continuous acoustic signal from each piezo is passed to the input of six virtual string models, running on a Bela microprocessor [14]. Strumming the strings results in a relatively realistic sounding guitar chord. The user can change chords using the six push buttons.

Accessible Instruments in the Wild: Engaging with a Community of Learning-Disabled Musicians

Jacob Harrison
Augmented Instruments Lab, Centre for Digital Music, Queen Mary University of London
London, UK
j.harrison@qmul.ac.uk

Alan Chamberlain
Mixed Reality Laboratory, The University of Nottingham
Nottingham, UK
Alan.Chamberlain@nottingham.ac.uk

Andrew P. McPherson
Augmented Instruments Lab, Centre for Digital Music, Queen Mary University of London
London, UK
a.mcpherson@qmul.ac.uk

ABSTRACT

Disabled people face many barriers to access in all areas of life, including creative expression. With music making, a lack of accessible instruments can be a major barrier, as well as environmental factors. The *Strummi* is an accessible instrument based on the guitar, designed as a technology probe to explore the technical and cultural role of guitar-like design and interaction modality. We have

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Figure 2: John Kelly performing with the Kellycaster *image credit: http://cdm.link/*

The Kellycaster:
Designed by John Kelly, Charles Matthews and Gawain Hewitt, with the support of Drake Music, the Kellycaster and its design philosophy echoes our approach to the social role of musical instruments. John Kelly is a musician with physical impairments, whose performance practice includes folk and rock songs, often with a protest or political theme. While the Kellycaster's design takes into account Kelly's functional limitations as a result of his physical disability, it is a high-end instrument clearly designed to fulfil the role of a guitar: the strumming interaction is preserved, as well as the overall form of an electric guitar shape. A video poster on the Kellycaster is presented on the Cripping the Muse conference website: crippingthemuse.com/presentation-recordings/

[1]heartnsoul.co.uk

been collaborating with Heart n Soul, an arts charity that works with young people and adults with learning disabilities. In this paper, we share findings from the first year of this collaboration, and reflect on the implications for doing HCI research with learning-disabled communities.

We took a longitudinal, situated approach with an intentionally simple technology inspired by *in the wild* and *technology probe* methodologies, allowing for interest in the Strummi to grow organically.

KEYWORDS

learning disability; neurodiversity; music; technology probes; accessible instruments, field studies

INTRODUCTION AND RELATED WORK

The last decade has seen growing interest in musical instruments designed for use by disabled musicians [5, 7, 12, 13]. In this paper, we discuss an emerging research project involving the *Strummi* (figure 1), an accessible digital instrument based on the guitar, and communities of neurodiverse and learning disabled people who are engaged in the co-design and use of the digital instrument.

The Strummi was originally designed as a research tool, a kind of *technology probe* [9] developed to explore the ways that various design aspects affect users' interpretations of 'guitar-likeness' [8]. The motivation for doing so was the idea that musical instruments play a *social* role as well as a *technical* one: they possess their own cultural cachet and bring with them meanings and associations that are separable from their technical feature set. We argue that harnessing the cultural cachet of existing instruments in our new designs could be one approach to designing accessible instruments that can address physical as well as social access barriers .

As research into digital musical instrument (DMI) design has progressed, there has been growing interest in instruments designed specifically for disabled people. A number of surveys provide overviews of accessible instruments, generally focusing on those designed for physically disabled people [5, 7, 12, 13]. An accessible instrument with a similar design to the Strummi is the Kellycaster (figure 2).

We have collaborated with Heart n Soul[1], an arts charity that works with young people and adults with learning disabilities. For the past year, the author has introduced the Strummi to a variety of music-making events. This makes up the preliminary stages of a research project focusing on the design of new DMIs for and with neurodiverse and learning disabled people.

Learning Disability, Neurodiversity and HCI

Armagno argues that the way we talk about disability in HCI discourse has *'practical, ethical and political consequences'* [1]. In this paper, we are concerned with designing musical instruments for and with people who might alternately be labeled *neurodiverse*[2], *learning disabled* or having *special educational needs (SEN)*. Dalton proposes adopting the neurodiversity movement in HCI work, and discusses ways that HCI research can accommodate and support neurodiverse people. They carried

out a meta-review of papers with references to dyslexia and autism from ACM conferences between 1999-2012, and found that out of 55 references, no paper mentioned the positive aspects of these conditions [4].

Armagno discusses disability in relation to design as a *'complex phenomenon that is more than a biological matter. Disability is an issue that reflects profound social asymmetries, unbalanced power relations, and engenders many conflicting interests'* [1]. If we understand disability as purely a deficit or impairment in function, we may be biased to more medicalized solutions in our designs.

HCI in the field

Two related methodologies in field research in HCI are *cultural/technology probes* [6, 9] and *in the wild* studies [3, 15]. We borrow tools and techniques from both methodologies, which feature the deployment of designed objects into an environment in which they might be envisaged being used. The instruments used in this study can be considered technology probes[3]. The 'probe' methodology allows us to uncover and provoke unexpected findings. Gaver's *cultural probe* concept addresses a problem in doing research through design, where studies concerned with technology have a tendency to focus on a technological solution to a problem [6].

Both methodologies explicitly avoid constructed or artificial laboratory settings for evaluating new technologies, instead performing ethnographic studies in situ. Kjeldskov and Skov suggest that this provides a *'high level of ecological validity [but] a low level of control'*[11]. Performing studies in the wild allows for long term relationships between people and technology that might not occur in controlled lab settings. Ethnography is not always a feature of research in the wild, but allows salient activities and features to be discovered [3].

THE STRUMMI IN THE WILD

We present observations of the Strummi in use from the first author's time as a volunteer and workshop facilitator with Heart n Soul (*See **An Overview of Heart n Soul** in the sidebar*).

Do Your Own Thing

The young people who access Do Your Own Thing (DYOT) sessions generally do not require one-to-one support, meaning they have sufficient communication and mobility skills to take part in most activities without constant assistance.

The Strummi was introduced to DYOT attendees as an additional instrument to use alongside the guitars, bass, drums and synths in the music room. During the first few sessions, responses ranged from interest and curiosity to ambivalence and even outright disdain. Some of the young people who

[2]Benton et al. define 'neurodiversity' as *"the subset of neurological conditions, which typically result in a child being labeled as having special educational needs (SEN). These conditions include (among others) attention deficit hyperactivity disorder (ADHD), autism spectrum disorders (ASD), dyslexia, anxiety disorders and intellectual disabilities'* [2]

An Overview of Heart n Soul Heart n Soul describe themselves as a *'creative arts charity [who] believe in the power and talent of people with learning disabilities'*. As well as long term professional artist support, three of their key 'taking part' activities include *Do Your Own Thing (DYOT)* (ages 16-25), *Allsorts* (ages 18), and *SoundLab* (all ages). These events run collaboratively with learning disabled and non-disabled people. DYOT and Allsorts host workshops and activities including arts and crafts, radio presenting, music recording and jamming with rock band instruments. SoundLab produces a series of events aimed at sharing music technologists' work with people with learning disabilities.

Heart n Soul events are a platform for promoting wellbeing through developing artistic skills and socialising. They are explicitly free of stigma or medicalising language. This affects the way that design research is done within this community. Each encounter is treated as a unique experience, almost always without prior knowledge of that person's condition.

[3]Hutchinson et al. define technology probes as *'Simple, flexible, adaptable technologies with three interdisciplinary goals: the social science goal of understanding the needs and desires of users in a real-world setting, the engineering goal of field-testing the technology, and the design goal of inspiring users and researchers to think about new technologies'* [9]

regularly took part in the music sessions are highly accomplished musicians, and spent no more than a few minutes exploring the Strummi before returning to the guitar or keyboard.

The first young person to become engaged with the Strummi was Simon (*pseudonym*). Simon had previously shown interest in song-writing and singing his own lyrics but had not played an instrument at a DYOT session before. Simon is male and in his mid-late teens. He is communicative but softly spoken and has no physical impairments. He was offered the guitar-body Strummi to try out and became engaged with it for the rest of the session, asking which buttons related to which chord and immediately grasping the concept of chord selection (at a later session, Simon revealed that he had previously taken guitar lessons). Most striking was Simon's immediate take up of 'guitar choreography', using the guitar strap to play standing up and striking familiar front-man poses. Simon wrote a song called *'Space Magic'* to perform with the Strummi at an upcoming concert. At the end of the session, DYOT staff commented that they had not expected Simon to take the role of frontman.

James (*pseudonym*) has spent some time with the Strummi in two recent DYOT sessions. James is a young male in his late teens. James does not typically attend the music room, but usually uses a microphone or hand percussion when he joins in. James uses a walking frame and has impaired motor function in his hands. He was originally drawn to the guitar-body Strummi but found it difficult to play while standing up due to its weight and his walking frame. He tried the tabletop Strummi while sitting down and played it for a short time before leaving the room. At the next session, James returned to the guitar-body Strummi and played it sitting down, with his left hand over the top of the neck which was more comfortable for him than holding it like a guitar. The Strummi here presented an explicit physical access improvement over the guitar. James made enthusiastic comments at the end of the session saying '*I grew up around music*' and commenting that his family would be happy to see him play the guitar.

Simon and James are not representative of the entire group at DYOT sessions. In general, there were more people uninterested in the Strummi than those who were. Many people appeared confused by the instrument, asking '*what does it do?*', '*why does it look like that?*' and '*is it a guitar?*'.

Allsorts and SoundLab

SoundLab sessions are open to people with learning disabilities of all ages, and so attract a wider audience. SoundLab is a much less structured and noisier environment, with many instrument demonstrations and interactive displays occurring in the same space.

The strongest reaction to the Strummi was from Vanessa (*pseudonym*). Vanessa is an adult in her mid-late 30s, and has learning disabilities, as well as a physical impairment to her right hand. She first encountered the guitar-body Strummi in guitar form and tabletop form at a SoundLab event. Vanessa used her left hand to strum and her impaired right hand to select the chords, leaving the Strummi resting on the table rather than holding it. She faced difficulty accurately and consistently pressing

down the buttons. This meant that she was often strumming on 'muted' strings, but continued strumming nonetheless. Vanessa immediately picked up the strumming technique without guidance, and reacted positively to the sound of the Strummi after being shown how the chord buttons worked.

Following this first encounter, Vanessa requested Heart n Soul staff for further opportunities to play the Strummi, resulting in a visit to an Allsorts event. Vanessa spent several more hours with Strummi here and at a subsequent SoundLab event, by which time she was well acquainted with the technique, showing confidence in teaching other SoundLab visitors how to play it. Over the course of these three encounters, Vanessa showed improved ability to select and hold chords using the buttons. A common theme for Vanessa was videoing her performances, either with her own mobile phone in 'selfie-mode', or asking others to film for her. She stated that she wanted to show the videos to her family as they could see her using her impaired hand. She made several references to the fact that she had to keep using her hand in order to improve its strength. Vanessa's improvised lyrics about her immediate environment with positive reflections on her experience such as: '*I'm at Heart n Soul, today has been a great day and I've played the guitar*'.

DISCUSSION

We are interested in learning-disabled and neurodiverse people as a community for whom access barriers to music-making exist, and for whom design could play a part in lowering and removing those barriers. These barriers are subtle, however. It is not simply a case of measuring and assessing individuals' functional limitations and designing a system to alleviate them. Often the barrier to access is a social, rather than a technical one, and the solution might simply be a change in environment. In our case, we were interested in the effects of the cultural associations that come with an instrument.

We introduced the Strummi to this community as a kind of 'minimum viable product': a device which is accessible in a general sense, being both physically and cognitively easier to play than a guitar, but which is not designed with an individual's specific access needs in mind. Our longitudinal and situated approach has allowed for interest in the Strummi to grow organically. This has made space for people's individual tastes and preferences to emerge. Conducting this research in situ has allowed to see how the Strummi can be appropriated, and what this might say about each person's motivation to engage with the instrument.

Heart n Soul are an organisation that explicitly celebrate the diversity and individual creativity of neurodiverse and learning disabled people. By situating our research with the pre-existing Heart n Soul community, we have found a way of doing HCI research which is more aligned with the social model of disability and the neurodiversity movement. We argue that musical tools should support individual creative expression, and an approach to research which allows for self-selection among participants, rather than trying to engage as many people as possible or attempting to average across a whole community, can reflect this.

These reflections represent the groundwork for an upcoming user study with Heart n Soul participants who have shown an interest in performing with and developing the Strummi. This will involve more formal data collection and evaluation methods, including audio and video recording for thematic analysis, as well as interviews and surveys with the participants and staff.

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