

Instruments, Ecosystems and Access: ADMIs in the Wild

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ABSTRACT

The potential for new technologies to address the access needs of disabled people has long been recognised in the field of HCI and in wider culture. Music-making is a particular activity in which disabled people come up against barriers to full participation - the result of a combination of inaccessible musical equipment and sociocultural factors such as negative attitudes towards disability or a lack of supportive environments in which to make and perform music. Within the context of Digital Musical Instrument (DMI) research, there is growing interest in the development of Accessible DMIs (or ADMIs). The technical challenges to be overcome in designing new ADMIs which meet the access requirements of disabled musicians are many and varied. Alongside this, addressing the socio-cultural or ecosystemic factors at play in inclusive music-making practice can complement and enhance our understanding of the role of ADMIs. In this article, we present an ethnographic account of a group of learning-disabled musicians and their use of *Strummi*, a bespoke guitar-based ADMI, alongside conventional instruments. Through reflecting on this exercise, we consider what defines the ‘A’ in ADMI: the technical attributes of the instrument itself, and the eco-systemic and social factors surrounding its use.

KEYWORDS

Accessibility; ADMIs; HCI; Musical Instruments

1. Introduction

Designing technologies which address the access needs of disabled people has been an area of concern for Human-Computer Interaction (HCI) researchers for many years (Mack et al., 2021). In the related field of Accessible Digital Musical Instrument (ADMI) design and research, practitioners have similarly focused on designs and methodologies which address the access needs of disabled musicians in order to improve access to music-making (Frid, 2019). Adapting existing instruments or designing new ones which meet specific access requirements can be understood to be a question of thoughtful engineering and problem-solving. While it is true that for any challenge involving developing custom circuitry, source code or hardware likely requires a sufficient level of engineering expertise, there are many additional components to consider in the process of lowering barriers to music-making. Recent discourse in Digital Musical Instrument (DMI) research has moved towards an ‘ecosystemic’ view of musical instruments, placing an emphasis on the social and cultural elements at play in the design, performance and evaluation of DMIs (Rodger, Stapleton, van Walstijn, Ortiz, & Pardue, 2020). Alongside this, HCI’s turn towards ‘in the wild’ and ethnographic methods has encouraged a wider view of the role of new technologies and the ways in which we interact with them (Rogers, 2011), beyond the controlled environments of lab-based usability studies.

In this article, we provide an ethnographic account of our engagement with a group

of learning-disabled musicians and their use of *Strummi*, an accessible guitar-like DMI which we introduced to the group's regular music-making activities, observing their use of the instrument over a year. This culminated in the *Strummi Sessions*, two music-making sessions set up with a focus on observing and recording the interactions between people, Strummi, the other instruments, and their environment. Through reflecting on the outcomes of the *Strummi Sessions*, we will explore the role of ecosystemic factors in the design and evaluation of ADMIs: how different stakeholders and attitudes shape the degree to which new technologies can lower barriers to music-making - and how conceptions of disability and disability identity may play a part.

2. Background

Although most closely aligned with DMI research communities, ADMI research can be informed by, and has implications for, a number of related fields. In this section, we discuss related work from areas such as disability arts, disability studies, DMI and HCI research, and music therapy.

2.1. Disability Arts, Learning Disability and Neurodiversity in Music

On the topic of discourse around autism and music-making, Bakan (2014) writes:

'There are a great many stakeholders, a plethora of views and agendas; most if not all warrant our serious consideration and critical engagement. Ultimately, however the preponderance of pathologizing and negating discourse about autism is so great that, if nothing else, there is a need to redress it and put it in better balance with the more ability-centred, affirming, and agentive perspectives of autistic self-advocacy, neurodiversity, and disability studies.'

Bakan's quote above highlights a crucial point on the topic of music and disability, not just limited to those on the autistic spectrum: much work has been done in various fields, from academic research, political activism, and policy-making, to better understand and articulate the lived experience of disability, and how disability relates to other factors such as technology and art, however the majority of this work has been shaped by the 'pathologizing and negating' discourse around disability. More affirmative, and largely disability-led, perspectives come from the related areas of Disability Studies and Disability Arts¹.

Barnes and Mercer (2001) state that '[t]he politicization of disabled people has also highlighted the significance of an alternative disability culture, which celebrates a positive disabled identity and consciousness'. Barnes and Mercer chart the representation of disability in culture, and the development of a disability culture in and of itself. Within popular culture, disability is often presented as one of a number of negative identities: something to be feared or pitied, set apart from the 'normalcy' of the non-disabled majority. Set against this, 'The emergence of a disability arts movement marks a significant stage in the transition to a positive portrayal of disabled people that builds on the social model of disability' (Barnes & Mercer, 2001).

Barnes and Mercer (2001) discuss two different approaches to disability arts: 'the

¹The National Disability Arts Collection and Archive (NDACA: <https://the-ndaca.org/>) provides a comprehensive archive and overview of the UK disability arts movement, charting its origins in the 1970s to the present day. Disability Arts Online (<https://disabilityarts.online/>) is an online platform where current and contemporary disabled artists' work is promoted and discussed.

disability arts movement ... [first] argues for disabled people to have access to the mainstream of artistic consumption and production. Second, it includes impaired-focused art that explores the experience of living with impairment'. Swain and French (2000) discuss this second approach to disability arts as representative of an 'affirmative model' of disability, which 'directly challenges presumptions of personal tragedy and the determination of identity through the value-laden presumptions of non-disabled people'. This model takes into account the political and social obstacles that disabled people face, but also uplifts and affirms the positive aspects of a disabled identity, for example the lyrics 'proud, angry and strong' in Johnny Crescendo's protest song 'Pride'.

Firth and Cane (2018) discuss disability representation in the operatic music performance industry, and use the terms 'integration' and 'affirmation' to consider where to locate the stance of their *Access All Arias* program of inclusive practice. They describe integration as being an almost seamless integration into mainstream arts and culture, without necessarily making explicit reference to disability; while the affirmation approach seeks to uplift and embrace the performer's disability identity. Finding themselves torn between attempting to maintain a connection with the mainstream operatic industry, and wanting to affirm disabled cultural identity, Firth and Cane argue that the two need not be mutually exclusive, and explore ways that their practice, shaped by disability studies and disability arts, can achieve a balance between these two concepts. It is important to note that there is no value judgment necessarily placed upon either approach: it is equally as important for disabled people to take part in mainstream culture as it is to contribute to and nurture a positive and affirmative disability culture.

This is by no means an exhaustive review of literature regarding disability identity in music and the arts, however these discussions invite us, as researchers, engineers and designers, to consider what is meant by 'accessibility' in music-making. It is tempting to consider 'accessibility' in purely functional terms: designing technical solutions in response to observable access requirements. This functional approach may make sense with technologies designed to assist disabled people with everyday tasks, such as screen-reading software for visually-impaired computer users. However musical instruments are more than tools required to complete an everyday function, and so the goalposts for what make a 'successful' accessible musical instrument are more likely to move and change depending on the artistic intentions and personal values of the musician. Considering, for example, where an instrument might be situated between 'affirmation' and 'integration' of disability identity, could inform the resulting instrument's design: the sound design, mode of interaction, materiality and overall aesthetic of an instrument could be leveraged not only to address access needs, but to open up opportunities for taking part in existing musical traditions, as well as leading to new ways of playing.

2.2. DMIs, ADMIs and Accessibility

Digital Musical Instrument (DMI) research is a discipline which is naturally linked to HCI and computer science research, but which is also informed by the pioneering experimental musicians of the 20th century such as Wendy Carlos, Daphne Oram and John Cage (Bin, 2018, Ch 2.1). As a result, discourse in the field of DMI research can take a wide range of forms: technical papers exploring novel applications of signal processing and embedded computing (McPherson & Zappi, 2015) and user studies

focussing on the effects of action-to-sound mapping or latency (Barbosa, Malloch, Wanderley, & Huot, 2015), as well as musical performances and installations such as those seen at the NIME conferences². In short, DMI research encompasses both the ‘problem-solving’ approach of an engineering mindset alongside goals of pushing the boundaries of musical expression.

The challenge of designing ADMIs might at first appeal more strongly to this problem-solving approach: many existing instruments are inaccessible for disabled musicians, and there is potential for technological solutions to meet those access needs. However, recent discourse in DMI research has shifted towards the sociocultural and ecosystemic implications of and for digital musical instruments.

Rodger et al. (2020) challenge the concepts of ‘instrument-as-device’ and ‘musician-as-user’, concepts which are prevalent in DMI research, due in part to the field’s origin as a subset of HCI research, and the borrowing of quantitative evaluation methodologies which placed a focus on usability studies. Rodger et al. instead discuss ‘what makes a good musical instrument’, arguing for a reframing of an instrument from ‘device’ to a ‘constellation of processes (affordances) which may be shared with other instruments, and which may change over time’. This reframing allows us to consider an instrument as something that ‘may mean different things to different musicians’, leading us to also consider the impact of the contextual factors at play (the performance ecosystem, following Waters 2007) which may determine how an instrument is used and perceived. As far as evaluation is concerned, the authors propose considering the ‘specificities’ of the musician-instrument system relative to its environmental context - as opposed to aiming for a generalisable methodology of evaluation based on a prototypical user.

Interest in topics of accessibility within DMI research appears to have grown steadily, exemplified by ‘Accessibility of Musical Expression’ being the theme of the New Interfaces for Musical Expression (NIME) 2020 conference. Frid (2019) provides an overview of ADMI research, highlighting the heterogeneity of approaches to ADMI design, research and evaluation, reflecting the wide range of disabilities, personal experiences, and music-making scenarios that are addressed by ADMIs. Topics of discussion in ADMI research include technical overviews of new ADMI designs such as the EyeHarp by Vamvakousis and Ramirez (2011), and design frameworks for particular scenarios such as in Special Educational Needs (SEN) settings (Ward, Woodbury, & Davis, 2017). Skuse and Knotts (2020) reflect on a co-design process aimed at developing an online ensemble for disabled musicians performing music over a network from their homes. Through considering the politics and power structures at play within the co-design process, Skuse and Knotts put forward recommendations for future music technology designers which can better address the multitude of access barriers that disabled people face.

In previous work, we developed a prototype adaptation for a bass guitar with a view to developing a system for one-handed playing (Harrison, 2020, Ch. 4; Harrison & McPherson, 2017). In our evaluation of the state of the art of accessible instrument design, we proposed classifying accessible instruments as either ‘therapeutic devices’ or ‘performance-focused instruments’. This was an effort to differentiate between what we saw as musical devices designed to support ‘non-musical’ goals such as supporting health and wellbeing exercises or education, and instruments designed for music-performance for its own sake. Taking an ecosystemic view of ADMIs involves viewing an instrument’s qualities as the result of a relationship between affordances, environ-

²<https://www.nime.org/music/>

ment and the musician. This approach dissolves the distinction between ‘therapeutic devices’ and ‘performance-focused instruments’, as these classifications rely only on properties which are fixed and inherent to the instrument itself. In this article, we will discuss how the same instrument can be perceived as both a vehicle for expressing ideas and values through music performance, and a support for wellbeing and therapeutic activities, even within the same music-making activity and by the same musician.

2.3. HCI in the Wild: Ethnography, Reflexivity and Design Probes

Rogers (2011) introduces *in the wild* research to denote HCI studies carried out in the environments where the technology is intended to be used. Kjeldskov and Skov (2014) suggest that this provides a ‘high level of ecological validity [but] a low level of control’. 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 (Crabtree et al., 2013).

Our motivation to adopt ethnography-based methodologies comes from two related goals. First, we are interested in the social and cultural role of musical instruments, in a general sense. Ethnography-based approaches, which originated from and were refined by the social sciences, have been shown in previous HCI studies to be highly effective at collating and communicating findings related to the sociocultural role of design artefacts (Dourish, 2007). Second, wider discourse around disability (for example Disability Studies and Disability Arts) has influenced our approach to researching disability-adjacent issues. The Social Model of Disability (Shakespeare, 2006) allows us to frame disability as a product of social and cultural attitudes as opposed to an embodied, functional deficit, so it follows that our approach to researching disability and music incorporates methodologies which take into account the social structures and cultural reference points which occur in music-making. Any attempts to generalise or formalise the technical access requirements of this community runs the risk of supporting a deficit-oriented, Medical Model approach. This is not to suggest that the technical challenges in addressing a person’s impairments and access needs should be ignored, but simply that they would not represent the intended findings of this research.

In *Implications for Design*, Dourish (2006) states that

‘Ethnography provides insight into the organization of social settings, but its goal is not simply to save the reader a trip; rather, it provides models for thinking about those settings and the work that goes on there ... [it] has a critical role to play in interactive system design, but this may be as much in shaping research ... strategy as in uncovering the constraints or opportunities faced in a particular design exercise.’

Dourish’s justification for the use of ethnography ties in with our goals of adopting the theory and language of the Social Model of disability. Our goals in this study are not to define a set of design requirements for accessible musical instrument design, through attempting to average across a population of learning-disabled musicians, or an overly medicalised view of learning disability with relation to music-making.

Ethnography in this case presents us with a ‘methodological win-win’: regardless of the politicised nature of the community we are studying, ethnography has proven to be a powerful tool in HCI research where there is an interest in the sociocultural context of technology use. In the particular case of disability and music, it also allows us to do HCI research which can more closely align with the Social Model, taking into

account the political and moral imperative in framing disability as a social issue, and avoiding overtly medicalised approaches.

Much of the methodological groundwork for ethnography in HCI comes from the field of Computer-Supported Cooperative Work (CSCW), which as a discipline is concerned with ways in which technology is used within a community or society. The methodological approaches used in this discipline are also appropriate here, as we are concerned with the role of a new music technology within the communal activity of a group music-making session.

Rode (2011) discusses the importance of understanding the ‘real world appropriation of technology and how it is situated within social conventions’ as a vital part of design, and the need for research approaches which strive to understand the ‘messy bit’ (i.e. Ackerman’s (2000) *socio-technical gap*, defined as ‘the divide between what we know we must support socially and what we can support technically’). In order to do this, Rode advocates for *reflexivity* in digital anthropology, as a contrast to more positivist approaches which are prevalent in HCI.

Rode uses Burawoy’s (2009) definition of reflexivity based on four criteria: 1.) embracing intervention as a data gathering opportunity, 2.) understanding how data gathering impacts the quality of the data itself, 3.) attempting to find structural patterns in what has been observed, and 4.) in doing so extending theory. Rode suggests that *confessional* ethnography is more suited to reflexive approaches than *realist* ethnography. Realist approaches tend to avoid the first person and aim to present a neutral account of what has been observed - working on a ‘good faith assumption’ that ‘whatever the fieldworker saw and heard ... is more-or-less what any similarly well-placed and well-trained participant-observer would see and hear’ (Van Maanen, 2011). This approach attempts to ‘convey a certainty over a correct interpretation of behaviour thereby guaranteeing reproducibility’.

Confessional ethnography, by contrast, does not assume authority on a subject or attempt to convey certainty, instead attempting to demystify the fieldwork process through accounts of specific relationships between the fieldworker and the informants, and ‘directly addressing the inherent subjectivity of ethnographic practice’.

Rode also discusses ways of framing ethnographic practice: as either *formative*, *summative* or *iterative*. *Formative* ethnographies aim to understand current practice surrounding technologies with the aim of improving existing technologies or creating new ones. *Summative* ethnographies evaluate the technology at the end of the design process, attempting to understand the socio-technical gap for its own sake. The third form, *iterative* ethnography, is coined by Rode, and addresses the issues raised by formative and summative approaches, drawing on participatory design tradition by allowing informants to participate in the design process in an indirect fashion: ‘while perhaps somewhat contrary to the spirit of traditional participatory design, ... it does still give [the users] a voice’.

With regards to the previously defined framings of ethnographic practice, this work comes in most neatly under the ‘summative’ category, in the sense that we are attempting to understand the ‘socio-technical gap’ at the end of the instrument’s development phase. However, the findings from this ethnography are intended to help shape and refine future ADMI research, although not necessarily with the Strummi instruments.

Ginsburg and Rapp (2013) discuss doing ethnography with learning-disabled communities, and the issues which arise from having stakes in this research as both anthropologists and parents of learning-disabled young people. They coin the term *entangled ethnography*, to describe the nature of being both an insider and outsider within the community under study, for example in the way that they ‘often found [themselves]

productively caught up in the projects [they] were studying, at times taking an active role in enabling the very activities [they] were examining'. They draw on the changing attitudes towards ethnographic work over the past few decades, stating that 'these shifts, both epistemological and methodological, continue to generate lively debates about the insider/outsider identity of the anthropologist, and the balancing act of participant/observation as a method, underscoring the significance of reflexivity in the field'. The first author's relationship with the community in this research is less 'entangled' than the parent-child relationship that Ginsburg and Rapp discuss, however their account of becoming 'caught up' in the work they were studying rings true here also: doing research with this community involved much more than acting as a passive bystander, not least because getting involved was so enjoyable.

3. Strummi

Prior to the activities described in this article, we had developed a guitar-like DMI which was informally referred to as 'the strummy instrument', and eventually settled on the name 'Strummi' to denote the instrument in its various forms. In this article, we are discussing two generations of Strummi: the original designs developed for a prior study, and a new set of instruments designed to address usability issues with the first generation that were discovered during the early stages of the research activities described here.

The Strummi instruments can best be described as 'guitar-like DMIs', in that they are intended to emulate various aspects of guitar playing. Although two early versions of the instrument incorporated touch-sensors, the instruments relevant to this article all featured guitar strings. The core technology behind the Strummi is the use of the Karplus-Strong plucked string synthesis algorithm (Jaffe & Smith, 1983). This is a low-cost synthesis technique that roughly models the way that the higher frequencies in a plucked string decay faster than the lower frequencies. When excited with a burst of white noise, the algorithm produces a somewhat crude 'plucked string' timbre, which can be improved with different acoustic filters and excitation waveforms. The way that the Strummi works is to continuously excite the algorithm in real-time, using the acoustic signal from a piezo pick-up. By terminating a short length of damped guitar string over the piezo, the performer can pluck or otherwise excite the string, producing a decay similar to that of an undamped, full length string.

The results are a strikingly realistic reproduction of an acoustic string, as the way that the string is plucked will have an audible effect on the resulting waveform - as opposed to the predictable and synthetic-sound results from a sample-based string synthesis approach. As the frequency of the resonating karplus-strong 'string' can be rapidly updated within the algorithm, a wide range of pitches can be achieved, without having to alter the tension or length of the physical string, which is only used to provide the initial excitation. The way the Strummi operates is analogous to an autoharp: pressing a button down retunes all six strings to different chord voicings, so that the user can 'strum' a chord sequence, or finger-pick individual notes from that chord voicing.

For the initial design of Strummi, we looked towards *technology probe* (Hutchinson et al., 2003) and *cultural probe* (Gaver, Dunne, & Pacenti, 1999) methodologies. The original designs were intended to support two related studies, focusing on the roles of global form vs. interaction technique (Harrison, Jack, Morreale, & Mcpherson, 2018), and the relationship between musical expertise and control intimacy (Jack,



Figure 1. All seven versions of Strummi to date

Figure 1 Alt text: On a blank background, seven instruments made out of black acrylic and wood, in different shapes and with different configurations of buttons and short lengths of guitar string or black rectangular touch sensor.

Figure 1 Long description: On a blank background, seven instruments made out of black acrylic and wood. Four instruments are shaped like different guitars, and three of the instruments are five sided shapes. The four instruments on the left all have buttons, and the three on the right have eight buttons. Some of the instruments have six short lengths of guitar string, and two have black rectangular touch sensors where the strings would be. One instrument is a Les Paul style guitar that has been modified to have buttons in the neck and strings in the body.

Harrison, Morreale, & Mcpherson, 2018). This involved designing four variations of the instrument, with four combinations of string-based or touch-based note triggering, and ‘tabletop’ or ‘guitar-like’ form factors.

Strummi could also be considered a *research product*, a term coined by Odom et al. (2016). We have discussed the implications of the research product approach in DMI design and how it relates to the study described here in a previous paper (Jack, Harrison, & McPherson, 2020). In short, a *research product* is an inquiry-driven research artefact intended to be used and lived with in real-world settings. One of the defining characteristics of the research product approach is the attention given to the ‘finish’ of the device, for example the materials used, the manufacturing process, and its robustness within an everyday use context. This is contrasted with a prototyping approach which leaves elements of the device unfinished, instead focusing explicitly on a particular aspect of the technology, asking the user to imagine what the ‘finished’ device might look like. The research product approach appealed to us as we were aiming to understand how novel instruments like the Strummi would be received by users in a real-world setting alongside familiar and existing instruments such as guitars and drum kits. We hoped that applying the research product philosophy to the building of Strummi, in terms of its *fit* and *finish*, would result in more authentic responses to the instrument.

3.1. Second Generation of Strummi

The first generation of instruments generated interest at early Heart n Soul³ events, and proved to be a valuable tool for observing the ways that people approached the instrument in its various forms. However we noticed a number of usability issues with the first generation. The guitar-body instrument was heavy and uncomfortable to wear with a guitar strap while standing, and was hard to play while using a wheelchair or walking frame. All instruments featured mechanical switches which were prone to failure due to the way they had been built into the enclosure.

Prior to the Strummi Sessions, we designed and built a second generation of Strummi instruments based on the original designs but incorporating improvements which addressed the issues of the first generation. As well as addressing the usability issues, we also wanted to further explore how guitar-like visual cues would influence people's responses to the instruments. The second generation of Strummi comprises of three instruments. All instruments featured eight silicon pads to replace the failure-prone mechanical switches used in the previous versions. We used the Sparkfun 2x2 button pads⁴ for this purpose as they are designed specifically for musical applications (e.g. DIY MIDI controllers), and are similar in action and materials to modern MIDI controllers. We also replaced the outputs on each instrument with a 6.35 mm guitar jack (wired in mono), so that they could be easily interchanged with electric guitars and basses using the same amplifiers. We designed a custom printed circuit board (PCB) to act as a breakout for the six piezo channels and eight buttons. The second generation Strummi are all based on the Bela Mini⁵ which reduced the required size for the instrument enclosures.

The first instrument (herein referred to as 'S1') was largely based on the original tabletop instrument described earlier (see Figure 2).

The second instrument ('S2') was designed to replace the 'guitar body' Strummi. We used a similar manufacturing process as S1, using layers of stacked 5 mm birch plywood, to maintain a consistency in the size, weight and materials used. The shape was based on a guitar body in the style of a Gibson Les Paul, but with a smaller size and shorter 'neck'. Figure 3 shows S2 during the build process and completed.

In order to go one step further towards 'guitar-likeness', we built a third Strummi instrument ('S3') using an actual Les Paul copy guitar as the enclosure, with the push-buttons embedded in the neck. This involved removing material from the neck and body of the instrument and designing a custom acrylic pick guard to house the electronics. The truss rod was removed from the neck to allow for wiring from the buttons to the Bela mini enclosed in the guitar body. We also designed a new PCB for the silicon push buttons as the original PCBs from Sparkfun were slightly wider than the neck.

4. Strummi in the Wild

The reflections in this article are centred around our engagement with Heart n Soul, a disability arts organisation based in South-East London, who work primarily with learning-disabled and neurodiverse people, many of whom also have physical and sensory impairments. The first author's relationship with the learning-disabled young

³www.heartnsoul.co.uk/

⁴www.sparkfun.com/products/7836

⁵www.shop.bela.io/products/bela-mini-starter-kit

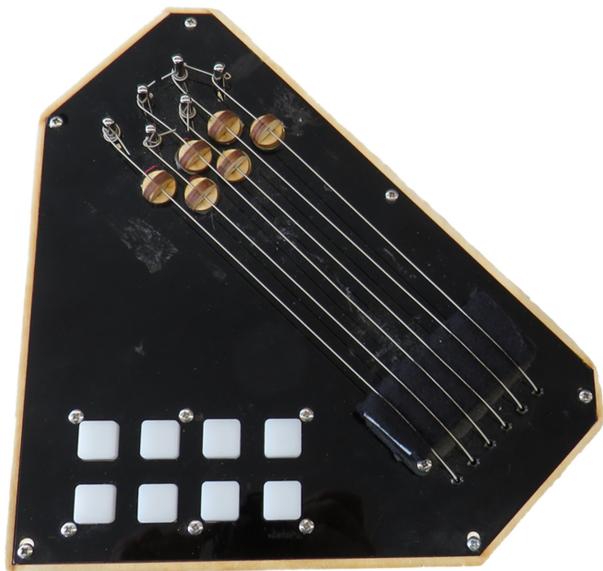


Figure 2. S1: tabletop Strummi based on first generation design

Figure 2 Alt text: The top view of a five-sided instrument made from black acrylic and wood. It has eight white buttons, with six short lengths of guitar string at a 45 degree angle to the buttons.

Figure 2 Long description: The top view of an instrument, made with a piece of black acrylic with a wooden trim. It is a five-sided shape with a 90 degree angle in the bottom left corner and one long side opposite at a 45 degree angle. In the bottom left, there are six white square shaped buttons. Parallel to the long side, there are six evenly spaced lengths of guitar string. Each guitar string is connected to a wooden disc and a black rectangular piece of foam at the other.



Figure 3. L: build process of S2 instrument using layers of glued plywood. R: finished S2 instrument

Figure 3 Alt text: The image on the right shows the finished version of an instrument which resembles a smaller Les Paul-style guitar, but with a shorter neck embedded with eight white buttons in two rows of four. The image on the left shows the same instrument but with no buttons or strings attached, and some pieces of plywood that have been cut out in the shape of a Les Paul being clamped together while glue is drying. Figure 3 Long description: The left picture shows a top view of the outline of a Les Paul guitar-shaped body made out of plywood, held together with clamps. A piece of acrylic is next to it, which has been cut out to resemble the top of a Les Paul guitar but with a shorter neck. The neck has eight holes cut out. The right picture shows the finished instrument, which resembles a smaller Les Paul guitar with short lengths of string and eight white buttons. A wooden pick guard has a USB port and a jack cable input.



Figure 4. L: Les Paul body with material removed for electronics. R: completed S3 instrument. Bottom: custom PCB made to fit neck width

Figure 4 Alt text: Three images, showing a black Les Paul style guitar which has been modified with the strings removed and the fingerboard cut short. Eight white buttons with a custom circuitboard have been embedded in the neck, and six short lengths of guitar string have been embedded in the body where the pickups would go. The image shows how the guitar body has been cut to house the electronics, and the custom circuit board that was made to fit the width of the neck.

Figure 4 Long description: Three images. The first image shows the top view of a Les Paul style guitar with a large rectangular hole cut out where the pickups would normally be placed. A USB port can be seen where one of the volume ports would be, and a wooden bridge in place of the metal bridge. A ribbon cable can be seen running through the middle of the guitar. The second image shows the same instrument, but a custom pick guard has been attached to the top covering the hole. Embedded in the pickguard are six short lengths of guitar string running through six wooden discs. At the top of the fretboard, the fingerboard has been removed up to the fourth fret, and replaced with a wooden panel with eight white buttons embedded. The final image shows a circuit board which is the same width as the fretboard. The circuit board has two rows of four metal contacts where the buttons are placed, and four holes for mounting screws.

people and adults, practitioners and artists who make up this community developed organically - initially with no research goals in mind - through an outreach event with colleagues from the Augmented Instruments Lab research group. This relationship culminated in two dedicated music-making sessions with members of Heart n Soul which we called *the Strummi Sessions*. In this section, we adopt the ‘thick description’ approach as described by Rode (2011): attempting to provide a full account of the context of where the research is taking place through descriptions of social and organisational structures, for example. In keeping with this approach, we provide an account of Heart n Soul events, including the first author’s initial engagements with this group which took place prior to the formal research activity⁶. A more detailed account of this work can be found in (Harrison, 2020, Ch.6).

4.1. 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’⁷. They provide long-term professional artist support to learning-disabled musicians and artists, as well as hosting regular creative arts ‘taking part’ sessions. Three of their key initiatives are ‘Do Your Own Thing’ (DYOT): monthly events for young people aged 10–25; ‘Allsorts’: regular ‘seasons’ of weekly events for adults; and ‘SoundLab’, which produces a variety of events aimed at bringing music technology companies, digital music researchers and sound artists in contact with people with learning disabilities. Each of these initiatives is run collaboratively with learning-disabled and non-disabled people.

DYOT and Allsorts sessions take place at the Albany arts centre in Deptford, South-East London, where the Heart n Soul offices are located. DYOT occurs one Saturday every month, from 12–4pm, with 20–50 young people in attendance. They take over several spaces throughout the Albany, including the main theatre space, where DJ decks are set up alongside hands-on arts-and-crafts and digital arts activities. There is also a radio show which runs throughout the duration of DYOT, and is broadcast via Heart n Soul’s website. A staple feature of DYOT is the ‘music room’, where a drumkit, microphones, electric guitar and bass, a synthesiser, electric keyboard, and occasionally other electronic instruments such as drum pads, vocal effects or Kaoss pads are set up. The music room is an opportunity to play loudly with others, and there is no requirement for prior knowledge of the instruments to take part. Other regular music activities include recording in a dedicated studio, and one-to-one songwriting sessions. Each activity is supported by a session leader, typically someone with expertise in the practice they are supporting (e.g. digital arts, community music, DJing), and volunteers, who take part in the activity alongside the participants and provide individual support when required. Many young people attend DYOT without a parent or carer present, although some young people require one-to-one support, especially where communication or behavioural issues are particularly acute. Young people at DYOT are free to move between activities as much as they want, although they are

⁶Pseudonyms will be used throughout this paper when referring to Heart n Soul participants and staff. As has been discussed by Heaton (2022), the use of pseudonyms in reporting qualitative data can be problematic, due to potential cultural connotations of names which may not align with the cultural identity of the people they are assigned to. We chose to use pseudonyms over other forms of anonymisation (for example codes such as P1, P2, P3 etc.) for the sake of readability and to avoid ‘de-humanising’ the people under discussion. The names were chosen at random, and names that were shared by other Heart n Soul members and staff were not used. They were chosen to reflect the gender identity of the participant, but are not intended to reflect the age, nationality or ethnicity of any participant.

⁷<https://www.heartsoul.co.uk/about>

encouraged to remain focused and engaged by facilitators. The atmosphere at DYOT is one of fun, experimentation, and creativity, with facilitators open to embracing the sometimes chaotic and noisy environment - people are rarely told to 'be quiet' at these events. Where there are desired outcomes of an activity, for instance making a music video, designing a poster or writing a song, the volunteers and facilitators respond in an open and encouraging way to participants' ideas, and do not tend to try and discourage particular ideas or shape the outcome to their own artistic values. At the end of every DYOT, there is a 'sharing' session, where everyone moves into the main hall and the outcomes from each activity are discussed and shown to the wider group. This typically ends in a performance from the music room, or playback of the day's recordings from the studio.

Allsorts events are similar to DYOT except made for learning-disabled adults (18+). They are scheduled as regular 'seasons' of six weekly events, occurring on Thursdays from 10am-5pm. The days are divided into four hour-long sessions with breaks in between. There is often an arts and crafts activity, while other activities include spoken-word poetry workshops, dance and choreography workshops, and digital arts. Participants can also take part in the Heart n Soul radio show which broadcasts throughout the day. A 'sharing' activity also closes each Allsorts event.

The Strummi was first introduced to Heart n Soul members at a SoundLab event as part of a showcase of technologies developed using the Bela embedded computer. SoundLab sessions are open to people with learning disabilities of all ages, and so attract a wider audience than Do Your Own Thing events. SoundLab is a less structured and more noisy environment than Allsorts, with many instrument demonstrations and interactive displays occurring in the same space. Visitors are welcome to come and go as they please, trying out different instruments and moving between demonstrations. Unlike at DYOT, there are no facilitators present to encourage a particular outcome from the session, as the focus is more on exploration of a range of music technologies.

Heart n Soul attendees do not represent a common series of traits associated with a 'learning disability' label, but represent a broad spectrum of conditions as a result of developmental disorders and learning disabilities. Their events are a platform for promoting wellbeing through developing artistic skills and socialising, and as such are not designed to alleviate, cure or counter symptoms of any specific condition. As such 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 with no prior knowledge of that person's condition.

Access requirements for music-making within this group are often subtle, if present at all. Many attendees are able to use musical instruments and controllers to varying degrees, although a significant number have physical access requirements alongside less visible access needs stemming from cognitive or sensory impairments.

Music technology plays an important role in much of Heart n Soul's activities. In the music room, synths and standalone devices such as vocal effects processors and the Korg Kaossilator are often featured. The recording studio is very popular and participants are encouraged to try out a range of hardware and software. Much of Heart n Soul's regularly performing artists use software such as Ableton Live with the Push controller, electric drum-pads, and synths.

4.2. First Author's Engagement with Heart n Soul

This section describes the first author (JH)'s initial observations and reflections from the first year of taking part at Heart n Soul as both a researcher and volunteer. These descriptions are intended as snapshots of salient moments to provide some context to the final study and do not provide a comprehensive account of this period.

Our engagement with Heart n Soul emerged following an invitation to demonstrate some of the Augmented Instruments Lab's instrument prototypes and demo instruments at a SoundLab event. This resulted in a conversation around how our work could be aligned in a research partnership. JH began working with Heart n Soul as a volunteer during DYOT and SoundLab events, in order to get to know the way that Heart n Soul worked, and continue a conversation on what a research collaboration might entail. This resulted in the Strummi being introduced to the DYOT music room sessions as well as Allsorts and SoundLab events.

Note that initially, we were working with the first generation of Strummi instruments, in both 'guitar' and 'tabletop' form. Both versions of the instruments were used, with people free to choose whichever one they preferred to play. Some people found that the larger guitar-shaped instrument was difficult to play with wheelchairs or walking frames, while others preferred to play standing up using the guitar strap. The tabletop instrument proved to be more accessible to some people due its smaller size and lighter weight. The second generation of instruments were developed shortly before the 'Strummi Sessions' events, described in Section 4.3.

4.2.1. Do Your Own Thing

JH's primary engagement with Heart n Soul has been as a volunteer at Do Your Own Thing. JH attended roughly 12 sessions between March 2018 and March 2019, usually in the music room, as well as supporting a small number of recording and one-to-one songwriting sessions.

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 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 Alex (pseudonym). Alex had previously shown interest in song-writing and singing his own lyrics but had not played an instrument in the music room at a DYOT session before. Alex 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, Alex revealed that he had previously taken guitar lessons). Most striking was Alex's immediate take up of 'guitar-like' choreography, using the guitar strap to play standing up and striking familiar 'front-man' poses. He was offered the use of guitar effects pedals and appeared to enjoy using large amounts of phaser and delay, which disguised the sound of the Strummi to a large extent.

At the time of this session, preparations were being made for the upcoming Squidz Club, a nightclub event for young people with learning disabilities, and the impromptu band which Alex was playing in was asked if they wanted to write and perform a song.

In preparation for the performance, Alex chose the name ‘Something Strange, Something Different’ for his band, and wrote a song called ‘Space Magic’ to perform, while singing and playing the Strummi. At the end of the session, DYOT staff commented that they had not expected Alex to take the role of frontman based on his behaviour at previous sessions. Author JH also attended Squidz Club event and supported Alex to perform with the Strummi at this event.

James (pseudonym) spent two sessions with the Strummi in February and March 2019. Like Alex, James is a young male in his late teens. James does not usually attend the music room, but usually uses a microphone or hand percussion when he joins in. James has physical disabilities: he uses a walking frame and has motor impairments in both 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. Unlike with Alex, 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.

Alex 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 questions such as ‘What does it do?’, ‘Why does it look like that?’ and ‘Is it a guitar?’. Most of the enthusiasm for the instrument came from the session leaders, who showed a lot of interest in the instrument and how it was made. This is possibly a result of a difference in priorities between the session leaders and participants. It is in the session leaders’ interest to explore new and potentially more accessible ways of making music, in order to ensure the sessions are as inclusive as possible. As well as this, there is widespread use of music technology at DYOT, such as synthesisers, recording equipment and DJ decks, perhaps leading to an open-minded and generally positive disposition towards trialling new music technologies. For the young people who attend the music room, there is a broader range of values and priorities: while some were clearly interested in trying out new and unfamiliar instruments, others appeared to express an interest in the instrument they were most familiar with. The session leaders also acted as ambassadors for the Strummi, asking the young people to try it out during the sessions. Those who showed interest in the Strummi from the start were generally engaged with using it for the remainder of the sessions they attended.

4.2.2. Allsorts and SoundLab

During the course of three SoundLab events, the Strummi reached a wider audience than at DYOT, but was not engaged with in a cooperative music-making context. We noticed many similar reactions to the Strummi as at DYOT, ranging from confusion and boredom, to focused exploration and engagement.

The strongest reaction to the Strummi was from Vanessa (pseudonym). Vanessa is an adult with learning disabilities, as well as a physical impairment to her right hand. She encountered the Strummi at the second SoundLab event we attended, where she played with both the tabletop and guitar-body versions. During this event, she spent roughly 2 hours with the Strummi, improvising lyrics and preparing a song to perform at the end of session.

Vanessa used her left hand to strum and her impaired right hand to select the chords. She placed the guitar-body strummi on a table, resembling the playing position of a lap-steel player. She encountered difficulty with accurately and consistently pressing down the buttons. This meant that for a lot of the time she was strumming on ‘muted’ strings, but continued strumming nonetheless. Throughout this first session, Vanessa repeatedly made positive comments about the Strummi, saying that she ‘never thought she would be able to play the guitar’ and that her parents would be very pleased to see her play. Vanessa immediately picked up the strumming technique without guidance, and had a positive reaction 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 proceeded to spend several more hours with the Strummi here. Her third encounter with the Strummi was during another SoundLab event, by which time she was well acquainted with the technique, and showed 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 so 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 lyrics were usually to do with her immediate environment and reflections on her positive experiences such as ‘I’m at Heart n Soul, today has been a great day and I’ve played the guitar’.

4.3. The Strummi Sessions: Research-Focused Music-Making Sessions

Our early observations and reflections from Heart n Soul events highlighted several key issues involving music-making and learning-disabled communities. We learned that the barriers to accessing music-making and the arts are multiple and varied: from stigmatising attitudes towards the artistic capabilities of learning-disabled people, to societal issues such as lack of access to regular arts programs, and physical access issues arising either out of cognitive or physical impairments. We observed a broad and diverse range of approaches to making music including recording covers of pop songs, free improvisation jamming and work on solo performances. Many Heart n Soul participants performed with instruments using recognisable techniques and playing styles, often to a very high standard of musicality. Others used instruments in unexpected ways, either out of preference or as a result of a physical access need (for instance strumming open strings on a guitar due to difficulty holding down chord shapes). Within the organisation, approaches to addressing individual access needs come from an open-minded attitude towards different performance styles and preferences: rather than attempting to draw boundaries around what are the ‘right’ and ‘wrong’ ways to perform with an instrument, paint or make digital art, session leaders encourage and support people to try different approaches which suit them.

The longitudinal, situated nature of our engagement with Heart n Soul provides us with a rich set of experiences and observations concerning the use of musical instruments in a learning disability context. However, we experienced a number of practical constraints regarding data collection which meant that we were unable to perform a formal research-focused engagement during the day-to-day activities of Heart n Soul.

Our main obstacle was the collection of recorded video and audio data during the DYOT music sessions, which were the locus of activity around the Strummi. The ‘walk-in’ nature of these events meant that obtaining informed consent from each person present during the sessions was impractical, and would likely negatively impact the nature of the DYOT sessions. A requirement for gathering video data of any population under research is to obtain informed consent before any filming takes place, via a consent form sanctioned by an institutional Research Ethics Committee. This process is somewhat more involved with a population which includes learning-disabled young people, as parents and guardians are also required to provide consent, and the forms must be presented in an ‘Easy read’ format⁸.

Due to these practical considerations, we organised two music-making sessions, dubbed the ‘Strummi Sessions’, which were scheduled outside of the regular DYOT events. In this section, we describe our motivations and objectives in organising the Strummi Sessions and the practical considerations involved, followed by an overview of the format of the sessions: the instruments used, our approach to participant recruitment, and the intended activities during the sessions.

4.3.1. Participants and Recruitment

Participant recruitment took place during one DYOT and one Allsorts event. Information sheets were handed out to people who had previously been identified as being interested in making music outside of the regular sessions. Their names were recorded and handed to Heart n Soul staff who coordinated with them to find two dates that the majority of people could attend. In total, 17 people were approached during the Heart n Soul events (9 at DYOT, 8 at Allsorts), and a further 3 people contacted Heart n Soul directly after hearing about the sessions through their peers. Eight people attended the sessions (3 from DYOT, 5 from Allsorts).

Two staff members were present, Edwin and Abraham, who are regular facilitators for music-making sessions at DYOT and Allsorts. Ismail, Jared, Imogen and Vanessa were present for both sessions. Raphael was only present for session 1, while Oscar, Liam and Felix were only present for session 2. Two assistants were present from our research group: Giacomo for session 1 and Jack for session 2. A co-researcher Alan Chamberlain was present for the majority of session 1 but left before the feedback session began. Felix also had a carer with him who was present throughout the day and assisted him during the music-making activities. Table 1 presents participants and the sessions they attended.

All participants were already familiar with the earlier iterations of the Strummi instruments to varying degrees, except for Felix. Vanessa had the most experience with the Strummi instruments, and her earlier interactions are described in section 4.2.2.

4.3.2. Session Format

We attempted to recreate the format of the music room at DYOT events, by arranging for two of the regular music facilitators (Edwin and Abraham) from DYOT to attend, and to use the same instruments and spatial layout. A major difference between these sessions and DYOT was that we were unable to use the Albany as a venue, so were relocated to Deptford Lounge, a library and community space about three minutes’ walk from the Albany. We had recruited members from both DYOT and Allsorts, so

⁸<https://www.learningdisabilities.org.uk/learning-disabilities/a-to-z/e/easy-read>

Table 1. Participants, staff and fieldworkers present at Strummi Sessions (X denotes presence during a particular session, * denotes use of pseudonym)

Person	Session 1	Session 2
Oscar*		X
Raphael*	X	
Ismail*	X	X
Liam*		X
Jared*	X	X
Imogen*	X	X
Vanessa*	X	X
Felix* (and carer)		X
Edwin* (Facilitator)	X	X
Abraham* (Facilitator)	X	X
Jacob	X	X
Alan (co-researcher)	X	
Giacomo (assistant)	X	
Jack (assistant)		X

there was a larger age range than typical DYOT music room sessions, and several participants who had not previously attended a session together before.

Both sessions began with a brief introduction, where everyone was sat in a circle and introduced themselves, then a discussion of how we wanted to begin the music-making. We also used this time to obtain written consent from each participant.

Following the introduction at the beginning of session 1, we introduced each of the Strummi instruments by demonstrating how to play them. For session 2, Vanessa and Liam demonstrated the Strummis instead. Introducing the instruments is often a feature at DYOT music sessions, where participants are encouraged to try out each instrument themselves before a jam occurs.

After this, the facilitators encouraged jamming in a free-improvisation format, encouraging ideas to develop into more structured jamming. For the final half an hour of both sessions, we returned to the circle of seats and conducted an audio recorded feedback session. Both sessions lasted around two and a half hours.

4.3.3. Data Collection and Analysis

We used the *ELAN* software to annotate and transcribe the two synchronised video streams from both cameras (see Figure 5).

The first stage in annotating the video footage was to divide the timeline into discrete ‘activities’, in order to get a sense of how each session was structured over time. We defined activities as whatever the majority of people in the room were currently focused on at that time, e.g. a group jam, or collectively waiting for a participant to learn their part. As the sessions were loosely structured, there was no formal guidance from the facilitators as to when one new activity would begin or end, and as such many activities were overlapping or did not involve every member of the session. However this annotation category was useful for providing an overview of the progression of events during the session, and how much time was spent on them. These annotations are provided in tables 2 and 3.

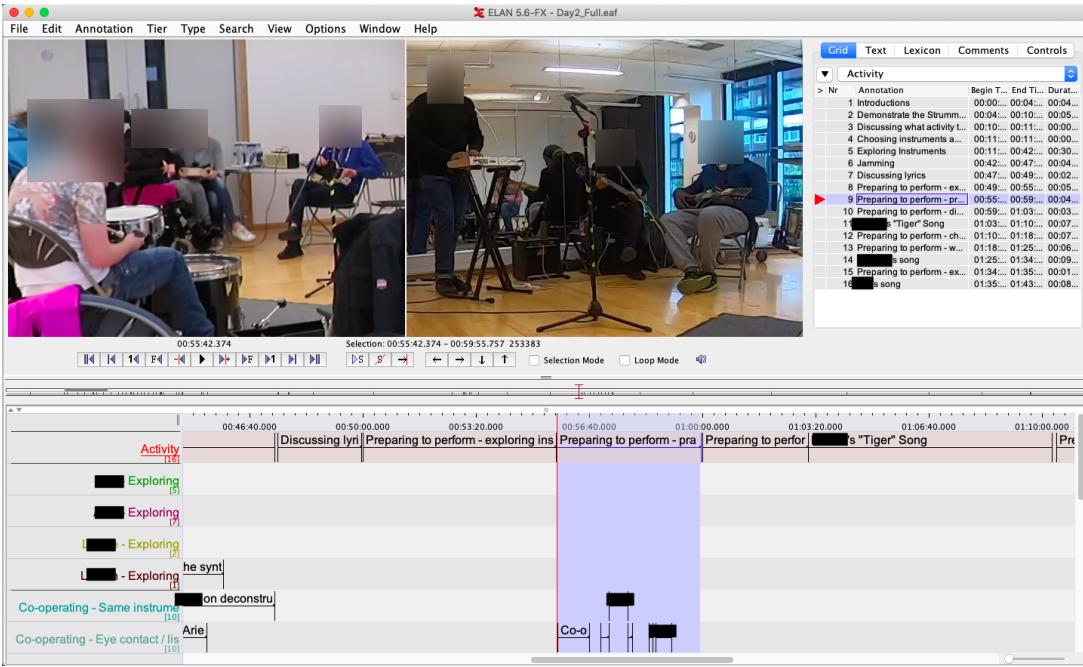


Figure 5. Video annotation process in ELAN software (names redacted)

Figure 5 alt text: A screenshot of computer software which allows the user to add descriptions to a piece of video footage and categorise those descriptions. There are two video frames on the screen, showing people playing different instruments. Underneath the video frames are descriptions of events in the video, arranged in a timeline.

Figure 5 long description: A screenshot of computer software. On the top left, there are frames from two videos, which show two different camera angles of the same room. In the room are people sitting on chairs or standing up, with different instruments including a drum kit, keyboard, and guitars. Their faces have been blurred. To the right of the videos, there is a list of event descriptions such as 'Introductions, Demonstrate the Strummi, Discussing what activity'. Each event description has a begin time, an end time and a duration. The bottom of the screen has the same event descriptions arranged in a timeline. The events are broken up into different descriptions which have been colour coded. The descriptions on screen include 'exploring' and 'co-operating'. The faces in the video frames have been blurred, and the names in the event descriptions covered with black rectangles.

Begin time	End Time	Duration	Activity
00:00:21	00:02:46	02:25	Jacob Demonstrating the Strummis
00:02:52	00:21:20	18:28	Exploring instruments
00:21:31	00:23:51	02:19	Settling down, getting ready to demonstrate each person's instrument
00:24:07	00:31:01	06:54	Demonstrating each instrument
00:31:04	00:33:49	02:45	Arranging order that everyone plays
00:33:54	00:34:14	00:19	Waiting for silence
00:34:14	00:46:16	12:02	<u>Jamming</u>
00:46:22	00:53:47	07:24	End of jam/food and comfort break
00:53:51	01:07:45	13:54	Jam/unstructured
01:08:36	01:11:39	03:02	Ismail learning to play Strummi/Edwin explaining it
01:11:55	01:14:09	02:14	Jam emerging
01:14:23	01:29:00	14:37	Unstructured jamming/free improv
01:29:13	01:29:57	00:43	Raphael and Ismail swap instruments
01:30:18	01:32:49	02:30	Free improv/conversations
01:32:59	01:41:28	08:28	Jam - based around Raphael and Ismail's drumming
01:41:47	01:46:48	05:01	Discussion about which chords to play
01:46:51	01:51:54	05:03	Writing Imogen's lyrics
01:52:00	01:55:41	03:41	Rehearsing parts/showing them to each other
01:55:48	01:07:28	11:39	Focused jam/performing Imogen's song
02:07:32	01:11:22	03:50	Jamming starts to wrap up

Table 2. Activities and timings during Day 1

4.4. An Ethnographic Account of the Strummi Sessions

As with earlier DYOT sessions, these sessions were predominantly made up of a mixture of structured and unstructured jamming. The unstructured jams primarily consisted of free improvisation: there were no instructions given as to what to play and when, and each musician was free to come in and out as they pleased. Communication between musicians and facilitators was largely non-verbal, consisting of encouraging gestures such as eye contact, smiling and head nodding. These seemed to be a way of showing approval or encouragement without distracting from the task at hand.

During the unstructured jams, several participants were primarily focused on exploring their instrument, without much apparent interest in what the other musicians were playing. An example of this was Liam who spent large amounts of time playing on the S3 Strummi, facing away from the other participants and looking at himself in the mirror.

While session 1 was weighted more towards free improvisation, exploration and unstructured jams, a feature of session 2 was more focus on structured jams, with a view to developing songs. These typically consisted of a preparatory stage where a facilitator would ask each participant to demonstrate the sounds they wished to make with their instrument - either a specific rhythm, keyboard preset or playing style. After that, a conversation about how the song would be structured in terms of who was playing when would take place. A clear distinction between the preparatory stage and the jam itself was made by the facilitator asking for silence before anyone played an instrument.

We noticed three distinct structured jams occurring in session 2, and here describe the first of these three to provide a snapshot of how they occurred: The first jam was Vanessa's 'Tiger' song, with the instrumentation as follows: Felix played S1, Oscar played S2, and Jared played S3. Imogen played synthesiser and Abraham played electric bass, with no-one playing electric guitar. The drums were rearranged with the kick

Begin time	End Time	Duration	Activity
00:04:54	00:10:21	05:27	Demonstrate the Strummis
00:10:29	00:11:23	00:53	Discussing what activity to do first
00:11:26	00:11:56	00:29	Choosing instruments and starting to explore them
00:11:58	00:42:52	30:53	Exploring Instruments
00:42:55	00:47:23	04:28	Jamming
00:47:28	00:49:55	02:27	Discussing lyrics
00:49:58	00:55:40	05:41	Preparing to perform - exploring instruments and deciding on parts, learning chords
00:55:42	00:59:55	04:13	Preparing to perform - practicing parts, jamming
00:59:59	01:03:05	03:06	Preparing to perform - discussing song structure
01:03:05	01:10:16	07:10	Vanessa's "Tiger" Song
01:10:24	01:18:10	07:46	Preparing to perform - choosing different instruments and exploring them
01:18:14	01:25:02	06:48	Preparing to perform - waiting for silence before beginning
01:25:03	01:34:09	09:05	Jared's song
01:34:14	01:35:16	01:02	Preparing to perform - exploring instruments
01:35:17	01:43:40	08:23	Liam's song

Table 3. Activities and timings during Day 2

drum lying flat on the floor so that Ismail, a powered wheelchair user, could play the kick drum with a beater in his right hand - although during this jam, Ismail played only the snare drum and Liam sat next to him to play the kick drum (see Figure 6).

The jam began with Imogen holding a sustained note on the synth with a pad setting. Edwin was conducting, bringing in each player at the points they agreed during the preparation for the jam. Edwin motioned to Oscar to start playing, who was playing the S2 Strummi. Oscar played by strumming a regular pattern of up and down strokes on every 2nd beat, in an exaggerated, performative gesture, and using a travel card in place of a plectrum. After about thirty seconds, Edwin then motioned to Felix to start playing. Felix's carer, sat to his left, held down the chord buttons and provided verbal support, for example confirming with Felix that he should start playing. After Felix had played with just Imogen's synth as a backing, Edwin motioned for Ismail and Liam to start playing drums, but had to give some direction in order for the snare and kick drum parts (played separately) to synchronise. Once this beat was established, Abraham and Jared came in on the electric bass and S3 Strummi and a more noticeable groove emerged. At this point (around two minutes into the jam) Vanessa began performing her lyrics that she had written in a continuous spoken word style. She had earlier written some lyrics about being a tiger who was hungry and bad tempered, and who was a Taurus. Despite having the lyrics written down, her performance was almost entirely ad-libbed, using lines and words from her lyrics as cues. The jam lasted for seven minutes, with Edwin continuing to signal for people to come in and out. Oscar and Felix were instructed to play more quietly during Vanessa's vocal parts, and then were brought back in for a few bars before Vanessa began singing again. Towards the end of the jam, Ismail stopped playing the kickdrum and Liam played more arhythmically. This had the effect of causing the other players of dropping the groove in order to create a 'wall of sound' effect of drum rolls and rapid strums, which built to a crescendo before finishing.



Figure 6. Two camera angles depicting the spatial arrangement of participants during the first structured jam.

Figure 6 Alt text: two images showing two different camera angles of the same room where people are playing instruments. The people are arranged in a circle and facing each other.



Figure 7. S1 (tabletop Strummi) after being damaged shortly after the session began

Figure 7 alt text: A close up image of the S1 instrument described in section 3.1. The wooden pickup assemblies have been damaged or are missing, with black and red wires sticking out.

4.4.1. *Interactions with Instruments*

As well as jamming and performing, activities also included more exploratory moments, especially during the beginning of both sessions. We encouraged the participants to try out each Strummi as well as the other instruments during the session and both the facilitators and JH asked participants at several moments if they would like to try a different instrument. Around 20-30 minutes at the beginning of both sessions consisted of people playing instruments in a more individual manner - i.e. not making eye contact or appearing to listen to other players, but focused on their own instrument.

A number of salient moments occurred during these moments. At the beginning of session 1, Imogen attempted to slide the bridge pieces up and down the strings of the S1 Strummi, and in doing so damaged the piezo wires attached to them (see Figure 7). For the remainder of this session and for much of session 2, she predominantly played the keyboard and did not return to the Strummi until she was encouraged to do so. Towards the end of session 2, all participants were encouraged to try out different instruments that they had not yet played, and Imogen chose the electric guitar. Her playing style was sitting down with the guitar on her lap, strumming the strings at the neck end rather than over the pickups. She appeared to be focused on exploring the instrument: turning tuning keys and volume pots and trying out unconventional ways of playing.

We also noticed moments of collaboration between participants, for example during session 2 when Vanessa and Felix began playing the same Strummi. Vanessa had identified early on that Felix had a similar impairment to his left hand as her, and took on a role of showing him how to play the S1 Strummi in the way that she did. Vanessa is an adult while Felix is in his teens, so a kind of mentor-student relationship emerged in which Vanessa gave encouragement on Felix's playing and his ability to use his impaired hand. For a while during the session, Vanessa was holding the chord



Figure 8. Co-operation between Vanessa and Felix: Vanessa drew on prior experience with the Strummi to teach Felix how to play it.

Figure 8 alt text: Two people are playing the S1 instrument described in Section 3.1. The person on the left is sitting in a powered wheelchair and is using his left hand to hold a plectrum for strumming the strings. The person on the right is using both her hands to press the chord buttons.

buttons while Felix strummed the strings (Figure 8). Felix's carer later took on this role during the structured jam sessions, presumably after observing Vanessa's approach.

Other moments of cooperation also involved de-constructing the drum kit so that Ismail, a powered wheelchair user, could access the kick drum. By taking the drumkit apart and placing the kickdrum so that the skin was facing upwards, Ismail could hit the kick with a drumstick in one hand and play the snare and hi-hat on the other. During session 1, Raphael joined in with Ismail so that they were both playing on the same drum kit in synchrony. This occurred again in session 2, this time with Liam joining Ismail instead.

4.4.2. Feedback Sessions

Following the video recorded music-making activities, at the end of each session we recorded audio of a feedback session which took the form of a semi-structured interview/focus group activity. All participants and facilitators sat in a circle and were invited to answer questions relating to the session itself as well as the Strummis and other instruments. There was no fixed protocol for the feedback sessions, however we prompted the group with questions along the lines of 'how did you enjoy today?' And 'what did you think of the different instruments you played?'. We then let the conversation naturally evolve as people contributed their thoughts. Responses included feedback on technical usability aspects of the Strummis, suggestions and comments on how the sessions were run, reflections on how and why the Strummis were useful to them, and the lived experiences of disability in relation to creative activities. Some key topics of discussion are presented below with an illustrative quote from recording transcripts. These topics were identified by the authors following transcription of the feedback sessions and reflecting on the themes which were either discussed more frequently, or which were more salient to the research goals of the Strummi Sessions. Please note that this does not constitute a full thematic analysis, but provides additional context to the observations and reflections made by the authors through our ethnography.

To read the transcripts in full, see (Harrison, 2020, Appendix A).

Pop culture/rock band references: (References to existing pop culture figures, likening the experience of the Strummi sessions to playing a band, plans for forming a band out of the Strummi sessions, desire to record and perform music.)

Abraham: Well you already worked out the name of the band didn't you?

Imogen: yes, The Expansives.

Abraham: She was going round the Albany with the full logo.

Jacob: You made the logo? That's so good! ...

Abraham: It was nice to feel the excitement from you guys.

Vanessa: It would be nice to show other people.

Reactions and feedback relating to the Strummi instruments: (Usability feedback, preference for one version over the other, ideas for improvements to future versions.)

Giacomo: What do you think is the main difference between the guitar and the Strummi?

Vanessa: Well the Strummi is very small and compacted. More than the guitar. The guitar you have to hold all the time.

Abraham: Its long neck as well ...

Experiences with other instruments: (Preferences for other instruments in the room, reasons for preference, how they were used, references to different instruments and ways of playing.)

Imogen: Yeah I had a go at the sort of 50s rock guitar over there [S3]. Not really me, I'm more keyboards and mixing. And maybe a bit of drums, but mainly keyboards.

Reflections on performance: (Techniques used, ways of communicating and shaping performance during jams, reflections on how well the jams/performances went.)

Edwin: It just brought out different singers, cos I haven't really heard much [Jared]. It was good you were taking your time.

Abraham: We've heard you rapping but never singing.

Edwin: You were singing you had a chorus that was developed there. And it felt great. And so did you [Liam], I've never heard you be that relaxed and think about what you were singing. I think in short it's nice to see it, it's a new instrument that allows you to do things in different way.

General session feedback: (Feedback relating to enjoyment of the session itself.)

Jacob: Is there anything else you'd like to say about today?

Vanessa: It was good, I'd like to do a bit more.

Liam: A bit more actually.

Vanessa: What do you think [Jared], would you like to do a bit more? What's the best bit about it?

Jared: Music.

Imogen: I think we should meet regularly every month if you can do that Jacob.

Values and personal goals: (Relating the session activities to personal values and beliefs, or to goals in personal life e.g. health and wellbeing goals.)

Jacob: Do you want to play a bit more or?

Vanessa: Yeah cos it helped my hand.

Jacob: How did it help your hand?

Vanessa: It helps my hand to open a bit more, never used to use this hand much. This

hand is a bit lazy. So I tried to use this one more. Make it stronger. Like to do a bit more. ... it would be nice to have other people come out their house ... and see other people ... there's people indoors in the house just day in they don't do things and I keep calling them to come downstairs. It would be nice for other residents to have a go.

Jacob: To have a go with the Strummi?

Vanessa: Yeah ... All they do is sit there eating and playing dominoes.

Vanessa: It'd be good for other people to see it and things ... They're just sitting going 'all I'm doing is watching telly'.

Imogen: Better than being excluded or at home doing nothing.

Vanessa: Some people just sit in the house and all they do is 'ah I'm bored'.

Lyrical ideas and values: (Ideas and values that came up in people's lyrics.)

Liam: I've been singing a bit of comic rap. All about Kendall Jenner, Theresa May and all the ... it's not my style.

Imogen: Those naughty naughty politicians who need to be taught a lesson.

Abraham: Socially and politically aware well done.

Liam: Those naughty politicians need to be learned a lesson.

Jacob: And they're not your style, is that what the song was about?

Liam: It's not my style, yeah. That's what I wrote that about.

Interactions with others in the group: (Reflecting on how people interacted with others.)

Vanessa: I liked it when [Felix] came in that had the same problem, that was very nice. And I noticed that he was getting shy quite a bit, and he came out of his comfort zone. He wasn't sure about me and I said look, you've got the same problem I've got, don't worry cos it'll come in time. So I gave him a bit of confidence.

Jacob: When you two were playing the same instrument, what did you think about that?

Vanessa: Well teaching him, is a different category, he didn't know me and I didn't know him, and he's got the same issues that I've got and his mum said thank you for teaching him. Cos we've both got the same dilemma ...

Vanessa: ... he looked at me and said what do I do, and I said here come bruv I'll show you how it works.

Jacob: And he was using both his hands at the end wasn't he.

Vanessa: Yeah because I helped him.

5. Discussion

As DMI researchers with a specific interest in accessibility, the Strummi sessions provided us with an opportunity to observe and reflect on the use of a novel instrument within a music-making context that was relatively familiar to the participants. While the sessions themselves were an opportunity to 'road test' the instruments, the goal of the sessions was not to iterate on the design, or to prove the instruments' viability, but to try and better understand how instruments designed to address specific access needs can play a role in inclusive music-making settings. It is important to note that while the participants at the Strummi sessions might share a common neurodivergent or learning disability identity, they all had a range of access needs; some of which the Strummi was more suited to addressing than others. Indeed for many of the participants, access needs were not related to the physical layout of any of the instruments, and so the Strummi was no more or less physically accessible than the guitars, drums and keyboards - in this sense we can observe how the Strummi is received as an instrument in its own right, and not as an 'assistive' or explicitly 'accessible' tool. Setting

up this study in the context of inclusive community music-making sessions allowed us to reflect on factors not directly related to Strummi, for example the role of trained facilitators and carers in supporting those who take part.

5.1. Personal Goals and Values

The open-ended nature of the jam sessions and feedback discussions allowed for personal values relating to music-making and disability to emerge. Brown, Reeves, and Sherwood (2011) reflect on the role of ‘lead participants’ in in-the-wild studies. Lead participants are described as a subset of participants who ‘engage with the technology and reflect on its use by themselves and others in a particularly insightful way, or alternatively work so as to encourage involvement by others who are involved in the trial’. During the Strummi sessions, we observed that Vanessa had taken on this role, through her enthusiastic feedback on both the instrument and the way the sessions themselves were structured. She also at several points led the discussion during the feedback sessions, asking for feedback from others in the group, as well as providing encouragement and support for Felix while sharing the instrument.

Vanessa’s responses during the feedback session were focused on music-making activities as a means of improving health and wellbeing. She was focused on the Strummi as a tool to improve her left hand (‘I’d like to play a bit more because it helped my hand’) as well as a concern that other assisted living residents are not busy enough socially/creatively (‘It would be nice to have other people come out their house ... all they do is sit there eating and playing dominoes’). Vanessa’s values in music-making appeared to be concentrated around these issues which were explicitly to do with the lived experience of disability.

During session 2, Vanessa took on the role of showing Felix how to use the Strummi, and stated in the feedback session ‘It was very nice to teach somebody else, I find it was useful to teach somebody else who’s got the same needs as I’ve got.’. This highlighted values which are not explicitly related to music-making: opportunities for developing strength in an impaired limb, promoting socialising and creatively stimulating activities, and connecting with other people with a similar impairment. The Strummi was not designed to be a platform for muscular rehabilitation or a tool to promote social interaction, although designs that explicitly address these issues do exist (See e.g. Kirk et al. 2016). However it was clear in the feedback session that these were important values associated with music-making for Vanessa. These concerns didn’t appear to be shared by others in the group, whose comments were in general more concerned with the playability of the Strummi and the musical aspects of the sessions.

A prominent feature of the feedback sessions were comparisons to existing popular music performers and bands, as well as expression of interest in forming a band out of the Strummi Session group. In particular, it emerged that between the two sessions Imogen had decided on a name for the band ‘The Expansives’, and designed a logo. Vanessa expressed several times that she wished to continue the music-making sessions, and others expressed a wish to record the songs. While it is potentially stating the obvious to suggest that groups of disabled musicians show a strong interest in taking part in culturally relevant activities, we believe that this is sometimes left out of the literature on accessible musical instruments, which can have a tendency to treat music-making as though it exists in a vacuum. As with any music ensemble, creating musically pleasing sounds is only one of many motives for taking part: the ‘musicking’ activities that also take place such as recording, performing to an audience, designing

logos, considering band names, stage production, are all part of the cultural fabric of playing in a rock band which make this kind of musical expression so appealing.

Other values which emerged from the feedback sessions and people's lyrics include Oscar's belief in the importance of recording and disseminating Heart n Soul artists' musical output, not just in CD format but with lyric booklets for people that are hearing impaired or speak another language.

5.2. Environmental Factors

The DYOT music sessions, and by extension the Strummi sessions based on them, could be categorised as 'free-improvisational community music'. Community music as a discipline is broad and makes up for a large amount of the grey area between *music therapy* and *amateur music-making*. Where community music is understood to involve 'an active intervention between a music leader or facilitator and participants', it can be defined as an 'intentional intervention involving skilled leaders, who facilitate group music-making in environments that do not have set curricula' (Higgins, 2012). Through community music's recognition of 'social and personal growth alongside musical growth', and awareness of the 'need to include disenfranchised and disadvantaged individuals or groups', it is closely aligned with music therapy, but remains an entirely separate discipline.

This setting is valuable to us as a place to explore what makes a musical activity or instrument design therapy focused. In the case of Heart n Soul, implicit therapeutic benefits of music-making are gained through an explicit focus on performance, song-writing and creative expression - goals arguably shared by amateur music ensembles for whom therapeutic and wellbeing benefits are not an explicit focus. This has served to complicate our distinction between *performance-focused* and *therapeutic* instruments as it has shown that there exists a context/environment in which there is no such distinction.

This idea of environmental factors complicating pre-existing notions of an instrument's status as performance-focused or not also extends to a more general question of the *accessibility* of an instrument. Our earlier ideas around accessibility framed the unadapted guitar as an inaccessible instrument, requiring significant adaptation and re-design in order to remove barriers to guitar playing. The Strummi sessions have helped illustrate the notion that access and accessibility are not always possible to measure or quantify for a general population. For Imogen, the design and intended functionality of the S1 Strummi may not have been clear, resulting in her inadvertently damaging it and choosing not to return to it later. Later in session 2, she used the unadapted guitar for a significant amount of time without changing instrument. In this context, the Strummi was not suited to Imogen's mode of exploration, due to a combination of fragility and unfamiliar design, whereas the guitar, being both a familiar and robust instrument, was better suited to her mode of playing. This could primarily be read as a lesson in designing durable instruments, but potentially points towards a more subtle point to do with *false affordances* (see Gaver 1991). The novel design of the Strummi's bridge pieces suggested an affordance which did not exist, and resulted in her damaging the instrument, and potentially being put off returning to it.

The approach to performance practice, repertoire, acceptability of instruments and playing styles during Heart n Soul creative sessions is fundamental in removing barriers to music-making that learning-disabled people face. These barriers can manifest as physical access issues with instruments and performance environments, as

well as attitudinal barriers towards what constitutes musical skill and musicality. The Strummi addressed individual access needs for some participants (most explicitly, Ismail, Vanessa and Felix who had physical impairments which made holding and playing an unadapted guitar difficult). De-constructing the drum kit for Ismail to play also addressed his individual access need (using a powered wheelchair prevented him from being able to access the kick drum pedal). However these adaptations only remove barriers to music-making if the structure around them supports these actions - the context allows a drumkit to be deconstructed and new and unfamiliar instruments to be brought into the mix, alongside unconventional ways of playing traditional instruments. This poses an important question to the wider field of accessible instrument design: can an instrument's claims of accessibility be taken at face value, without taking into account the context in which it is performed?

5.3. 'Access to Music-Making' - The Importance of Context

Taking a wider look at inclusive music-making practices, it is clear that while there are many designers, researchers and makers focusing on the development of new musical instruments for use by disabled musicians, there is no single interpretation of what 'making music' means in practice, and therefore what removing the barriers to accessing music performance entails.

Two illustrative examples from practitioners who specialise in acoustic (i.e. *non-digital*) accessible instruments are the open-tuned harp and guitar-based instruments described by Longden (2019, Ch 3-6), and the one-handed recorders, clarinets and whistles built by Peter Worrell⁹. Longden's emphasis on the inclusive, improvisatory and community-oriented practices of non-Western indigenous music sets up a performance context in which open-tuned string instruments provide a means of full participation in musical expression for all participants. Meanwhile, instruments such as Worrell's one-handed recorders are examples of bespoke instruments designed to provide access to mainstream music education, often in classroom settings, for pupils with upper-limb impairments. They are explicitly designed to provide access to Western classical and mainstream popular music traditions and conform as closely to a traditional recorder's design as possible, in both looks and playing technique.

In both of these examples, the design philosophy of the instruments is rooted in differing interpretations of 'music-making'. While these interpretations are contrasting, what is common to both approaches is the acknowledgment of the cultural expectations of these approaches to music, and the values inherent in both. The one-handed recorder is a recognition of many young musicians' goals of taking part in what we recognise as Western classical and mainstream popular musical traditions: learning music theory, notation, ensemble performances etc. Meanwhile the open-tuned harps, guitars and zithers employed by Longden are well suited to the rhythmic, drone-based and improvisatory community music sessions, drawing on musical traditions from non-Western cultures.

While it is true that moving away from Western classical and mainstream popular music traditions can open up opportunities for less rigidly-defined and more egalitarian performance structures, we should not dismiss the fact that many musicians aspire to take part in existing Western musical cultures. In the design of new ADMIs, we must work to address the access needs of disabled musicians, but ensure that we are not redefining what is meant by 'performing music' in order to suit the affordances of

⁹<http://www.peterworrell.co.uk/onehandedrecorder.htm>

the instrument. Just because an instrument provides an accessible means of triggering pitched sounds, does not mean it is inherently capable of providing access to music-making - it depends on the *kind* of music-making the instrument is designed to support.

This has implications both for the way that new ADMIs are designed, and the way they are evaluated and discussed. To address the first point, we suggest that prior to any design work, we must ask the question ‘what kind of musical culture is this instrument intended to enable access to?’. Again, it is easy to imagine this being readily answered in a participatory design process, where the intentions of the performer are addressed from the beginning of the design process. In other instances, answering this question may be a matter of, for example, ensuring that the repertoire of a particular musical tradition is accessible - an instrument tuned to a fixed pentatonic scale may be sufficient for taking part in an improvisatory community music session, but not necessarily for performing a set list of folk songs in different key signatures. To address the second point of evaluation, we suggest that when writing about new ADMIs, we avoid generalised claims along the lines of ‘enabling access to music-making’, and aim to specify the parameters of the music-making activity.

By considering the issue of ADMI design from the perspective that ‘music-making’ is a loosely defined concept, we can also avoid ‘technosolutionist’ stances that frame ADMIs as a solution to a problem, and consider them more as a broadening of the palette of available tools for musical expression. It invites us not to stop at the point that we have solved the technical hurdles of providing physically accessible means of producing pitched sounds, and encourages us to move further to consider the instrument as a component in a rich ecosystem of people, their attitudes and environments.

5.4. Participation and Participatory Design

Participatory Design (PD) was originally conceived as an attempt to address power imbalances between designers and users, especially when developing new tools for use in the workplace (Muller & Kuhn, 1993). Today it is commonly incorporated into many design projects where other power imbalances might be in place, for example, when ‘expert’ designers work with marginalized communities or users that are unfamiliar with the technology or the design process. It is common practice for ADMI design activities to be structured in this way, through engaging with disabled musicians from the start of the design process, with the goal of collaboratively building new instruments which meet the access requirements and musical goals of the musicians. This is a valuable approach, not only for its egalitarian stance, but in its acknowledgment that disabled people provide expert insights into the lived experience of disability, and how that translates to design needs and goals.

By contrast, the Strummi’s design was more or less crystallised well before we began engaging with this community - as a result, it is important to be clear about what the Strummi *is* and *is not*, in the context of this project. The Strummi *is* essentially the result of a combination of the authors’ own design instincts and research interests. It was originally developed as a means of exploring the roles of form and strumming-hand interaction technique in guitar-like DMIs (Harrison et al., 2018; Jack et al., 2018). While we foresaw disabled musicians as being potential beneficiaries of the development of naturalistic digital guitar-based instruments, we were not explicitly designing the first generation of Strummi for this purpose (although many features of the second generation Strummi were incorporated following feedback and observations of its use by Heart n Soul participants - see section 3.1). The Strummi *is not* an

attempt to design the ‘best possible’ ADMI for meeting the access requirements and musical goals of this community - many people were uninterested in playing guitar, while others did not face any barriers to access in guitar playing. The Strummi began as a technology probe (Hutchinson et al., 2003) - a means of provoking new and interesting insights around guitar playing, not explicitly aimed at addressing access issues. However, it is through the use of the Strummi at Heart n Soul, and not through our original design intentions, that we now consider it an ADMI. It is worth noting that our primary reasoning behind bringing Strummi along to further Heart n Soul sessions was due to the engagement shown by people such as Vanessa and Alex, who came across Strummi during outreach sessions and showed considerable interest in using it as a means of performing guitar music. In fact, the Strummi Sessions themselves would not have come about, if not for Vanessa’s enthusiasm - she was instrumental in asking Heart n Soul to arrange additional music sessions during which she could use the Strummi - another example of the roles of ‘lead participants’, as discussed by Brown et al. (2011).

To situate this project within wider ADMI research, we might consider this as an attempt to understand the work done *after* an ADMI has been developed - as opposed to the steps taken to design the ADMI itself. At the end of the design phase of a new ADMI, whether designed in a participatory way or not, we might wish to see the ADMI’s continued use within a particular user group. But what happens when the user group changes in some way? Perhaps a different user group with similar access requirements may wish to use a replication of the ADMI, or the access requirements of the original participants change over time. While PD is a valuable method of uncovering values, goals and access requirements of a particular group at the time of its design process, additional steps can be taken to ensure that these needs are being met throughout the instrument’s lifetime - for example through environmental and attitudinal factors involved in the music-making progress. We suggest that it is worth discussing not only the outcomes of the ‘design phase’ of an instrument in ADMI research, but also attempting to understand how the instrument might be incorporated into existing musical practices and used by wider audiences. This is especially relevant in the context of Heart n Soul, who, through their *SoundLab* initiative, commonly incorporate existing commercial music technologies in inclusive music-making activities. In this way, they leverage the accessible properties of certain music technologies - even those that were not initially designed to meet access needs.

6. Conclusion

In this article, we have described the use of Strummi in an inclusive music-making scenario. The accessibility of the instrument was not something that was explicitly built into the design in order to meet a particular set of access requirements, but emerged through its deployment in group music-making contexts such as those described here. A key insight we gained from this situated work is the notion that instruments themselves cannot be inherently accessible: accessibility is the product of a relationship between the musician, the instrument and their surrounding environment. But if accessibility is socially constructed in this way, what, then, is the point of designing new ADMIs? We argue that removing barriers to music-making is neither a purely technical process, nor solely the result of environmental factors. It is more a process of creating an alignment between an instrument and its environment. Central to this idea is the notion that, in designing new ADMIs, we are not ‘solving problems’ of inaccessibility,

but rather attempting to expand the range of possibilities for musicians with access needs beyond what is currently available. This can be done through design exercises that seek to explicitly address the access needs of one or more musicians. Alternatively, as in our case, it can be achieved through supporting the use of an instrument with potential as an ADMI, within a group where engagement with the instrument can naturally emerge depending on the needs and values of each individual.

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