The Meanings in Making

Openness, Technology and Inclusive Music Practices for People with Disabilities

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ABSTRACT

Digital musical instruments and interfaces can be designed to enable people with disabilities to participate in creative music-making. Advances in personalized, open source technologies and low-cost DIY components have made customized musical tools easily accessible for use in inclusive music-making. In this article, the author discusses his research with the Drake Music Project Northern Ireland on making music-making more inclusive.

The barriers to music-making faced by people with disabilities can be viewed through two predominant theoretical models: the medical model and the social model [1]. The medical model sees the disabling factor as a limitation within the prospective musicians themselves. In contrast, the social model of disability perceives the exclusionary designs of musical interfaces, as well as noninclusive social attitudes to music-making, as the disabling factor. Thus, the social model perspective shifts the focus from the limitations posed by the disability to implementing enabling techniques and assistive technologies for transcending or transforming disabling barriers.

In 2014, I conducted a year-long ethnographic study with the Drake Music Project Northern Ireland (DMNI), a charity that exists to enable people with disabilities to overcome disabling barriers to musical participation through digital interfaces [2]. In operation since 1992, DMNI is one of the most established and recognized community arts organizations operating in Northern Ireland. The methodology of my ethnographic study was based on participant observation. I trained alongside 10 other Belfast-based musicians to become a DMNI access music tutor. Our training was followed by a period spent shadowing experienced access music tutors before completing the training process and becoming lead tutors for inclusive music workshops.

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The activities of DMNI exist at the intersection of music, technology and disability. Workshops take place at one of two DMNI studios (Fig. 1) or at day centers in and around Northern Ireland. The workshops range from large group songwriting and performance sessions to small and focused composition workshops. Other activities have included residential songwriting weekends and "hackdays" to create new DIY-accessible musical interfaces. We aspire in our classes to bring people with disabilities and professional musicians together to explore music and sound creatively and collaboratively.

INCLUSIVE MUSIC: PRACTICES AND TOOLS

Individuals creating artistic work in any medium have diverse abilities and, accordingly, develop specific techniques and customizations of the tools that shape their work processes and practice. Among disabled musicians, the spread of these abilities and techniques can be especially broad [3]. Inclusive design emphasizes the creation of technologies that consider the broadest spectrum of user abilities.

Electronic musicians can potentially create new tools, patches or instruments for individual works or configure software or adapt hardware in ways specific to each instance of performance. I do not suggest that instrument extension and modification are new phenomena; rather, the advent of electronic instruments and tools, particularly MIDI controllers, digital musical instruments (DMI) and programming languages for audio, have made instrument design itself available to musicians and makers as a form of artistic expression [4]. In a similar vein, musicians can create custom inclusive musical tools aimed at overcoming specific barriers for individual musicians or user groups or aimed at providing widely accessible tools for music and sound creation.

Brendan McCloskey [5] is an inclusive digital musical instrument designer who has worked for over 15 years as both a practitioner and a researcher for DMNI. Since 2011, as a Ph.D. researcher at the University of Ulster, he has co-developed an inclusive DMI for three musicians with quadriplegic cerebral palsy who have some degree of upper limb motor

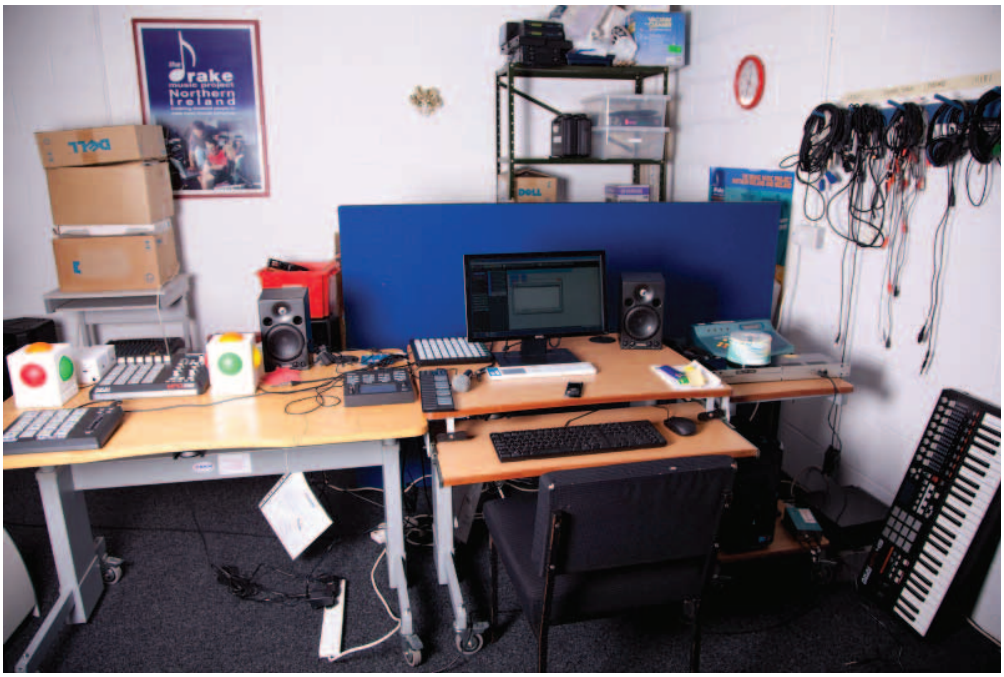

Fig. 1. Workstation setup at the Belfast DMNI studio, 18 December 2014. (Photo © Koichi Samuels)

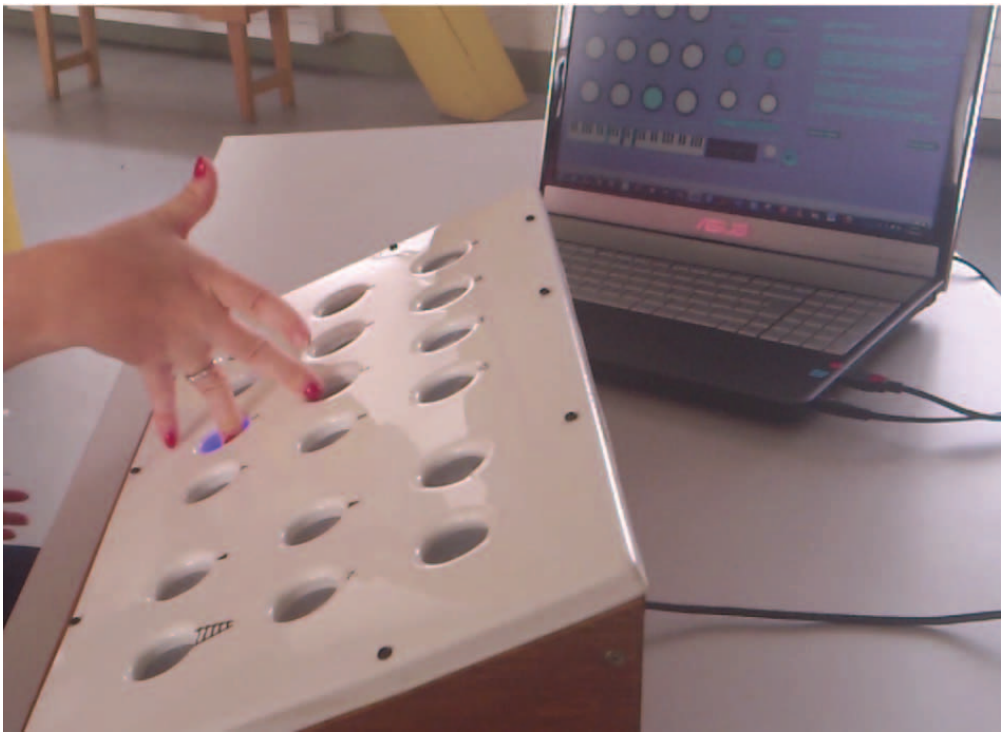

Fig. 2. inGrid hardware and software interface, 21 November 2014. inGrid was collaboratively designed to accommodate the unique abilities of three specific users who face physical barriers to their participation in music-making. (Photo © Brendan McCloskey)

capability. This collaboratively designed device is called inGrid [6] (Fig. 2). McCloskey built inGrid from a matrix of 16 DIY force-sensing resistors (FSR), which control a physical modeling synthesis engine built in Max/MSP [7].

The collaborative methodology of inGrid's creation emphasized participatory design and customized methods in the assessment of need and capability among the small group of physically disabled digital musicians. Interviews and discussions with the three collaborating musicians were followed by several stages of prototyping; each prototype was then qualitatively assessed by the group. The feedback from these assessment stages informed technical revisions. The final design emerged through an extended circular process of collaborative testing, dialogue and prototype revision.

The outcome of this process was a DMI suited to the three collaborating musicians' specific requirements. Instead of keys or buttons, inGrid features ports into which one can "plug" a finger. This feature removes a barrier for a player who finds discrete hand movements and finger control challenging by enabling steady, fixed placement of fingers into the

ports. Through this interaction paradigm, inGrid enables independent, real-time expressive control for shaping a sound's loudness, timbre, vibrato and resonance through a simple switch-targeting gesture.

MEANINGS IN MAKING

In electronic music practices, as with more traditional music forms, the "tools of the trade" hold individual and social meanings inscribed in their making and performed in their usage. The design and making of inGrid exposed design limitations in conventional mainstream controllers and DMIs, explored solutions to overcoming disabling barriers to music-making and challenged common assumptions of the abilities of musicians with disabilities—in this case, of three digital musicians with quadriplegic cerebral palsy.

Matt Ratto [8] discusses how "making" can supplement and extend critical reflection on the relationship between digital technology and society. He defines his research experiments as "critical making": a mode of materially productive engagement intended to bridge the gap between physical and conceptual exploration. Practices of creating and using inclusive DMIs can likewise be seen to deconstruct conventional understandings of disability, as well as help enable participation of those who face barriers in making music.

"OPENNESS"

The intrinsically modifiable and adaptable nature of certain contemporary music technologies makes them particularly useful in inclusive music settings. I use the term "open music technology" to encompass practices surrounding the customization of MIDI controllers; hardware hacking and DIY/maker cultures in experimental music; and music and digital media programming languages (such as Max/MSP and Supercollider [9]). A recently published study on accessible design titled *Enabling Technology* [10] finds that open source hardware (such as Arduino and Raspberry Pi) and "curated ecosystems" (such as iOS and Android) also afford much versatility and customization useful to people with disabilities. In designs that aspire toward inclusion, systems in which the interface between musician and sound generator can be adapted or easily customized offer significant benefits over traditional, unmodifiable instruments [11].

In March 2015 I curated a 3-day collaboration between DMNI and the Sonic Arts Research Centre, Queen's University Belfast, that brought together five DMNI musicians, student musicians from around the U.K., engineers and interaction designers [12]. Over the 3 days, the participants worked collaboratively in teams to design and build prototypes of Arduino-accessible musical interfaces [13] (Fig. 3). On the final day they performed improvised music together. The students discussed the specifications with the DMNI musicians so that each musician had an interfacing solution tailor-made to his or her individual requirements.

In one team, Ruben, a young man who had sustained a brain injury that weakened his motor skills, related to his student designer that he enjoys using the joystick UI on his electric wheelchair because it allows him to use two fingers on his left hand for discrete control. Based on these discussions, the student designer implemented a similar interface with a T-bar shaped joystick (Fig. 4): A touch sensor on the

Fig. 3. Ray, a longtime DMNI musician, trying out a prototype interface built specifically for his use by student DMI designers at a 3-day hacking event held at the Sonics Arts Research Centre, Queen's University Belfast, 27 March 2015. (Photo © Edward Butt)

Fig. 4. Ruben and his joystick Arduino interface, 27 March 2015. The interaction mode was designed to be similar to his assisted control wheelchair system. (Photo © Cathryn Hogg)

top of the bar turns on the sound generator, the joystick's movement along its *x*-axis controls pitch, and its movement along its *y*-axis controls the length the note is played.

Open music technology sensor interfaces can be appropriately matched to overcome an individual musician's specific barriers to access and participation. Furthermore, as Jewell and Atkin [14] note, the availability of open source design can eliminate the need for a manufacturer, investors or both, since designs in the public domain can be used and manufactured by anyone. From my fieldwork experience with DMNI, I have come to the realization that adaptations or customizations of existing mainstream and accessible technologies can also lead to effective interfacing solutions. When a workshop participant wants to use a DMI or tool with an interface he or she finds challenging, the interface can often be temporarily adapted on the fly with additional controllers rather than permanently hacked or modified. An example of this kind of temporary adaptation is using a MIDI keyboard and iRig MIDI interface [15] to input into an iPad synthesizer or sampler app, or connecting an accessible music technology device such as the Soundbeam [16] to remove the necessity of a tangible interface to hold or touch. Sometimes much simpler solutions are appropriate. For example, to enable live percussion play, a drumstick can be adapted by fixing an object with a larger surface area to the end, making it require less physical force from the musician to strike the drum. These kinds of solutions require creativity, improvisation and flexibility from both the access music tutor and the musician, as well as a space to experiment with improvisations of enabling techniques, performances of music and performances of ability.

It is important to note that, in most cases, it is the trained access music tutor who implements the hack or adapts a tool for the musician's use. Thus, an important question to ask when considering openness is: open to whom? Whether for inclusive music or any other purpose, a precondition for the person hacking or adapting a tool is a certain level of expertise. Thus, a universally "open" technology (one that is easily adapted, modified or hacked) is hard to conceive; there will always be the requirement of a certain level of knowledge and therefore exclusions.

TECHNOLOGY AND INCLUSION

Despite limitations to the universality of open technology, the potential of open music technologies for customizations and tailored specifications to suit an individual's specific abilities is undeniable. Whether they come from within universities or "third sector" (nonprofit or volunteer) initiatives, organizations like DMNI are growing in number, as is their reach and impact for musicians with disabilities in the U.K.

One of the most high-profile examples of musicians using inclusive adaptation is the British Paraorchestra [17], the world's first professional ensemble of disabled traditional and electronic musicians. Jewel and Atkin [18] assert that the Paraorchestra provides a fertile environment for its members to exchange information about enabling music technology and to collaborate in the creation of new instruments. Through my research with DMNI I have learned not to focus solely on the abstract concern that many open technologies are not universally open, but instead, as Jewell and Atkin emphasize, to extend the manner of collaboration and the sharing of information exemplified by the Paraorchestra in

order to understand and promote useful devices and software, and to design better musical interactions for the benefit of the musicians using them.

CONCLUSION

Openness, transparency and intelligibility are all fundamental themes when thinking about electronic music. In inclusive music practices, these themes are particularly relevant for discussion and questioning. At the same time, it is vital not to lose the essential ethos of inclusion itself. As an academic researcher, electronic musician and hardware enthusiast, I am aware that my own personal concerns come to bear when analyzing a device's level of openness, questioning who has access and assessing how intelligible and transparent work processes are to users and audiences. These are important considerations, but are perhaps most valuably posed within the context of academic research. To the workshop participants and the access music tutors of DMNI, concerns with the politics of making digital music technologies and their practices of use take a backseat when compared to the primary purpose and object of the workshops: the creation of the tools and environment to enable participants to collaborate in composing and performing music, and to facilitate the process of overcoming disabling barriers and enabling creativity.

References and Notes

1 Alex Lubet, *Music, Disability, and Society* (Temple Univ. Press, 2010).

2 "The Drake Music Project Northern Ireland": <www.drakemusicni.com>.

3 Sam Jewell and Ross Atkin, *Enabling Technology* (The Helen Hamlyn Centre for Design and Scope Disability Charity, Royal College of Art, 2013).

4 Andrew Goldman, *Materialized Music and the "Monome"* (2011): <www.andrewjgoldman.com/Writing_files/Goldman%20Monome%20PDF.pdf>.

5 Brendan McCloskey, unpublished Ph.D. thesis, University of Ulster, August 2014.

6 For a demonstration of inGrid, see <www.youtube.com/watch?v=qeW9bj3D40c>. For Brendan McCloskey's blog, see <sensorsformusic.wordpress.com/>.

7 Cycling '74 Max: <www.cycling74.com>.

8 Matt Ratto, "Critical Making: Conceptual and Material Studies in Technology and Social Life," *The Information Society* **27**, No. 4, 252–260 (2011).

9 See <supercollider.github.io>.

10 Jewell and Atkin [3] pp. 11–13.

11 Barry Farrimond et al., *Engagement with Technology in Special Educational & Disabled Music Settings* (Youth Music Report, December 2011).

12 See <bigearswithdrakeni.tumblr.com>.

13 See <www.arduino.cc>.

14 Jewell and Atkin [3] p. 28.

15 See <www.ikmultimedia.com/products/irigmidi2>.

16 Soundbeam is an ultrasonic sensor that converts physical movements into MIDI data. See <www.soundbeam.co.uk>.

17 The Paraorchestra received international attention when they performed at the closing ceremony of the Paralympics in 2012. "About Us," The British Paraorchestra: <www.paraorchestra.com/editorial.php?ref=about-us>.

18 Jewell and Atkin [3] p. 28.

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