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A Musical Improvisation Interface for People With Severe Physical Disabilities

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Abstract

In response to the challenge of including students with minimal controlled voluntary movement in a drum class with their peers, a software interface was created to enable participation in group musical improvisation. It was developed at Abilities First Inc., a school for children with disabilities in Poughkeepsie, New York, some of whom have profound physical disabilities. This collaborative research project employs a participatory action research approach, emphasizing the inclusion of students using the interface, their parents, and teachers as researchers in the ongoing development and use of the interface. A disability studies framework is used to investigate the extent to which improvising with the interface serves as an opportunity for artistic expression for the participants, and as a form of resistance to the socially constructed idea that people with disabilities are somehow inadequate. The interface—Adaptive Use Musical Instruments (AUMI)—was also used in patients with acquired brain and spinal cord injuries at Teletón Rehabilitation Institute in Santiago, Chile.

Keywords

accessibility, disability, improvisation, musical software interface, participatory action research

Introduction

This article reports the development of a noninvasive software interface originally designed to accommodate students with severe impairments associated with cerebral palsy. Its development grew out of a need identified by a musician and occupational therapist (OT) at a school in Poughkeepsie, New York. The article will also describe the use of a participatory action research (PAR) approach to the implementation and refinement of the interface at Abilities First Inc. (AFI), a school in Poughkeepsie, New York, that is, the ways in which the OT and others worked in partnership with the students, parents, and teachers to introduce the interface to the students and work together to see how best it might be used and improved. The article will also describe the use of the interface at the Children's Rehabilitation Center in Santiago, Chile, and include the methodological approaches used and observations made by the music therapist (MT) there. Finally, the article will articulate the theoretical principles that underscore the entire project: that improvising music, even when it is not intentional—or when intentionality is difficult to discern—is valuable and is particularly valuable in a group setting. In addition to addressing the particular problem of how to make the drum class more inclusive, the research team hopes to change perceptions about who can make music and thereby participate in creating community and changing societal constructs of ability and disability.

The development of Adaptive Use Musical Instruments (AUMI) grew out of a need identified by a musician and OT at AFI. The OT runs a weekly drum class for students, and prior to the development of the interface, only students who had mobility and functional control of their arm movements could participate independently in the class. The OT consulted with the Director of the Deep Listening Institute (DLI) about her frustration at not being able to facilitate independent participation in the drum class for students without voluntary mobility and control. The OT and the Director worked with a student designer at Rensselaer Polytechnic Institute (RPI) in Troy, New York to develop a prototype interface for musical improvisation that could be used by all the students in the class. To ensure that the interface would work for everyone, the designer collaborated with school staff, therapists, and 3 students from AFI who used wheelchairs, could not speak, and had limited controllable head movement. By developing AUMI for children with profound physical disabilities in mind, the research team hoped to produce an interface that

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would make musical improvisation and collaboration accessible to a broader range of individuals.

In developing the design for the interface, the designer worked with the OT and 3 students from AFI to determine how best to develop an interface that would adapt to the needs of the students. The 3 students were aged 7, 9, and 11; all 3 had diagnoses of cerebral palsy with severe physical impairments and varying levels of cognitive function. In the setting of the drum class, these students could participate only by having teaching staff or therapists provide maximum "hand-over-hand" facilitation. Other instruments with limited application were used, such as hanging chimes that could be "swiped" if they were placed within the reach of a student's outstretched arm. At the time, the only alternative music technology at AFI consisted of an analog electronic switch that could be activated by head movement, usually to turn a device (such as a cassette player) on or off. The designer observed the students' use of switches, and based on these observations, he programmed an interface that would also be activated by head movement, but would offer the students a much wider range of instrumental and environmental sounds, and control over the production of those sounds, than was possible with the switches. The prototype interface provided camera tracking of the head motion of these students, so a student could use his or her nose, as seen reflected on the screen, to move a red dot virtual marker on the screen in order to yield a drum sound. There was no need for the student to touch the computer; all movements were tracked by the camera, and the movement triggered various sampled sounds. The prototype also included a virtual keyboard that could be played with lateral head movement tracked by the camera. All 3 students were immediately able to activate sounds during their music sessions. After a few sessions, the oldest student was able to respond to drum patterns produced by the OT with her own patterns, engaging in a session of call and response, and she was soon able to improvise with others in the drum class. Over a 2-year period beginning in 2007, AUMI software evolved and was refined by a music technologist in consultation with the OT. Since 2010, the OT and DLI music technologist have been working in collaboration with students, staff, teachers, and parents to develop a training manual that explains how to use the interface and emphasizes that improvisation is an integral part of the use of AUMI. It is through improvisational exploration of a wide range of tones and sounds that the students find expressive musical means otherwise unavailable to them, as well as a strong sense of community through listening, collaborating, and playing together. As Heble et al suggest:

> when students become active participants in the production of knowledge—as is possible through improvisation-based music education experiences—rather than passive recipients of information, they model new kinds of relationships, and they become engaged and curious listeners; they begin, in effect, to hear and to play the world anew. These new levels of attentiveness . . . lead to achievements of insight, social cooperation, and understanding, as well as to an openness to unexpected outcomes and encounters by *saying* and *playing* who they are.[1(p24)]

The theory that improvising music in a group setting is an important part of child development and social interaction[1-4] is integral to the development and use of AUMI at AFI. While the New York team is not explicitly employing music therapy techniques (there are no MTs on the New York team), the project's commitments to improvisation and to making music in a community setting align with some of the principles of clinical improvisation in music therapy[5-7] and community-based therapy.[8-10] Certainly the inclusive community component of the drum class—which was the inspiration for the development of the software—is key to the research project. One of the AUMI researchers, Sherrie Tucker, captures this powerful sense of community in her field notes based on her observations of one of the drum classes:

> Three children are at the laptops before I know it . . . . It is loud. It is joyful. There are probably 30 participants in the drum-laptop circle at a time, counting children and staff . . . . But people are coming and going, so there are more altogether, fifty perhaps. Leaf is at the centre in her orange striped shirt leading the rhythm with calls of "Play the drum! Play the drum! Play the drum!" Others take up the call and we have a beat, we have loudness, we have laptops. . . . Everyone in the circle is a part of it. Leaf is using the principle of the drum circle to create this community, and the Adaptive Use Software adapts the drum circle to everyone, even those who do not drum. There is so much going on at once. There is room for individual achievement, there are many moments of celebration for individual children, or the three children at the laptops (since these are quieter than the drums) but the overall feel is of connectedness, loudness, activity, community and play.[11]

One of the guiding principles of AUMI's use and development, then, is that anyone, even those with profound physical and cognitive impairments, can produce music and be part of a community in doing so. Students who are hearing and visually impaired have also had success in using AUMI.

Developing a PAR Approach

As the team in Poughkeepsie came together, they employed a methodology consistent with PAR. Indeed, there are a number of ways in which this project embraces the principles of PAR. It emerged out of the desire to address a particular problem,[12,13] that is, the inability of some children to participate independently in a weekly drum class, and it was and continues to be approached in a collective and collaborative way that includes the various stakeholders as research participants.[12,13] The approach has also been cyclic, a key component of PAR.[12] The problem was identified; a solution was developed in collaborative discussions among the therapist, the Director of DLI, and the designers at the DLI and RPI; a solution was implemented (the use of AUMI at the school); the researchers have reflected on the effectiveness of the solution, and continually refine the interface. For example, based on the collaborative use of the interface, and feedback from various stakeholders, the video

window has been enlarged so that it is easier for participants to see themselves while using the AUMI interface.

As indicated above, the inclusion of stakeholders as active participants in the research process is integral to the principles of PAR. In this research project, the stakeholders include the students, their parents, the teachers, and the staff, as well as the OT, the MT, the director of DLI, and the interface designers. In the research being done at the school, the students are not being positioned as research subjects to be observed. While the therapist does, based on her training, observe improvements in the students' range of motion, ability to concentrate, awareness of cause and effect, and ability to process sensory information, she is equally committed to interacting with them in determining the wide range of ways in which the students can use the interface and identify ways to improve it.

One of the complexities of a PAR approach in this project, however, is that many of the AFI student participants cannot speak, and consequently understanding their sense of how well the interface is working for them can be difficult. For students with greater mobility and cognitive function, the OT and the MT observe the duration of students' voluntary interaction with the interface and the particular sound samples they prefer (as evidenced by their response to such sounds through facial expression, laughter, vocalizations, and, in the case of some students, repeated selection of particular samples). In some cases, however, a student's interactions with the interface are passive, such as when the movement being tracked is involuntary chest movements caused by breathing; in such situations, understanding the user's assessment of the interface is more challenging but can sometimes still be ascertained by facial expression.

One of our goals, then, is to change the perception of who can make music, participate in a group, and contribute to a community. Indeed, the team embraces PAR's commitment to research that results in action that leads to social change, particularly for disempowered populations, and to new ways of thinking, based on principles of social justice.[12,13] One of the theoretical frameworks informing this project is the field of disability studies; this project is founded on the principle that all people have a right to "full and effective participation in society on an equal basis with others."[14] The interface is designed with that philosophy in mind. It is designed to adapt to the users, to provide the means for anyone, regardless of cognitive or physical ability, to make music in a community setting.

Review of Other Technologies

Other interfaces that have been used in therapeutic and educational settings range from switch devices to movement-tracking interfaces such as MIDIcreator,[15] which offers a range of switches and sensors, E-scape,[16] which uses switches, and Soundbeam,[17] which uses sensors. The technologies most similar to AUMI are the movement-to-music system (MTM)[18] and Virtual Music Instrument (VMI),[19] both developed by researchers at the Bloorview Research Institute in Toronto. Like AUMI, these technologies are based on camera tracking of participant movement, and the researchers report positive outcomes in the studies they have conducted. Tam et al[19] report that children were able to explore opportunities to play music that were previously unavailable, and reported that parents interviewed in the study observed improved psychosocial skills, body function, and family dynamics. Ahonen-Eerikäinen et al[20] observed improvements in the areas of visual, auditory, kinesthetic, and self-awareness, as well as enhancements to students' "physical, cognitive, communicative, emotional, behavioral, and social functioning." Like AUMI, the development of these technologies has included an emphasis on group dynamics. One of the differences between AUMI and these technologies, however, is that MTM and VMI have been developed with the intention of having students progress through music lessons and being able to learn to play recognizable melodies,[18,19] whereas AUMI has been developed with the intention of having students improvise with sounds as well as tones and rhythms. To facilitate the students' progressive ability to play recognizable melodies, M2M and VMI have employed geometric symbols identified with particular notes that students can then activate through movement to play a melody.[18,19] The research and development of AUMI have been based on its use for improvisation, and while the geometric shapes of M2M and VMI would not preclude improvisation, our researchers are less interested at this point in having students identify and play known notes (eg, to go from a C to a G) than in facilitating these students' ability to improvise in a collaborative community setting. Whether that means AUMI will continue to develop in very different ways from these other ones is difficult to say at this point, but our expectation is that it will since it is serving a different end. The next update, for example, will allow for playing intervals on the virtual keyboard, but not in order to facilitate students being able to learn melodies, but rather to enhance the possibilities for improvising (although playing notated music would also be possible with this mode). We will also continue to have the other modes that have no markers identified with a particular sound, but which rather allow users to activate a limited number of selected samples through movement tracked through the divided sections of the on-screen box.

One of the other principles of AUMI is that it should be able to adapt to any participant, no matter how severe the physical and cognitive impairments are. Our researchers have been able to track the movement of a participant's breathing—someone who had no other voluntary or involuntary movement. The level of control this participant has over the production of sound is obviously very limited, but it is nonetheless significant here that this participant did produce sound, something that this person had previously never been able to do, and furthermore was able to create sound in the collaborative community setting of the drum class. While it is difficult for us to do an objective evaluation of the positive effects of such participation on this participant, our assumption is that this is a very valuable social experience. Finally, AUMI is easily accessible from the DLI's Web site,[21] and there is no cost for downloading and using it, again distinguishing it from other technologies, such as VMI

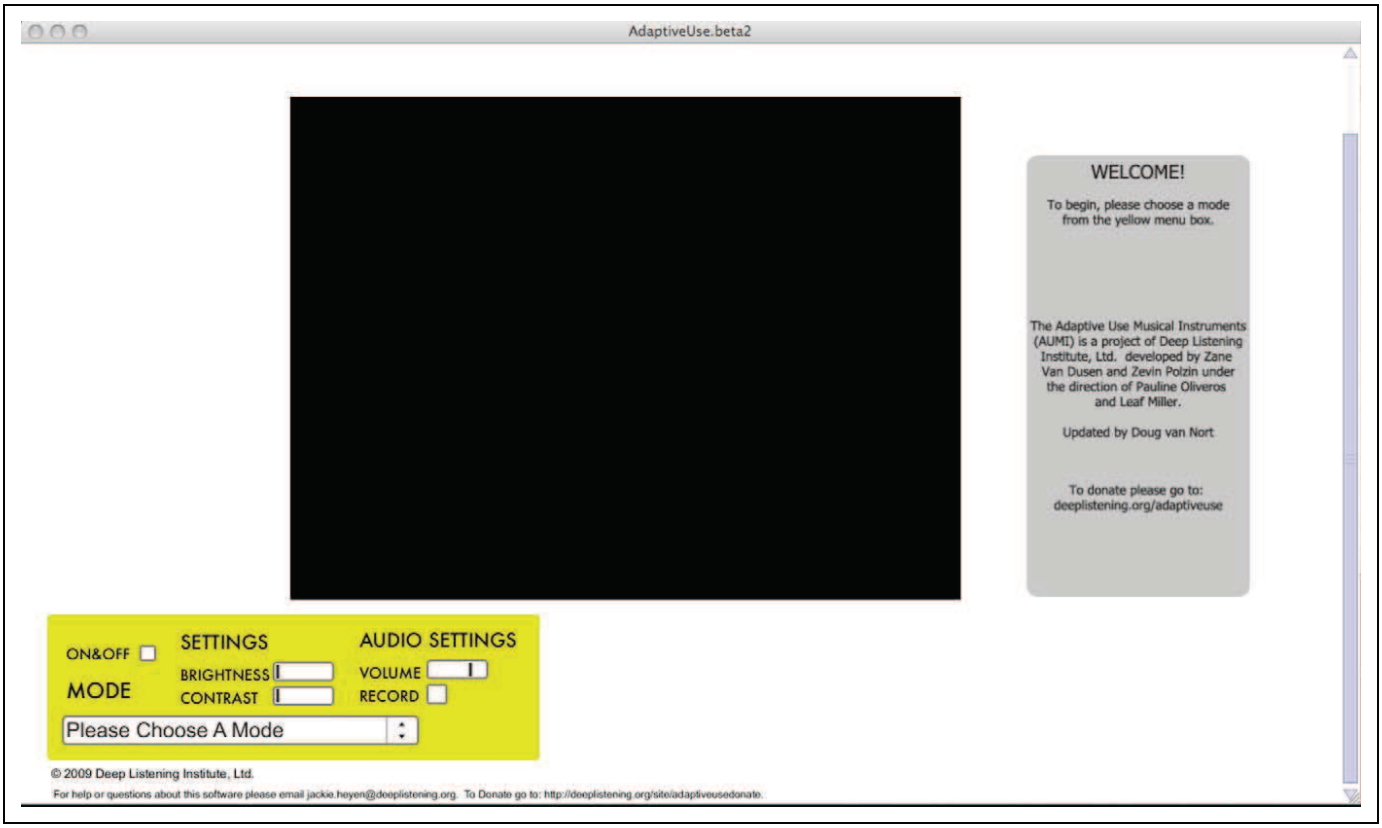

Figure 1. View of the adaptive use musical instruments interface when first opened.

and the Soundbeam. The research team intends to keep AUMI available for free download to anyone who wishes to use it.

How the Interface Works

The AUMI interface uses video camera tracking of the participant's movement to create sounds. The computer and camera are positioned in front of the user. When the AUMI interface is turned on, the user's image is shown on the computer screen. In most modes, the on-screen image is supplemented with a red dot virtual marker. Using a mouse, the red dot virtual marker can be placed over the part of the body that is to be tracked (a hand, a nose, etc) and will subsequently trigger sounds in real time when a participant moves the tracked part of his or her body. The software interface runs on Macintosh and PCs using an internal or external camera and speakers. Once set up, AUMI can be used independently by people of all abilities.

When the interface is opened, the initial screen (Figure 1) will appear. Four options will appear for selection of mode: keyboard, quarter screen percussion, relative movement percussion, and split screen percussion (Figure 2).

Keyboard Mode

The keyboard mode uses a red dot virtual marker to track horizontal movement. The red dot virtual marker is placed on a part of the body that has consistent movement. This mode is melodic with multiple sounds to choose from. There are options for selecting sound source, type of scale, and key.

Participant movement is tracked within the orange guide box. For the most successful use of the interface, the participant should be able to move the red dot virtual marker so that it reaches both sides of the guide box. The "Guide Size" setting adjusts to accommodate users with varying amounts of horizontal movement. Dragging the black line within the guide size box from left to right will make the guide box smaller or larger, respectively. The more limited the movement of the participant, the smaller the guide box should be. This can allow for very subtle movement to be tracked. For example, the AUMI team has successfully tracked a child's tongue and another child's breathing by creating a very small guide box and then clicking on the tongue or chest to place the marker (Figure 3).

Quarter Screen Percussion

The quarter screen percussion mode is divided into 4 sections with a box in the middle. Each of the outer sections plays a different percussion sound. The middle box is a silent zone; when the red dot virtual marker is within or crosses into this box, there is no sound. To make sound, the user moves the red dot virtual marker into one of the outer boxes, thereby triggering the sound. Moving the guide size to the far left will minimize or even eliminate the middle box, which is a desirable setting for beginners or for someone with very limited movement.

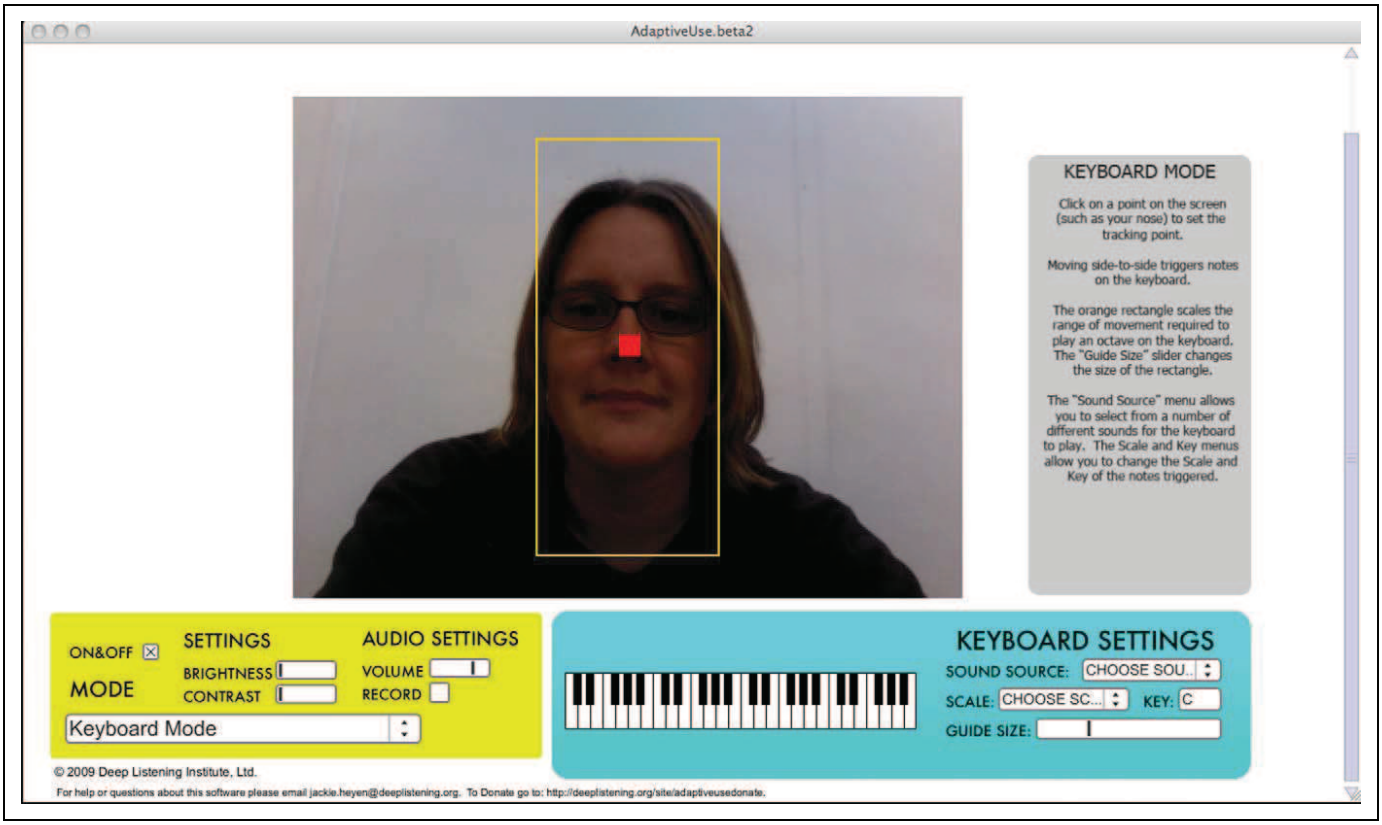

Figure 2. View of the keyboard mode.

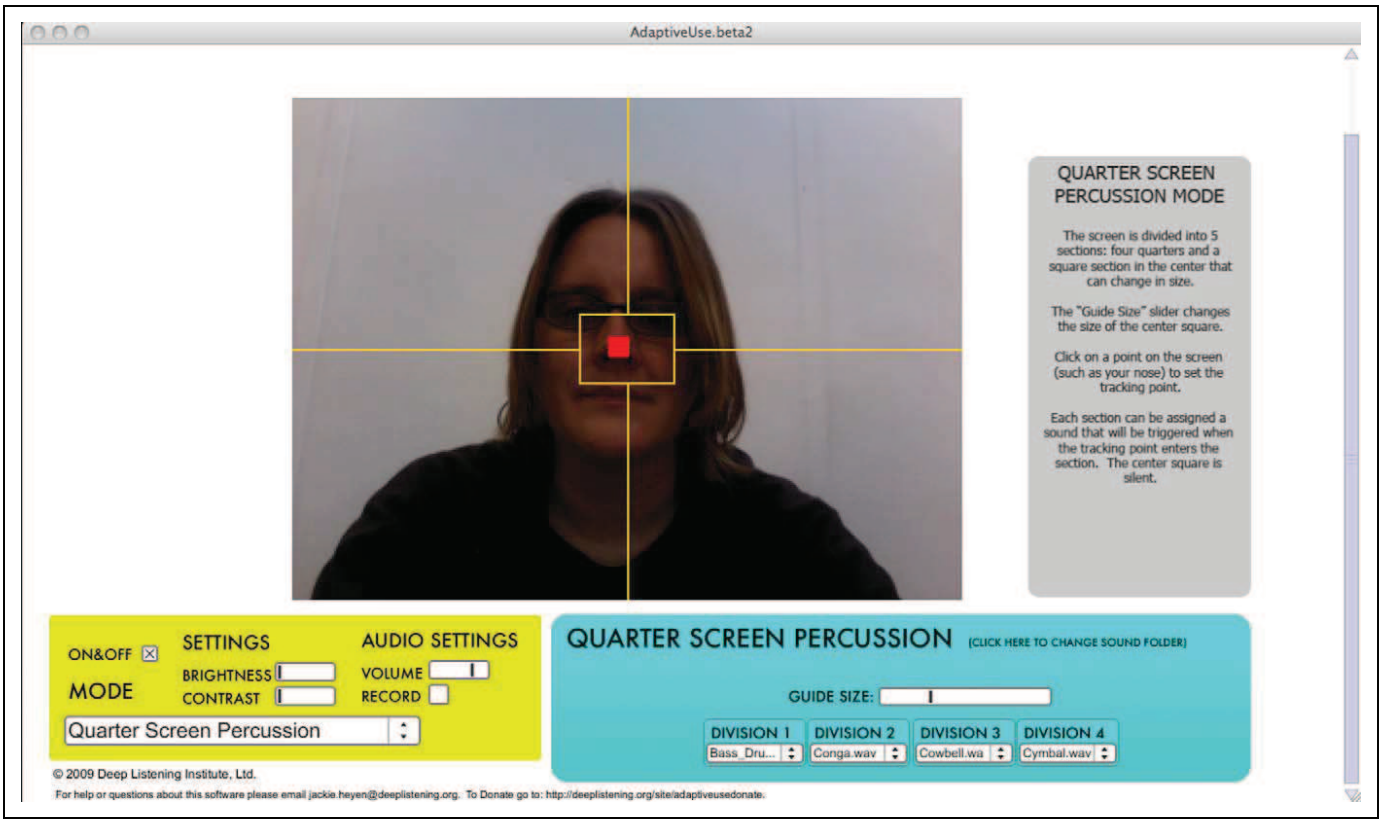

Figure 3. View of quarter screen percussion mode.

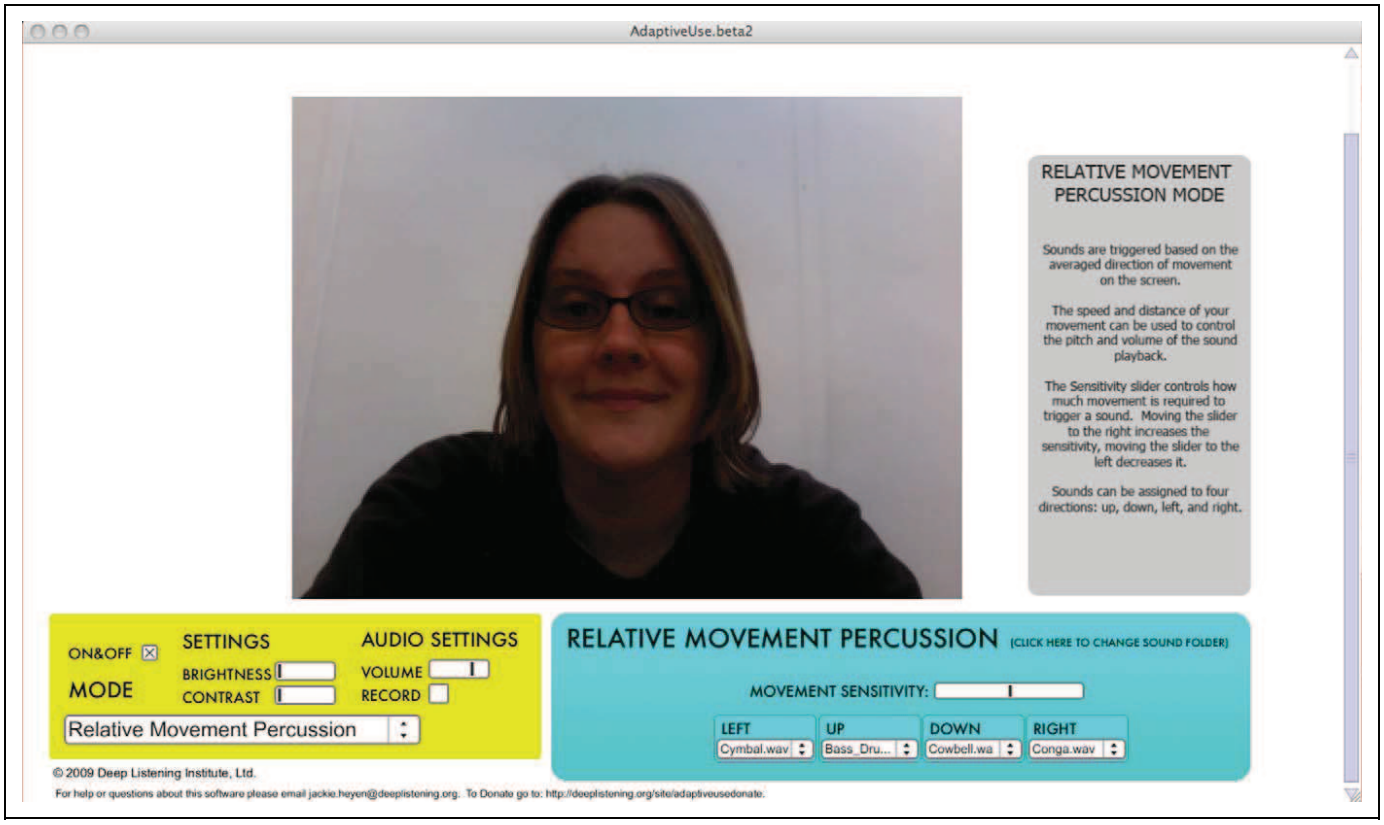

Figure 4. View of relative movement percussion mode.

The quarter screen mode also works well for a user whose movement is more vertical than horizontal. The user does not need to use all 4 squares for this mode to work effectively. For someone with limited vertical movement, the camera can be placed so that the user moves within 2 outside squares instead of the middle of the screen. The middle box is useful for more mobile users, since the user will have to reach outside the middle box to create a sound (Figure 4).

Relative Movement Percussion

Relative movement percussion does not use the red dot virtual marker. There are 4 sounds to set in this mode: left, up, down, and right. Once the sounds are set, the user makes sound simply by moving within the entire space of the box. The movement sensitivity of this mode can be set so that it is sensitive enough to track the slightest movement (such as raising an eyebrow) or less sensitive to make large movements trigger a sound (Figure 5).

Split Screen Percussion

Split screen percussion divides the screen into vertical sections, when the red dot virtual marker crosses a division and a different sound is triggered. This mode can use as few as 2 or as many as 8 divisions. This mode can also be used to track breathing and very slight horizontal movements. A user with limited horizontal movement using 2 divisions can become quite rhythmic. The AUMI team witnessed a user with slight but rapid horizontal head movements create very rhythmic percussive sounds that matched the group of drummers he was playing with. People with more mobility can use more divisions to trigger multiple percussion sounds by tracking their hands or body as they dance or move back and forth.

The AUMI Software Interface in a School Setting: Poughkeepsie, New York

Occupational therapists are dedicated to improving a person's ability to participate independently in daily life activities such as self-care, work, and play. The philosophy of occupational therapy is holistic in nature and creative arts modalities are often used to enhance therapy sessions. In addition to promoting self-expression, music can also be used to enhance many foundational life skills, such as posture, focus, and attention to task, and bilateral coordination.

In 2005, a musician and OT working at AFI started a weekly drum class. Students at AFI present with a variety of diagnoses, such as cerebral palsy, Down syndrome, developmental delay, and autism. In 2007, AUMI provided the opportunity for the AFI students, with a wide range of physical and cognitive abilities preventing their participation, to come together and play music in the drum class. Today, the AFI students and staff continue to contribute to the ongoing development, refinement, and improvement of the AUMI software interface. With the PAR approach, the students are an integral part of the research team, rather than participants to be observed or measured. For

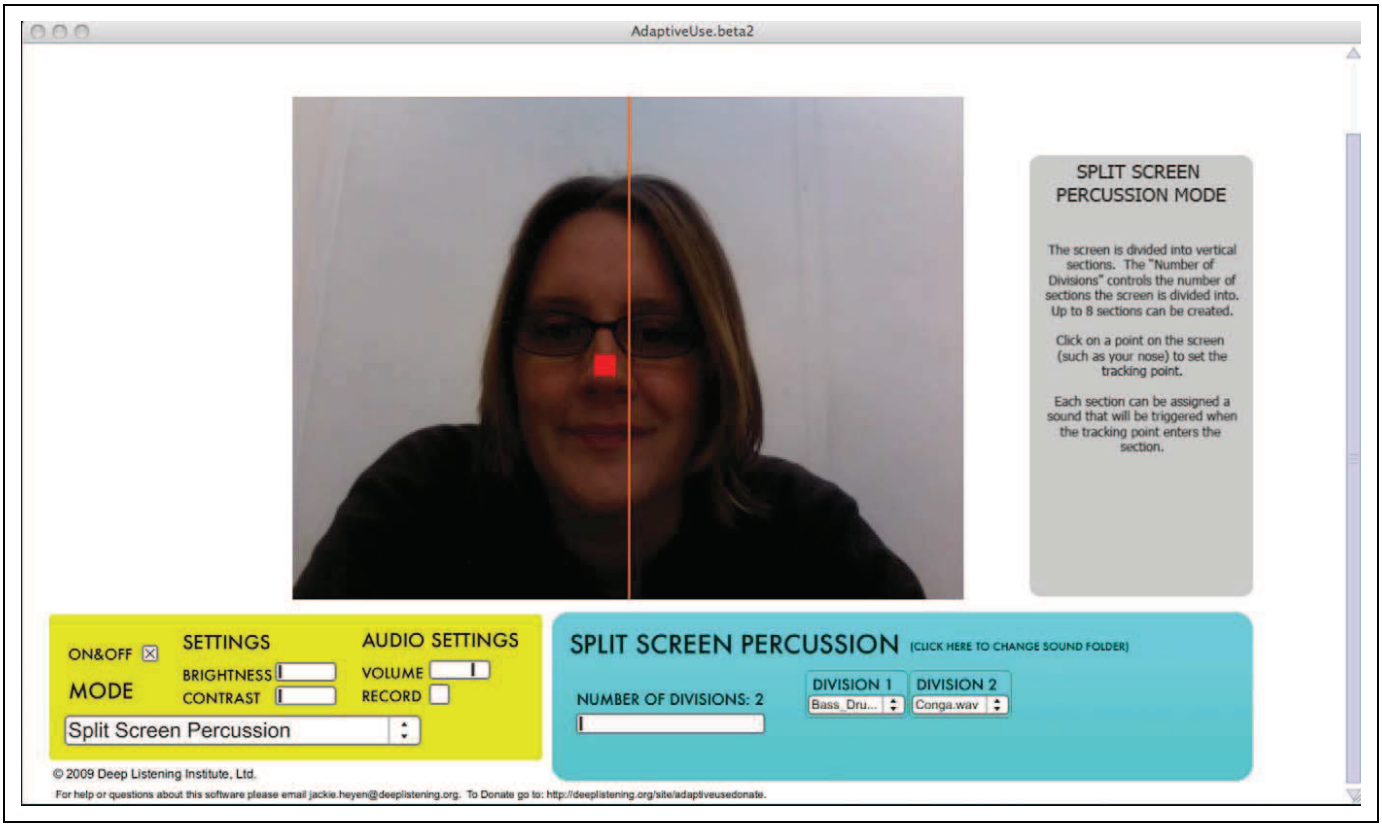

Figure 5. View of split screen percussion mode.

example, "S" is a student at AFI and was involved in the initial research and development of AUMI in 2007. S has made ongoing contributions as a researcher/participant, and S's input has been responsible for many improvements that have made AUMI more user-friendly and effective. Although S is nonverbal, her ability to use AUMI and give feedback is communicated through body movement, eye gaze, facial expression, and vocalizations. She continues to be a member of the AUMI team, as a musical improviser and participatory action researcher.

This combination of Occupational Therapy, drumming, and music technology encourages functional movements and independence through musical expression and creativity. In addition to the students' participation, the support and involvement of the school staff, therapists, and administrators have transformed this music class into a musical community that fosters inclusion and empowerment, breaking down societal barriers of ability/disability and challenging societal assumptions of who can be a musician.[22]

The following sections identify key points to using the AUMI interface and the observed positive outcomes (therapeutic and musical) for the students at AFI who are using the AUMI software interface during the weekly drum class.

Recommendations for Successful Use of the AUMI Interface

The posture of the user is of utmost importance for improved interaction with his or her environment. When a child in a wheelchair is well positioned, his or her ability to access the software is enhanced, encouraging good head and trunk control. Also, the height and position of the computer screen can be adjusted to the user to encourage improved posture and visual attention.

It is important to track one consistent movement at a time, such as a voluntary movement of the head or an involuntary movement, such as chest movement while breathing. Individualized parameters, such as guide size, sounds, and sensitivity, will enable the greatest self-expression and ease of use. It is also important to be patient and respect processing time; people with disabilities often process information slowly.

A team approach to using this software is extremely valuable. Involving students, parents, teachers, therapists, musicians, programmers, and technical support staff helps provide consistency in the students' experience of the software interface. The results of a feedback survey distributed to the classroom staff at AFI indicate that the teachers and therapists support the use of AUMI and appreciate the opportunity for the active participation and inclusion of their students in the drum class. School staff at AFI will be participating in an upcoming training program to encourage increased use of and familiarity with the AUMI software interface.

The OT also emphasizes the importance of celebrating and experimenting with the musicality of the software interface. The software interface is a musical instrument, and like any other musical instrument, familiarity and improved technique

will lead to more dynamic musical experiences. Since AUMI was designed for expressive musical improvisation, not for playing composed pieces of music, there are no ''right'' or ''wrong'' notes. Improvisation creates a welcoming musical environment. The use of the AUMI software interface with drumming provides a musical context and combination that is both effective and engaging for the students. World drumming traditions and styles readily lend themselves to playing music in community and collaboration. The drum circle is a community-based art form that encourages the participation of all.

Therapeutic Outcomes

The OT has observed a number of positive therapeutic outcomes in the use of AUMI: increased motivation and attention; improved multisensory processing of auditory, visual, and vestibular information; improved head control and midline orientation; improved dynamic movement control and expansion of movement repertoire; increased awareness of cause and effect; increased independence; active participation in a group; and enhanced interactions with others, including peers, family members, and school staff.

Musical Implications

Adaptive Use Musical Instruments promotes accessibility of musical expression for all people, regardless of the level of physical ability and builds new inclusive musical communities and musical collaborations.

The AUMI Software Interface in a Clinical Setting: Santiago, Chile

The Children's Rehabilitation Institute—Teletón (CRI-T)—provides comprehensive rehabilitation programs for patients with complex neurological disabilities. Its objective is to assist children and young people in the process of integration into family, school, community, society, and/or employment. An MT from Universidad de Chile downloaded the software in 2007 and, with some technical assistance from DLI, began using the AUMI interface in a therapeutic context. Adaptive Use Musical Instruments is used to contribute to and encourage the process of neurorehabilitation in functional and psychosocial aspects of patients with complex neurological disabilities in the CRI-T. With regard to functional aspects, the goals are to improve range of motion, muscular strength, and implementation capacity in activities of daily living (ADLs), and to encourage voluntary motor control. With regard to psychosocial aspects, the goals are to encourage attention and concentration capacity; communication and interaction skills; and to contribute to the reduction in symptoms associated with mood and anxiety disorders.

The program consists of a minimum of 16 sessions, each lasting about 40 minutes, twice a week. Four different methods are used: (1) musical sound feedback, (2) rhythmic auditory stimulation, (3) receptive and active music therapy methods, and (4) preparation techniques for ADLs performance.

Musical sound feedback is a technique and a concept emerging through clinical practice related to interaction from patients' movements with the AUMI interface. The therapist notes that sound can be produced even by the tiniest movement from the participant.

Rhythmic auditory stimulation is a technique developed primarily by Thaut, McIntosh, and Rice[23,24] at the Center for Biomedical Research in Music at Colorado State University that utilizes the physiological effects of rhythm on the motor system to increase the efficiency of controlled movement patterns during rehabilitation.

Receptive and active music therapy methods are related to classical methodology on this field. The receptive method mainly uses interaction and listening to sounds and music that is preferred by the patient. The active method mainly uses musical improvisation using acoustic instruments or the AUMI interface.

Preparation techniques for ADLs performance are related to the development of basic motor skills such as range of motion, muscle strength, eye-hand coordination, and cognitive ability to lead the intent and motivation to perform the task.

The clinical setting includes the AUMI Software interface, acoustic instruments, and electronic devices. The intervention system is based on 3 axes of actions: the functional axis, where the main activity is the gross and fine motor skills retraining; the psychosocial axis, where the main activities are focused on the improvement of cognitive processes, as well as reduction in associated emotional symptoms; and the technological axis, which is related to the role of sound and music technology in the therapeutic context, and has a transverse development through the overall clinical music therapy work.

The health team has observed that applying the AUMI interface in clinical music therapy has a positive effect. In relation to functional aspects, the team observed an increase in control and range in the voluntary movements of upper limbs and trunk, an increase in respiratory capacity, and an improvement in fine movements of head and neck. They also observed positive developments in psychosocial aspects: improvement in the capacity of attention and concentration; increase in motivation and willingness to do new tasks and learning; a positive impact on family relationships; and strengthening of self-esteem and personal capabilities including creativity, expression, and communication.

Improvisation, Community, and Social Practice: The Importance of Improvisation

In 2009, the DLI Director invited fellow researchers from the international Improvisation, Community and Social Practice (ICASP) research project to join her team in New York. The project's overarching hypothesis is that improvisation can be used as a model for social change. Improvisation's emphasis on careful listening in a collaborative context and its celebration of experimenting with non-notated sounds and rhythms

make improvisation ideal for fostering respect among its participants playing together as well as fostering new ways of thinking about sound and music. The ICASP project director asserts that "the most absorbing testimony of improvisation's power and potential may well reside in the spirit of movement, mobility, and momentum that it articulates and exemplifies. From the social relationships envisioned and activated through improvisational music making, we learn that in the ongoing search for new categories of momentum resides the hope that will sustain and empower us in our efforts to work toward a more inclusive vision of community-building and intellectual stocktaking for the new millennium."[25] The researchers from ICASP and the DLI New York team are working together to examine the extent to which the sessions the participants have with AUMI can not only increase their creativity and sense of autonomy concomitant with a strong sense of community—a sense of producing something new with others—but also enact the kind of community-building and intellectual stocktaking to which the ICASP director refers, particularly in the context of disability studies. In other words, they are investigating the extent to which improvising with AUMI serves not only as an opportunity for artistic expression for the participants but also as a form of resistance to the ways in which people with disabilities often get constructed socially as deficient, as having to adapt or be "cured" so as to have a "normal" body.[26]

That AUMI users are improvising, rather than playing written music, is crucial here. Lubet, who has written extensively on disability studies and music, notes that the emphasis of the western classical tradition on notated music excludes people with physical impairments (including many left-handed people) and argues that jazz, with its emphasis on improvised rhythms and notes is much more adaptable for people with disabilities.[26] He further argues that "disability activism demands for accommodation rather than 'cure.'"[26] One of the principles of AUMI is precisely that it is designed to adapt to the needs of those who use it. What the OT and music technologist are doing with the children at AFI and the MT is doing with the patients at Teletón works against the stereotypes that these people with disabilities cannot accomplish many tasks, cannot be creative, and cannot be participants in a community. It also works against the widespread notion that people with disabilities ought to adapt to the non-disabled world.[22,26] The joy, the creativity, the sense of participating in a community and the sense of independence experienced by AUMI users and those with whom they improvise indicate that the drum classes the AUMI team is running and the sessions the MT has with his patients constitute effective sites of resistance to dominant cultural assumptions about disability.

Conclusion

The AUMI interface was developed to enable people with little to no voluntary mobility to participate in improvising music. Both the OT in Poughkeepsie and the MT in Santiago observed positive effects in participants using the interface. These somewhat subjective observations will be supplemented by a new function in the next update of the patch. It will include data-gathering functions that will measure all of the movements of the user globally and in detail. Preferences of the user will also be noted. The data will be collected and compiled in a database specific to the user. The user will be recognized by the patch so that previous settings can be invoked automatically. Reports specific to a session will be printed out for the teacher or therapist. Over time reports could be compiled by software for comparative results. The next update will also include improved attack and interval skipping on the keyboard. There will also be a data output from the patch to run other external software or devices.

Attempts have also been made to gather data from those who download the software. There have been over 400 downloads of the software, but only a small number of people have forwarded data to the research team. We will be continuing to encourage people using the software to provide us with data that can assist us in refining it. In the meantime, we have taken account of the feedback we have received, and it will assist us in making the refinements outlined above.

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