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Communities of sound: Examining meaningful engagement with generative music making and virtual ensembles.

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ABSTRACT

In this paper, we examine the affordances of the concept of 'network jamming' as a means of facilitating social and cultural interaction that provides a basis for unified communities that use sound and visual media as their key expressive medium. This article focuses upon the development of a means of measuring social and musical benefit through correlation with meaningful engagement and provides examples of inclusive ensembles and the specification of musical knowledge through algorithmic and educational experience design. This research builds on the design and development of the jam2jam 'family' of generative software and hardware applications. An emerging theoretical model for observing meaningful engagement in community music making is examined against three case studies selected from a larger scale long termed research project. In this analysis of case studies we specifically employ an observational tool called the meaningful engagement matrix, discuss its development and describe how it functions to feed back data which informs software development, theories of social engagement and experience design.

Keywords

Meaning, engagement, generative, virtual, network, ensemble.

Introduction

'Communities of sound' is a term we use here to describe a community where sound or music is central to the expressive relationships between people in a community. As our research deals with both present and virtual social networks we are faced with discussions about how the virtual extends present relationships and communities how virtual communities exist and what value they have in social life. Community music has multiple definitions but the commonality is that music is important in facilitating relationships between people in expressive ways that also define and articulate the identity of a community and the individuals within it in ways that are different to language based relationships. Working with virtual music making provides us with both a different kind of 'community' and an amplifier for

present communities, so we can see what the qualities of music making experience and practice are that underpin these relationships and their meaning for social life. With virtual environments musical practices like 'improvisation' and musical structures like 'small ensembles' can be seen almost as a model of the present practice and we can focus on the qualities that these practices contribute to identity and community.

In this article we build on the argument that generative arts tools can support creative participation in community music settings and have the potential to enhance people's capacity to participate in meaningful cultural activity (Adkins, Dillon, Brown, Hirche, & Gibbons, 2007). The focus of this research is about increasing access to meaningful music making experience. Participation through engagement is as much about social capital as it is also about collaborative music making and well-being, and is perhaps fundamental to all community music experience. When we increase access to musical experience, we also increase the access to the embedded knowledge within the music itself and the potential for meaning making and personal growth. Over the past seven years our team of researchers has examined generative music making instruments with several thousand young people in four countries. When the jam2jam software was first developed in a community music setting two philosophical perspectives were applied to the design: one concerning creative engagement (Brown 2000; Brown 2003) and the other the meaning of music to children (Dillon, 2001), which we have combined into a theory of meaningful engagement. As research on generative systems widened and lengthened we became increasingly fascinated by how we might observe and measure meaningful engagement. This article recounts the story of research that involves observing meaningful engagement with music using generative technologies or new instruments and how the analysis of those observations has been fed back into the development of generative software instruments, the design of musical experiences, and the pedagogy for creative social relationships. In short, the whole Community music experience, even the development of new instruments. In this article we would like to begin by defining the process of generative arts, outline the jam2jam research project and our use of the meaningful engagement matrix, and then examine three case studies that contribute to our emerging understanding of the value of collaborative 'jamming' as a means of building relationships and identity through experience with generative music making.

What is generative music and why use it in Community settings?

Creating music through generative processes has a history reaching back at least to "Mozart's

Dice Game" where fragments of music were assembled in an order decided by the roll of a dice for performance, a process that provided numerous variations and combinations (Jones, 1991; Sohne, 1993). In this project we use computational implementations of similar generative processes to create music and media software 'instrument' called jam2jam. With this software users can play a software instrument with a mouse or simple MIDI controller to 'generate' complex musical improvisations in real time. Users can connect several jam2jam applications over a computer network to a group of other users in an ensemble performance. The focus of our technology development is to facilitate performance and the social/ensemble activity and interactivity. We have worked through several iterations to design an accessible interface for experiencing the complex interaction of ensemble performance or jamming with others. It is worth noting that most other music and visual arts technologies are generally solo or individual activities rather than collaborative and the creative activity is often focused upon recording and exhibiting (production) rather than real time performance. The jam2jam generative processes allow access to collaborative activity with a 'low skill' entry point to make high quality music/visual presentations in a performance that replicates DJ/VJ performance or live instrumental jamming between musicians. Generative processes are, by their nature, based upon a 'set of natural language rules' and in the cases described in this article these rules were often determined by asking the users in the community what sounds, styles and images they valued. These cultural materials and the possibilities of creating with them are encoded within the rules of the generative algorithm. We have observed that when users play a part in deciding what sorts of rules and materials (the sounds and images) the software uses, their experience is one that they are more likely to value and have an opportunity to expressively amplify in a collaborative performance. What this enables is a highly engaged communicative musical improvisational experience that musicians know as jamming or group improvisation, where musical ideas are communicated between players as a distinctly musical experience available to even inexperienced musicians.

A brief overview of the Network Jamming Project

The Network Jamming project examines how to create meaningful and engaging creative activities based on generative music software that exploits an online environment. In particular the project has produced the Jam2jam suite of software and hardware applications where users manipulate media through a series of simple controllers such as real or virtual sliders or via a computer game like environment where the movement of icons in space

effects changes. The use of computer-based systems to aid composition is not new. Jennings, in his study of the use of graphical interfaces for music composition, proposes that the value of such systems “may lie in their ability to present alternative, intuitive notational forms as a vehicle for directly manipulating sound without the need for note reading or instrumental skills, facilitating musical reflection and action for both student and teacher” (Jennings, 2006 p.31). Whilst this description aptly suits jam2jam, this software differs from other computer-based music systems in that its integral focus is on improvising or “jamming”, on music-making via spontaneous performance rather than planned composition. Hence jam2jam is a tool, which enables users to intuitively create music, but experience the personal, social and cultural types of meaning experienced by active music-makers. Jam2jam utilises generative content and uses computer processes to facilitate musical changes based on a stylistic algorithm. More recent iterations of the research have also incorporated movie and still picture images which users can transform in a 'photo booth' style set of transformations reminiscent of Andy Warhol's installation but as a live VJ (Video Jockey) performance (http://www.qag.qld.gov.au/exhibitions/past_exhibitions/2007/andy_warhol). Interface gestures facilitate changes in the density or complexity of musical activity, volume and timbre or combinations of visual effects. What is unique about it is that it is collaborative. A small group of players can play in a virtual ensemble easily and without much musical or video knowledge or experience. We call this type of activity Networked Improvisation (Brown 2006; Brown & Dillon, 2007; S. Dillon, 2006) or simply use the musical metaphor of 'jamming'.

The technical development of these applications originally used a Java programming language (Sorensen, 2005) and the more recent versions use a new development environment called Impromptu (Sorensen & Brown, 2007). The design is influenced by emergent theories that identify and examine the modes of creative engagement of contemporary composers (Brown, 2000, 2003) and a proposed a model for observing the location of meaning in musical experience (Dillon, 2007; 2001). Successive iterations of this research merged these theories into matrices that have been applied as an observational and analytical tool for meaningful engagement with the software and experience design. Over the past two years this model has been tested against a large body of video data collected in field trials that documents users interaction.

Meaningful Engagement

Musical experiences are often valued for the ways they affect a sense positive well-being while participating and facilitate an expressive involvement in a community. The theory of meaningful engagement aims to clarify our understanding of these experiences and how and why they occur. This understanding also informs our ongoing design of new instruments and activities with the view to maximising these positive experiences. There are many ways to participate in music making, through composing, performing, conducting, recording, listening and these roughly correlate to the different modes of engagement. In our previous research we have seen that a comprehensive musical understanding arises from having a broad range of engagements with music, each of which brings a unique perspective contributing to the development of rich musical knowledge. The modes of creative engagement are listed below. Often a large part of the reason for continuing with music making is because of the enjoyment and meaning it provides. Three aspects of musical meaning have been characterised: firstly it is important that the participant takes pleasure in making and controlling sound, collaborative music making is a great means of interpersonal communication, and our communities value musical talent and participation as a way of continuing and progressing our culture. We have listed these types of meaning below.

The meaningful engagement matrix is a way of visualising these aspects of musical experiences (see figure 1: (S. Dillon, 2006, 2007)). It has emerged from successive iterations of our research to provide us with a lens to examine how participants interact during generative arts making experiences. It has also allowed us to identify the location of meaning and build understandings drawn from these observations into teacher/ coach behaviour or experience design planning. In the next section we will describe three case study experiences involving separate versions of the jam2jam software instruments focusing in particular on the ensemble or jamming experience. Each case offers emerging perspectives that were fed into subsequent designs and provide us with critical perspectives on the research tool and the nature of the activity itself.

[Insert fig 1 here]

Figure 1. The Meaningful Engagement Matrix

Modes of Creative Engagement

- Appreciating – listening carefully to music and analysing music representations.
- Selecting – making decisions about musical value and relationships
- Directing – managing music making activities
- Exploring – searching through musical possibilities and assessing their value
- Intuiting – participating in intuitive music making

Types of Meaning

- Personal – the activity is intrinsically enjoyable.
- Social – through activity the user develops relationships with others.
- Cultural –by participating (or succeeding) in activities valued by the community, the student achieves a sense that they too are important.

What follows is a brief summary of each case and a discussion of what the use of the meaningful engagement matrix revealed about the phenomena of interaction and how this translated into software and experience design.

[Insert fig 2 here]

Figure2. Jam2jam grey (Download a copy: <http://www.explodingart.com/>)

Case Study 1: Jam2jam Grey

The ensemble experience with jam2jam grey has evolved over six years of observations in three countries with children aged four to sixteen. Primarily in these short-term trials players demonstrated clear personal and social meaning with cultural meaning observed when the improvisation was performed in front of an audience of peers or family or recorded. We noted that engagement focused primarily around 'exploring' and 'appreciating' because the relative complexity of the interface caused activity to swing between these modes of engagement. 'Selecting' and 'directing' appear to be more closely associated with moderately advanced users who planned structures and performances while 'intuiting' experiences arise with advanced users and were usually facilitated by a teacher or music coach. These observations have implications for how a teacher/ coach plans for increasing the challenge of the performance over longer periods of time and looks to provide opportunities for including selecting and directing in these processes. It is worthwhile pointing out that in an

improvisational setting for 'expert' musicians, the modes of engagement principally cluster around exploring and appreciating but as the jam becomes established other modes of engagement such as intuiting and directing become more obvious as a sense of consciousness and control and communication emerges. The modes of engagement in the matrix are often interrelated; and the presence of one particular mode may depend on the presence of others. Similarly, the presence of personal meaning in the matrix may in turn lead to the presence of social or cultural meaning. During trials of jam2jam grey, many instances were noted in which exploration on the personal level apparently motivated the participant to share with others. Typical indications were the swapping of headphones or showing/describing what they've "discovered" to another participant.

As you can see in figure 2, jam2jam grey features a chat box, which was originally included to encourage musical discussion while the music is in progress and for Wide Area Network communication between players. What was observed, however, was that student activity became more like an MSN chat with music in the background. This suggested that we needed to look at building upon the natural activity of playfulness with 'chat' and social networks, and also led us provide options to hide the chat window if it was not required or desired. Students are engaged with online chat in their lives and we needed to have teaching/facilitating strategies to turn this into a functional and educative process that builds upon this natural engagement. Students found this messaging function engaging and teachers commented that it had potential for literacy development. The observed students were involved in a multi-tasking shift between social chat and music making.

The styles built into this model were based upon players' preferences for grunge, hip-hop and dance styles. Broad possibilities of changing these styles were available allowing the discovery of other styles embedded within. For instance, users exploring the tempo aspects of the style discovered that slowing down the hip-hop style resulted in a groove not unlike reggae. These kinds of insights about the relationships between styles and the syncretic evolution of popular music suggest a deeper experience of musical knowledge embedded within a very simple environment. Professional musicians might only gain this kind of insight after years of playing, analysing and listening. Pedagogically, teachers and coaches were able to use the software to teach ensemble skills of listening and performance planning as well as using the generative nature of the software to allow discussions about the music whilst it was playing, thus drawing out the musical knowledge inherent in the style. It was this idea of

framing learning around the parameters of style that led us to consider the idea of a networked improvisational musical environment as an interactive listening and ensemble experience. What is suggested here was that the musical knowledge could be embedded within the algorithm, the learning design could revolve around drawing this knowledge out, and developing a language around its understanding. It was this idea that has led us to develop a simpler interface that focuses upon two aspects of musical knowledge whilst still facilitating the social ensemble experience. This kind of interface was aimed more squarely at younger children and disabled people.

[Insert fig 3 here]

Figure 3. Jam2jam blue

(See Documentary: <http://networkjamming.com/about>)

Case Study 2 jam2jam Blue: More like a game

The jam2jam blue interface grew from analysis of the use of the grey interface and in particular its use by younger participants - this is what led us to intentionally remove most of the on-screen text labels and the text chat facility, and to give it a simpler, colourful and more game-like appearance. With jam2jam blue, vertical movement of the instrument icons affects volume whilst horizontal movement affects the complexity or density of the instruments' activity. Greater activity to the extreme right and less activity or simpler playing to the extreme left. These changes involved quite a drastic reduction in complexity, and hence control, but worked well for the younger users in particular. We also changed the underlying generative music engine with this version to make it easier to create new musical styles to interact with. Instead of an entirely algorithmic description of the styles they were based on a series of specially written MIDI files that were manipulated to provide the variation in musical parameters. Given that only two musical parameters, loudness and density, were used these modification algorithms were not extensive. These changes to the generative processes were not evident to the user but made the development of additional resources much more efficient.

With this iteration of the network jamming research we wanted to capture the user experience in more detail than the usual ethnographic and video strategies and to the development of a

more compelling data collection method that was able to capture the personal, ensemble and computer interactions. To do this we used what we called 'Kid-Cam'; a multi-video camera-capture set up that recorded the performed sounds and screen activity, the child's face as they used the instrument alongside an overall video camera directed at capturing the group's activity. These data were then annotated and coded using Interact software (2007) that allowed us to code and meta-tag multiple instances of audio-visual data. This method enabled us to track detailed observations of interaction and to analyse musical development (Adkins et al., 2007). Subsequently with this approach we observed a strong emphasis on the exploring mode of engagement correlated with personal, social and cultural aspects of the matrices and were able to gain detailed analysis of the nature of this kind of discovery approach to learning within a focused and bounded environment.

The jam2jam blue interface has also provided an effective means of reflection, especially for younger and/or novice participants. In the following excerpt, #2 was asked by the researcher to demonstrate what happens when the icons are moved up and down. #2's response involves using the graphical interface as a kind of musical map or diagram and in turn this causes #3 (his brother) to respond via his interface, so that #2 is simultaneously jamming with his brother and reflecting on his musical experience.

(0:21:14.4) 2 (looking at screen, hands using touch-pad): "OK. OK, let's say I grab the drum" #2 moves drum icon to top of screen, #3 moves keyboard to behind guitar, then guitar up and down to the left, leaving it at the bottom of the screen, approx 2cm to left of centre)

(0:21:19.9) 2: "When you get higher it gets, (moves bass to left, approx 2cm from top left corner) it gets, what do you call it? (Gestures with hands, then puts hands back on touch-pad) Louder."

(0:21:27.3) 3 moves guitar to top right, approx 2cm lower and 1cm to the left of the top right corner.

(0:21:28.4) 2: "When you put it this way (moves drum icon to the right, towards top right corner) it gets (icon in top right corner) faster."

(0:21:32.5) 3 moves keyboard to top left corner.

(0:21:34.2) 3 moves keyboard to right side, nearly halfway down.

(0:21:34.2) When you go this way (2 moves icon towards top left corner, while 3 moves keyboard down to bottom right corner) it gets slower." (Transcript of Interact video sequences)

This excerpt highlights an incident noted frequently by the researchers when a participant was asked to describe/explain the effect of moving the icons from left to right. The participants could demonstrate knowledge of a musical parameter and yet apparently did not have the appropriate terminology to accurately convey their understanding. In the above transcript an increase/decrease in density (complexity) of sound is described as faster/slower. What we observed here is not simply what Schon (1984) describes as reflection on action and in action but *through* action. In this incidence music is not an ephemeral activity where we discuss it or write about it after the event but a dynamic one, which has the qualities of 'real' musical reflection where musicians are able to discuss music by demonstrating musically. Music is present in the conversation about music. It is not musical practice to write in a diary after or during a rehearsal it is more likely that a conversation will occur during the rehearsal or with an artifact of the music present in the conversation. Reflection in musical practice refers directly to music as present sound or through some representation that enables a musical conversation in music, a symbol system or a recording. What the above segment suggests is that network jamming affords this kind of reflective process and that this holds great potential for educating musical thought and action. With community music this understanding about the qualities of reflective practice with music present in the process contributes to engagement and the pursuit of quality of musical expression and understanding that helps participants to sustain engagement and interest and increase the quality of their musical and social relationships.

Multi age ensembles

jam2jam blue design seemed to support multi-age communication. Parents and young children sat at the computer playing together, as did siblings and children with grandparents. The observation showed consistently how the accessibility of this version of the jam2jam interface facilitated cultural and social meaning. The two dimensional interface of jam2jam blue spawned comments such as, "It's like I was running around the stage" and triggered friendly user rivalry as two players competed to control the same instrument (See an example of this in the documentary). The absence of on screen language showed the potential for inter-cultural and non-speech communication amongst participants whilst encouraging present communication between players in the same location.

15 seconds of fame

With jam2jam blue the experience design focused on the ability for users to describe what was happening with the two focused activities of volume and note density. Initial analysis suggests that recognition of 'density' rather than tempo increase was recognizable around ten years of age. There is a question that arises about musical knowledge as a developmental perceptual framework, which could be explored here. This iteration of the research allowed us to focus experience design around two simple musical concepts and then develop language and musical knowledge around ensemble experience. Also consistent with our experiences of observing 'natural' or playful behaviour that was often unexpected observation of intrinsic engagement we observed an instance following our research field research that led to an even larger change in our approach and design. Following one session we observed participants spontaneously playing with the Apple computer Photo-Booth software. Shortly after this experience an Andy Warhol exhibition opened at the Brisbane Gallery of Modern Art (http://www.qag.qld.gov.au/exhibitions/past_exhibitions/2007/andy_warhol) researchers reported the long lines of people of all ages experiencing the photo booth installation where they played with still images of themselves and printed them. One researcher reported that his own child had over 400 Warhol style photo booth pictures on their home iMac. We wondered at how we might also employ these intrinsic visual aspects to the learning experiences and also affect a focus on personal identity in this process. Once more our focus upon how, why and where engagement occurs led us to try to bring this kind of engagement to the jamming experience. What if we could jam with images as well as sound like VJ's and DJ's do at dance parties?

Case Study 3: AV Jam

[Insert fig 4 here]

Figure 4. AV Jam

(See examples: <http://www.jam2jam.com/>)

AV-jam introduced two major new changes, physical controllers connected to one computer (rather than use of a mouse on several computers) and the introduction of generative video mixing to accompany the generative music. AV-Jam consists of an Apple iMac Computer, 5 USB multi-slider control surfaces, speakers and the AV-Jam software. ACID Research fellow

Andrew Sorensen wrote the AV Jam software for the project and this marked a shift in our computational development environment from using the Java language to a Scheme language in a development environment called Impromptu. With AV-Jam users collaborate using music-video environment that generates music in real time so that users can jam/improvise with bass, drums, harmony and solo synthesizer sounds and simultaneously process video using the built in web-camera. Players use USB controllers that look like mixing desks with sliders and dials, which are assigned specific functions and expressive parameters. The sound source in this iteration also marks a shift from the low quality sounds provided by the Java environment to a professional sound sample engine enabling the system to sound like a professional band rather than a computer game. These sounds were implemented partially to appeal more directly to 'style conscious' adolescents. We observed that adolescents were unlikely to play with the software at all if it did not make sounds that they valued. In this version the collaborative audiovisual improvisations made by groups of 'jammers' can also be captured and stored for replaying. This software is aimed at adolescents and field trials have focused upon use with disaffected and disengaged youth in multi cultural and Indigenous Australian urban communities. These groups were selected specifically to examine the potential effects upon youth identity and self esteem and to see whether the process and software was able to be engaging to youth who had been disengaged with mainstream learning and community participation.

The ensemble experience with this software is, firstly, more complex in appearance. Typically we observed that adults seemed reticent to use it despite its relative simple use of gestures. The physical sliders and more professional sound engine perhaps reinforcing the 'I'm not good at music' or 'technology frightens me' stereotypes. Youth involvement with the software varied from creative use primarily involving intuiting and exploring modes of engagement across personal and social domains of meaning. In some contexts there was a fear of public performance perhaps due to the reinforcement of participants experiences of 'failure' with other learning. It was only when we incorporated the AV capturing capacity to record a video clip of the performance that we observed stronger cultural meaning that emphasised appreciating and directing. This function allowed the capacity to jam and review the jam and then collaborate on producing a more refined product. It enabled a more compelling mode of reflection and allowed a developmental approach to ensemble experiences that contributed to self-esteem alongside a capacity to document improvements in the musical outcomes. Pedagogically, we were able to focus experience design around musical structures in time,

texture, density and volume. The visual function, which pulses with the music, stimulated interesting live visual input such as using Indigenous Australian dot paintings as source material for the vision, colorful shirt designs, and book covers from the library shelf. It facilitated a kind of found object visual improvisation. Because the recorded product can be exhibited on sites such as YouTube we were able to tap into an even more interesting public performance outcome that has wider implications for cultural meaning. This iteration of jam2jam software development marked a new kind of instrument, which has both audio and visual materials in its design. AV Jam can be both a virtual ensemble and an audio-visual installation (see installation: Sydney Powerhouse: beta_space February-March 2008: <http://www.explodingart.com/networkjamming/>). One only has to consider the replacement of USB controllers with wireless controllers like Wii's or iPod touch and the thought of a player controlled dance party or user controlled musical environment is possible and imminent.

Computer as xylophone

jam2jam is essentially a software instrument. Through a graphic or physical user interface it allows users to make music collaboratively using a computer. Metaphorically we could describe it as the Xylophone of computer music. Just as orchestral xylophones and percussion instrument were recognised by the developers of the Orff method (Orff, C. & Keetman, G. 1958-66) as being intrinsically motivating instruments for children when reduced to a manageable size. The Kodaly method for example has also used games based learning in music education (Kodaly, 1974) and with jam2jam we recognise that computer games and computers hold a similar intrinsic value for children today. With jam2jam AV we add a physical controller in the form of 5 small mixing desks each connected to an instrument function. The jam2jam AV version integrated the 2D interface designs from jam2jam blue with the audiovisual integration from AV-Jam to produce a networked audio-visual jamming system. The jam2jam AV interface merges concepts from jam2jam grey and blue. It retains the 2D layout and interaction style from blue but re-introduces the ability to select and control a wide range of musical parameters, as available in grey. Learning from our experience with offline and ongoing conversations and reflections on music products and processes we have also incorporated a social network framework to increase the access to cultural meaning for participants and user led content creation. (See examples at: <http://www.jam2jam.com/>) This site allowed users, and groups of users, to create a web page where they could display their recorded jam "clips". There is a facility for people to comment and rate each other's jam clips,

and for users, facilitators or teachers to share their ideas, experiences and resources through a jam2jam online forum. This also builds on observations about how young people use social networks such as Facebook, Youtube and Myspace to build on natural intrinsic engagement. The meaningful engagement matrix provided a framework for these observations and has influenced the design of these instruments and the approach to pedagogy and experience design.

From a technical perspective this version of jam2jam rewrote and extended the generative music engine from jam2jam blue. It developed and implemented algorithms to transform the MIDI file-based style material along many more musical dimensions, and utilises specifically developed audio library allowing the professional quality of audio found in AV-Jam without relying on commercial software synthesizers. It also employed synchronised video mixing processed based on those used in AV-Jam.

What we have learned.

What we have learned through these experiences are a number of things that refer primarily to the observation and facilitation of meaningful engagement. Firstly, that for the full range of engagement to unfold ensemble experiences needs to be pursued over longer periods of time – typically several sessions. Methodologically we have dealt with this recently by refocusing our attention on the group experience rather than the individual's engagement with the interface, which now seems to be well established. Long-term engagement will be dependent upon experience design that highlights the development of ensemble skills as a social outcome and the development of associated language to draw out and make musical language more conscious. Engagement is highly related to challenge and what Csikszentihalyi describes as a flow experience (Csikszentmihalyi, M.1994) and the experiences with the software seems to provide an abundance of this kind of effect. The idea of flow is inextricably linked with happiness and intrinsic engagement and a sense of extreme focus. With adolescent and disaffected youth we noted that the 'sound' - as a feature of a recognisable style - was particularly important and seemed to resonate with personal identity and ensemble relationships. The directing mode of engagement emanated from those with leadership roles, this was particularly noticeable amongst adolescent players but also noted amongst multi-aged groups where older siblings took on leadership responsibilities.

Our work with 'disengaged' adolescents drew attention to cultural meaning or performance as a potential problem even with 'fail safe' equipment. It was suggested by social workers involved with the projects that the player's history of perceived failure compounded by adolescent identity issues affected the willingness to perform even within the relative safety of a community setting. Recorded work was preferred in this context as it allowed the expressive product to be monitored and edited, appreciated and selected. This poses a question about what and for whom performance serves in this context. For example, public outcomes may serve as indicators of institutional prestige but may be detrimental to participant's self-esteem. The capacity for the jam2jam software to record and review was an important addition to the experience design that enhanced opportunities for cultural meaning and pedagogical application.

Through these case-studies we have described how different interfaces can effect the engagement of users, leading to differences in their musical experiences. In particular we have responded to differing age ranges with a variations in complexity, virtual control metaphors and physical control devices. We have responded to the strong integration of audio and visual media in youth communities by integrating music and video creation in to the one-synchronised performance experience. We have also focused more intensely on media-based expressions by taking out almost entirely any reliance on text in the software design, which also has the advantage of better suiting our increasingly international research reach. All along, we have maintained a focus on maximising meaningful engagement through observation through the lens of the meaningful engagement matrix, and continual refinement of the software and ways in which it is used.

Ruthmann (2008) stresses the importance of pedagogical feedback and discussion beginning from the student's perspective, and of having music present in the discussion about music. The new interface offers the ability to "relive" the musical experience, the icons showing in real-time a moving map/diagram of the decisions made by the jammer(s). According to Blair, "the process of creating a musical map serves as a form of inquiry, enabling understanding of an experience and affecting change in self through the living and constructing of the story and affecting change in others through the sharing and telling of the story" (2007. p.1)

What we have also noticed about network jamming is that we are gaining a new understanding about the qualities of 'jamming' as a means of facilitating both a social and a

pedagogical understanding for users. What had been reserved for an elite musical interaction between professional players able to intuitively and articulately communicate with each other and create a complex interaction of musical expressiveness and identity seemed to be available to the novice user. Network jamming affords this kind of relational experience in a community of sound.

Conclusion

What has been presented here is a longitudinal overview of our network jamming research, a kind of meta analysis, which reveals our understanding of meaningful engagement with generative music making accumulated over many years. What emerges from this process is a growing understanding about how we can build engaging and meaningful networked environments where players of all ages can experience creative ensemble performance with relatively little artistic expertise. We suggest that when we can give access to musical experience we also provide access to the embedded knowledge and social/cultural experiences that music making affords. With this research the meaningful engagement matrix has enabled us to observe and describe the nature of the activity and feed these data back into the software and experience design and to validate or develop new teaching approaches. Using jam2jam we have observed a consistent and continuous social engagement across age groups and demographics that contributed to players experience of 'flow' (Csikszentmihalyi, 1994). Through the action oriented-user led design processes we have observed that generative software has potential to facilitate benefits for social, health and learning, outcomes through providing access whilst presenting challenging, meaningful and engaging educative experience. This has been most apparent through the employment of meaningful engagement theory and the emerging observational tool. The meaningful engagement matrix affords us a lens on the phenomena of interaction with collaborative performance that potentially reveals where we need to develop our approaches to incorporate other modes of engagement or widen the location of meaning. It also enables us to identify the intrinsic qualities of performance activities and work with them to create meaningful and engaging experience for participants.

In the same way that the Orff method looked at orchestral instruments and identified that percussion instruments were instantly engaging and accessible instruments to provide orchestral experiences for children, we believe that networked generative software systems provides access to experiences of contemporary music-based culture. With the network

jamming project our goal is to help provide access to meaningful engaging experiences with media performance that help make sense of this complex world through expressive and collaborative play. More specifically we have also begun to understand the qualities of the musical process of jamming or collaborative improvisation that can affect human relationships, cultural expressiveness and self-esteem. In future research we hope to compare these generative experiences with 'live' jamming' and find a means of measuring the social and pedagogical benefits of jamming as a community practice.

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