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Being Together—or, Being Less Un-together—with Networked Music

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Introduction

When a technology merges irrevocably with a core human function such as communication, that it is clear that technology is not value-neutral: as with any new technology, emerges it becomes co-constructive with humans. Networked audio technology exemplifies common design behaviors where the tool maker determines the development of certain features based on the target market. As such, networked audio software has tended to service certain segments, most commonly the voice communication market that values speech intelligibility and echo cancellation over music fidelity. Consequently, if musicians wish to perform together over the Internet, they must address technical hurdles that may initially seem insurmountable without an experienced guide such as latency and acoustic feedback. Despite these challenges, networked music is a powerful tool for fostering the experience of "togetherness" for musicians who may otherwise experience isolation—from one another, and from their communities—and the development of technical and education tools that address the difficulties specifically faced by music performance will increase adoption.

This paper follows an ethnographic and autoethnographic format to present ongoing research by the authors on how the performance practice of networked music allows for musicians to experience being-in-time together while inhabiting a different space, and how that experience affects them performing together over the Internet while separated by distance. The authors are particularly interested in presenting networked music in the context of connecting those who cannot, for one reason or the other, travel to perform with each other in a shared physical space. This research has become increasingly interesting as technology advances, particularly in Internet reach and bandwidth, allows for affordable and accessible high-quality streaming. Such technical advancements afford networked music projects between parties who otherwise may not be able to access to dedicated institutional network systems. In order to situate the research in the personal contexts that their position is derived from, the authors, who met in New Zealand while

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researching networked music independently and have since been collaborating remotely, will begin by introducing themselves.

Rebekah: I grew up in New Zealand, an island deep in the south Pacific, where visiting other countries seemed a distant (and expensive) dream throughout my childhood. In the mid-90s, the Internet suddenly brought the world to my fingertips and after completing my degree in music composition my work with computers, networks and music-technology related activities led to the serendipitous starting of a tech company in 2005.[3] We develop real-time, high-quality public- and private-Internet audio streaming products and services for sound studios, actors and musicians. Initially, we embarked with the goal of becoming a replacement for the expensive alternative of ISDN codecs. However, we quickly realized that the Internet afforded so many more opportunities than simple two-way communication, such as synchronizing systems to develop truly collaborative remote workflows. My experience as a technical developer in the field heavily informs my personal approach to networked music; from my shared perspectives as a developer and composer, I consider technical and aesthetic concerns with equal weight. Technology emerges through a combination of purposeful and causal developments, where a particular goal is in mind efforts are made to reach that goal using technology; the goal may shift according to feasibility and cost. Likewise, aesthetics emerges, alongside the act of creating within a cultural and technical context. My research is grounded in the belief that networked music, a nascent field with little exposure outside of academic circles, will become widespread once the technology becomes easy enough to work with without requiring experimental, recondite knowledge.

Andrew: As a performer/improviser on primarily acoustic instruments (saxophones) and some electronic/software instruments, having a debilitating accident in 2004 left me with real challenges in how to approach making music. I suffered a spinal cord injury (C3/4) that left me paralyzed from the chest down (no movement in my hands, limited movement in my arms, and very little movement in my legs). My independence, let alone the ability to make and create music I was used to making, was now altered in ways that I could not have imagined. I returned to creating pre-recorded music on my computer for theater, dance, and any other projects I could get myself involved with, and while this was satisfying to a point, it did not give me any outlet to perform live—something which I dearly missed. My first attempts to perform live came some years later where I would experiment with various percussion and wind instruments with the help of friends, including attempts to play my saxophone. Although rewarding to some extent, these attempts were largely unsatisfying as I could not experience making music to the same technical level I was used to before my accident. In 2011, I went back to university to complete my Master's degree, where part of those studies was focused on Human Computer Interfaces (HCI).

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[3] For more information, see "Source Elements," *Source Elements*, https://source-elements.com.

Consequently, I learned to use Pure Data (Pd) and Max/Multi-Pitch Detection (MPD), which opened up the idea of using my laptop as a performance tool.[4] Suddenly, I was able to perform with significantly less physical effort, and with a stronger interaction with those I was collaborating with. I have since developed a small number of performance patches that I use and have even returned to using an acoustic instrument—an electric guitar on a stand. Performing acoustically is most satisfying to me, especially with the use of a good distortion pedal and a loud guitar amp![5]

While progress has been made developing a live performance practice, and I have opportunities to perform in my local region, it is difficult to be able to navigate the financial and coordination difficulties of travel, especially when those visits are only for a short period of time. Sometimes I watch and hear with some envy of the people around me heading off for short trips to perform in different cities, or countries as they stay with friends, crash on couches and just do it whatever way they can—a kind of travel that for somebody in my situation is not possible to do with ease. Hence the possibilities, opportunities, and my yearnings for the solutions that networking performances can offer, excites me. I hope as I progress exploring the technology in my artistic practice, I am in some way able to fulfil some of these expectations and create musical connections that I would not have dreamed of being able to make even a year or two ago.

In the following section we look at the common challenges and rewards of networked music, continuing in section two with specific examples from real-world experiences that acknowledge those challenges. In the final section, we discuss how the experience becoming "less un-together" acts as a reward to overcome perceived effort, and summarize what kind of system might enable wider participation in the field of networked music.

Challenges and Rewards of Networked Music

Andrew: Maintaining or establishing relationships is valuable: even when the technology is working at its most dysfunctional, it is still better than sitting here knowing that a gig is happening, and not being involved or having the opportunity to be involved. Once the technology issues are ironed out, it will be even more rewarding, so I am really excited. What networked music gives me is the sense that I don't lose touch with two things: the community that I have been or am becoming engaged with—it keeps those relationships deepening and expanding and ongoing— and also deepens my own artistic practice. I get a better understanding of that practice so I become motivated. When the connection with the community is lost, motivation to pursue an artistic

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[4] Pure Data (Pd) is an open-source visual-programming application for creating live, interactive electronic media works. For more information, see "Pure Data," *Pure Data*, https://puredata.info; Max/MSP Multi-Pitch Detection (MPD) is the commercial version of Pure Data. For more information, see "Cycling '74: Tools for Sound, Graphics, and Interactivity," *Cycling '74*, https://cycling74.com.

[5] With the electric guitar, I can live out my dreams of emulating Jimi Hendrix: the first album I ever bought was The Jimi Hendrix Experience's *Live at Monterey*.

practice drops, and the feeling of being isolated easily occurs. Cultivating relationships at a local regional level is one thing, and having the opportunity to expand and connect with communities beyond my own region is something else—something that can make me feel as if I am some sort of network intrepid explorer; an Internet highway traveler and artist, sharing experiences through performance and the sharing of cultural or other practices. The connections can lead not only to sharing ideas and experiences, but it can provide me with motivation to travel further distances, thanks to the support gained by the relationships sustained through Internet networking.

Rebekah: Establishing a remote music practice requires some effort. In the fifteen years I've been working with networked audio, I consistently get asked one question by musicians: when is technology going to "fix" latency? By this they mean, when is latency going to disappear? Network latency is tied to the speed of light, and is a characteristic of the Internet that cannot be mitigated without addressing a core property of physics itself.[6] Further, there is the challenge of time zones: it is inconvenient to schedule a concert between the Netherlands and New Zealand. Which audience must leave the house early for the breakfast version? As train scheduler William F. Allen put it, "time is not just some objective measurement of where the sun is in the sky. It is also about the needs of society."[7] Further difficulties arise when we must also take into consideration the problem of acoustic feedback, discussed in detail in the next section, and bandwidth issues. Particularly, when video is also desired, bandwidth is not suitable for high definition video in addition to high quality audio except in institutions that have dedicated networks; this causes frustration for participants who may not be prepared for these challenges. Such difficulties should not, however, dissuade musicians from seeking to play together over the network as the rewards are plentiful.

Andrew: When approaching difficult tasks, effort and reward jointly shape many human decisions. In fact, errors in predicting the required effort needed for a task can lead to suboptimal behavior.[8] There have been many studies undertaken for professional, health and wellbeing, and financial goals, tasks and various other activities. Some studies find that effort can be overestimated, and reward be underestimated. This idea is put forward by Stijn A. A. Massar, Árpád Csathó, and Dimitri Van der Linden, who find that "actions are only engaged when task goals are deemed sufficiently important" and suggest that whether someone engages with an action or not is the result from "a weighing of action-costs (e.g., effort) against the value of its outcomes."[9] Further, if

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[6] See Ankit Singla et al., "Towards a Speed of Light Internet," *Computing Research Repository (CoRR)* abs/1505.03449 (2015): 1–15.

[7] Sally Helm, "Episode 918: The Day of Two Noons," *National Public Radio,* June 7, 2019, accessed September 23, 2019, https://www.npr.org/2019/06/07/730727038/episode-918-the-day-of-two-noons.

[8] Arezoo Pooresmaeili, Aurel Wannig, and Raymond J. Dolan, "Receipt of reward leads to altered estimation of effort," in *Proceedings of the National Academy of Sciences of the United States of America* 112, no. 43 (October 2015): 1.

[9] Stijn A. A. Massar, Árpád Csathó, and Dimitri Van der Linden, "Quantifying the Motivational Effects of Cognitive Fatigue Through Effort-Based Decision Making," *Frontiers in Psychology* 9, no. 843 (May 2018): 13408.

the effort is determined as being high, the person who is considering the action may actually lower the value of the reward, in comparison to when effort is low. That is to say, in fact while a reward may be high, if the effort is viewed as significant it the reward may be considered less favorably.

Before any task or activity, it is common for people to overestimate the effort required, and underestimate the reward associated with the task or activity. Upon completion of the task or activity when asked again it has been noted that the same persons rating of effort and reward has changed, with a rating of less effort and more reward stated. We could then promote the idea that once this realization of effort and reward is rebalanced it could help to motivate the needs to keep familiarity up and repeat these tasks and activities. As stated earlier, networked music can—and should—become a motivation for musicians to build relationships, towards deciding to make the effort to travel to play together in the same location. The amount of effort required to make these journeys could be diminished with the support gained through relationships created online, enhanced through networked performances.

The following section examines case studies that illustrate common challenges faced by networked music performance practices outside of dedicated institutional support.

Case Studies

Case Study: Vocal Postcards

Rebekah: In the first half of 2019, I collaborated with the Swedish Red Cross International Choir in Gothenburg, Sweden, and the Greek National Opera Intercultural Choir in Athens, Greece with a project called *Vocal Postcards.*[10] I provided software and technical support for the networked music system.[11] The concept of the project was to acknowledge journeys undertaken through a musical setting, as many of the choir members had arrived to their respective cities as refugees. For me, the project was very meaningful: I have worked with refugee concerns previously and am fully aware of the difference between being a traveler by choice, rather than a traveler by circumstance. The project asks how "can we use our stories to achieve a better understanding of one another and the world."[12] The concert began with each choir performing to the other songs they had prepared and ending with a specially-composed piece for both choirs by Canadian/Dutch composer Trevor Grahl that highlighted the networked music environment. The composition used methods such as dovetailing and call-and-response that could be performed by the choirs without extensive rehearsals together. Initially, choir members were curious about how the project would work; some

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[10] "Vocal Postcards | The Göteborg Opera," Göteborgs Operan, accessed August 17, 2019, https://en.opera.se/forestallningar/vocal-postcards-2018-2019/.

[11] We used the WebRTC-based service Source-Connect Now. For more information, see https://source-elements.com.

[12] "Vocal Postcards | The Göteborg Opera."

were even skeptical. S.A. comments that initially he was "enthusiastic about the idea but still I was a bit worried … about the technical aspects knowing that streaming online can go wrong for many reasons."[13] I.B. told me that he "thought it would be difficult to sing at the same time. But I was surprised when I discovered that we could have a dialogue, and we didn't need to sing together, but for each other."[14] E.K. was particularly interested in the project, as for her "to make a performance across the countries had a special personal meaning" where "this kind of performance gives [the] possibility for people to feel included even if they cannot physically leave their homes or countries."[15] E.K. recalls how she was "thinking about all [the] people that cannot travel, like my mom who could not come to see us, but she still was with us! She saw the performance via link!!"[16]

Some significant effort was required on a technical level to achieve this performance, where the main concern was acoustic feedback. Acoustic feedback occurs when a sound signal is sent out of a speaker which then feeds back into a microphone nearby. This can be avoided by having microphones and speakers placed at suitable distances, but it diminishes the reception of the sound. As such, the remote choirs were not heard by each other with complete clarity. S.A. "got some feedback from the audience … that the choir in Greece sounded a bit low, but as for me I stood near the speaker on the stage, so I heard them loud and clear". An alternative method would be to provide a 'close-miking' configuration[17] to all singers which reduces the gain needed for each microphone and thus greatly reduces the chance of acoustic feedback. However, this requires expensive equipment. Instead, the sound technicians in each facility worked tirelessly during rehearsals and performances to maintain as clear a signal as possible while avoiding feedback while we were text messaging furiously back and forth between Gothenburg and Athens, for example "we need more signal from the double bass," "the guitar is too loud," or "please ask the conductor to bring the choir closer to the microphones." It was thanks to the dual efforts of the technical and creative teams at both locations that the sound levels were suitable.

Overall, participants agreed that the sound worked suitably enough for the project. I.B. "really liked it … this type of 'imperfect' synchronization of vocals and instruments talking to each other is something I had not seen before."[18] For E.K., she felt that "the technology brings us closer and the limits exist mostly within us."[19] S.A. adds that "it felt like we are united and singing as one but still I did not fully lose the feeling that we were still at 2 different places. It is hard to explain, I can say I had a combination of both feelings, that we were 'together' and still that we were 2 different

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[13] S.A, Email interview for Vocal Postcards with Rebekah Wilson, September 23, 2019.

[14] I.B., Email interview for Vocal Postcards with Rebekah Wilson, September 30, 2019.

[15] E.K., Email interview for Vocal Postcards with Rebekah Wilson, September 23, 2019.

[16] Ibid.

[17] Close-miking involves placing the microphone close to the source thus requiring less power to pick up and project up the sound, limiting the possibility of acoustic feedback.

[18] I.B., Email interview for Vocal Postcards with Rebekah Wilson, September 30, 2019.

[19] E.K., Email interview for Vocal Postcards with Rebekah Wilson, September 23, 2019.

choirs that works to complete each other."[20] I.B. puts it another way: "somehow the sounds we were yelling and whispering made us be aware of each other ... It felt really like we were one only choir."[21] It was clear to all of us that the performances were a special experience; the performance brought together singers who were separated over a distance—a distance as least as wide as that they had traveled across in their journeys—to become momentarily bound together by the music in a single shared experience. Situating the performance over the Internet required all of us—audience, choir, creative and technical staff included—to acknowledge this distance.

Case study: Extending the Home Studio

Andrew: My entrance into networked music for artistic practice began with theatre projects. I was working as a composer and sound designer and would Skype or FaceTime into rehearsal rooms for the theatre productions I was working on. We used non-real time solutions at first to share audio files, production files and notes, images and videos, etc.[22] After finding both success and artistic satisfaction with this method I started thinking about working in real-time, leading to the idea of network performance—an area of which I had no knowledge at all and did not even realize there was already an established community exploring this. After just a simple Internet search, it was obvious that this was already happening and now it is something that I am keenly pursuing. As I write this, I have participated in two collaborative live performances, and two rehearsal/testing sessions. As an improviser, I am very interested in how I can embrace and exploit both the opportunities and the limitations that networking performance provides.

The two collaborative live performances were on two separate dates in different venues; the first was at the Audio Foundation, and the second was at the Wine Cellar. Both performances were improvised collaborative music events, and both were in Auckland, Aotearoa New Zealand. On both of these occasions, and in the rehearsal sessions, I used my computer and a Max/MSP patch to process live sound. Through the patch, I not only processed sound I created from my location at home, but processed the audio that was streamed to me from the performers I was collaborating with in the venue. Both the performances and the rehearsal/testing sessions have been all done using WebRTC technology.[23] My bandwidth was 50Mbs download and 20Mbs upload with a ping of 15ms. This was over a VDSL connection. These performances and sessions have been highly rewarding, especially as at the time of wishing to test out collaborating improvised music through network performance, I was actually stuck at home due to a minor medical complication. Because of my inability to be physically present at the performances, the opportunity to use networking

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[20] S.A, Email interview for Vocal Postcards with Rebekah Wilson, September 23, 2019.

[21] I.B., Email interview for Vocal Postcards with Rebekah Wilson, September 30, 2019.

[22] Dropbox and *Google Drive* were most commonly used for non-real-time collaboration.

[23] A custom version of Google's webRTC reference app was used (https://appr.tc).

technology was invaluable to me in not having to miss an opportunity to perform and engage with the artistic community that I regularly collaborate with.

As these are early stages in my process of using networked music systems, I am still finding the best way to make it work. For each of the performances and rehearsal sessions I asked the artists I collaborated with to fill out a short questionnaire so I could get some documented feedback. The positives that I have listed here are made from combining responses from the other artists involved:

1. responses ranged from "Yes, an enjoyable experience," to "Mostly an enjoyable experience;"
2. responses were ranged from "strong" and "satisfactory" performance connection between both performers;
3. responses ranged from the approaches "slight" and "strong" different approaches explored to performing and improvising over the network technology, as opposed to performing "together" in the same location;
4. J.R. said it was "refreshing and stimulating to be involved in a live feed from a remote player/network performance;"[24]
5. C.O.C. commented that the "short periods of uninterrupted connection were great, amazing to hear and respond to the sound."[25]

Continuing the performer responses, some of the challenges have been:

1. Freezing or jittery connection, or dropouts in the connection.
2. Isolating what was coming from my sound source in relation to what else was going on in the space at the time.
3. The performers not being able to see the operation of my instruments/equipment. Again, intermittent connection made it difficult to establish a [continuous] performance relationship, but satisfying when intact but unfortunately too short lived due to the dropouts.[26]

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[24] J.R, Email interview for Vitamin S performance with Andrew McMillan, September 2, 2019

[25] C.O.C, Email interview for Networked Music performance rehearsal with Andrew McMillan, September 14, 2019.

[26] My webcam was set up directly in front of my face, so that was all that anybody saw, not me operating my computer or the software patch. This is very different when in the same location, there would be an opportunity to glance at each other's screens or use gestures to get an idea of what might be going on.

For me, the positives for using networked performance was not just the obvious ability to stay connected with the community, but additionally:

1. having access to a number of the aids and devices for making music that I would not be able to take to a venue;
2. not needing to rely on a caregiver, friend, or personal assistant to help with getting myself and equipment to the venue;
3. very little physical equipment setup time required.

Again, for me, the challenges I am facing and working through are listed below:

1. Setting up balanced and good quality monitoring. I think a lot of this has to do with the input from the other end.
2. Intermittent dropouts and needing to reconnect.
3. Using a webcam at home, and laptop screen/projection in venue placement—I am still working out how to best place cameras and screens in both locations. This directly refers to the challenges feedback from the other performers.
4. Opportunities to practice with others.

For the next few sessions, I will focus on using audio streaming without the video to see how these compares with interconnectivity as performers, as introducing video has a detrimental effect on the streaming quality.

Being Less Un-together

While many musicians ultimately choose to perform in the same space to avoid the characteristics of latency, acoustic feedback and networking challenges, networked music is a performance medium that is embraced by many musicians for these same characteristics. In this context, networked music's limitations are an integral part of the medium and artists exploit these limitations as part of their creative process; networked music does not replace the experience of performing music together in shared space but serves as a standalone art form where disrupted presence dynamics are considered a part of the experience. To take some utility from this art form, networked music can bring together musicians isolated by location or circumstance—in projects such as those discussed in the previous section. In this case, musicians are seeking to replicate the experience of performing together rather than using the platform for experimental purposes; we can approach this experience by addressing how presence dynamics are affected. Communicating over a network disrupts the shared rhythms, or "flows" that occur when people perform within the same

physical space.[27] R. Keith Sawyer defines flow as a desirable psychological state, a "collective state of mind" that occurs when "members develop a feeling of mutual trust and empathy, in which individual intentions harmonize with those of the group."[28] The research of Satinder Gill suggests that the body needs to be in tune to experience flow together, where "action-reaction rhythms maintain the flow of information."[29] Network technology allows musicians to experience flow while being remote with one another however certain limitations of the technology leads to participants still remaining partially isolated from each other: flow can be destabilized by latency and imperfect technical implementations. Yet, solutions can be found to increase the experience of flow, such as finding mutual satisfaction in performing together remotely even when rhythms cannot be aligned to the degree that musicians are traditionally accustomed to or, when this is the objective, resolve the experience of isolation through social cues. In an example, musician J.W. was suddenly unable to travel for a concert performance that Rebekah organized in September 2019 in Amsterdam. Given the concert was a celebration of an institute that J.W. had been an important part of, we quickly agreed it was worth the effort to stream his concert live from his home studio.[30] To enhance J.W.'s experience of "being there" with us, we connected with him over a video stream on a cellphone to roam J.W. through the audience where he felt "having them all come in your private space so abruptly was just the best experience" and he "loved the twisted private / public scenario."[31] He did comment however that though "the spontaneous improvisational gesture was great" he was "more compelled to interact with each person which made it more difficult for me to concentrate on my set." J.W. emphasized that ultimately it was the "best solution to a complicated situation."[32]

When the transmission of sensory information is mediated by imperfect network technology, we experience latency, drop-outs, compression: all factors that lessen the feeling of togetherness. This disruption of flow means that if we wish to experience "being-together" effort is required both physically and psychologically; new cultural mindsets and technology must be developed. Regardless, wherever a musician is, they are "less un-together" when they have the opportunity to connect.[33] In fact, they are quite a lot more "less un-together" as opposed to being "together." It is almost an impossible task to negotiate around recreating full-bandwidth sensory connections: "being-together" is not something we can aspire to while remote connection software remains limited in transmission quality. We can, at least, aspire to be less un-together.

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[27] See Caroline Nevejan, "Presence and the Design of Trust" (PhD diss., University of Amsterdam, 2007).

[28] See R. Keith Sawyer, Group Creativity: Music, Theater, Collaboration (New York, London: Taylor & Francis, 2014).

[29] See Satinder P. Gill and Jan Borchers, "Knowledge in Co-Action: Social Intelligence in Collaborative Design Activity," *AI & SOCIETY* 17, no. 3 (November 2003): 322–339.

[30] We used Source-Connect for the sound (via laptop) and Skype for the video (on cellular phone).

[31] J.W., Email interview with Rebekah Wilson, September 25, 2019.

[32] Ibid.

[33] Andrew coined the phrase "less un-together" during a conversation with Rebekah. Private conversation with the authors, September 23, 2019.

To obtain less un-togetherness, networked music technology needs design solutions for explicitly known issues that create adoption barriers. Technological development is a constant process of what Richard Thaler calls "choice architecture," i.e. making and following through with the design choices that make it more likely that people can embrace the technology.[34] Where possible, technical solutions to known limitations can be developed, following Hoven's statement "what we can and cannot do in the world of tomorrow will be firmly shaped and determined by designers of our socio-technological milieu."[35] In summary, we list a number of approaches towards becoming less un-together:

1. develop a remote mindset, for example acknowledge the presence of those who connect remotely as valuable and include remote participants in decision-making processes;

2. accept that there is effort involved in achieving a successful networked music experience;

3. repeating and practicing challenging actions can lessen the perception of how much effort is actually required, i.e. rehearse as much as possible with the technology;

4. seek knowledge with others on how to achieve a successful technical setup, as well as share tips on remote etiquette;

5. generate and share your own documentation on your remote collaboration efforts;

6. seek to extend remote relationships in real-life, where possible;

7. develop cultural systems that allow for multi-time zone experiences to promote cross-hemisphere collaboration, for example "breakfast concerts;"

8. develop or seek out ease-of-use technologies, for example those that prioritize audio over video when bandwidth is limited, and tools that detect and manage acoustic feedback;

9. engage with technical developments such as using AI and machine-learning to discover and strengthen performance patterns in network-mediated presence;[36]

10. become "latency native:" fully embrace latency as a core aesthetic and functional characteristic of networked music.

Andrew: The benefits of networking performance and meeting these challenges to better enhance the experience and develop my process in this field excites me. Although, it doesn't, for me, quite replace being there and sharing a drink and a laugh with all of your fellow collaborators, it has a valuable place for those facing difficulties with mobility or locational isolation. Here, networking performance serves a valuable purpose in keeping connected and developing

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[34] See Richard H. Thaler, Cass R. Sunstein, and John P. Balz, "Choice Architecture," *Social Science Research Network (SSRN)* (April 2010).

[35] See Jeroen van den Hoven, "The Design Turn in Applied Ethics," in *Designing in Ethics*, ed. Jeroen van den Hoven, Seumas Miller, and Thomas Pogge (Cambridge: Cambridge University Press, 2017), 11–31.

[36] Rebekah Wilson, "Towards Responsive Scoring Techniques for Networked Music Performances," in *Proceedings of the International Conference on Technologies for Music Notation and Representation (TENOR)*, (Monash University, Melbourne, 2019).

relationships, an artistic practice, and ultimately a sense of reward for the effort put into finding the motivation to create, connect, and perform.

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Abstract

When musicians cannot travel to another location where other musicians are, they generally assume that this means they cannot perform music together—even while the technology exists to allow them to do so. The perception that Internet technology is not suited for music performance is due to a lack of exposure on navigating the limitations specific to networked music, along with the cultural belief that latency is incompatible with music performance. Many groups, however, have successfully created networked music performance systems. Such systems are particularly interesting in affording new musical and social opportunities in cases when musicians cannot travel due to restrictions of one kind or another. And while technical and cultural limitations remain to be addressed, networked music can have a highly constructive role in the development of remote communities and isolated musicians by fostering the experience of "being together." We review several case studies where networked music has had a meaningful effect on the socialization of distance-separated musicians. We address a number of features and concerns that limit the adoption of networked music among communities who seek to shrink the perceived distance between musicians, and suggest some approaches that may facilitate their accessibility to the platform.