

Experiencing Online Orchestra: Communities, connections and music-making through telematic performance

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Abstract

Telematic performance offers significant potential for musicians in remote communities to perform together, increasing access to the type of ensemble music-making that is commonplace in urban areas. This article presents a range of perspectives taken from interviews with participants in the Online Orchestra pilot performance. Participants highlight the significant potential of telematic performance to overcome the challenge of music-making in geographically remote communities. The feasibility of making music in latency-rich environments is corroborated, as is the importance of the conductor in telematic performance. Suggestions are given for the fine tuning of peripheral equipment, and a preference emerges for the more traditional and simple music commissioned by the project.

Keywords

Online Orchestra; telematic performance; participant interviews; remote communities; latency perception; remote conductor

Introduction

The central research question of Online Orchestra asked how burgeoning network technologies and creative approaches to composition might be used to give young and amateur musicians who live in remote communities opportunities to play in large ensembles (see [Rofe et al. 2017](#)). The project culminated in a pilot performance on 15 July 2015, connecting four locations in Cornwall: a conductor at Falmouth University led an orchestra formed of strings, voices and soloists in Truro Cathedral, brass at Mullion School on the Lizard Peninsula and flutes at Five Islands' School, Isles of Scilly. The project set out to use (as far as possible) readily available Internet connections and affordable technologies, rather than specialist networks and equipment such as that required by, for instance, the LOLA system (see [LOLA 2015](#)), in order to increase access to music-making opportunities for those living in remote locations. Given this focus on real-world applicability, Online Orchestra was concerned to consider those who would use the system and aimed to enable participant musicians to feel both connected to remote musicians and immersed in the overall musical experience.

Musicians from the local community were engaged throughout the process of developing Online Orchestra as part of its action research approach; examples can be found in other articles in this special issue (see [Prior et al. 2017](#); [Geelhoed et al. 2017](#)). However, it is also useful to explore performers' perceptions of Online Orchestra in its final incarnation and as a holistic musical experience, to consider both the desirability and benefits of telematic performance for remote communities, and the feasibility of Online Orchestra. To explore these questions, a small-scale qualitative study was carried

out with a view to investigating and evaluating: (1) performers' experiences of participating in Online Orchestra, including reflections on their musical practice in general as well as the experience of the performance process and (2) how future iterations of telematic performance in general, and Online Orchestra in particular, should be configured and implemented.

Method

In investigating performers' preconceptions and experiences of Online Orchestra, the intention was to keep an open mind about what they found important, salient, challenging and interesting, rather than directing their attention to particular phenomena that had concerned its designers.

Participants

A purposive sample of four participants was used, all adult musicians involved in performing in the Online Orchestra pilot. Sixty musicians in total participated in the Online Orchestra performance; the participants for this study were approached separately and agreed to be interviewed after the performance as part of a piece of evaluative research. They were selected because each was an experienced musician, and each took a leading role in the performance (see [Figure 1](#)). Interviews took place following the performance; one participant was unable to be interviewed and was sent a request for written feedback during the same period, following the same questions asked in

interviews. In addition to taking part in the pilot performance, Participants 3 and 4 were involved in working groups during the design phase of the project, so had good understanding of Online Orchestra’s approach to latency and system design. Participants 1 and 2 only took part in the final performance, without knowledge of the underlying system. [Figure 1](#) summarizes these factors.

Figure 1: List of participants.

Participant	Job	Location in OO performance	Role in OO performance	Involved in working groups?	Interview method
1	Head of Music	Scilly Isles	Lead Flautist	No	Skype
2	Music Teacher	Truro	Lead Cellist	No	Face-to-face
3	Music Lecturer	Truro	Lead Vocalist	Yes	Face-to-face
4	Student	Truro	Violinist	Yes	Questionnaire

Design and analysis

Interviews were semi-structured, allowing participants to explore in detail areas they felt to be of relevance to their experience. Interviews lasted approximately 30 minutes and were structured around three broad questions: (1) what were their experiences of performing in the pilot? (2) what challenges did they face and what improvements would they suggest? and (3) how did they feel overall about telematic performance? Interviews were recorded and transcribed, and responses were coded under six headings:

1. Context – the musical opportunities and music education system in their locations

2. Potential of telematic performance – potential benefits of telematic performance, and how the technology might be incorporated into, and extend, their current musical practices
3. Performing in a telematic environment – experience of performing in a latency-rich, technology-driven environment
4. Conductor–performer relationships – experience of working with a televisual conductor
5. Inter-performer relationships – experience of performing with remote musicians
6. Repertoire – reflections on the compositions

A further level of analysis cuts across all of these themes, which extrapolates participants' suggestions, in the spirit of participative action research, that could be used to inform future iterations of Online Orchestra, as well as telematic performances in general.

Analysis

Context

A primary objective of Online Orchestra was to enable music groups in isolated rural areas to make music with other similarly isolated groups. Cornwall is a prime example of a remote area that, despite benefitting enormously from European supportive funding and the roll-out of BT's Superfast Broadband, remains relatively segregated into remote

communities due to its geography and rudimentary transport infrastructure. Three of the interviewees (Participants 1, 2 and 3) located in geographically remote locations – the Scilly Isles, Bude and Falmouth, respectively – made reference to their remote context as part of their discussion of their experience. The Scilly Isles, in particular, are at the extreme of geographical isolation. Unpredictable weather makes journeys to and from the mainland difficult, and this has associated costs. This means that the pupils at Five Islands' School on the Scilly Isles have less opportunity to play in a full, or at least a more extended, orchestra, and Participant 1 was clear about the prohibitive logistics involved:

It's cost, I mean there's loads of opportunities in Cornwall, but we just can't afford to get over the water, because it's not just the getting over the water, it's having accommodation. And when the weather is bad you can't get home; it is just not viable.

(Participant 1)

Due to the absence of musical instrument teachers on the islands, pupils at Five Islands' School are forced to learn a limited range of instruments. Hence the presence of so many flautists: the school is served primarily by a woodwind teacher, who herself specializes in flute. Pupils do not have the opportunity to learn other instruments and indeed do not have the opportunity to play alongside other instrumentalists.

The last really good experience that we had was when we played at the School Proms two years ago with the Co-Create project. Their funding actually covered our costs. I think for virtually all of us that was the only time we played with strings and brass, all instruments that we've only learnt about but never actually seen. So that for us is the big issue.

(Participant 1)

Bude in North Cornwall is similarly isolated, mainly due to the lack of a developed public transport system. Similar to the Scilly Isles, it is extremely difficult for

pupils to play in a larger orchestra or have access to a full range of instruments. As Participant 2 suggests, this has an impact on the quality and progression of talented young musicians.

There are areas where there is not that much happening, like in North Cornwall; it is all depending on transport. The nearest [Youth Orchestra] is Camelford. It depends on which kind of instruments they play.

(Participant 2)

Participant 3 summarizes what she perceives to be the norm throughout Cornwall:

It seems to me to be quite fragmented. There are small pockets of musicians here and there [...] In terms of classical music, the standard seems to be quite low to medium.

There doesn't seem to be a culture of high achievement and certainly here we don't seem able to pull an orchestra together at all. There just, just aren't enough of those sorts of instrumentalists. There doesn't seem to be very little experience of that broader playing field, of having been together in a big group.

(Participant 3)

Participant 3 feels this is a common situation in many smaller communities in Cornwall, as numbers of students interested in classical music are smaller, and spending cuts affect the education system.

I think partially there is a bigger thrust these days towards playing modern music. There's kind of the rock-school idea. Also, schools are quite small in Cornwall, and so therefore fewer people are interested in [classical] music. There's also the cuts to music and education in schools, so children are probably getting less opportunity to learn, or to hire instruments.

(Participant 3)

It is clear that the challenges of geography and money make the situation significantly harder to make music in remote locations than in urban centres, where more

people, more progression opportunities and better transport infrastructure enable a more active and developed musical landscape.

Potential of telematic performance

Given this challenging context for making music, the opportunities afforded by telematic performance were clearly recognized and valued by participants, who were quick to think on a global level. Participant 2 talks about the potential to play with musicians worldwide without the need to travel:

I love the idea that maybe, hopefully, somebody can bring people together from all over the planet, to potentially open the doors and bring music together from all different places, and without travel. Anything to connect people is brilliant, especially with everything in the world at the moment. Yes! If you can do something with music as an international language to do something together, that's just great.

(Participant 2)

Participant 4 sees telematic performance as a powerful way for classical music to be brought to a wider audience and describes the attendance at the performance as evidence that this new technology falls in fertile soil:

In this day and age, one must always consider the future of music alongside the power of technology. Imagine musicians being able to connect easily across countries. What could be achieved is immense; it is time to push the boundaries. It has been a long time since I saw [Truro] cathedral this packed. This is evidence that people yearn for something new and spectacular. I feel it might have just been found.

(Participant 4)

Participant 1, a teacher, drew attention to the education and progression opportunities enabled by Online Orchestra:

I would like my children to have a level playing field. I would like them to have the same opportunities that the children on the mainland have. When they start competing for university places, they won't have the same background as musicians on the mainland have and I would just like them to have the same opportunity regardless where they live. Wouldn't it be great if we could actually offer the same chance? And that's what this project would do.

(Participant 1)

Participants' interest in the potential of telematic performance is not only abstract: they see significant potential in practice to address the lack of musical opportunities available in remote communities, particularly in the extreme case of the Isles of Scilly:

It would be such an amazing tool to have because then you could have the [mainland] Cornwall music staff delivering lessons to our pupils and they'd have the whole range of instruments available.

(Participant 1)

With respect to connecting smaller amateur ensembles, Participant 3 notes the potentially far-reaching scope of telematic performance:

The idea of working across communities that are so separated from each other is fascinating and exciting and attractive. The idea of working with people who might be in say Brazil or any other part of the world that is remote from us is really deeply exciting.

(Participant 3)

However, for this participant, this global reach also presents something of a threat to the existing community:

If there were something like a global orchestra, you know a world orchestra, then I think yes, people would want to take part. But my sense at this point in time is that smaller groups want to keep their community close; it's a social gathering with some music.

(Participant 3)

There is a clear preference here to preserve community identity and to view telematic performance as an additional opportunity, rather than a replacement for existing groups.

In order to realize the potential of telematic performance, and to take part on a regular basis, three participants identify the need for simple software, and quick and easy equipment set-up. Asked whether she would use such a system on a regular basis, Participant 1 responds,

If the software was click and go, yes. Most school departments will have microphones, video cameras and tripods. We have microphones and most schools now have interactive whiteboards and screens. I mean in our performance hall we have a huge drop down screen and projector. If it was a case of me going to my performance hall and plugging my laptop into a system that is there already; plugging in the projector cable and the sound cable into the sound system that's already in the hall [...] that would be very easy for me to manage.

(Participant 1)

Such set-up requirements are not uncommon for music educators, and pupils/musicians can often be involved in the process:

If the equipment were organized and on hand, I could conceive of it being a reasonably swift set-up time. Having worked in bands most of my life I know that set-up is part of the job.

(Participant 3)

Participants 1, 2 and 3, who are all music educators in their respective communities, proposed that any cost involved in participating in telematic performance would not be out of the ordinary for musicians.

I'm sure they would still to be able to pay a certain amount. If you think, ensemble membership for a term [in my ensemble] is £28. So, I think, yes, particularly if it was in

co-operation with something like the Music Education Hub, I could imagine that people would pay a bit.

(Participant 2)

Performing in a telematic environment

As discussed in [Rofe and Reuben, 2017](#), in this special issue, a key challenge for telematic performance is how to manage latency. Broadly defined, latency is the time delay between the input and output of a system; in musical terms, it is the delay between the moment a musician in one location makes a sound and the moment a second musician in a different location hears that sound. Latency can be highly disruptive to musicians: latencies over 20–30ms cause disruption to the perception of simultaneity, inhibiting musicians from playing *‘in time’*.

The approach taken by Online Orchestra was twofold: a programme to lock latency to musical tempo, and musical works composed specifically for a latency-rich environment. A key measure of the success of this solution is therefore the extent to which it is manifest in the performers’ experiences: if the aim was to control latency, then performers’ perceptions of it should have been minimized. It is notable, then, that of the four interviewees, only one (who had taken part in working groups in the design stage of the project, so was familiar the challenge of latency and our approach to it) mentioned latency (Participant 3), and this was to note its lack of impact (although it did give rise to some anxiety):

I don’t think latency was a problem [...] it didn’t inhibit our capacity to make music.

There was a sense of trepidation that it might. There’s this added *‘what if?’*, but the *‘what ifs’* didn’t manifest themselves.

(Participant 3)

Of the remaining three interviewees, no one else raised latency as a factor, even when prompted to comment on difficulties they faced as online performers. The problem of latency inherent in telematic performance has – from the perspective of the participants’ experience at least – been negated.

One manifestation of latency that was noted, however, was not part of the music-making as such, but emerged in the communication between conductor and performers. Whereas musicians did not notice latency when making music, they did report a ‘lag’ (Participant 1) when trying to talk with the conductor. It may be that a more effective feedback mechanism for musicians to communicate with the conductor than that developed by Online Orchestra is needed in large-scale telematic performances of this sort.

A key difference between a telematic and traditional performance environment is that sonic and visual information is mediated through technology, requiring the presence of significant amounts of equipment: microphones, cameras, screens, speakers and so on. However, participants reported that equipment was not overly intrusive to their experience:

I didn’t find it scary at all. I found it really interesting. I like challenges and it was really exciting to see that, technically, it works. The microphones didn’t bother; that’s no problem. I personally didn’t find it invasive.

(Participant 2)

Participant 3 frames this issue in the context of the overall experience: ‘I didn’t find it intimidating. Generally my sense from speaking to people that were involved was that they found it all extremely exciting’ (Participant 3).

The presence of technology, whilst not problematic in itself, did however affect the dynamics of the ensemble as a whole: that is, the relationships between conductor and performers, between performers in different nodes, and between performers and audience.

Conductor–performer relationships

All interviewees mention the difficulty posed by working with a televisual image of the conductor. When playing together face-to-face, the physical and locational presence of the conductor plays an important role: equally important facial expressions, gestures and whole body movements present themselves as the embodiment of an orchestral piece (see Moran 2013; Davidson 2008; Biasutti et al. 2013; Keller 2013; Williamon and Davidson 2002; Camurri et al. 2005; Palmer 2013). These physical relationships are all potentially diminished in telematic performance, requiring adaptation by performers.

It is very strange to have a conductor in 2D and not 3D. I'm sure there's so much you pick up by somebody being in the same room. You have eye contact, you have body language, you just pick up different vibes, which the screen just can't do.

(Participant 2)

Participant 2 felt that, in contrast to the contact with the co-present musicians, greater visual concentration on the televisual conductor was necessary in order to ensure coherence with other nodes.

It's definitely a more visual approach to music-making. We had our group which was great so you're listening to what's happening in the room, but, then trying to keep together with the nodes, it is quite tricky. You usually watch the conductor with a peripheral vision; I was watching like a hawk.

(Participant 2)

Mimicking eye gaze may be particularly crucial to bridging the digital divide between conductor and musicians:

I felt that the hardest thing to get used to was not having the conductor there; having to watch the screen. Normally you have an eye-line with the conductor when you're playing and the screen was not placed where I expect to be in my eye-line. Being able to see his facial expressions was important. Especially when he was cueing us.

(Participant 1)

In rehearsal, performers requested alterations to seating position in order to compensate for this. They also requested modifications to conducting technique: 'We did ask the conductor to make the gestures a bit bigger, I think more than when you're conducting us live. It's needed' (Participant 1). Indeed, the role of musical coordination played by the conductor in a telematic environment became even more significant than in traditional performance: 'The idea of having no conductor fills me with dread, when I think about how much we relied fully on him' (Participant 3).

Given the number of musicians participating in the performance (60), each node had a local leader: an experienced musician from that community. Participant 4 finds this to be valuable in the context of creating links between the musicians in each node and the conductor: 'I feel a middle person is required, who works alongside the musicians in more depth' (Participant 4). At times, this role was somewhat challenging, particularly when bi-directional communication with the conductor was attempted (perhaps also due to the issue of latency in spoken communication noted above):

If I stopped to try and communicate anything to the group, we would sometimes miss what the conductor was saying. So there wasn't much room for that. Some of the time we ended up at the end of a rehearsal frustrated by not being able to communicate what had

happened because if I did communicate with the conductor I would have to put my hand up, get his attention, and disrupt the flow of the rehearsal.

(Participant 3)

Further, due to the wide camera angles employed in the project, Participant 2 reports that ‘There was less contact amongst the leaders of the sections than there would have been otherwise’. This too adds to the reliance of all musicians on the conductor.

Inter-performer relationships

All four participants also commented on their visual experience of other remote musicians, noting that higher detail might create a greater sense of connection.

You just thought ‘oh there are some musicians there’. We couldn’t really see faces [...] I feel facial expressions in a musical performance play a vital role [...] If you had somebody with a camera at the other end, zooming in and out, you could pick up individual faces as well; I think that would have helped.

(Participant 4)

However, Participant 4 also notes that perhaps ‘Some of the players might have been put off by it’ (Participant 4) and suggests potentially limiting this to rehearsals, when musicians are meeting one another. The lack of detail created through the use of a static, wide-angle camera was further augmented by screen equipment in some locations.

We found the screen quite small. We just had the flat screen TV and we could really have done with a bigger screen. In Truro [the largest venue], there were things that we didn’t actually see; we could hear them, but we didn’t see them. I think to make the experience of playing together better, in general, bigger screens would make us feel more a part of it.

(Participant 1)

Also challenging was adequate audio monitoring of remote musicians, with three participants commenting on a difficulty at times hearing other musicians over the sound of co-present performers. The positioning of speakers in front of screens also reduced the sense of immersion for performers.

Some parts weren't loud enough, and you sometimes didn't get a sense of being in the middle of the orchestra because of the sound coming from the direction of the speakers, whereas in an orchestra some sounds would have been behind us.

(Participant 1)

This difference in sound quality points to a key difference in experience in contrast to playing in a traditional orchestra:

There were particular evenings where the volume was lower than at other times. What we wanted was to feel immersion, the sense of being immersed in sound, which is of course what happens when you're in the middle of an orchestra. So it would be helpful to have some spatialization; something going on behind.

(Participant 3)

Despite these challenges, participants report that, as rehearsals progressed, the online environment became more familiar: 'By the time we got to the concert, we actually got very used to it; playing online felt almost normal. In fact, quite, quite natural' (Participant 1). This in turn led to the capacity for meaningful musical interaction across the network:

When the sound was right, we felt really connected, really uplifted and thrilled by that whole collision of music. From that point, we experienced music making. Every time we got together in the online environment, the moment that there was a musical exchange it was hugely thrilling; the delight was almost more than you would get if you were just in a room together where you expect that to happen.

(Participant 3)

The sense of community between locations also developed as the project progressed:

I thought the concert went marvellously well. At the end of the performance there was a real sense that we wanted to meet. For me, I particularly wanted to meet the flautists, and I think that was because there was a spark between our node and the flautists. There was a real sense of wanting to connect, to be able to share the experience, and say 'wow,' 'wasn't that amazing,' 'how did you feel about that?'.
(Participant 2)

That such a desire emerged suggests the formation of an initial, meaningful relationship online. However, it also exposes the limitations of online community forming: Participant 2 now wants to meet in person in order to have that conversation, but of course this may well be prevented by the very remoteness that gave rise to the connection in the first place.

Repertoire

Online Orchestra commissioned three new works for its pilot performance: *In Sea-Cold Lyonesse* by John Pickard, *Re-Tracing* by Jim Aitchison and *Spiritus Telecommunitas* by Federico Reuben (see Rofe and Geelhoed 2017). The pieces were written specifically to work in a telematic context, taking account both of the spatial distance of musicians and the temporal manifestation of this distance through latency. It is striking that – despite the many unusual aspects of the telematic environment that could have been raised – participants' comments on the pieces themselves emerged as a dominant theme in the interviews. This focus on the musical content is an indication that, notwithstanding the disparate locations, being surrounded by technology, and unusual relationships between

performers, conductor and audience, it is still the music itself that remains the phenomenon that is most salient to participants. Their comments were couched in terms of the telematic environment, but arguably do not describe an experience any different from a real-world amateur ensemble experiencing music.

All four participants agreed that Pickard's work was pitched most successfully with respect to the musical abilities of the young and amateur performers who made up the ensemble. Participant 1, for instance, states that her pupils '[...] found [Pickard's] easiest and it's because you could latch on to it; you could feel where you came in. If you got a bit lost, you could feel where the next phrase was' (Participant 1). Likewise,

I think that John Pickard's piece was the one that everybody got into most quickly. It was the most traditional: people were able to understand the music fairly instantly, and have a sense of the metaphorical language of the music, as well as the notational language of the music.

(Participant 3)

By contrast, the more contemporary aesthetic, and technical complexity, of Reuben's work presented a significant challenge to performers.

It was experimental; in places strange and technically challenging. The music was difficult; many had never been confronted with this type of repertoire before. It was vital to play and hear the music with different ears.

(Participant 4)

Participant 1 shares this perception: 'If you got your timing wrong and you missed your entry, there were no points where you all came together and you could feel where you were' (Participant 1).

Some comments did relate more specifically to the appropriateness of repertoire to a telematic environment: the slow-paced nature of Aitchison's piece was regarded to be well suited to its online context:

Jim Aitchison's piece similarly worked very well, once everybody heard it go together as a whole piece. It was very beautiful, and the fluidity of that piece was extremely beautiful in that environment.

(Participant 1)

In particular, its sparse and less rhythmically complex content was felt to enable greater capacity to hear remote musicians.

[Telematic music] needs more space so you can hear the others. I thought [Aitchison's piece] worked really well because it is sort of more atmospheric and it's not about timing so much, where things have to be together.

(Participant 2)

All four participants commented that Pickard's and Aitchison's works enabled a greater sense of connectedness. The ensemble felt more able to immerse themselves in this music because of the familiarity of its (tonal) language and the lesser complexity of its content.

If you want to bring the element of connecting with the other ensembles more, then it needs to be where you can respond to what you hear and not just having one focal point – the conductor.

(Participant 4)

Again, whether or not such observations are unique to a telematic context is debatable. In any case, the extent to which the musical language was familiar to participants was clearly an important part of their experience.

Discussion

Context and potential

It was clear from the interviews that participants actively felt the impact of their remote geographical location as a barrier to engaging in musical ensembles, which led to excitement at the potential offered by telematic performance. The potential of network technology to promote inclusion of and connection between remote communities is clear (see Warren 2007), and the community of practice that it promises is tapping into a tangible need.

At the same time, music-making can promote cohesion *within* communities just as much as it can do so *between* communities (Gibson et al. 2010; Duxbury and Campbell 2011; Thomas et al. 2013; Bell and Jayne 2010; McHenry 2011), leading to a duality wherein the local is complemented by the global and *vice versa*. While participants reported a sense of excitement at being involved in a potentially global community, as well as the desire to make real-world connections subsequent to the performance, there was also a desire to retain the existing localized community of practice. This tension between the local and the global not only points to the challenge of retaining a sense of identity in the face of seemingly limitless possibilities of communication, but also – perhaps paradoxically for a project that seeks to overcome the problems associated with geographical isolation – ‘whether the flip-side of remoteness [is] a local cultural distinctiveness, a proximity rather than isolation’ (Gibson et al. 2010: 27). Indeed, although isolation in the context of ensemble performance is a challenge, creative practitioners in general often actively seek out isolation in the hope of ‘finding creative

inspiration away from high rents and homogeneity of urban areas [...] and particular 'place' strengths such as strong regional cultural networks and economies' (Roberts and Townsend 2015: 3).

The new community formed by Online Orchestra is both virtual (in the sense that it takes place online) and face-to-face (in the sense that it takes place via audio-visual streaming rather than, say, social media or an Internet chat room), and consideration of online performance environments may need to bridge both of these aspects (see Plant 2004; Dede 2004; Akoumianakis and Alexandraki 2010; Akoumianakis 2011). To some extent, holding both in tension is part of the challenge when first entering a telematic environment, as Tanzi observes:

Online communication implies a different curve of cognitive parameters: while learning how to manage the flow of information coming from that reality, one has to balance the divergence between online and offline narratives. It is the matter of living in a composite reality that – as Virilio points out – requires the development of a sort of 'stereo perception' of events that relies on two separate orders of reality [...] We should ask ourselves whether the appearance of artificial features of musical spaces is going to be an addition to, or simply a replacement of the 'natural' ones.

(Tanzi 2003)

In all cases, musicians in Online Orchestra were able to adapt and flourish in the online environment, but it took time to become familiar with the technology. Overall, there is a sense that issues may lie more in performers' own preconceptions than in the system itself. It is interesting to note that the participants quoted above locate their responses in terms of time: 'by the time we got to the concert'; 'when the sound was right'; 'at the end of the performance'. This may suggest that performers' experiences change over time, from a more disparate, less comfortable engagement early on to an

increasingly immersed and familiar experience. Despite some expressions of trepidation, all participants were able to embrace and feel comfortable in the new environment by the time of the performance. Future research could investigate the nature of these processes of familiarization in more depth; in particular, tracking performers longitudinally as they enter, become familiar with, and finally embedded in, a new telematic community would shed light on any particular barriers or critical incidents that performers undergo as they engage in telematic performance.

For performers, then, negotiating this transition from a locally based, real-world community of practice, by necessity limited in scope, to a global, virtual environment, there may understandably be some sense of discomfort or readjusting. These issues of how the local community of practice (in the context of Online Orchestra, the individual node) relates to the global (the ensemble as a whole) raise questions of how and whether it is desirable or inevitable that these boundaries remain fixed or fluid. Rather than adopting a deficit model of remoteness, telematic performance can, and perhaps should, seek to reinforce community at the local level, acting in a telematic context to reinforce local communities of musicians whilst also building new inter-nodal collaboration. A particular aim of Online Orchestra was to connect existing groups, rather than individuals, and this initial evaluation suggests that approach to be sound.

Performing in a latency-rich environment

Another key aim for Online Orchestra was to develop a system that controlled latency to the point where musicians could perform relatively traditionally in terms of conductor-score-rhythm relationships. Participants' responses confirm overwhelmingly the

feasibility of making music in latency-rich environments: participants did not raise a single instance in which latency inhibited their music-making, and indeed most did not mention latency at all during interview. That Participant 1 was able to conclude that, by the time of the performance, 'playing online felt almost normal. In fact, quite, quite natural', is testament to the viability of Online Orchestra's approach to handling latency (see Rofe and Reuben 2017). More generally, this is very encouraging for the broader feasibility of telematic performance in community contexts: latency control – rather than latency reduction – does not require specialist equipment or high bandwidth and indeed can be implemented over any geographical distance. This in turn enables a wide array of potential users to take part in telematic performance.

Latency was, however, noticeable during spoken interactions between conductor and musicians, and future applications of this technology may benefit from 'push-to-talk' functionality, that enables a momentary reduction in latency, and a way of musicians attracting the conductor's attention within larger groups.

Musical relationships in a telematic context

The community of practice of a musical ensemble as a whole is made up of a series of smaller groups and individuals, all of whom are interacting between one another as well as with the whole. This is of course true for any given ensemble, but is arguably more the case with a telematic ensemble than with a traditional orchestra, given its dispersed and multi-faceted nature. Given this distributed environment, a key question for the success of Online Orchestra is the extent to which these multiple interactions could work together

not only smoothly and effectively, but in a way that led to a high-quality musical experience for all performers.

Online Orchestra's approach to telematic performance involves a technical and compositional solution to latency – a programme that locks latency to musical tempo, and works that are written for a latency-rich environment. But it is the conductor who brings this system to life, in rehearsal and in performance. Indeed, significant demands are placed upon the conductor in order to shield performers from the potentially disruptive effects of latency on music-making (see [Hargreaves 2017](#)). This is one of many solutions to working in latency-rich environments, and of course alternatives could include an active engagement with the latency on the part of performers. Participants in Online Orchestra clearly valued – and indeed relied heavily on – the conductor as the glue that held the remotely located groups of musicians together. Relative to the context of traditional performance, participants in fact note an increased reliance on the conductor: a point of familiarity in an otherwise unfamiliar musical world. This in turn brings practical challenges to musicians, who must adapt quickly to working with a 2D televisual image of the conductor, rather than a 3D person who can be viewed peripherally: a process that clearly proved to be difficult at first, though ultimately achievable. Performer–score–conductor sightlines were particularly important in this regard, again, even more so than in traditional performance.

The reduced sense of immersion in the sound, due partly to monitoring levels and perceptible details, and partly to the directional nature of sound produced by speakers, also seemed to require significant adjustment of expectations, as did the reduced capacity to see in detail musicians in other nodes. Participants were able by the end of the project

to feel musically connected to other nodes – to be performing ‘together’ – but interpersonal relationships were felt not to be as strong as would be possible in traditional music-making.

Much research has stressed the importance of the relationships between musicians, including the non-verbal, bodily cues and gestures that go to make up a musical performance, whether communicative or incidental (Moran 2013; Davidson 2009; Biasutti et al. 2013; Keller 2013; Williamon and Davidson 2002; Camurri et al. 2005; Palmer 2013) and the social interactions between players (Davidson and Good 2002; Keller 2014; Keller et al. 2016). Indeed, making music together is an inherently shared experience, when a ‘sharing of the other’s flux of experiences in inner time [during a piece] constitutes [...] the experience of the “we” which is at the foundation of all possible communication’ (Shutz 1951: 94). Performers working together will aim to achieve what Sawyer has described as ‘group flow’ (Sawyer 2006: 160), where group creativity is essential as ‘you’re either making music or just playing notes’ (Faulkner 1983: 74 cited in Sawyer 2006: 160). Despite the physical distance between Online Orchestra performers and the more disjointed nature of their communication, there is evidence from this study that, for some participants at least, players were certainly making music rather than just playing notes: ‘When the sound was right, we felt really connected, really uplifted and thrilled by that whole collision of music. From that point, we experienced music making’ (Participant 3).

In general, participants were not in fact overly concerned with the presence of peripheral equipment, nor did they raise the issue of audio and visual quality, suggesting broad satisfaction with the final solution: having a screen per node and a mono mix-down

of audio from each node, for instance. However, there is clearly scope for further fine tuning of peripheral equipment in order to improve the experiences of musicians. In particular, improved audio monitoring is needed, such that musicians have a more immersive experience. This might take the form of additional speakers, perhaps in a surround format, real-time mixing by sound engineers (or indeed this could be accomplished algorithmically) to enable greater consistency in monitoring levels, or additional in-ear monitoring. More dynamic camera usage is also proposed as having potential to create greater interpersonal connection between nodes, particularly if close-ups of individual musicians were possible; multiple, switchable cameras could be deployed to achieve this relatively simply (see [Johnson et al. 2015](#)). Further development of a layout that allowed a greater sense of connection between co-present musicians and audience members may also be desirable and could be implemented, for instance, through separate visual monitoring of the conductor for the benefit of musicians such that they could face the audience in a more traditional format.

Repertoire

In the context of the unfamiliar online environment, participants had a strong preference for the more familiar musical textures and tonal harmonies of Pickard's work – a point of familiarity in an otherwise challenging musical experience. That said, part of the opportunity brought about by telematic performance is educational, with a view to pushing musicians in terms of technique and exposure to new types of music. As such, the successful performance of Reuben's work marks a significant achievement in its

demonstration of telematic performance as a teaching tool, as well as a vehicle for participative musical experience.

However, it is interesting to note that coming to terms with a new environment led participants to resituate their perceptions of the pieces they were playing. Their framings were cast in terms of the suitability of the pieces to be played online, but in fact their observations were arguably little different from any young or amateur musicians' reactions to playing traditional, tonal, technically simpler pieces in contrast to more difficult, atonal works. In practice, the ensemble successfully performed all three works, suggesting that a wide range of repertoire can be achieved in an online context using latency-control technology. In any case, it is clearly vital – as in any performance – that musical materials are well matched to the abilities of performers, stretching them sufficiently that the experience allows growth, but ensuring that this growth is ultimately achievable, and enjoyable in the process.

Conclusion

As outlined in [Rofo et al. 2017](#), in this special issue, participation in ensemble performance has been shown to have wide-ranging benefits, both to music development and to participants' broader well-being. Yet participants in Online Orchestra note that music-making opportunities in their remote locations remain rudimentary. This results in limited choice in instrumental tuition due to the low numbers of available music teachers, limited capacity to perform in larger ensembles due to the low numbers of musicians, and limited progression opportunities due to the dispersed nature of ensembles.

Interviewees' experiences of Online Orchestra are frequently formed in the context of experience of traditional, off-line music-making. This is manifest in their descriptions of the opportunities offered by telematic performance, which are overwhelmingly defined in the context of what is not currently possible in traditional performance; access to a wider range of music-making opportunities and access to a wider pool of musical collaborators (both within Cornwall and globally) are seen to be the key potential benefits of telematic performance. Those benefits, though, come with an attendant desire to preserve the identity and solidarity of local communities of musicians, giving credence to Online Orchestra's decision to connect groups of musicians, rather than breaking apart local ensembles in order to enable individuals to connect and make music online. In this way, telematic performance has the capacity to augment existing opportunities, rather than to replace them. However, detailed observations by participants also evidence a difficulty adapting to the online environment, and these observations are again framed in the context of traditional musical experience.

The journey taken by participants in Online Orchestra can be summarized as a great willingness to experiment with the technology, an initial phase of unfamiliarity, and a process of adaptation that ultimately led to highly successful performance. In many ways, Online Orchestra's design solution models a traditional orchestral experience, with musicians following scores, led by a conductor, playing compositions in which individual parts come together to form a broader musical whole. These decisions served as sources of familiarity to performers, allowing a musical practice that mirrors traditional performance, but also gave rise to challenges, as an online experience will never feel the same as real-world music-making. But in all cases these were decisions as opposed to

requirements of working in a latency-rich environment; future telematic performances of this type may benefit from exploring more bespoke means of coordinating the musical ensemble, from the use of digital cuing, to animated scores, to group improvisation.

However, most significant in participants' responses is confirmation of the feasibility of Online Orchestra's two-part solution to latency management, which enabled music-making in a latency-rich environment in a way that did not affect the musical experience. This in turn suggests the longer term feasibility of telematic performance in community contexts in which bandwidth and equipment limitations do not enable latencies below the threshold of perception. As such, there is significant potential for telematic performance to increase opportunity and access to music-making for people living in remote locations, or indeed for any other musician (for instance, people with mobility problems, or those confined to their homes, hospitals, prisons and so on) for whom travel prohibits participation.

In order to realize that potential, a pertinent question emerges: how credible is it that schools and/or community groups might take part in telematic performance on a regular basis? This remains to be seen, but participants' responses suggest that, given a click-and-go software and a relatively simple hardware set-up, regular participation would not only be possible, but would be readily adopted. That several participants – unprompted – raised the possibility of paying for such a service suggests real appetite here, and the potential for a significant solution to the challenge of making music in remote communities.

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