

<b>Institution: Falmouth University</b>		
<b>Unit of Assessment: 32</b>		
<b>Title of case study: Online Orchestra: providing access to ensemble music-making for people in remote communities</b>		
<b>Period when the underpinning research was undertaken: 2014 - 2015</b>		
<b>Details of staff conducting the underpinning research from the submitting unit:</b>		
<b>Name(s):</b>	<b>Role(s) (e.g. job title):</b>	<b>Period(s) employed by submitting HEI:</b>
Professor Michael Rofe Dr John Hargreaves	Principal Investigator Co-investigator – performance	Aug 2011 – Oct 2018 2014 – present
Professor David Prior	Co-investigator - technology	Sept 2010 - present
<b>Period when the claimed impact occurred: 2015 - 2020</b>		
<b>Is this case study continued from a case study submitted in 2014? N</b>		
<b>1. Summary of the impact</b>		
<p>Online Orchestra examined how we can use burgeoning network technologies and creative approaches to composition to give people in remote communities access to the acknowledged benefits of large-scale ensemble music-making. 60 participants directly benefited from this opportunity (<i>“we felt really connected, really uplifted and thrilled by that whole collision of music”</i>) that they would not otherwise have had, and a scalability study saw Bournemouth Symphony Orchestra offering a masterclass to children using Online Orchestra technology. Superfast broadband connections were established in Truro Cathedral and the Isles of Scilly for project delivery that remain to benefit those communities. It continues to have an impact within industry and the public sector: Professor Rofe provided consultancy for the Connect:Resound project that creates opportunities for young people across the UK to experience live music; and for Trinity College London exam board for arts and English teaching, directly deploying findings developed via this project.</p>		
<b>2. Underpinning research</b>		
<p>The benefits of participating in music ensembles are well documented. These include benefits to technique and creativity, social interactions, and a sense of community, and psychological well-being and skills development. Indeed, the UK Government’s 2011 National Music Plan recommended that <i>‘Children from all backgrounds and every part of England should have the opportunity [...] to make music with others’</i>. However, young and amateur musicians living in geographically remote communities often do not have access to ensemble music-making opportunities. The time, expense or logistics of travel can make regular participation impossible. For example, on the Isles of Scilly, with a population of 2,200, there are simply not enough specialist instrumental teachers to provide full coverage of instrumental lessons, and school-wide instrumental ensembles are limited to flute choir and wind group, with no string and/or brass instrument teaching or ensemble performance. Networked performance provides a starting point to address this problem [6].</p> <p><b>Research team:</b> The team was led by Professor Michael Rofe, Senior Lecturer in Music (Falmouth 2011-18). Co-Is were Dr Jon Hargreaves (Music) and Professor David Prior (Technology), and the research team included other members of the Music Department. The team also included Professor John Pickard, University of Bristol, who composed one of the pieces.</p>		

**Research aims:** Online Orchestra was a large-scale pilot that sought to realize the potential of online performance by finding design solutions that might, with future refinement, enable musicians in remote communities to experience the well-documented potential benefits of ensemble music-making.

**Research process and design:** Online Orchestra developed its design solution through action research over eight working groups between October 2014 and July 2015. Using an iterative process based on Kolb's learning cycle the project team explored (1) software options; (2) computer and peripheral equipment options and usage; (3) approaches to latency (a time delay that results from processing data and sending/receiving it between locations); (4) compositional options; and (5) approaches to online rehearsing and directing. The project culminated in a four-location pilot performance in July 2015 [1] of three new works, commissioned for the performance, involving a conductor at Falmouth University, leading an orchestra of flutes on the Isles of Scilly, brass in Mullion on the Lizard Peninsula and strings, and choir and soloists in Truro Cathedral.

**Key findings and outcomes:** Musicians were found to perceive latency above roughly 30ms [5]. Given (1) the lower bandwidths available in community contexts, (2) the need for the large data streams involved in video communication and (3) the preference to avoid specialist equipment, it emerged that existing low-latency solutions would not be possible. Instead, new software was developed that stabilizes network latency and locks this to a specified musical tempo [6]: latency was matched to the length of a musical beat. Composers were thus able to compose music specifically designed for this latency-rich environment, and latency stopped functioning as an impediment to performance instead becoming part of the musical content [2]. Evaluation found that participant musicians reported no disruptive effects of this latency on their ability to perform [4]. As such, Online Orchestra could adopt a traditional model of rehearsal and performance. In addition, as Online Orchestra did not operate at ultra-low latency, the need for specialist equipment was significantly reduced, and so it was possible to use only freely available audio-visual streaming software (JackTrip and VSee) and low-cost hardware.

### 3. References to the research

[1] Rofe, M., Prior, D., & Reuben, F. (2015). The Online Orchestra: Connecting Remote Communities through Music <http://onlineorchestra.com/performance> Listed in REF2 (part of multicomponent output: Output identifier 508) [Performance]

[2] Rofe, M., Murray, S., & Parker, W. (2017) Online Orchestra: connecting remote communities through music. *Journal of Music, Technology and Education* 10 (2-3), 147-166 DOI: [10.1386/jmte.10.2-3.147\\_1](https://doi.org/10.1386/jmte.10.2-3.147_1) [Journal article]

[3] Rofe, M., & Prior, D. (2017) Online Orchestra - Special Issue of *Journal of Music, Technology and Education* <https://www.ingentaconnect.com/content/intellect/jmte/2017/00000010/f0020002> Listed in REF2 (part of multicomponent output: Output identifier 508) [Edited journal]

[4] Rofe, M., Geelhoed, E., & Hodsdon, L. (2017) Experiencing Online Orchestra: communities, connections and music-making through telematic performance. *Journal of Music, Technology and Education* 10 (2-3), 257-276 DOI: [10.1386/jmte.10.2-3.257\\_1](https://doi.org/10.1386/jmte.10.2-3.257_1) [Journal article]

[5] Rofe, M., & Reuben, F. (2017) Telematic performance and the challenge of latency. *Journal of Music, Technology and Education* 10 (2-3), 167-184 DOI: [10.1386/JMTE.10.2-3.167\\_1](https://doi.org/10.1386/JMTE.10.2-3.167_1) [Journal article]

## Impact case study (REF3)

[6] Rofe, M., & Reuben, F. (2020) *Collaborative session over a network* (European patent EP3673634A1) <https://patents.google.com/patent/EP3673634A1/en?q=rofe+reuben&oq=rofe+reuben> Listed in REF2 (part of multicomponent output: Output identifier 508) [Patent]

Journal of Music, Technology and Education is a peer-reviewed journal; the project was awarded as part of the peer-reviewed AHRC Standard Route; it won several awards at the REIMAGINE Education awards 2018.

**Research grants led by team members directly supporting the impact outlined in this case study:**

G.1 AHRC. 'Online Orchestra'. AH/M001482/1. Lead: Rofe. £202,297. 01/02/14-31/3/17.

G2. ACE. 'Online Orchestra – Scalability Study. GFTA-18462. Lead: Rofe. £14,948. 19/9/16-22/1/17.

**4. Details of the impact**

The new processes, technology, and understandings pioneered by Online Orchestra continue to constitute the cutting edge of online music-making and communication, and have benefited schoolchildren, musicians, audiences and venue, music teachers, and broader national and international teaching and exam practice.

**Impact on schoolchildren, amateur and professional musicians**

There was a direct impact on participants in the pilot, which the project impact evaluation found to have had a positive benefit; as one participant said: *"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"* [5.1].

In collaboration with the Bournemouth Symphony Orchestra (BSO), we co-designed a workshop, delivered online on 10th November 2016, to test the feasibility of the BSO to augment its music education programme by delivering content online, thereby increasing its geographical reach to more distant locations. The workshop involved BSO musicians, located at the BSO headquarters in Poole, delivering an online workshop to a string quartet of four pupils, located in Jewell Academy, Bournemouth facilitated by Online Orchestra technology. In part one, the string quartet performed an extract from Mozart's Quartet in D minor, K421; BSO musicians then provided a 20-minute coaching session on the performance, in which they worked with the children to improve their performance. In part two, all musicians performed together, led by the Online Orchestra conductor, to rehearse and perform a specially-commissioned work written by Jim Aitchison.

More confidence in making music online and so increased opportunities to do so: *"One of the biggest differences I've noticed as a result of Online Orchestra is confidence working online, and so an increase in the amount of music-making we've been able to do. The teachers we work with have been a lot more comfortable moving their lessons online than they were before, as they're more familiar with the online environment. I've had the confidence and knowledge to start new projects online, since I now know what I need to think about using different programmes, and what's possible and what's not, which has helped us to keep going and keep people connected during the Covid-19 pandemic. There's also been an increase in groups getting together online as they can see the possibilities now."* Head of Cornwall Music Service Trust [5.2].

**Impact on audiences**

Around 400 people were enabled access to music as audience for the world premiere in July 2015, in Truro Cathedral and at the other nodes. As one participant said, *“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.”* Online Orchestra participant [5.1].

**Permanent impact on Online Orchestra venues**

As part of the project, superfast broadband was installed in Truro Cathedral and at Five Islands’ School, Isles of Scilly. At Truro Cathedral, in particular, access was negotiated and paid for via OpenReach – including planning and archaeological approval processes needed to connect the cathedral itself – which remains in place for daily use.

**Impact on music teachers and students**

This new means of music-making was seen as a practical solution by evaluation participants [5.1]: *“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.”* Online Orchestra participant.

Direct influence on other networked music projects: In 2015 Professor Rofe acted as a project consultant to the Connect:Resound project run by the North Yorkshire Music Education Hub. Rofe drew on Online Orchestra research findings to advise the project team in designing their solution, which involved live-streaming music broadcasts direct to schools. As a result, they gained a more nuanced understanding of network conditions, latency, and interactive music-making online. Over 70 pupils took part in the pilot, with music performances and resources made available to all primary and secondary schools in North Yorkshire [5.3].

**Impact on national and international teaching and exam practice**

Research developed during Online Orchestra has been applied to industry and public sector settings, particularly via consultancy undertaken by the PI through which it has had direct influence on worldwide arts policy and practice. Professor Rofe initially consulted with Trinity College London exam board during the Online Orchestra project and was subsequently recruited on the basis of his body of work on latency, as Director of Music and Group Director, Sector Strategies. He developed a digital strategy across Trinity embedding online teaching and assessment, begun in 2018 but of particular impact during Covid-19. Deploying the principles and limitations of latency rich interaction, as defined during the research, as well as the particular challenges of remote communities, was crucial in developing these digital products, not least since learners and teachers are likely to be using lo-fi internet connections in many of Trinity’s international markets such as India, Thailand, or Malaysia.

Findings uncovered by Online Orchestra underpinned video support packs that were created for music teachers adapting to an online environment (accessed by ~10k users to date), and webinars delivered globally giving guidance to teachers on delivering music, drama, and English Language teaching online:

*“We were able to take account of the principles that Online Orchestra uncovered when we designed our materials to support music teachers delivering their sessions online, which was particularly valuable during Covid-19 when music learning would otherwise have stopped altogether for many. Understanding what’s possible and how we can support teachers to take account of latency to deliver quality musical interaction online has helped us to make our products globally relevant.”* Head of Music, Trinity College London [5.4].

In 2020, Trinity launched video-conference based English Language examinations, with examiners remote from the candidates. This involved testing examiners’ ability to have a meaningful conversation and interaction in a latency-rich scenario (bearing in mind that

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learners are distributed around the world, including in regions with low bandwidth). This work was directly informed by the findings and methodologies developed within Online Orchestra:

*“In developing new ways for English Language testing to be carried out digitally, Professor Rofe’s insights into how to cope with high latency and low bandwidth were invaluable in telling us where to put our energy and what was and wasn’t possible.”* Director of English, Trinity College London [5.4].

In 2020, Trinity made video-conferenced examining a permanent part of its product suite; and made substantial investment in a new type of digital test that can be viably delivered in very low bandwidth conditions. 30,000 candidates have been examined using this method to date, with projections for the permanent test being 100,000 candidates per year.

#### Awards and esteem

The new technology developed by the Online Orchestra research was granted a patent in 2020 [B3: 6]. It was promoted by Paul Hamlyn Foundation, one of the UK’s largest grant-giving organisations for artists, as an example of *‘inspiring work’* constituting *‘effective music education’* [5.5]. The project won prizes at the 2018 Reimagine Education Awards in its categories of Arts and Humanities, ICT, and Region, for its contribution to pedagogy [5.6].

#### 5. Sources to corroborate the impact (indicative maximum of 10 references)

[5.1] Project evaluation, *Journal of Music Technology and Education* (2017) 10: 2-3 special issue. <https://www.ingentaconnect.com/content/intellect/jmte/2017/00000010/f0020002>

[5.2] Head of Cornwall Music Service Trust (Nov 2020), personal communication.

[5.3] Connect:Resound project

- Professor Rofe talk to NYMAZ [www.youtube.com/watch?v=RjYH9KKv0hA&t=39s](http://www.youtube.com/watch?v=RjYH9KKv0hA&t=39s)
- Connect:Resound project legacy site [www.inspire-music.org/case-studies/67-connect-resound](http://www.inspire-music.org/case-studies/67-connect-resound)

[5.4] Trinity College testimonials

- Head of Music, Trinity College London (Sep 2020), pers. comm.
- Director of English, Trinity College London (Sep 2020), pers. comm.

[5.5] Paul Hamlyn Foundation, *Inspire Music* <http://www.inspire-music.org/case-studies/72-online-orchestra>

[5.6] Reimagine Education Award Winners 2018 [www.reimagine-education.com/winners-2018-2017/#1591083590690-888828eb-6a87](http://www.reimagine-education.com/winners-2018-2017/#1591083590690-888828eb-6a87)