

# The Cave Of Sounds: An Interactive Installation Exploring How We Create Music Together

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## ABSTRACT

The Cave of Sounds is an interactive sound installation formed of eight new musical instruments exploring what it means to create instruments together. Each instrument was created by an individual but with the aim of forming a part of this new ensemble, with the final installation debuting at the Barbican in London in August 2013. In this paper, we describe how ideas of prehistoric collective music making inspired and guided this participatory musical work, both in creation process and in the audience experience of musical collaboration. Following a detailed description of the installation itself, we reflect on the successes, lessons and future challenges of encouraging creative musical collaboration among members of an audience.

## 1. DESIGNING FOR ENSEMBLE

*The Cave of Sounds* is an interactive installation inviting its audience to connect with each other through playing with eight original instruments. The work is the outcome of a ten month process in which eight individuals each created an instrument, all focused on forming a single ensemble.

It is not uncommon for digital musical instruments (DMIs) to be created as collaborations between individuals, or to be played together within an ensemble. However, new DMIs are often created as solo instruments. Particularly with the seemingly limitless options available, there can be a temptation to create a one-man-band instrument, in need of no accompaniment to create a complete sound. By contrast, many traditional instruments have evolved together to work as an ensemble. Within an orchestra, the instruments typically fit within a specific spectral space and fulfill different roles. This is not to suggest that the creative possibilities of DMIs should be limited by boundaries we infer from traditional instrumental practice. DMIs need not occupy the same role in musical performance as traditional instruments [6]. However, a consideration of history can highlight new types of musical practice made possible by DMIs.

When we design an instrument, we decide the sounds it

creates, the actions its player will perform and how action and sound relate. Therefore, as well as a challenge of engineering [8], the instrument can itself be an artistic medium expressing its creator's musical ideas [11]. Instruments designed through personal artistic practice may be created not for their take up by others, but as part of the composition process [9]. However, such instruments can also be created as an interactive work specifically for others (including non-musicians) to play [1, 2]. Here, the experience of the participant is of primary interest. More so, we argue, than how an audience might rate the performance. A bespoke instrument provides a window into its creator's musical mind. It is a first-hand journey of discovering the sounds available to you, the actions you must perform to create those sounds, and how much control you have over the process.

In this way, creating instruments, whether for one's own performance practice, or with the aim of asking an audience to play them, can be a form of open musical composition [10]. But if we take this view, what does it mean to improvise or compose music together? Can we compose instruments together much like we jam together? Dudas [4] describes 'comprovisation' as improvisation with DMIs where aspects such as mappings are prepared ahead of time and then modified or cycled through during improvisation. With *The Cave of Sounds*, we wanted to go a step further, creating instruments that are not only individually expressive artefacts of their respective creators, but conceived and created from the outset to belong to this new ensemble.

Related work includes *SensorBand*, a trio formed of van der Heide, Karkorwski and Tanaka who played DMIs created for, and evolved through, ensemble performance. Tanaka [14] describes how the group play with potential confusion as to which instrument different sounds originate from. Identifying instrumental roles forms a part of the aesthetic experience. Although instruments in *The Cave of Sounds* are played by audience members rather than performers, the emergence of roles through musical collaboration remains similarly integral to the work, as discussed below.

## 2. ORIGINS

*The Cave of Sounds* is the outcome of a residency completed by the first author at the Music Hackspace, a self-organised community devoted to exploring the new forms of music, sound art and musical practice made possible by technology.

The concept was inspired by Werner Herzog's film *The Cave of Forgotten Dreams* (2010), showing discoveries of 30 000 year old prehistoric instruments and the transcendent atmosphere created through paintings of animals and spirits on the walls of inhabited caves. While we can only

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Figure 1: The Cave of Sounds exhibited at the Barbican, London, August 2013.

imagine the musical rituals of our ancestors, Small [13] explores the idea of making music as a collective activity allowing relationships to be explored and a group to form a common identity. Music can provide a space for people to demonstrably act towards a common end, while simultaneously allowing individual expression to be voiced and form a part of this common purpose. Indeed, Small argues that musical practices mirror and potentially reinforce its participants' political norms, from the reverent silence of an audience during a Western classical concert to the communal anarchy of an illegal rave. In a similar vein, Jo and Tanaka [7] categorise musical practices based on their level of audience participation. They highlight the scope of contemporary interactive work to increase the level of involvement granted to audiences in determining how a performance unfolds.

These themes are visible in the outcome: an interactive installation where individuals transition between the roles of audience and performer [see 12]. They also shaped the creation process. Involvement was inclusive and non-selective. And while support and feedback were continuous among those involved, everyone remained free to create their instrument as they pleased. Ideas of prehistoric music guided many aspects of the work but primarily we wanted our audience to feel the *activity* of collective music making and the connection it creates between those involved.

The project began with an open call to members of the Music Hackspace interested in creating an instrument for a new ensemble, culminating in a group of eight diverse individuals including musicians, programmers and artists. Meeting, initially every few weeks and later more frequently, we negotiated the outcome we wanted (performance or installation) and what themes and constraints would shape its development. These meetings provided a space to discuss ideas, present work in progress and, crucially, experiment with each other's work to gain an understanding of the common discourse that was emerging. From here, we could see which ideas resonated with the group and understand

how our own contribution might fit within the ensemble as a whole. On two occasions, a member of the group decided to drop completely their current concept of an instrument and begin something new. Through this process, familiar roles emerged organically without explicit direction with different instruments focusing on rhythm, melody and harmony.

### 3. REALISATION

From the first meeting in November 2012, the final installation debuted for a weeklong exhibition in the appropriately cavernous ticketing hall of the Barbican Centre, London in August 2013 (Figure 1). It was also exhibited for one day at the Victoria & Albert Museum, London and three days in at Watermans Gallery, London.

The installation is both the outcome and a reflection of its creation process. Each instrument encapsulates not only its creator's personal practice, but the advances and compromises made in order to find a place within the ensemble. This balance is experienced by an audience member first hand as they navigate the range of sounds, actions and musical possibilities afforded by each instrument. We strived to create a space where visitors would be provoked to create music and connect with each other. But we were also committed that the final outcome be an honest reflection of the socially negotiated creation process. If relationships soured then this should be felt when interacting with the work.

#### 3.1 Instruments

The Cave of Sounds has eight instruments, as follows.

##### *Sonicsphere by Panagiotis Tigas*

A palm-sized sphere containing an Arduino Uno, accelerometer and Bluetooth transmitter. Custom software maps orientation to a pitch space by assigning pitches to a face of an equivalently oriented polyhedron. Notes are triggered when different faces move through a fixed axis, with further

processing effects being controlled through acceleration of the sphere. (Arduino, Processing, Ableton Live, Max4Live)

### *Joker by Wallace Hobbes*

The player is invited to wear a mask lined with conductive tape and tap onto strips of conductive tape on a plinth. In doing so they complete a circuit, with a tap on each strip triggering a hit of a different percussive instrument. (Makey-Makey, Ableton Live, Max4Live)

### *The Animal Kingdom by Daniel Lopez*

An instrument played by casting hand shadows onto a translucent surface, which are sensed by a camera hidden beneath. Custom image processing software identifies hand and finger shapes allowing familiar shadow puppet shapes of animals to be detected. As well as triggering samples of bird flapping and barks, an FM synthesiser can be controlled. (Custom software using openFrameworks, OpenCV)

### *Generative Net Sampler by Tadeo Sendon*

Experimental audio clips created by randomly sampling the internet are triggered by moving through cylindrical trigger zones. (Kinect, Custom software using Cinder, Max/MSP)

### *Lightefface by Kacper Ziemianin*

A drone played by shining lamps onto an array of 24 light dependent resistors. Each sensor modulates the intensity of a harmonic of the fundamental frequency. (Arduino, Max/MSP)

### *Campanology by Dom Aversano*

Generative rhythms based on the mathematics of English church bell ringing patterns are controlled by hand movement. (Kinect, custom software using Cinder, PureData)

### *Rockmore by Sus Garcia*

A handmade theremin is run through a pitch tracker with the proximity of a participant's hand controlling the loudness of a series of harmonious audio loops. (Custom pitch tracking software, Ableton Live, Max4Live)

### *Wind by Tim Murray-Browne*

A breathy flute controlled by moving the hands around the body. A virtual cylinder surrounds the participants with a 2D grid of notes mapped to its surface. (Kinect, custom software using Cinder, Ableton Live)

## 3.2 Installation form

Following our ideas of prehistoric music and inclusive participation, we decided on a circular arrangement of instruments reminiscent of ancient stone circles. To emphasise music as a collective participatory activity, the instruments faced inwards. The circular arrangement also served a technical purpose. The three instruments relying on a Kinect camera required an unobstructed distance of at least a metre between Kinect and participant. These were placed in the centre on the floor, and the circle provided a natural but unproscribed space where people (mostly) did not wander. Within the centre of the circle, a low circular table hid the Kinects. In later exhibitions of the work, this also served as a screen onto which a visualisation was projected. The five non-Kinect instruments were each placed on a plinth.

Each instrument consisted of an interface and a distinct laptop processing interaction and sound synthesis. From an early stage, we decided to network the instruments to facilitate a level of musical convergence between them. This was implemented through developing a *stabilizer* program that each instrument communicated with. Introducing invisible

external inputs to an instrument requires delicacy. Overriding the intentions of a player can confuse and frustrate by reducing their perception of agency over their musical output [10]. Our solution was to clearly delineate two sets of musical parameters for each instrument: those over which it provides control and those which it does not. Parameters included note onsets, pitches, harmony, loudness and rhythmic complexity and tempo. Only some would be relevant for a given instrument. Player-controlled parameters are never overruled but the overall instrument behaviour may still respond to externally controlled parameters. For example, Wind and Sonicsphere both provide the player autonomy to trigger notes from a pitch space. However, the pitches available in the space are determined externally. Some parameters are exclusively player-controlled – for example an instrument would never create sound without action from its player – while some are exclusively external, such as tempo. This allows us to converge the sounds produced by the instruments towards a unified piece of music without imposing requirements on the actions of participants.

As a part of the above collection of musical parameters, all instruments communicate to the stabilizer an *activity* parameter indicating how much an instrument was being played (interpreted by its creator as they saw best). From this, the stabilizer derives a *narrative* parameter which slowly increases with sustained activity. This narrative determines a range of parameters including tempo and harmony, all of which are broadcast back to the instruments. In this way, sustained use by a group of individuals would trigger harmonic progressions and changes in the atmosphere of the work. Our interpretation of narrative at an instrument level was again inspired by ideas of prehistoric musical rituals. We aimed to create a more hypnotic sound as the narrative value increased, through introducing effects modulated by low frequency oscillators (LFOs) and increasing attack times. In addition, the stabilizer controls a visualisation projected onto the floor. As the activity values for instruments increase, lines connecting those instruments become more pronounced in the visualisation. This is intended to communicate to participants the collective aspect of their playing, as well as encouraging them to look into the circle rather than focusing solely on their own instrument.

Where multiple participants are playing with unfamiliar interfaces, providing the means for each to identify their own contribution is essential [5, 14]. But our goal of forging a musical ensemble among participants made it equally important for them to hear each other. We decided from the outset to produce the sound from each instrument through a monitor located directly next to its participant. We experimented with facing the monitors into the circle or out of it. Neither was quite satisfactory. We settled with facing the monitors outwards but additionally routing the instruments through a PA system installed around the installation.

## 4. CREATIVE CONNECTIONS

Creating a successful Digital Musical Instrument (DMI) takes time and experimentation. But creating for an ensemble introduces a considerable amount of additional work. This was not unanticipated but we were surprised to find that even though the instruments had been created together with regular meetings, the majority of the workload was spent incrementally tweaking the instruments towards a more cohesive ensemble. Work that could be done individually decreased over the course of the project, shifting towards 'hackday' style meetings of alternations between playing together and individually working on instruments.

Throughout the work, our biggest challenge was in pre-

senting the work in a context where audience members would feel free to be creative in their exploration of the instruments, and inspired to use them to connect with those around. Running test events midway through the development process provided the biggest help towards achieving this. It allowed us to experiment with aspects of the work such as the circle size, written instruction and monitor placement, each of which had its own impact on how the audience approached the work. However, the biggest impact on achieving this aim was made through the incremental evolution of the overall sound of the ensemble. This happened primarily through reduction and simplification. EQ was applied to reduce spectral clash. Instruments became more focused on the role that had emerged for them. For example, both SonicSphere and Wind initially included rich but subtle textural sounds as well as melodic aspects. They sounded great when played alone but were dropped to clarify the overall ensemble sound.

There was a diverse range of responses among audience members in terms of our success in encouraging creative exploration and collaboration between participants. Visitors seemed more likely to participate when others were already actively creating sounds. As might be expected, young children were most receptive and easily engaged. This is perhaps influenced by the absence of explicit external directions [3]. Interestingly, groups of teenagers responded most closely to our intended audience experience, often splitting themselves among instruments and on occasion explicitly planning how they would play together. One group of teenagers spent over three hours on the installation in one day. Such occasions were not as widespread as we had hoped. Although the developments described above created notable increases in audience-to-audience communication and collaboration, this remains the main target for future improvements. Many visitors did not appear to progress beyond experimenting with a single instrument to consider how they might use it to contribute to the wider soundscape. Costello [3] describes two categories of behaviour for audience members exploring interactive art: *investigative*, exploring ‘what does this do?’, and *diversive*, exploring ‘what can I do with this?’ Like Costello, we found the first stage a precursor of the second. We additionally observed that this second stage further divided into ‘what can I do with this by myself?’ and ‘what can I do with this with others?’ Some participants progressed through all three stages, some only the first two, some only the first. In this lattermost case, the instruments seemed to be considered as puzzles, where the aim was solely to discover how to create a sound. These are reflections from the artists involved rather than formal observation or interview-based investigations. It is possible that many audience members felt completely connected to other players but did not appear so to us due to our assumptions about how this might look.

## 5. CONCLUSION

The Cave of Sounds originated out of a desire to explore what it means to create music together when designing instruments is an integral part of one’s musical practice. The boundaries between instrument creator, composer, performer and audience are increasingly blurred within NIME and the maker community. This creates opportunities to explore not only new instruments but new musical practices. Many new DMIs are created as solo instruments, often with a myriad of features to control many aspects of a performance. Creating instruments together for a single ensemble resulted in instruments that were in many ways simpler and more focused on their single role within the en-

semble. However, each retained a character reflecting that of its creator. Channeling individual expression into collective unity is at the heart of any musical collaboration. Just as when playing together, creating instruments to be played together requires compromise and self-restraint.

On a more personal level, a particularly rewarding aspect of this project was that our entire group – established from the second meeting onwards – stayed intact with no dropouts. In this sense, the process was as anticipated in the introduction: music as a means to connect with each other and establish a communal bond.

*Video documentation of The Cave of Sounds may be seen at <http://caveofsounds.com>.*

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