Sound Archaeology: Terminology, Palaeolithic Cave Art and the Soundscape

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Abstract

This paper is focused on the ways that terminology describing the study of music and sound within archaeology has changed over time, and how this reflects developing methodologies, exploring the expectations and issues raised by the use of differing kinds of language to define and describe such work. It begins with a discussion of music archaeology, addressing the problems of using the term "music" in an archaeological context. It continues with an examination of archaeoacoustics and acoustics, and an emphasis on sound rather than music. This leads on to a study of sound archaeology and soundscapes, pointing out that it is important to consider the complete acoustic ecology of an archaeological site, in order to identify its affordances, those possibilities offered by invariant acoustic properties. Using a case study from northern Spain, the paper suggests that all of these methodological approaches have merit, and that a project benefits from their integration.

Keywords: Music; Archaeology; Sound; Caves; Palaeolithic; Acoustics; Archaeoacoustics.

Background

Music and Music Archaeology

Terminology is an important but problematic subject when addressing the study of music, acoustics, sound and archaeology. Music archaeology is a form of terminology that has been used for over thirty years (Lund 2010; 2012). Initial research within the International Study Group on Music Archaeology (ISGMA), a part of the International Council for Traditional Music (ICTM) (Deutsches Archäologisches Institut 2002-2011), was musically based, focused on trying to learn more about ancient musical instruments, seeking sources in literature, archaeological finds and iconography, and exploring experimental approaches to recreating both instruments and musical performances. Various other related terms have been used, such as archaeo- (Hickmann 1985) and archeomusicology (Lund 1981). A focus on musical instruments has also been reflected in the adaption of the ethnomusicological term for the study of musical instruments, organology. Palaeo-organology is a term coined by Vincent Megaw, and also used is archaeo-organology (Lund 1988).

The study of music by archaeologists and anthropologists is significant, as music is something that is found in most cultures. Nettl (2000, 469) discusses the importance of music, both in ritual and in addressing the supernatural,

describing such as association as a universal shared by all known societies; however, the term “music” is problematic when dealing with cultures globally and in antiquity. A twenty-first century Western conception of music is focused on particular elements, such as scores, melodies, rhythms, recordings and concerts, and it is a separate and separated concept. Frith has suggested (1996, 237) that within contemporary Western culture the musical experience has been individualized and that music is no longer necessarily a social or collective force. In contrast, when Chernoff discusses ethnographic examples of musical culture, he states that the most fundamental musical aesthetic in Africa is participation, without which there is no meaning (1979, 23), and that it is only possible to understand African musical forms in the context of how they operate within African social situations (ibid., 30). He compares this with Western attitudes, in which art is seen as something separate and distinct: “we isolate the work of art from the social situation in which it was produced in order to concentrate on our main aesthetic concern, those qualities which give it integrity as art” (ibid., 31-32).

This separation is not universal, and other ethnographic reports have described cultures that do not have a separate word for, and concept of, music. Ehrenreich (2006, 157) describes how in the Bantu language group of southern, central and eastern Africa, “the word *ngoma* can mean ‘ritual’, ‘cult’, ‘song-dance’ or simply ‘drum’”. To use the term “music” is to assume a set of cultural imperatives and constructions, and to imply a separation of music into an art-form. If this is the case in (relatively modern) Africa, how much more might it be the case if we are considering cultures that are differentiated not just geographically, but by hundreds if not thousands, or tens of thousands, of years. As Cross and Watson (2006, 115) state,

> It is critical that, alongside the application of rigorous methods, acoustical investigations acknowledge the social contexts within which sound may have been experienced, and remain aware that it is easy to impose modern cultural understandings and experiences onto past societies.

Music’s context is a topic of current debate within musicology. Developments in ethnomusicology and popular music studies have led to a “new musicology” exemplified by the work of writers such as Susan McLary (1989, 1990), Joseph Kerman (1985), Robert Walser (1990) and Rose Rosengard Subotnik (1991, 1996), in which the context that surrounds music is regarded as an integral and inseparable part of its nature that frames the music itself. Such a contextualized approach is far from universally adopted, and discussion of absolute music (Chua 1999, 229; Babbitt 1958, 127), music described as having no meaning or context, is still common, especially in discussions of western “classical” music. For example Scruton (2009, 31) suggests that musical sounds can be heard as pure events, detached within our imagination from their sources “neither reflecting upon nor hypothesizing the background causality from which they arise”.

Music is commonly defined within the field of musicology as organized sound and silence, a broad definition that is able to include a wide range of improvised, avant-garde, electronic, popular and worldwide musical forms. Organized sound is a term taken from Varese (Goldman 1961, 133), whose

interest in electronic timbres required him to find ways of conceiving of music without referring to notes, as delineations between sound and music became increasingly indistinct. The inclusion of silence has been added to such a definition through the work of John Cage (1961), which pointed out its significance. His ideas further emphasized acoustic context, the sound(s) heard during silence, and has led towards the study of what Kassabian (2013) has described as ubiquitous music, music that is heard rather than listened to, further movement away from concepts of absolute music.

Such questions of terminology and definition are brought to the fore when we begin to consider music in an archaeological context. Archaeologists may be drawn to music archaeology by musical instrument archaeological finds, but ancient music may be inseparable from dance or ritual, or an archaeological site itself may act like a musical instrument, generating sounds as a result of its own acoustical properties. It may introduce such a characteristic quality to any other sounds made at or in the site, that this becomes the dominant sonic presence. Acoustics are clearly an important part of sonic context, and in recent years the study of the acoustics of archaeological sites, archaeoacoustics, has emerged.

Acoustics and Archaeoacoustics

As digital audio equipment has become increasingly cheap, portable and simple to use, sophisticated tools for acoustical study have been able to leave the laboratory and recording studio and be used more widely in the field. Such developments have afforded the opportunity for a number of studies to emerge that have explored the acoustics of archaeological sites. Digital audio technology has allowed archaeoacoustics researchers to study the significance of sonic characteristics of a site. Portable audio equipment can be used for acoustical characterization, mapping out sonic qualities, recording impulse responses (the acoustic response or fingerprint of a space) for later analysis, providing for a quantitative, and scientific evaluation. Such impulse responses can be assessed to evaluate what acoustic effects might be present, and how noticeable they might have been. One early example of this approach is the work of Watson and Keating (1999) at Stonehenge, and more can be seen in Scarre and Lawson's volume *Archaeoacoustics* (2006).

Computer modelling can be used to reconstruct the acoustics of sites that only partially remain, or that are no longer present. For example Rindel and Neilson (2007) have written about the acoustics of ancient Greek and Roman venues, and my own research has involved reconstructing the acoustics of Stonehenge (Till 2010; 2011; 2012). Combined with contemporary visual modelling techniques, such research can provide phenomenological multi-sensory immersive experiences, which allow one to explore an archaeological site by virtual immersion within it. In such a context sound has an important role to play, to animate, to bring alive what could otherwise be a rather static and lifeless space. As Barrett (1994, 12) puts it, "time is collapsed for the archaeological observer" (*ibid* 12). It is frozen into stratigraphic temporal slices, whereas "sound is a sensation, and belongs to the realm of 'activity' rather than 'artefact'. Sound brings the world to life. It can appear to fill

spaces, create atmospheres, and have an intense emotive power." (Watson 2001, 180)

Aural architecture has clear relevance to the activities that are set within it, and affords different possibilities depending upon its nature. Acoustics allows for the investigation of how changes in acoustic ecology might benefit societies. Because spaces and buildings are long lasting, they preserve and memorialize the relationship between aural architecture and culture, conserving within the acoustics of a space the attitudes to sound of the context within which the building was created, and space was defined as a place. Later generations develop their own cognitive frameworks through interaction with such inherited places, and from such frameworks they create newly constructed spaces, creating a sonic history of culture that can be observed within the fabric of buildings. "Just as we may trace Western attitudes toward politics to ancient Greek culture, so we can trace our attitudes toward aural architecture to earlier cultures as well" (Blesser and Salter, 2007, 67-8). As well as offering scientific and quantitative methodologies, archaeoacoustics enhances the study of culture and context within music archaeology, moving the focus away from music and towards sound.

Sound and Soundscapes

"Sound archaeology" is a term that has been used for some time in the field (Moberg 1986; Lund 2010; 2012). Sound within an archaeological study is a part of the context, part of the environment. Just as archaeologists study the landscape surrounding a site, so sound archaeologists study all the sounds in a context, and an assessment of sound or soundscape, no matter how brief, should be a component of all archaeological studies. Standard forms and a best practice document for such assessments are available on the website of the Acoustics and Music of British Prehistory Research Network (http://AMBPNetwork.wordpress.com). As well as a music archaeological discussion of musical instruments, a project might explore what Lund (2012) has called sound-making devices. These could include jingles placed on a sleigh, shells on a costume, the twang of a bow and arrow, or the noises made by flint knapping. It could include the sound of the wind in the trees, the rush of a river, or the hubbub of speech. The wider acoustic ecology of an archaeological site is something that could, or perhaps should, be explored and characterized.

Such an approach has roots in the work of a number of musical composers who explored using sound in their work. Futurist composer and painter Luigi Russolo wrote in his *Art of Noises* (1913) manifesto that "we must break out of this narrow circle of pure musical sounds and conquer the infinite variety of noise sounds". He divided sounds into categories and called for composers to take a sound-based approach, rather than one focused on music. Pierre Schaeffer and Pierre Henry began composing with sound objects as early as 1948, using turntables and tape recorders. Like Russolo, Schaeffer also categorized sounds, while Henry divided sounds up simply between those that were human and non-human (Schaeffer 2012; Chion 2003). John Cage's (1961) exploration of the nature of silence pointed out that every "silent"

concert hall has an acoustic context, a surrounding sonic environment, a background “noise”. Others such as Attali (1985, 2001) went on to explore the boundaries between music and “noise”.

The acoustic ecology of a space is part of what turns a space into a place. As Yi-Fu Tuan tells us, definitions of space and place are mutually dependent, if we think of space as that which allows movement, then place is pause, “each pause in movement makes it possible for location to be transformed into place” (1977, 6). Cresswell (2004, 11) has discussed how places are contextualized spaces:

> Place is also a way of seeing, knowing and understanding the world. When we look at the world as a world of places we see different things. We see attachments and connections between people and place. We see worlds of meaning and experience (…) To think of an area of the world as a rich and complicated interplay of people and the environment – as a place – is to free us from thinking of it as facts and figures.

Spaces are physical locations, but a consciousness of sound, the act of listening to a space, begins to turn it into a place. When we listen to the time-based medium of sound in a specific place, we pause but do not stop, embedded within its soundscape.

A number of composers have explored soundscapes, what we might call musical places, including R. Murray Schafer (1994), Barry Truax (Paynter 1992, 384) and Hildegard Westerkamp (http://www.sfu.ca/~westerka/). They looked beyond absolute music, or even the creative use of sound, to begin to explore how sound creation and the agency of humanity interacts with a wider environment, including the use of anthropological techniques in this context. This idea has been further explored by ecomusicologists, who are interested in ecologies of sound, soundscape studies, sounds made by animals, eco-critical musicology and the study of music, culture and nature (Pedelty 2011). Ecomusicology has explored how the soundscape surrounding a particular context provides particular ecological affordances (Clarke [2005] discusses affordances in music in some detail).

Sound archaeology is a field that includes many approaches, subject areas and methodologies. The different terminologies that have been used to name and describe this field illustrate the different methodological approaches that can be adopted for a study of this kind, and terms such as music (archaeology), (archaeo)acoustics and sound (archaeology) raise a number of issues that address the choice of methodology and methods adopted.

Songs of the Caves: Methods

The next section of this paper will discuss how the methodological issues (in terms of ontological or epistemological framework) already discussed, play out as methods used within a case study, the Songs of the Caves research project, exploring the soundscapes of five caves in northern Spain that feature Palaeolithic art/motifs. This involved UK and Spanish researchers from the fields of archaeology, acoustics, music, music archaeology, music

technology, art and archaeoacoustics. It involved the study of sound in four caves in Cantabria (La Garma, Las Chimeneas, La Pasiega and El Castillo) and one in Asturias (Tito Bustillo), all of which are part of the Cave of Altimira and Paleolithic Cave Art of Northern Spain World Heritage Site. The project aimed to explore the hypothesis of Reznikoff and Dauvois (Reznikoff and Dauvois 1988; Reznikoff 2000; Dauvois 2005) that positioning of Palaeolithic cave paintings and engravings is linked to sound. The key research questions to be addressed were to explore to what extent is it possible to confirm the existence of relationships between visual imagery and acoustic phenomena; to what degree can we reconstruct or understand the aural past; how might a multisensory approach to monuments be applied to interpreting how people in the Neolithic and early Bronze Age experienced and understood their world; and how can we explore ways of capturing and conveying these experiences in the present day?

The caves feature a range of unusual visual characteristics. There are paintings and engravings, shapes and patterns, red dots, hand stencils and lines, as well as many (somewhat later in date) images of animals, including horses, bulls, bison, cows, goats, deer and bears. In many cases natural shapes within the rock are enhanced, animal shapes for example being inferred by the shape of the walls. In addition the caves are in themselves highly dramatic visually, especially due to the presence of many stalagmites and stalactites.

This study aimed to sonically characterize the totality of the context of the subject under study. This involved literature review, recording, analysis, interpretation, experimental archaeology, dissemination and public engagement activities. A review of existing literature relating to the caves under study was vital to ensure that the project was set within the context of existing knowledge. The team of archaeologists included in the project provided specific expertise in the caves under study. This included experts on the archaeology of the caves of this area and/or who have published relevant works (Arias 2009; Arias, Ontañón *et. Al.* 2008; Ontañón *et al.* 2008; Pike *et al*. 2012; Pettitt 2011; Bahn and Pettitt 2009; Scarre and Lawson 2006) and music archaeologists, including a mixture of Spanish and UK participants. An archaeological artist was recruited to create digital multimedia artworks, working with a soundtrack composed by the author of this paper, whose background is as a music technologist and composer. Two acoustics researchers completed the team, who together facilitated the use of approaches taken from archaeoacoustics, music archaeology and sound archaeology.

An archaeoacoustics approach, such as recording of the acoustics of a site, can use a number of techniques, which are described in a best practice document (op cit. - http://ambpnetwork.wordpress.com). Different levels of technology can be used. An elaborate equipment set up can be difficult to manipulate in a space, and specialist acoustical equipment, more used to laboratory conditions or use in buildings, can struggle within the challenging conditions that may be present in an archaeological site such as a cave. Simpler, and inevitably more affordable, equipment can also produce good results. Something as simple as bursting balloons and recording the sound

using a handheld sound recorder can produce results that can be analysed and manipulated using freely available or open source software. Northwestern University has even developed a simple iPhone app called ClapIR, which allows you to explore acoustics with only a mobile phone. (Seetharaman and Tarzia 2012).

We used a range of archaeoacoustics methods in an initial pilot study, and a second field trip. The most complex set up used a dodecahedron-shaped loudspeaker (designed for making acoustic measurements and diffusing sound test signals in all directions equally), supplemented by a sub bass loudspeaker (to enhance low frequency response). A laptop with professional soundcard was used to generate sine sweep signals. These test signals gradually sweep a sine wave through all audible frequencies. The acoustic response of the space to these signals is captured, recording its sonic fingerprint or impulse response. In one cave the dodecahedron loudspeaker would not fit through the narrow entrance, and in other spaces, moving the equipment was cumbersome and time consuming. Returning a year after the initial pilot study, we used a smaller portable loudspeaker. By recording the acoustic response of this loudspeaker in an anechoic chamber, we were able to assess its qualities and compensate for its inaccuracies. The battery powered speaker provided us with a highly portable signal generator for positions with difficult access, or where the proximity of fragile archaeological remains caused difficulty. It balanced acoustic fidelity and portability.

We used recording studio microphones for their robustness, as well as a three dimensional Soundfield microphone, having found acoustic measurements microphones too fragile for the moist and inhospitable environment of the caves. A laptop computer was used to record audio where possible, turning to a professional portable location digital audio recording device where a quicker mobile workflow was required. Having recorded acoustical signals from loudspeakers (sources) with microphones (receivers) placed in numerous positions, we were able to carry out a range of analyses. Impulse responses extracted from the recordings provided an acoustical sample of the specific location of each acoustic measurement, from which we produced a range of standard acoustical metrics, including T30 (reverberation, how sound is sustained); EDT (early decay time, another measure of reverberation); STI (speech intelligibility); D50 (definition or deutlichkeit, how well defined speech is); C80 (clarity, how clear music is); LEF (lateral energy, how much sound comes from the side rather than the front); and LG80 (envelopment, how much the sound envelops the listener). These metrics allowed us to quantify the sonic context.

We carefully recorded the position of each measurement, and made detailed notes about the archaeological context present. We then tested for significant statistical correlation at the $p<0.05$ level between these acoustical metrics and a number of contextual factors related to the Palaeolithic images present, such as presence or absence of images, chronology, colour, type of image, number of images present, and distance from the original entrance. A number of significant correlations have been found, but analysis is still in progress. We have found statistically significant evidence that there are relationships between acoustical context and visual imagery in such painted caves,

although these relationships are not simple, and the individual context of each cave is important. These results confirm and validate the use of archaeoacoustical study to learn more about such archaeological sites. We were able to investigate in detail the differing acoustic characteristics of the caves, with for example a wide range of reverberation, ranging from 0.25s to approximately 3s (EDT). Details of results will be published on the project website http://Songsofthecaves.wordpress.com.

Sounds in the Caves

As well as archaeoacoustic approaches such as acoustic testing, the project included experimental techniques and methods drawn from music archaeology, something that proved highly valuable. The team included a number of musical specialists who used a range of different instruments. Such performances were valuable in exploring and illustrating the acoustics of the spaces qualitatively, before acoustical measurements were taken. This allowed us to get to know the sonic qualities of the caves, and informed our ideas about where to make measurements. The sound of a musical instrument such as a drum, voice or bone flute in a space can tell one a great deal about its acoustical nature.

Non-musical sounds were also highly affective due to the very low background noise we measured in these caves. Even in natural environments, there is usually a sustained level of background noise, for example from wind, rain or wildlife, which masks other sounds. Within the cave this was noticeably absent, making it easier to perceive very quiet sounds, from water dropping to the floor, to the sound of footsteps. The music archaeologists involved in the project explored different ways of performing on bone flutes, and the use of percussion instruments and voices, assessing the ways the cave reacted sonically to different sounds. Adding a consideration of the acoustics in which an instrument is played (archaeoacoustic methods), to an exploration of how musical instruments sounded in the past (music archaeology methods) extended both approaches (as sound archaeology).

In addition to musical exploration, we studied the sound made by the caves themselves. Some lithophones, rocks that ring when struck, were already known in the caves, and one was marked with paint in prehistory. We discovered that many more of the nearby stalagmites also acted as lithophones. In some positions, drops of water falling onto these stalagmites produced marimba-like notes, the cave acting like a natural musical instrument. These “noises” caused difficulties for the acoustic measurements. They were problematic from an archaeoacoustic perspective, but from a sound archeology point of view they are a significant part of the acoustic ecology of the space. These are the only sounds that we know for certain were present in prehistory. They illustrate well the value of considering soundscape and of sound archaeology methods. Other sound archaeology recordings were made, for example of running water that could be heard rising up from out of deep chasms.

As access to these caves is restricted, it was important to the research team that the results of the project could be made available to a wider public,

through a website, and a digital film was based on the project by archaeological artist Aaron Watson, who was able to draw upon his own archaeoacoustics experiences (Watson 2001; Watson and Keating 1999). This film will also be featured on the project website, alongside other files, including audio files, photos and reports. In addition results will be archived with the UK based Archaeology Data Service (ADS).

Sound Archaeology

Overall this project had a number of key features. It used a rigorous scientific methodology to record and characterize the acoustics of a significant archaeological site. This was an archaeological context where acoustical and sonic features were clearly present, and likely to have been significant in the past. To reflect this significance, a complex, well-defined methodology was implemented. For a site where sound was potentially less significant, more simple methodology and methods may have been adequate. The project used a systematic approach to provide objective data that could be analyzed in order to examine the significance of the sounds in the space. This approach found significant correlation between acoustical metrics and archaeological context, and this provides evidence that sound was important in the ritual context of this cave. As well as this quantitative approach, qualitative work explored different musical sound sources within the cave, providing a number of examples that illustrated the sound of the cave's acoustical character. We were interested in the sounds made by the caves, not merely by the people within them.

The interaction of a number of experts in their own fields was vital to this project, and its strength lay in this interdisciplinary approach. The moments where the project made breakthroughs involved researchers from different fields interacting closely together, where acoustician met with archaeologist, video artist with composer, or music archaeologist with archaeoacoustician. Such cross-fertilization between disciplines did slow the project, but the results could not have been achieved without it.

This project included sound-, music- and acoustics-led approaches within an interdisciplinary context, and disseminated the results using multimedia arts. The statistical correlations discussed have provided evidence for the significance of sound in spaces in prehistory, and how this related to imagery. The acoustical analysis gave us a detailed qualitative and quantitative analysis of the architectural structure of the spaces, and has created an analysis that is able to interact with their contextualized identity as places. In this case an interdisciplinary methodology has described the acoustics of each sector of each cave; has identified previously unknown archaeological features and relationships between features; has helped us to understand why specific positions were chosen for decoration; has illustrated the sonic context using musical instruments; and has enabled a phenomenological exploration of the caves using a multi-sensory reconstruction illustrating how it may have felt to have been there in the past. This shows the potential of such a sound led methodology to contribute to our knowledge of significant archaeological sites.

This project has provided evidence of the significance of sound in prehistory, but is has not tried to attempt to establish musical intent, as opposed to activity that is considered primarily functional. For this author, such an approach rather misses the point. It is the total acoustic ecology, the soundscape of the context that is of most significance, whether those were what we might today call musical or functional sounds, or background noise. There is no need, in this case at least, to create such categorical distinctions. We cannot know the intentions of the people who made either sounds or images in the caves in prehistory, but we can learn more about these people through a better understanding of the nature of such sonic and visual ecologies, and their relationships to one another.

It is not questions related to our modern conceptions of music that are important here, nor those related to concepts of intent or function. What can be achieved is a better understanding of the sonic context present, to add information about acoustical ecology to our understanding of the broader archaeological context. The songs of the caves under study consist of the vibration of air within them, sonically activated by human and natural agency. They can be defined ecologically as the sonic affordances available as a result of particular architectural structures, and are understood through the whole context of the site, including the archaeological, cultural, visual and sonic.

This paper has suggested that the use of the terms music archaeology and archaeoacoustics are limiting in that they impose implicit restrictions, expectations and assumptions. It concludes that it is more useful to use the term sound archaeology, as this includes research framed by these other terms as well as research excluded by them. It highlights the advantages of integrating such methodologies and methods, particularly when specialists from a range of backgrounds work together. Terminology provides an indication of priorities, and a focus on sound archaeology encourages research projects that integrate approaches from the fields of music, acoustics and archaeology.

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Biography

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