

Experiencing sounds in ancient spaces: an overview

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Abstract: This article aims to analyse recent studies that have raised new hypotheses concerning archaeomusicology, archaeoacoustics, and aural architecture as an emerging trend in humanities research, with a particular focus on the intersection of musical performances, theatrical spaces, and sound experience in the past. These studies have highlighted how theatrical buildings not only defined a place for performances, but also established the setting for multisensorial events in which music, dance, and other sonic events played an important role. This overview also considers how digital technologies can help shape our understanding of the architecture-sound nexus.

Keywords: Archaeomusicology; Soundscape Archaeology; Archaeoacoustics; Aural Architecture.

Introduction

Sound and hearing in archaeological contexts and acoustic intentionality can be difficult to identify. However, since sound has always been an omnipresent component of human experience, recent trends in archaeomusicological inquiry have analysed the importance of acoustics, instruments, and what was heard in the past, considering that ascribing cultural meanings to sonic experiences is possible, and that sounds have played important functions in quotidian and religious life (Power 2019; Power 2022). Recent research has also trended towards exploring the experiences of past peoples, considering sensorial aspects and seeking new methodologies in which the important role of sound is developed and investigated (Betts 2017: 1-12).

Sound and hearing especially can provide an important dimension for thinking about

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social interaction in the past and how individuals observed their environment and navigated through it. In this regard, sounds heard by people who lived in a particular landscape, sonic environment, and performative space can be explored to improve our knowledge on how they experienced a sonic event in more depth (Miles 2016: 151-195; Holter *et al.*, 2019: 44-60): by focusing on sensory experience, a site, a sacred event or a sound object can be understood and interpreted, considering other senses. This is in line with recent developments in archaeology over the past few decades, particularly the interest in new approaches for understanding how ancient people experienced their surroundings (Day 2013: 1-31; Hamilakis 2013:48-55; Skeates and Day 2019: 1-17). As Shannon Mattern (2019: 225) has argued, “opening the ears during archaeological investigation allows for a recognition that human experience is, and always has been, multisensory, and that ancient spaces have long functioned, either by accident or by intention, as resonance chambers and transmission media for sonic

activity – for public address, interpersonal communication, ritual or musical performance.”

We must keep in mind that sounds, performances, and music were more than a mere channel of communication, they conferred connotations of sacredness and power and contributed to form individual and group identities since they were important aspects of sacred and performative activities (Inomata & Coben 2006: 11-12).

Moreover, sounds and auditory experiences have occurred ubiquitously throughout time and within all cultures. Given that “soundscape” is influenced by a combination of anthropological data which is framed within an audible space and an acoustic space, it must be remembered that the sound associated with particular sacred places, performative spaces, and architectures, as well as the production and use of material culture, influenced people in a variety of ways (Blessner & Salter 2007: 67-78; Chiai & Haussler 2019: 40). Therefore, when soundscape is addressed in archaeology, we can enliven material archaeology with sensory methodologies to answer anthropological questions in cultural heritage settings.

Considering the experiences of human beings, their perceptions, and their relationships with the world opens up new ways of understanding the past. This means that from a deeper understanding of our physicality, shared by all human beings on a biological level, we could compare our sensorial experiences with the people of past societies. Our “common biological humanity” mediates our interaction in the landscape, and therefore allows us partial access to past constructions and interpretations of the material world even though contemporaneous experiences may differ.

The survey on past soundscapes can provide more information on an acoustic or experiential level and in the way we interpret sound artefacts found in the archaeological record. In this regard, soundscapes and archaeoacoustics provide us with more information for the archaeomusicological interpretations of material evidence, sacred architectural structures, and physical spaces. Moreover, organological and acoustical studies can also define landscapes and territories.

Also, Steven Feld (2015: 11-16) has proposed new ways to link culture, space and sound. His definition of acoustic space and audible space offers an interesting way of understanding archaeological spaces and buildings. With the term ‘Acoustemology’, he defines an acoustic epistemology where sound is the key to knowledge: “Acoustemology, acousteme: I am adding to the vocabulary of sensorial-sonic studies to argue the potential of acoustic knowing, of sounding as a condition of and for knowing, of sonic presence and awareness as potent shaping forces in how people make sense of experiences.” In this respect, the environmental reconstruction, or the analysis of specific acoustic conditions of certain archaeological sites, may lead to a better understanding of the uses and functions of sound and its cultural meanings.

This approach enables the intersection of sensory sonic concerns with heritage preservation and management, offering new insights for understanding the past. Attentiveness to sound in precise archaeological contexts is a valuable means of becoming better informed on the many different ways in which sound pervades spaces, architectural places, social interactions, material engagements, and also human-animal relationships; only by acknowledging, investigating, and recognising the role of sound in a place, can we begin to understand the complex relationship and the “entanglement” between spaces, social interactions, and the environment.

Exploring ancient sounds in theatrical and performative contexts

Sound is not often considered in archaeological works since it does not leave any trace to be discovered. However, sound represented an important aspect of ancient life that can be investigated by using a new approach to archaeological methodologies and by exploring the evidence of acoustic aspects in the archaeological records (Kolltveit & Rainio 2020). Human beings are surrounded by a rich sonic environment in which they create, reinforce, or contest their worldviews.

In this respect, soundscapes can shape cultural knowledge, including not only symbolic meanings and musical aesthetics related to sound, but also social behaviours, religious beliefs, memories, and even emotions. Given that the term “soundscape” refers to human-environmental interactions, it also consists of all sounds present in any given environment and how these sounds interact within that environment. Moreover, soundscapes delineate cultures and can mark time, frame ritual contexts, establish borders in the landscape, reinforce or separate cultural identities, and even define sacredness, power, and prestige. This would be considered a valuable benchmark for approaching the matter from different perspectives, highlighting the interconnection between the sounds pervading the spaces and their social functions.

On this basis, important public spaces of antiquity, such as performative spaces or theatrical structures, having been investigated almost exclusively with a focus on their visual function seems surprising. Since ancient times, the interconnection of space, dancing, and sound has characterised performative practices, highlighting the role of acoustics in determining the volume shape and the boundary marking the space where the performance took place.

Structures, decorations, and the surrounding landscape of the performative spaces and theatrical buildings were the best ingredients for creating specific acoustic characteristics, which influenced the perception of the performances. Based on archaeological discoveries, the architectural components could have been adjusted based on developments in musical subject, including vocal and dance practices that contributed to modifying the theatres and performative space design. Moreover, the soundscapes in performative spaces also comprised songs, music, recitations, and vocal utterances.

The setting of theatrical structures could be established for performative and multisensory activities where music, dance, and other sonic events played an important role. By recognising theatres as embodied spaces, based on how the sound physically reacts to these architectural

structures (Blessner & Salter 2007: 67-97), the correlation between acoustics and the architectural shape of historical buildings could be explored, including any association with the performance and consequently social and sensorial interactions (Holter *et al.*, 2019: 44-60). Furthermore, the exploration of the social utility of ancient performative spaces could be addressed alongside acoustics to offer new insight into the connection between sound and ancient architectural structures (Sü Gül 2019: 493-495).

A key element in this selection pertains to the physical scale of the analysis of the auditory experience; this could vary from the perception of sounds in a limited area up to interactions within large sonic environments and soundscapes. Such an approach concerns sonic archaeology and focuses on attentiveness to contemporary sounds in research contexts to stimulate alternative ways of thinking about engagement with and relationships between places, people, and built environment (Mills 2005: 79-89).

In this regard, based on its intrinsic multidisciplinary nature, the study of sound in theatrical and performative contexts concerns many subject areas ranging from archaeomusicology to aural architecture, traversing physics and acoustics (Mills 2014: 18-26). Each of these areas raises several challenges concerning the choice of the methodology and the approaches to be adopted.

Towards a historical acoustics approach

Current research approaches to archaeomusicology, soundscapes, and archaeoacoustics have highlighted how sonic hypotheses on the acoustics of ancient theatres and performative spaces can be different and variable. Indeed, within the same field noticing different aims and methods is possible, especially when it involves investigating sound in the performative spaces from across places and time.

Archaeomusicology and archaeoacoustics (Scarre & Graeme 2006; Schofield 2014: 289-291) have laid the methodological basis for reflecting on the possibilities of unveiling past soundscapes and musical and

acoustic behaviours in ancient spaces as agoras, theatres, assemblies, council houses (*bouleuteria*), stadia, and music halls (*odeia*) that were also used for other events and social meetings. Although soundscapes have been thoroughly discussed at a theoretical level – providing a grounding for many archaeoacoustical studies – the survey on historical acoustics in the performative spaces related to Greek architectural structures has been sparsely considered so far in archaeological research. This could be due to the conceptualisation of historical soundscape being understood differently by every field, and even by archaeomusicology and ancient sound studies.

While acoustical research methods typically focus on physical aspects of sound, cultural and performative contexts should also be investigated since this will be crucial in forming an anthropological approach to the study of sound in archaeology (Blake & Cross 2015: 81-103). Historical acoustic approaches can intersect the technical concerns with the preservation and management of the heritage, offering new insights for understanding the past (Aletta & Kang 2020: 128-130). This would be considered a valuable benchmark for approaching the matter from different perspectives, highlighting the interconnection between the sound pervading the spaces and their social functions.

The knowledge of acoustics of performative spaces in the ancient world appears to reflect a process of gradual change. If, on the one hand, sonic features of a particular space might have directed the choice of suitable places for a greater understanding of the sounds produced in that space, on the other hand, the development of architecture and the evolution of the form of theatrical spaces seems related to the presence of an ever-increasing number of participants in performances and assemblies, where performers and speakers needed to be clearly understood by the audience. This is one of the aspects covered by the project *Stesichoros. The Archaeology of Sound in a Greek City* carried out at the Institute of Heritage Sciences of the National Research Council of Italy. This research placed the study of sonic heritage at the centre of its interest and aimed at evaluating the acoustic quality of a

performative space in an ancient city in Greek Sicily with auralisation techniques.

Note that the considerable variation in methodological approaches to archaeoacoustics often derives from how data is collected or produced. For example, archaeoacoustics of performative spaces raises several challenges concerning the choice of methodology and the approaches adopted. Archaeoacoustics has always featured computational approaches and modelling (Till 2014: 292-304, 2019: 661-692); however, when given a soundscape framing, archaeoacoustics “can be considered as a contextual experience of spaces, and auditory perception as one of the ways in which people made sense of their world” (Primeau & Witt 2018: 875). Research in this area has adopted various approaches that also consider the relationship between architecture and acoustics and the state of conservation of buildings, as well as the analysis of anechoic recordings of music and sounds used in the auralisation processes at archaeological sites.

Moreover, archaeoacoustics certainly does not only intend to re-enact ancient sounds or listening experiences, or merely claim to approximate auditory perception in the past: archaeoacoustics aims to carry out investigations on a great variety of places and historical periods, shedding light on sound in the past, and providing data for a re-evaluation of archaeological sites thanks to studying their sonic features (Eneix 2016; Eneix & Ragusa 2018).

In the last few years, many researchers have devoted their studies to these themes with different methods and results, exploring how digital technologies based on 3D modelling and sound simulations can expand our knowledge on sounds and open new perspectives on the study and preservation of sound heritage. In this respect, the *Stesichoros* project aimed to explore the sonic interactions and the spatial configuration of a theatrical area dating to the Archaic age in its respective landscapes and environment to investigate the use of experimental interpretative 3D reconstructions integrating acoustic models as well as auralisation technology in the archaeological field.

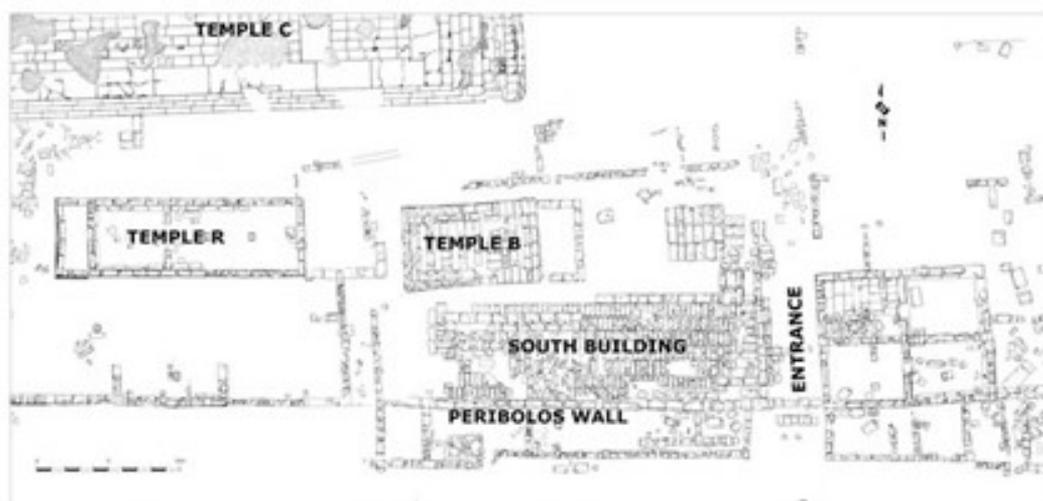


Fig. 2. State plan of the area of investigation.
Source: Institute of Fine Arts, NYU.

This theatrical building and the related performative open-air space belong to an interesting group of buildings found in various regions of the Greek world, including the Peloponnese, Crete, Attica, East Greece, Magna Graecia, and Sicily. The seats predominantly faced the centre of the sanctuary, as did the temple of the deity, so that both those seated and the “deity,” the cultic statue or the priest/priestess, could “watch and listen to” the proceedings in the rectilinear *orchestra*, where the altar was also normally placed. In this regard, these buildings were not proper theatres in the modern sense of the word, but rather rows of seats (with linear and non-circular *theatre* and/or *orchestra*) (Anti & Polacco 1981; Polacco 1990, 119-159; Gebhard 1973; Csapo 2007; Sokolicek 2015). The quality of the stones was carefully selected regarding their placement in the theatrical steps; this selection was based on structural, aesthetic and, in all likelihood, acoustic considerations of the space where these buildings were built.

Rectilinear theatres are a category of buildings brought to the attention of scholarship on Greek drama by Carlo Anti (1947) and Elisabeth Gebhard (1974), but first investigated regarding religious contexts by Inge Nielsen in her study on cultic theatres

and ritual drama in the ancient world (Nielsen 2002), by Alexander Sokolicek (2015: 97-102) in his study on the form and function of the earliest Greek theatral structure, and by Hollinshead (2012: 46-56; 2015: 3-15) in her study on the steps as components of monumental construction at Greek sites as early as the sixth century.

These theatral structures in sanctuaries seem important for understanding the communicative and multisensorial possibilities of ritual performances, since they appertain to the observation of ritual procedure at the altar and are perhaps connected even more intensely with the visual and aural experience in a framework of sacred representation and/or public events.

As Joannis Mylonopoulos (2006, 59-97) has argued, theatral steps can by no means be connected to any particular divinity, although they are especially common not only in sanctuaries of Dionysos, but also of Demeter, these buildings appear to have played an important role in her cult. At least three of her most important sanctuaries, in Corinth, in Lykosura, and in Pergamon, possess monumental steps. To these buildings we can add the theatre stairs in the south of the Telesterion In Eleusis – probably built in

the time of Hadrian (Hollinshead 2012: 32-48; Hollinshead 2016: 41-50) – and the ‘South Building’ in Selinus (Marconi & Scahill 2015: 279-292) (Fig. 3).

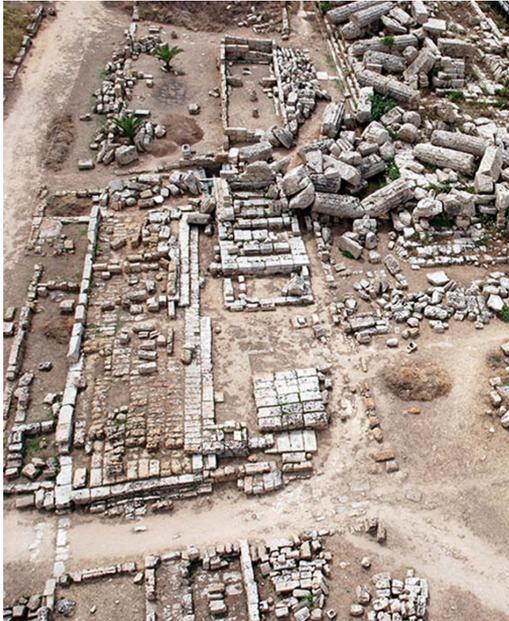


Fig. 3. Aerial view of the area of investigation.

Source: Institute of Fine Arts, NYU.

Several elements suggest the identification of this building as an impressive viewing area in the main urban sanctuary on the Acropolis. According to Clemente Marconi (Marconi & Scahill 2015: 289-290), this structure was built to accommodate audiences during sacred festivals and celebrations, as well as spectators of cultic performances and public assemblies associated primarily with Temple R, probably a temple of Demeter Thesmophoros.

The performance of choral dancing and musical performances in this part of Selinus' main urban sanctuary is also suggested by the discovery of a series of Corinthian vase fragments in the area of Temple R, featuring chains of dancing women that conform to the so-called *Frauenfest* iconography (Marconi 2013), and of the aforementioned two parts of a bone *aulos*, which can be dated to 570 BCE (Marconi 2014: 105-116; Bellia 2018a). These discoveries

show the importance of music and dance in a sacred context at Selinus which already existed in the Early Archaic period, that is, since its foundation (Bellia 2018b). These pieces of choral and musical evidence at Selinus are very significant, particularly regarding sonic events and ritual dancing associated with the sacred activity of Temple R. Considering the ‘South Building’ as a ritual stop or a stopping place for processions (including a dramatized ritual related to the Demetriad myth), note that at Megara Nisea, the motherland of Selinus, a kind of sacred drama was performed in honour of Demeter and her daughter. Pausanias (1.43.2) mentioned that the dramatic performance took place with the active participation of female worshippers who performed lamentations.

The women celebrated Demeter during a festival, holding a performance that was a mimetic representation of her myth, probably across the connecting route between the *megaron* on the Carian acropolis and the *Tesmophorion* on the acropolis. We are not sure if a similar sacred drama was enacted at Selinus and if music and dance activities were performed within this sort of ritual drama or ritual reenactment. However, we can consider that music and dance performances were enacted in this theatrical area; in this case, the *aulos* was the instrument best suited for the female lamentation and the ritualised movements. Indeed, the *aulos* was typically used to give intonation to the lament and was also omnipresent in processions since the performers, often non-professionals, were able to easily carry it to the location of the ritual. This wind instrument could have contributed to “marking” the ritual soundscape of the performative space and its audible space, providing the participants of rituals with a sonic recognisable place where the performances took place. Moreover, this instrument could have constituted an anthropophonic contribution to the overall sonic fabric of the performative space, complementing the natural and biological sounds that made up “place.”

However, ritual practices in the sacred spaces in Selinus may have differed significantly from elsewhere. As Marconi (Marconi &

Scahill 2015: 290) has highlighted, the altar of Temple R being placed right in front with a configuration reminiscent of the Sanctuary of Demeter at Pergamon (judging by inscriptions, finds, and architectural arrangements it served as a *Thesmophorion*) means that the 'South Building' would have served as a viewing area for any sort of ritual performances or public assemblies in the open space between the temple and the access to the sanctuary. In particular, processions reaching the sanctuary and Temple R for musical and dancing performances as well as sacrifices, festivals, and public events. Moreover, the scale and placement of the theatral structure at Selinus's Temple R provide emphatic architectural codification of viewing and listening as participation, a fundamental premise of Greek religious ritual.

Considering rectilinear theatral as material evidence within the lived sonic experience of the cult – as ritualised sound and movements, which, alongside other, non-musical sounds and gestures, make certain physical impressions upon the worshippers who listen to and perform them – these buildings contributed to the effort of ritual performance and synesthetic experience, which would have included various acts of worship in the sacred and public space.

Auralisation and architectural reconstruction: an example

A common methodological trait for most of the research studies that deal with historical acoustics of theatres and performative spaces is the presence of both acoustic measurements and acoustic simulations in the investigated cases (Till 2019: 82-86). Regarding the measurements, the researchers' works should always be commended for the considerable challenges demonstrated in implementing standardized measurement protocols in locations that are often hardly accessible and show operability issues (Barkas 2019: 337-353). Applying both qualitative and quantitative methodologies to the studies of ancient performative spaces, it is possible to investigate

both the past and present soundscapes of the sites, with the support of binaural recordings mirroring the original performance.

In the *Stesichoros* project we used a range of techniques to investigate the various acoustic properties of this architectural space. To explore and recreate the aural experience, the techniques included 3D modelling to simulate site acoustics, using microphones, speakers, and musical performances to assess sounds and evaluate the auditory perception within the theatral area (Fichna *et al.*, 2021) and experiments using replica of musical instruments, as well as sound tools and voices to assess the range of sounds produced and their physical impact.

This survey revealed surprising sonic qualities in the theatral area. Given that the theatral structure is not fully preserved, we worked on a 3D model of this theatral building and used software capable of calculating acoustic values. Thanks to the development of a virtual application for Oculus Rift, we explored the 3D reconstruction of the theatral area (Farina & Tronchin 2013; Pinardi & Farina 2021) in the Acropolis of Selinus (Fig. 4) and, at the same time, listened to the auralisation from different positions; audio files of the recorded musical performances were also used in our survey. The main aim of this VR application, developed with Unity, is to experience theatres as an ancient listener. Therefore, we developed the VR application in two phases: the first was the 3D modelling and texturing of the theatral area; and the second was the auralisation of an anechoic file of a musical performance from different positions in the 3D model of the theatral structure and its immediate surroundings.

To create and to texture the 3D model (Fig. 5), we used the software 3D Studio Max 2016. Considering that Mental Ray materials could be applied to the surfaces of the 3D models, the renderer was set to NVIDIA Mental Ray, since Mental Ray materials include a kit with preset features for certain materials, like stones, which were used in the building of ancient theatres. After new images on the 3D model were mapped, they were

exported as .fbx files to easily import them into Unity. Moreover, the 3D model was used, considering not only the available documents on ancient theatres acoustics, but also the comparisons with the acoustics of other theatres in the ancient world.

The auralisation process was performed with the software Odeon Room Acoustics. We used from five to eight audio files and the files were auralised in different positions in the theatrical structure and its related space. The anechoic file was recorded in the laboratory of the Institute of Heritage Science at the National Research Council of Italy, with the collaboration of a music maker and professional musician, who performed short melodies on his *aulos*, an ancient Greek instrument contemporaneous with the theatrical structure in Selinus, which was reconstructed in different materials. After that, the *aulos* melodies were recorded in the anechoic room in the laboratory, and the recorded files were

imported to the theatre project in Odeon Room Acoustics.

We also used audio files of the recorded human voices and natural sounds in the Acropolis to recreate the ‘sonic fabric’ of the performative space in Selinus and to assess the complete sound experience in this theatre. The Neumann KM 183 omnidirectional microphone was used for recording the impulse responses in nine different receivers located along three directions of the orchestra. The microphone was in the orchestra along three directions at a constant pitch, on the seats and at a height of 0.8m. The audio files were automatically convolved with the impulse responses recorded by the receivers placed in the theatrical building and space. Since the impulse response contained information about the architectural features of the theatrical structure, creating a corresponding audio file for the actual sound in a particular position in the theatre was possible.



Fig. 4. Temple R. Virtual reconstruction of Archaic phase (ca. 580).

Source: Institute of Fine Arts, NYU.



Fig. 5. Virtual reconstruction of the area of investigation in the Archaic period.

Fonte: Institute of Fine Arts, NYU.

The resulting values obtained from acoustics analysis were necessary for exploring whether, for example, the theatral area in Selinus was more suitable for talks or for music (and choral) performances and/or sonic events, and to analyse if the acoustics in the performative space met the criteria for good comprehension of speech or for enjoying music. Moreover, acoustic parameters were useful in understanding the interaction with surrounding sounds from geophony, biophony, and anthrophony (Mills 2005: 79-89). The specific sound content in the zone of the theatre in the present in Selinus is likely to be different to that in the past, but the overall trend in the distribution of sound can be considered likely to be similar. To aid in thinking

the significance of sound in the present and in the past, our research considered a range of contemporary sounds including those associated with rivers and the sea that can be heard in the Acropolis of Selinus. Obviously, if anthrophony was different, geophony and biophony could have been similar. An example is the presence of wind in the theatral steps in Selinus (Fig. 6). We cannot discount that, in the past, wind was present in the area of this performative space as it is today in the acropolis. This is an interesting interaction to be considered in assessing acoustics in public spaces in antiquity and to have an idea of how they were experienced by ancient people, also considering the interaction between nature sounds and the ‘human sounds.’



Fig. 6. Acropolis of Selinus.

Source: Author's.

Conclusion

Information about this ancient performative space by acoustics analysis of its 3D models raises new questions and new hypotheses. The analysis of the acoustics of the performative space in Selinus – which can be considered an important space for communication and social interaction – seems to reveal unexplored aspects of this architectural structure and consequently the habits of people in the past, particularly in this ancient Greek city in the West.

The first element to arise from this research concerns acoustic properties that can be identified and associated with this archaeological space; revisiting materials from old excavations and analysing discoveries in the context of data from new surveys, provide a hypothesis on the abandonment of this theatrical area at the end of the Classic and the beginning of the Hellenistic period, perhaps connected to the demand for a performative space in which a larger listening audience could be involved in line with the evolution of the historical events,

religious practices, and public performances of this ancient city. It is worth noting that this period corresponds to the dissemination of the construction of circular stone theatres in Sicily, where acoustics could have allowed for a better understanding of music, voices and sounds. Considering that the acoustic aspects could be a result of architectural transformation and development, it cannot be excluded that the evolution of the theatrical structures could be also connected with their acoustic evolution and sonic features and with the development of musical practices, both in terms of instruments and of the 'spectacularization' of music (and dance) from the 5th-4th centuries BCE, involving religious, musical, and technical changes. Written sources mention that these changes included additions to instrumental capacities, a broadening of melodic effects, a new mixing of musical style structures, increased employment of musical mimeticism, and a dramatic approach to music and dance requiring suitable spaces for performances (Bosher 2012, 2021).

For this reason, the research on the theatrical area in Selinus explored written and, where possible, figurative sources related to performative spaces of the past, to complement the material evidence and the archaeological remains with their sonic aspects. Moreover, analyses on a fairly large number of literary texts by orators, philosophers, and historians (e.g., Aristotle, Aristoxenus, Plutarch, and Vitruvius), which mention theatre acoustics issues more or less incidentally, allowed us to obtain very helpful information on the acoustic rules for the construction of theatrical buildings and spaces in antiquity.

Another important element arising from this research concerns the affirmation of new research fields, such as sensory archaeology (Betts, 2017), aural architecture in the past (Blessner & Salter 2007) and, especially, “experienced ancient religious sound (studies)” (Power 2022: 6). In this regard, this research can try to answer the questions surrounding the typology of performances, sonic events, or ritual activities held in the theatrical space in Selinus and underline the importance of acoustics in archaeology and architecture and of

how the sonic world could be perceived, conceived, and produced in the past. In this regard, discussions about Greek aural architecture yet again illustrate the complex interactions among the various social and acoustic issues (Geoffroy-Schwinden 2018; Graham *et al.*, 2019). By intersecting data and contextualising archaeological evidence, as well as comparing them with written and figurative sources, these approaches, methods and disciplinary contamination can allow for an ever-wider knowledge of the function of sound in ancient communities and of sound interaction in the places, spaces and buildings frequented by the human beings who preceded us. In this respect, a “soundscape archaeology” approach can enable the intersection of sensory sonic concerns with sonic heritage preservation and management, offering new ways of understanding the past.

Given this burgeoning body of research, new investigations should make use of 3D reconstructions and virtual acoustics that could highlight the intention behind the placement of ancient performative spaces.

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Resumo: Esse artigo visa analisar estudos recentes que levantaram novas hipóteses sobre arqueomusicologia, arqueoaústica, e arquitetura aural como tendências emergentes na pesquisa em humanidades, com foco particular na intersecção entre performances musicais, espaços teatrais, e a vivência do som no passado. Esses estudos destacaram como edificações de teatros não apenas definiam um local para as performances, mas também estabeleciam o contexto para eventos multissensoriais nos quais música, dança e outros eventos sônicos apresentavam um papel importante. Esse panorama também considera como tecnologias digitais podem ajudar a moldar nosso conhecimento do nexo arquitetura-som.

Palavras-chave: Arqueomusicologia; Arqueologia da Paisagem Sonora; Arqueoaústica; Arquitetura Aural.

Bibliographic references

Aletta, F; Kang, J. 2020. Historical Acoustics: Relationships between People and Sound over Time. *Acoustics* 2: 128-130. <https://doi.org/10.3390/acoustics2010009>

Anti, C. 1947. *Teatri greci arcaici. Da Minosse a Pericle.* L'Erma di Bretschneider, Rome.

Anti, C.; Polacco, L. 1981. *Il Teatri greci arcaici.* Maggioli, Rimini.

Barkas, N. 2019. The Contribution of the Stage Design to the Acoustics of Ancient Greek Theatres. *Acoustics* 1: 337-353. <https://doi.org/10.3390/acoustics1010018>

- Bellia, A. 2018a. Towards a New Approach in the Study of Ancient Greek Music: Virtual Reconstruction of an Ancient Musical Instrument from Greek Sicily. *Digital Scholarship in the Humanities* 34: 233–243. <https://doi.org/10.1093/llc/fqy043>
- Bellia, A. 2018b. *The Study of Musical Performance in Antiquity: Archaeology and Written Sources*, Cambridge Scholars Publishing, Newcastle upon Tyne, Performative Aspects of Music in Sacred Contexts of the Western Greeks, 155-173..
- Betts, E. (Ed.). 2017. *Senses of the Empire: Multisensory Approaches to the Roman Culture*. Routledge, London; New York.
- Blake, E.C.; Cross, I. 2015. The Acoustic and Auditory Contexts of Human Behavior. *Current Anthropology* 56: 81-103.
- Blessner, B.; Salter, Linda-Ruth. 2007. *Spaces Speak, Are You Listening? Experiencing Aural Architecture*. Massachusetts Institute of Technology Press, Cambridge; London.
- Bosher, K.G. 2012. *Sicily: Art and Invention between Greece and Rome*, The J. Paul Getty Museum, Los Angeles, Infinite Variety: Ancient Greek Drama in Sicily, 110-121.
- Bosher, K.G.; Hall, E.; Marconi, C. (Eds.). 2021. *Greek Theater in Ancient Sicily*. Cambridge University Press, Cambridge.
- Chiai, G.F.; Häußler, R. (Eds.). 2019. *Sacred Landscapes: Creation, Manipulation, Transformation*. Oxbow Books, Oxford; Philadelphia.
- Csapo, Eric. 2007. *The Greek Theatre and Festivals: Documentary Studies*, University Press, Oxford, The Men who Built the Theatres: Theatronai, Theatronai, and Arkhitektones, 87-121.
- Day, J. 2013.. *Making Senses of the Past: Toward a Sensory Archaeology*, Southern Illinois University Press, Carbondale, Introduction: Making Senses of the Past, 1-31.
- Eneix, L.C. (Ed.). 2016. *Archaeoacoustics II. The Archaeology of Sound*. OTS Foundation, Myakka City.
- Eneix, L.C.; Ragussa, M. (Eds.). 2018. *Archaeoacoustics III. The Archaeology of Sound*. OTS Foundation, Myakka City.
- Farina, A.; Tronchin, L. 2013. 3D Sound Characterisation in Theatres Employing Microphone Arrays. *Acta Acustica* 99: 118-125.
- Feld, S. 2015. *Keywords in Sound*, Duke University Press, Durham; London, Acoustemology, 11-21.
- Fichna, S.; Biberger, T.; Seeber, U.B.; Stephan D., E. 2021. Effect of Acoustic Scene Complexity and Visual Scene Representation on Auditory Perception in Virtual Audio-Visual Environments. *Proceedings of 2021 Immersive and 3D Audio: from Architecture to Automotive (I3DA)* 1. <https://doi.org/10.48550/arXiv.2106.15909>
- Gebhard, E.R. 1973. *The Theatre at Isthmia*. University of Chicago Press, Chicago; London.
- Gebhard, Elizabeth R. 1974. The Form of the Orchestra in the Early Greek Theater. *Hesperia* 43: 428-440.
- Geoffroy-Schwinden, R.D. 2018. *Digital Sound Studies*, Duke University Press, Durham, Digital Approaches to Historical Acoustemology, 231-249.
- Graham, S. et al. 2019. *Seeing the Past with Computers. Experiments with Augmented Reality and Computer Vision in History*, University of Michigan Press, Ann Arbor, Hearing the past 224-236.
- Hamilakis, Y. 2013. *Archaeology and the Senses: Human Experience, Memory, and Affect*. Cambridge University Press, New York.
- Hollinshead, M.B. 2012. *Architecture of the Sacred: Space, Ritual, and Experience from Classical Greece to Byzantium*, . University Press, Cambridge, Monumental Steps and the Shaping of Ceremony, 27-65.

Experiencing sounds in ancient spaces: an overview
R. Museu Arq. Etn., 41: 17-31, 2023.

- Hollinshead, M.B. 2015. *Shaping Ceremony: Monumental Steps and Greek Architecture*, The University of Wisconsin Press, Madison.
- Holter, E.; Muth, S.; Schwesinger, S. 2019. *Sound and the Ancient Senses*, Routledge, London; New York, Sounding Out Public Space in Late Republican Rome, 44-60.
- Inomata, T.; Coben, L.S. 2006. *Archaeology of Performance: Theatres of Power, Community, and Politics*. AltaMira Press, Lanham.
- Kolltveit, G.; Rainio, R. (Eds.). 2020. *The Archaeology of Sound, Acoustics & Music: Studies in Honour of Cajsa S. Lund*, Ekho Verlag, Berlin.
- Marconi, C. 2013. Nuovi dati sui culti del settore meridionale del grande santuario urbano a Selinus. *Sicilia Antiqua* 10: 263-271.
- Marconi, C. 2014. *Musica, culti e riti dei Greci d'Occidente. Telestes: Studi e Ricerche di Archeologia musicale nel Mediterraneo*, Istituti Editoriali e Poligrafici Internazionali, Pisa, A New Bone Aulos from Selinus: Music and Spectacle in the Main Urban Sanctuary of a Greek Colony in the West, 6: 105-116.
- Marconi, C.; Scahill, D. 2015. *The Architecture of the Ancient Greek Theatre*, University Press, Aarhus, The "South Building" in the Main Urban Sanctuary of Selinus: A Theatral Structure?, 281-294.
- Mattern, S. 2019. *The Routledge Companion to Sound Studies*, Routledge, London; New York, Sonic Archaeologies, 222-230.
- Miles, M.M. 2016. *Valuing Landscape in Classical Antiquity: Natural Environment and Cultural Imagination*, Brill, Leiden; Boston, Birds around the Temple: Constructing a Sacred Environment, 151-195.
- Mills, S.F. 2005. *(Un)setting the Neolithic*, Oxbow, Oxford, Sensing the Place Sounds and Landscape Archaeology, 79-89.
- Mylonopoulos, J. 2006. *Ritual and Communication in the Graeco-Roman World*, Centre international d'étude de la religion grecque antique, Liège, Greek Sanctuaries as Places of Communication through Rituals: An Archaeological Perspective, 59-97.
- Nielsen, I. 2002. *Cultic Theatres and Ritual Drama: A Study in Regional Development and Religious Interchange between East and West in Antiquity*. University Press, Aarhus.
- Pinardi, D.; Farina, A. 2021. Metrics for Evaluating the Spatial Accuracy of Microphone Arrays. Proceedings of 2021 *Immersive and 3D Audio: from Architecture to Automotive (I3DA)*. <https://doi.org/10.1109/I3DA48870.2021.9610887>
- Polacco, L. 1990. *Il teatro di Dioniso Eleuterio ad Atene*. L'Erma di Bretschneider, Rome.
- Power, T. 2019. *Sound and the Ancient Senses*, Routledge, London; New York, The Sound of the Sacred, 15-30.
- Power, T. 2022. Are You Experienced? Recent Approach to the Study of Music in Greek and Roman Religion, *Greek and Roman Musical Studies* 10: 327-356.
- Primeau, K.E.; Witt, D.E. 2018. Soundscape in the Past: Investigating Sound at the Landscape Level. *Journal of Archaeology Science* 19: 875-885.
- Scarre, C.S.; Lawson, G. 2006. *Archaeoacoustics*, McDonald Institute for Archaeological Research, Cambridge.
- Schofield, J. 2014. The Archaeology of Sound and Music. *World Archaeology* 46: 289-291.
- Skeates, R.; Day, J. (Eds.). 2019. *The Routledge Handbook of Sensory Archaeology*. Routledge, London; New York.
- Sokolicek, Alexander. 2015. *The Architecture of the Ancient Greek Theatre*, University Press,

- Aarhus, Form and Function of the Earliest Greek Theatres, 97-104.
- Sü Gül, Z. 2019. Acoustical Impact of Architectonics and Material Features in the Lifespan of Two Monumental Sacred Structures. *Acoustics* 1: 493-516. <https://doi.org/10.3390/acoustics1030028>
- Till, R. 2014. Sound Archaeology. *World Archaeology* 46: 292-304.
- Till, R. 2019. Sound Archaeology: A Study of the Acoustics of Three World Heritage Sites, Spanish Prehistoric Painted Caves, Stonehenge, and Paphos Theatre. *Acoustics* 1: 661-692. <https://doi.org/10.3390/acoustics1030039>