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Soundscapes in the past: Investigating sound at the landscape level

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ABSTRACT

During the past few decades, researchers have developed methodologies for understanding how past people experienced their wider world. The majority of these reconstructions focused upon viewsheds and movement, illustrating how individuals visually observed their environment and navigated through it. However, these reconstructions have tended to ignore another sense which played a major role in how people experienced the wider, physical world: that of sound. While the topic of sound has been discussed within phenomenology at the theoretical level, and has been approached at the site level through the growing study of "acoustic archaeology," there has been limited practical application at the landscape level. This article illustrates how GIS technology can be utilized to model soundscapes, exploring how people heard their wider surroundings.

1. Introduction

During the past few decades, researchers have developed methodologies for understanding how past people have experienced their wider world. The majority of these reconstructions focused upon viewsheds and movement, illustrating how individuals visually observed their environment and navigated through it. However, these reconstructions have tended to ignore another sense which played a major role in how people experienced the wider, physical world: that of sound. While the topic of sound has been discussed within phenomenology at the theoretical level, and has been approached at the site level through the growing study of "acoustic archaeology" or "archaeoacoustics," practical application at the landscape level has been limited. The place where sound is experienced at this larger level is named "soundscape," a term borrowed from environmental science (e.g., Miller, 2008; Pijanowski et al., 2011; Villanueva-Rivera et al., 2011). In this article, we illustrate how GIS technology can be utilized to investigate soundscapes, exploring how people heard their wider surroundings. Furthermore, this paper presents results of the first preliminary tests using an ArcGIS Soundshed Analysis tool, providing an example of its application to the landscape of Chaco Canyon, New Mexico. Specifically, we explore possible relationships between the location of features within the built environment and performance space within the canyon. Preliminary work indicates that certain features may have been placed at their locations so individuals may have heard events occurring elsewhere.

2. Theory

We approach archaeoacoustics as a contextual experience of spaces, and auditory perception as one of the ways in which people made sense of their world. Here, space is not a neutral universal container; it is intertwined with human agency and is therefore subject to social production and transmutation over time (Cummings and Whittle, 2004:9–10; Tilley, 1994:9–11; Van Dyke, 2014). As such, landscapes are meaningfully empowered and are a component of lived experience, memory, and identity negotiations (Brück, 2005:47; Johnson, 2012:273–275).

The phenomenological approach to landscape archaeology seeks to "describe the character of human experience, specifically the ways in which we apprehend the material world through directed intervention in our surroundings" and to "break down the subject-object divide" (Brück, 2005:46). Tilley states that phenomenology can be described as the "relationship between Being and Being-in the world" (Tilley 1994:12, 2004:1). As people explore this relationship, they encounter both connection and separation among self and other, and this space between self and other is navigated via perception, decision making, beliefs, intention, and other channels (Tilley 1994:12-15, 2004:10-12). This experience of navigating space creates place.

Tilley believes that observation and thick narrative description of an archaeologist's experience represent the best way to study the meaning attached to places, because even though our contemporary experience differs, it is still mediated through our "common biological humanity," i.e. the body (Brück, 2005:47-48; Tilley 1994:74-75, 2008:39-41,

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2010:25). This "kinesthetic" approach to perceptual experience centers on the relationship amongst the body, places, and the landscape: "…a rich and structured sensory domain…" (Tilley, 2008:39, 41). In contrast, Van Dyke and others champion a less ambiguous methodology as well as considerations of replicability taking into account researcher characteristics such as gender, group, or individual experiences. For example, some researchers have created observation forms as a way to standardize phenomenological methodology (e.g., Hamilton and Whitehouse, 2006). In our study, we utilize tools such as GIS to aid in this observation, while introducing a measure of "evidential base and critical rigor" (Johnson, 2012:279; see also Cummings and Whittle, 2004). We acknowledge that while the use of GIS or other methods of "abstracted experience" has been critiqued as positivistic (e.g., Hacigüzeller, 2012; Sui, 1994; Tilley, 2010:25-26), the physical laws that apply to the propagation of sound allows it to be modeled in GIS and applied to the archaeological landscape as approached through a phenomenological framework.

The phenomenology of sound has been explored in various disciplines such as ecology, anthropology, musicology, psychoacoustics, and philosophy (e.g., Miller, 2008; Pijanowski et al., 2011; Plack, 2005; Villanueva-Rivera et al., 2011). While most of the work involving sound in the archaeological record has focused primarily on the artifactual or site level (e.g., Cross et al., 2002; Cross and Watson, 2006; d'Errico and Lawson, 2006; Devereux and Richardson, 2001; Eneix, 2014; Jimenez et al., 2013; Watson and Keating, 1999), we continue the conversation at the landscape level.

Phenomenologists have been implicitly aware of the relationship between sound and landscape. Tilley noted "surfaces, according to their direction in relation to one another, inclination, texture, and degree of absorption will structure, reduce, or amplify sound; and auditory perception derives its basis from the flow of sounds through the landscape from one place to another, producing different acoustic properties" (Tilley, 2008:41). Beyond such passing mention, prior discussion on this topic, including comprehensive review articles such as Matthew Johnson's, 2012 article, "Phenomenological Approaches in Landscape Archaeology" appears limited. Two exceptions are Dimitrij Mlekuz's, 2004 article entitled "Listening to the Landscapes: Modelling Soundscapes in GIS" and Hamilton and Whitehouse's, 2006 article, "Phenomenology in Practice: Towards a Methodology for a 'Subjective' Approach." However, these projects had their limitations. For example, Hamilton and Whitehouse approached the concept of soundscape, conducting experiments to determine effective distances for interaction, including speaking and shouting (Hamilton and Whitehouse, 2006). Yet their project is difficult to replicate with any consistency as their determinations were made based upon their personal experience. Additionally, Mlekuz stated "The modelling of sound propagation over a landscape is computationally extremely difficult, as it depends on a range of variables, which are, at best, ill defined…. A reconstruction of past sonic environments, a sequence of sound profiles in a space at a specific moment, is therefore impossible" (Mlekuz, 2004: Section 4.2). As such, he did not continue this work, but over the past 13 years, technology has advanced to the point where this is possible.

2.1. Hearing - the perception of sound

Sound "is essential to our lived-in world, for communication and allowing us to identify place" (Cummings and Whittle, 2004:8). A unique aspect of the definition of sound is its reliance on a receptor; without someone or something to experience the sound, it does not exist. Beranek and Mellow state: "A sound is said to exist if a disturbance propagated through an elastic material causes an alteration in pressure or a displacement of the particles of the material *which can be detected by a person or by an instrument*" (Beranek and Mellow, 2012:5, emphasis added). People's perception of sound includes both its loudness and pitch. These subjective responses are reactions to the sound's amplitude and dominant frequency respectively (Beranek, 1954; Cowan, 1994; Cross and Watson, 2006:109–10). For a sound to be heard by people, its component frequencies must range from approximately 20 to 20,000 cycles per second (Hertz, or Hz). Most dominant frequencies of speech, however, range from 500 to 2000 Hz (Cowan, 1994:5; Lamancusa, 2001; Lord et al., 1980:5). The term "noise" is simply defined as "unwanted sound" (Cowan, 1994:274; Lamancusa, 2000; Scullin and Boyd, 2014). As observed by Beranek, people's reaction to various noises within the same study and under the same conditions can change as the listener's own attitudes change (Beranek, 1954:389). This same type of subjectivity within a group of listeners would constitute cultural and individual perceptions of specific noises, each with its own meaning and purpose.

2.2. Culturally relevant sounds

Archaeoacoustics is an integral method for understanding the lived experience of past people (Scarre, 2006). However, archaeological evidence for culturally relevant sounds is limited, though this is likely result of a lack of interest in the topic, rather than a lack of evidence. The sounds produced by humans in the form of speech are of primary importance (Scarre, 2006:3). These can range from the soft murmur of a crowd to a loud voice calling for attention. The noise from domesticated animals or the creation of tools may also be considered to be the result of cultural activities. However, it is the sound from musical instruments that may have the most direct evidence, as instruments have been recovered from the archaeological record. Within the American Southwest, these instruments include bone flutes, whistles, foot drums, copper bells, and conch shell trumpets, among others (e.g., Brown, 1967, 1971; Brown, 2005, 2009, 2014). These instruments have been linked to ritual performance due to examples found within historic ethnography and their locations of recovery within civic-ceremonial architecture. For example, in the post-contact period, both the Hopi and Zuni utilized conch shell trumpets as the voice of the Feathered Serpent during Soyal ceremonies meant to convey social norms (Mills and Ferguson, 2008:341–343). The Hopi link flute-playing with emergence stories (Taube, 2010:113) and the Flower World are evoked through song (Brown, 2014; Hays-Gilpin et al., 2010; Weiner, 2015:234). Drums and rattles are used in modern Puebloan rituals (Van Dyke, 2015:90). Ceremonies take place within kivas and other ritually charged locations; the discovery of conch shell trumpets in ritual contexts at Pueblo Bonito, such as kivas, ritual storerooms, and the burial chamber in Room 33 have been interpreted to illustrate potentially similar use in the pre-contact period (Akins, 2003:97; Mills and Ferguson, 2008:346). The study and replication of these instruments, particularly conch shell trumpets, have provided insight into their acoustic properties that allow us to demonstrate how to incorporate their sounds into a phenomenological study at a landscape scale.

Within the American Southwest, various researchers have incorporated considerations of sound within their studies, as noted above. Richard Loose has perhaps conducted the most methodologically rigorous studies of sound in the Southwest; he has investigated both the existence of a natural amphitheater at Chaco Canyon (Loose, 2008; see also Stein et al., 2007), as well as recreated a conch shell trumpet (Loose, 2012). Both of these studies required the modeling of sound at a level of precision that is rare within archaeology. Conversely, researchers such as Van Dyke (2008, 2013, 2015) and Weiner (2015) have approached sound as part of sensory engagement and lived experience, placing the experience of sound within its greater contexts. We blend both methods here in our examination of soundscapes.

3. Method

Our initial exploration of sound physics consisted of the development of an Excel spreadsheet to calculate the propagation of sound. This spreadsheet could be used to investigate how sound was experienced by an individual at a set distance from the source of the sound,

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