

Aural Architecture: The Missing Link

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While concepts such as architecture, acoustics, sound, perception, and anthropology have been part of our culture for centuries, they are usually considered in isolation from a narrow perspective. In contrast, *aural architecture* combines and reconciles them into a single interdisciplinary perspective, providing a new way of looking at the human experience of sound and space.

Acoustic scientists and aural architects are fundamentally different. The former have the skill and experience to design a space that will have specific measurable acoustic properties (physical acoustics). The latter are able to discover what aural properties would be functional and desirable for the inhabitants (cultural acoustics). By focusing on aural architecture, we can design (real or virtual) spaces that better match the needs of the inhabitants.

Many of us have dined in an upscale restaurant where conversation is almost impossible because of high ambient noise levels. In such restaurants the acoustics of the space are inappropriate for social contact, and diners are forced to shout at each other as if they were functionally deaf. Instead of enjoying an intimate evening, the diners might as well be at a basketball game. Whether consciously designed or not, the restaurant has an aural architecture just as it has a visual architecture. This simple example illustrates that the acoustics properties of a space strongly influence the emotions and behavior of the inhabitants.

We forget that hearing is more than understanding speech and enjoying music. We become aware of an unhappy baby by the sound of crying, an automobile moving at excessive speed by the sound of screeching tires, an approaching storm by the sound of distant thunder, the presence of a predator by the sound of soft footsteps, a dangerous fire by the sound of crackling combustion. In our personal interactions, we sense the internal emotional state of a lover by the intonation in their speech, regardless of linguistic content. Sound connects us to the dynamic events of life, thereby bringing remote events into consciousness.

Sound sources and spatial acoustics interact with each other in a dual way. On the one hand, although mechanical vibrations and impacts produce a sound at their source location, we never hear those original sounds. Rather, as sound waves propagate from the

source location to the listener, they are modified by spatial acoustics. For example, the sound of a clarinet is a different when heard at a beach versus in a concert hall, and a whisper sounds different in a forest than in a bowling alley. On the other hand, spatial acoustics is itself audible. For example, we hear the emptiness of an uninhabited house, the depth of a cave, the nearness of a low hanging ceiling, the expensive carpets in the executive suites, and the density of an urban city with cavernous avenues. Sound sources “illuminate”¹ the audible properties of a space.

To illustrate that we can hear passive objects, slowly walk towards a wall in a room containing ambient noise while your eyes are closed, and stop 6 inches before hitting the wall. Most people can do it the first time and everyone can do it after a little practice. We “hear” a wall even though it is not itself a source of sound because the wall change the spectral balance of ambient noise. Similarly, it is easy to hear the difference in the spatial volume between a living room and a cathedral. *Auditory spatial awareness*, hearing passive objects and spatial geometries, is an ability shared among dozens of mammalian species, including human beings.

*Aural architecture*² refers to the human experience of sound-in-space; the aural architecture of a space modifies the experience of sound sources as well as providing a means for experiencing passive objects and geometries directly. In order to discuss the dual experience of aural architecture without reverting to the narrow scientific concept of physical acoustics, we use the word *spatiality* for describing how people experience space by listening. Aural architecture contains at least five types of spatiality: navigational, social, musical, aesthetic, and symbolic.

Navigational spatiality is the ability to use auditory spatial awareness to “visualize” a space in order to navigate around objects and geometries. In 1749, the French philosopher Diderot reported the ability of some blind individuals to “see” by listening. In laboratory studies, some individuals could distinguish square, circular and triangular objects only through hearing. The jazz musician Ray Charles and the Indian writer Ved Mehta moved through space without either vision or conventional aids for the blind. In the figure below, blind teenagers ride their bicycles in the California mountains using only navigational spatiality. To a much lesser extent, we can all navigate a dark room by listening.

¹ The word *illuminate* is borrowed from the visual domain because there is no corresponding vocabulary to describe the aural equivalent. Just as light illuminates objects and geometries to provide a visual experience of them, sound illuminates objects and geometries to give them an audible manifestation.

² For more information about aural architecture, consult our book, *Spaces Speak, Are You Listening? Experiencing Aural Architecture*, MIT Press 2006, or visit its companion web site www.SpacesSpeak.com.



Social spatiality refers to the way spatial acoustics influences the behavior of the inhabitants. An *acoustic arena* is that region of space within which individuals can hear a specific sound. Outside of the acoustic arena, an individual is functionally deaf to that sound. The ability (or inability) to hear a sound creates invisible boundaries that acoustically delineate spatial regions. Consider the following: we have all attended parties where the space is so noisy that our social acoustic arena does not even include the person standing next to us. Alternatively, a guest laughing loudly may have an arena that includes the entire house.

People are most comfortable when the acoustic arena matches the appropriate social distance. For intimate lovers, the arena should be no larger than 1 foot; for a public lecture, the arena can be 100 feet. In Hogarth's painting, *The Enraged Musician*, his private parlor and the street are both part of a single arena, even though the two spaces appear to be visual distinct.



Symbolic spatiality refers to those aural attributes that have acquired additional meaning by being associated with specific activities occurring within particular spaces. Over time, the acoustic properties of spaces become linked to the symbolic meaning of those places. Consider the enveloping reverberation of a grand cathedral; it acquires religious symbolism. Similarly, the unique acoustics of forests and mountains can become a symbol of nature; the hushed quiet of an elegant office can become a symbol of wealth; and the diffuse echoes of a vast office entry can become a symbol of power.

Aesthetic spatiality refers to the experience of localized acoustics that provide varying auditory texture and variety. Just as a window seat can provide visual aesthetics, an alcove also provides acoustic variety. Consider, for example, a wall composed of alternating resonant cavities, absorption panels, and reflective surfaces that change the experience of sound as one moves along its length. Local regions within a single space can have different acoustics. For example, the domed ceiling in one region of a corridor at the Houston airport provides a surprising experience while walking through the space. Momentarily, the echoes of footsteps appear and then suddenly disappear. The sudden change in local acoustics creates a sense of a textured space, like a change in color or lighting.

Music spatiality refers to the influence of the acoustics of a space on the music performed within that space, which is composed of two primary attributes: *temporal spreading* and *spatial spreading*.

Spatial reverberation changes the time structure of music by extending the duration of all musical notes. Consider a sequence of three notes from a clarinet played in a reverberant

space. The pitch of the first note continues as reverberation while the second is being played; and when the third note is played, the pitches from the first and second are still present as reverberation. This creates a chord-like blending of the three notes.

Spatial reverberation also transforms a musical note located on stage into enveloping reverberation that embeds the listener in ocean of sound that has no apparent location. From a biological and evolutionary perspective, our binaural ability to localize prey and predator had important survival value. Conversely, the inability to localize would have produced increased anxiety, awareness, and arousal. A sound that cannot be localized is evaluated differently from one that has a location. When we experience enveloping reverberation, it is like *aural caffeine*, a stimulant. Listeners who were privileged to hear Stockhausen's performance in the Caves of Jeita in Lebanon described the mystical experience of being in an ocean of ethereal sound.



Aural architecture, with its five manifestations of spatiality, explains how the combination of sound and space influences human emotions, behavior and experience. When we design or select a space, we are therefore functioning as aural architects.