

The Lack of Interest to Enrich the Hearing Experience in Architecture

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Summary

This research is an attempt to obtain a well-grounded picture on the sound as an unused potential in architectural and urban design. The researchers aim at having a better understanding of how people experience the sound in a place, and to refine issues for more systematic investigation and formulation of new research. Hearing experiences in architecture are studied by understanding how people detect sounds in general, and then aspects of aural architecture are reviewed with some possible applications such as applying silence as an acoustic experience, and applying aural illusion to expand a space. After the theoretical analysis some results from an applied survey in coffee shops in Cairo are reviewed. The survey studied the relationship between people and architectural spaces, by not just being interested in how the place looked, but also in how it made people feel and how it sounded, smelled, and felt when touched. Sound manipulation seemed to be a neglected aspect in design, as sound control was found to be a major concern for the customers and a neglected aspect by the designers of the coffee shops as well.

1. Introduction

The special thing about the sense of hearing in architecture is that people have major roles in the resulting sounds they hear, every footstep, and word said forms the sound that they hear in the place. Buildings do not react to people's gaze, but they do return their sounds back to their ears [1].

“It is omni-directional, not focused like vision. A view at a building will not show the person watching the building but a building will return the sound of a person walking in it and listening to the sound” [2].

People are not aware of the significance of hearing in spatial experience, although sound often provides the temporal continuum to the visual impressions. Some researchers compared the sound in architecture to the sound in movies and how different impressions are aroused when the sound track changes, or starts suddenly in a certain scene, or is muted in another for acquiring different feelings from the viewer that are suitable to the scene [1]. Like a soundtrack in a movie, where music is increasing the tension in a thriller or the drama in a love story, sounds in architecture can increase the intensity of its perception [2].

“A space is understood and appreciated through its echo as much as through its visual shape, but the acoustic percept usually remains as an unconscious background experience”[1, p50].

There is a different feeling one gets when entering an uninhabited and unfurnished house compared to that of entering an inhabited home, in which sound is softened by the objects used in living. And the ability to sense the size or the volume of the space in complete darkness if one hears the sound of dripping water [1].

Problem Statement

With the development of technology, people are getting more and more isolated from their surroundings. Moreover, the architecture isn't helping enough in the proper integration with the world. Architects are more

concerned with the visual aspects of the buildings, neglecting sometimes the potentials of the aural aspects of the buildings. It could be the role of architecture to regain the engagement between people and their surroundings by developing better interaction between the architecture and people's senses. When people describe a place they have been to nowadays they barely say anything about its sounds. The architectural design should consider the whole human experience in the spaces, acquire harmony and obtain a more meaningful relation with the world.

Hearing Experiences in Architecture

There is a clear architectural example showing the various possibilities of hearing experiences in architecture, and sound manipulation. The town houses in the Rococo period, where the houses were produced such that their rooms not only varied in size and shape, but also in acoustical effect. So the visitor first entered to a marble hall which resounded to the sound of his side arm and from his high heels, then came a series of rooms with more intimate and musical tones. First, a large dining room acoustically adapted for table music, then came a reception with silk paneled walls which absorbed sounds and wooden furniture for the right resonance of chamber music, next came a smaller room for more fragile notes, and finally the 'Madame boudoir's' which resembled a satin jewelry box, and was for intimate talks and whispering [3].

Our cities nowadays have lost their echo, which depend on the pattern and the scale of the streets and the prevailing architectural styles and materials used as well; the echo of a renaissance city differs from that of a baroque city. The wide open spaces of contemporary streets do not return sound, and the interiors of today's buildings absorb sound [1]. When people describe a place they have been to now, they barely say anything about its sound, there is no special sound characteristics in a place that they can recall later. "There is no longer any interest in producing rooms with differentiated acoustical effects, they all sound alike" [3].

Hearing Stimulus

There are three factors that must be present for sound to be detected: the presence of a vibrating source or stimulus. the presence of a medium for

transmitting pressure waves from that source; like air, liquid or solid. Finally, for detecting sounds there should exist a receptor as well.

The physical stimulus for sound is usually pressure waves, these vibrating waves of pressure are known as sound waves. Sound waves have three physical characteristics which are: Wave length (frequency of vibration), intensity (amplitude), and purity. These characteristics are perceived by people as follows; people perceive wavelength as pitch, intensity as loudness, and purity as timbre which is complexity due to overtones [4]. The transmission of the sound includes such processes as reflection, dispersion, refraction, absorption, and so on. All of which depend on the properties of the space. When the sound waves arrive at the inner ear, they are then converted to neurological signals that are processed by the brain; connecting the external world to the inner consciousness [5].

“We see the light it reflects and thereby gain an impression of form and material. In the same way we hear the sounds it reflects and they, too, give us an impression of form and material” [3, p224].

In several interviews blind people were asked to describe their feelings about architecture, and they said that the outside could be sensed with hearing and description, they could hear the wind blow off the building and sense the size of it that way, smooth glass and steel was not preferred for example by some because it sounds very hollow and cold. Others also described how they perceived the interiors of architecture without the sense of sight; for example inside rock walls tended to muffle the sound which wasn't a help for them, brick was reported to be a little better. High ceilings tended to make the room sound huge, wood paneling seemed to hold the noise out [2].

Aspects of Aural Architecture

Auditory spatial awareness manifests itself in four different ways. First it influences users' social behavior; some spaces emphasize aural privacy or aggravate loneliness, other reinforces social cohesion. Auditory special awareness allows users to orient in and navigate through a space; hearing acoustic objects, or surfaces supplement vision or in the case of darkness or visual disability it actually replaces vision. It affects users' aesthetic sense of a space. Just like visual embellishments make a space aesthetically pleasing, aural embellishments can do so for the ear by adding aural richness to the space. Finally, auditory special awareness

enhances people's experience of music and voice. Physical acoustics of a musical space merge with sound sources to create a unified aural experience. To obtain various hearing experiences in architecture, aural embellishments can be used. An aural embellishment is an acoustical object or geometry, weather local or global, which produces aesthetically recognizable acoustic attributes, adding aural richness and texture to the space. Local aural embellishments are experienced by listeners when they are relatively close, such as the sound of water from fountains. And on the other hand global aural embellishments can be experienced by listeners all over the place, like most acoustic objects. Aural embellishments can be categorized into two other categories as well, like visual embellishments they are categorized into active and passive. Active aural embellishments can be water spouting from fountains, birds singing in a cage, and wind chimes ringing. And passive aural embellishments can be reflecting and absorbing panels, curved surfaces that focus on sound, and the aural analogues of pictures, tapestries, mirrors, arches, and statues [5].

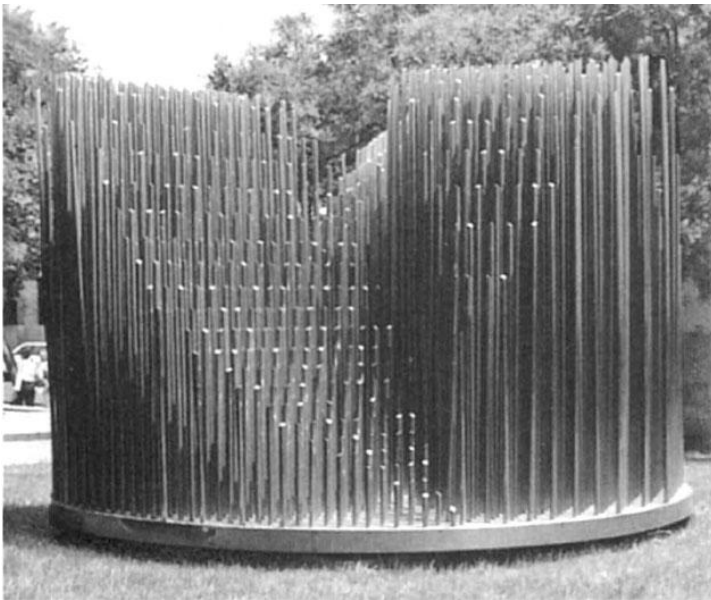


Figure 1: Eusebio Sempere's sculpture in Madrid

Almost every visual embellishment has some acoustic influence. For example, a large mirrored wall reflecting light also functions as a perfect

reflectant of sound. An elegant tapestry absorbs sound, and a marble statue diffuses it. Therefore depending on the sensibility of the designer or the perceiver, every embellishment can be perceived as either visual, aural, or both at the same time [5]. Eusebio Sempere, the 20th century Spanish artist, created a sculpture composed of a three-dimensional array of polished stainless-steel tubes that rotates at its base, as shown in (figure 1). In addition to its visual effect as the moving surfaces reflect in the sunlight, it was also a sonic filter that blocked transmission of particular frequencies. A listener on one side heard a tonal modification of those sound sources located on the other side; it can be considered the visual equivalent of colored glass prisms. This sculpture is an aural embellishment because it changes sounds that propagate through it [6].

Aural embellishments in a concert hall are considered to produce unwelcome acoustic effect and should be avoided, because aural experience of a concert hall should be uniform. In contrast, aural embellishments are welcome in a social or religious space, providing aural variety, symbolic meaning and spatial texture [4]. Therefore there are architectural case study categories for sound, and each category demands its specific treatment:

- a) Spaces where sound needs to be absorbed based on the activity, such as hospitals, libraries, halls surrounding conference rooms, and theatres.
- b) Spaces where sound needs to be reflected based on activity. Such as mosques, and main halls in churches.
- c) Spaces where public address is necessary, such as train stations, and air ports.
- d) Spaces with background ambient sounds from utensils and other noises that can be suppressed, such as hotel halls, malls or shopping spaces, and restaurants.
- e) Handicap requirements at lifts, etc. announcing floors or arrival at a certain level for orientation of blind users.

Sound manipulation for architectural spaces can be applied for three reasons. The first reason is to control the proximity of the sound of the speaker or the sound source in a room, making the sound feel louder or quieter, or even like focused whispers. The second application for sound manipulation in architecture could be the absorption of noise or illumination of noise. The third application for sound manipulation in architecture could

be for giving a space a bigger or smaller illusion from experiencing its sounds.

Applying Aural Illusion to Expand a Space

There exist aural space manipulators the same way there exists visual space manipulators that can expand a space such as windows, mirrors and pictures by establishing a visual connection between the observer and the additional physical space. A mirror expands space by connecting the observer to a replica of the existing space, and a picture expands space by inserting the image of another environment. Small rooms with many mirrors give the impression of being much larger than their actual size. Mirrors on multiple surfaces as in dance studios make the space feel infinite.

To create aural illusion of an expanded space, architects replicate the sound field that would have been present if an additional space were actually present. Sound absorption is considered an aural space expander. Complete sound absorption simulates a virtual window into an infinite, unbounded space. Therefore a dense sound absorbing panel that would absorb all sound waves that arrive would aurally replicate a window into an absolutely open space. As if the sound had actually encountered a window and disappeared into open space.

But if the intended virtual space is to be equivalent to an actual room rather than an infinite void, the virtual space would reverberate sound entering from the real space through the virtual window, and architects would need to reproduce the appropriate sound field at the virtual window. This illusion would be done in a sequence of stages [5]:

- a) Embedding an array of small loud speakers in a sound absorbing panel. The sound speakers would duplicate at the surface of the panel the sound field of a space as it would appear at a virtual window.
- b) For refining the virtual window onto a virtual space, the virtual space would need to respond to sound originated from the actual room. For example listeners would hear the reverberations of their voices when shouting through this window. This can be done by embedding an array of microphones into the panel that would create the virtual reverberations.
- c) Finally, to make the virtual space simulate to an extension of an actual room, architects might expand the area of sound absorbing panel to cover an entire wall, such that sound arriving from the room

would be completely absorbed. This would remove the aural perception of this wall and make it feel further.

Applying Silence as an Acoustic Architectural Experience

The existence of a variety of sound experiences can make people appreciate 'silence' as an acoustic experience in itself. In movies when the sound track stops suddenly, spectators concentrate more and get the feeling that something important is going to happen. Experiencing natural silence (not just absorbing every sound) and tranquility is very healing as it puts the person in a meditative like state of mind. The experience of silence has been used in the past as well.

“One of the most exciting auditory experiences in architecture is tranquility. In the past the tool of silence has been used to create great atmospheres. The silence in the pantheon combined with the great view of the roof is indescribable. The absence of sound is actually creating the atmosphere” [2].



Figure 2: The interior of the pantheon

A powerful architectural experience silences all external noise; it focuses our attention on our very existence and as with all art, it makes us aware of our fundamental solitude [1]. Large enclosed spaces, where a listener could hear the whisper of a speaker at a remote distance for example, dome of Saint Paul cathedral in London, Saturday hall in the capital at Washington DC, and Saint John lantern in Rome were called “whispering galleries”. Even if these examples were mostly architectural accidents resulting from curved surfaces, they were presumably designed for the visual impact [5]. The following explain how this experience of silence or whispering galleries can be created. The time delay for the sound to return from the ceiling, combined with its focused direction gives the visitor standing in the center of such a gallery the effect of an invisible and mocking presence. This is not an echo, for the visitor, the sound of the distant speakers’ voice is focused directly at the him/her, as if the speaker is right next to him/her. When a space has curved surfaces, its acoustics can readily change the aurally perceived geometry of the space. Like the side mirror of an automobile warning that visual objects are closer, larger than they appear. Curved surfaces also change the apparent location of aural objects. Particular surfaces can focus sound such that the source appears aurally closer or further, larger or smaller. Curved surfaces can also produce acoustic dead zones such as the source is inaudible as if it were in an acoustically isolated arena. This aural privacy doesn’t require walls, some curved surfaces can give the same aural impression that a speaker is sitting on the right or left of the listener. A parabolic sound reflector can displace a speaker 30 meters away to an aurally perceived distance of 3 cm. Finally, there is always the active way to acquire silence, which is by using sound absorption panels [5].

Case Study Survey

A case study survey was conducted that shows the great effect of the hearing experiences in architecture on people, and consequently the demand of enriching the hearing experience in the architectural design process. The survey was done in coffee shops in Cairo as a part of a wider scope research to study the relationship between people and architectural spaces, by not just being interested in how the place looks, but also in how it makes people feel and how it sounds, smells, and feels when touched. The survey phase was done on the course of one month from the end of December 2012 till the end of January 2013. It was decided for a minimum of 15 people; male and female to properly undertake and complete the

survey in each of the six selected coffee shops. A total number of 93 questionnaires were distributed on male and female adults from ages 20 to 64. Since the majority of the customers who went to the chosen coffee shops for the study were found to be adults within this age bracket.



Figure 3: Interior of one of the studied coffee shops

From people's answers it was found that 25% of the problems that were mentioned were related to the furniture setting or layout based on inconvenient hearing experiences in the coffee shops. The most common words used by people to state the reason behind this problem were 'uncomfortable', and 'no privacy'. People didn't feel comfortable with the little spaces between tables; they wanted more space to feel more comfortable. And regarding the privacy issue, it was learnt that people needed privacy regarding their conversations; on the sound level. The visual level was not mentioned except once were the people were annoyed by passersby outside the coffee shop starring at them, the visual privacy was not mentioned as a concern inside the coffee shops among the customers. So if the spaces between the tables were kept the same and visual barriers were used; in Cairian coffee shops that wouldn't solve the problem. The second most popular problem in the coffee shops were pure

sound problems; whether it was the noise from outside, or the noise from people or any element inside and the music played as well.

Case Study Results

The lack of sound control was found to be a major aspect neglected by the designers of the coffee shops. People in the coffee shops were annoyed from many sources of noise, first of all, the outside noise especially if the coffee shop was in a vital street full of traffic. The second type of noise was from the kitchen utensils and that from the service counter. And finally the last source of noise was that coming from people's talking. The possible solution for these noises from the previous literature can be through the use of some aural embellishments like tapestries to absorb some noise in specified areas of noise, or the use of absorbing panel, or manipulating the reflection of sound actively by curved surfaces reaching even acoustical dead zones. But that could not be applied evenly in all the coffee shop, as people wouldn't feel comfortable talking in a very quiet place; people need some acoustical privacy where a customer sitting at a nearby table wouldn't be able to hear their conversation. Therefore in the compact seating areas, some aural embellishments can be also used like marble figures that diffuse sound or actively manipulating the reflection of sound by curved surfaces to make the sounds feel further and change the apparent location of people sitting nearby speaking.

2. Further Research

A certain phenomenon was noticed during the surveys; that sometimes people didn't mention the sense of hearing in forming their impressions at all about the coffee shops, but when people were asked about what they disliked in the coffee shops, music and noise were among from the points mentioned. Most of the time the unmentioned sensory attributes were perceived by the customers as negative attributes, so people only mentioned attributes if they regarded them as positive.

For future studies; it would be useful to understand how people's brains respond to the sounds in the architectural space they inhabit, it would be more beneficial to be part of a laboratory that has sophisticated equipment to observe people's brain activity, and to avoid the problem that people sometimes tend not to describe their full experience, or this problem can be simply avoided by conducting more informal interviews as well.

3. Conclusion

Considering the sense of hearing in design can lift the quality of experience for the occupants they serve; buildings become more efficient in serving their occupants ever changing needs. Enriching the hearing experience in architecture can influence social behavior, help in the orientation and navigation through the architectural space, it can affect users' aesthetic sense of place, and enhance users' experience of sounds and voice. Almost every visual attribute in the architectural space contributes to the acoustic effect of the space. Thus, usual visual attributes of architecture; such as windows, ceilings, mirrors, tapestries, statues...etc can be used as aural embellishments depending on the sensitivity of the architect and the users, and depending on the architect's knowledge with the interactive relationship between the users and the architectural space they inhabit.

It is important then to integrate the latest scientific researches on how occupants perceive and engage with the built environment with the architectural design process; basing the choices of architectural physical attributes on scientific bases. This would better equip the architectural decisions to better connect with the occupants needs, thus bringing value to the buildings, and further empower the occupants they serve, solving problems starting from the most complex of commercial buildings to the simplest of home design.

4. References

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