On the nature of the ambient sound

Gary W. Siebein, FAIA, FASA[a]
School of Architecture
University of Florida
Gainesville FL 32611-5702

Reece Skelton[b]
Siebein Associates, Inc.
625 NW 60th St. Suite C
Gainesville, Florida 32607

ABSTRACT

Case studies are presented to illustrate the concept that the ambient sound is actually a complex interaction of specific acoustic events that can each be identified, measured, mapped, modeled and simulated. The meaning associated with specific sounds is what often distinguishes among sound, music and noise. Murray Schaffer's original concept of a soundscape or acoustical landscape proposed that environmental sound can be composed by deliberate design. A reformulation of concepts about ambient, background and residual sound as something that can not be characterized by an average L_{90} or Leq independent of the meaning, source, duration, pitch and other attributes of the sound is philosophically at the basis of soundscape theory. A sound walk through a park where all sounds have approximately the same sound level, but entirely different sources and meanings is presented to illustrate this idea. A second sound walk in a city near an amphitheater where time average sound levels show music, traffic, wind and other sound sources to be of equal level, but where individual sound sources are clearly identifiable is also presented to illustrate the opportunities for defining the ambient as a complex set of specific acoustic events rather than an indistinguishable mixture of unidentifiable sound sources.

1. INTRODUCTION

The ambient sound level is defined by Harris (1998), Cowan (1994) and Beranek (1971) as the total noise level in an environment including the noise source(s) of interest while the background noise level is the total sound level without the noise source(s) of interest included. ANSI S 1.1 describes the ambient as the "all encompassing sound at a given place, usually a composite of

[a] Email address: gsiebein@siebeinacstic.com
[b] Email address: rskelton@siebeinacoustic.com

many sources near and far". ANSI 12.9 adds "including the source of interest" to the definition of ambient. ANSI S 1.1 defines background noise as the "total of all sources of interference in a system used for the production, measurement, detection or recording of a signal independent of the presence of the signal." Furthermore, ambient sound measured, detected or recorded with the signal is part of the background noise whereas ANSI 12.9 considers the ambient to be the source of interest plus the background sound. Egan (2007) uses the terms background and ambient sound as interchangeable.

ANSI 12.9 also defines the residual sound as the all encompassing sound, usually a composite of many sources at many directions, near and far remaining at a given position in a given situation when all uniquely identifiable discrete sound sources are eliminated, rendered insignificant or otherwise not included. A note states that this is often the L_{90} or L_{95} of the measurement period. Interestingly, ASTM C634 defines background noise similar to ANSI but does not include ambient sound or residual sound within its defined terms.

The notion of arriving at the residual sound by eliminating many specific acoustic events that compose the soundscape that are either intermittent or can be turned off is relatively easy to grasp. The notion of "rendering (some sources) insignificant" is very interesting because it implies making some value judgment about various constituents of the soundscape. According to the Oxford English Dictionary (OED), render can mean performing a service; return, give back or restore; to reproduce or represent by artistic means; or to reproduce or represent in another language. One wonders which of these definitions is intended to be the basis of the definition in the standard. Likewise, to "otherwise not include" constituent elements of the soundscape to arrive at a residual sound raises interesting questions regarding the intended method.

2. BACKGROUND SOUND AND THE SPECIFIC ACOUSTIC EVENT

Background sounds can also colloquially be thought of as the sounds that exist after all of the individual sources of sound that can be identified are accounted for, although ANSI calls this the residual sound. Residual means an amount still remaining after the main part has been subtracted away or that which is formed by the subtraction of one quantity from another. However, it can also mean that which is unexplained or uncorrected which can have statistical implications in analysis of acoustical measurement data.

Background noise is often colloquially thought of as a combination of sounds whose sources are not directly discernible. The typical definition of noise as unwanted sound leads one to a definition of background noise as those unwanted sounds that are listened to through "background listening." Truax (2001: p.24) defines background listening as where a sound such as a foghorn can be heard as a specific acoustic event, but the sound moves to the "background of one's attention is implying a cognitive, analytical component involved with assigning meanings to sounds. One may notice the sound and if asked if it occurred say yes, it was heard; but because one is not listening for the sound or it does not convey an important meaning to the listener, one may place the sound in the "background of their attention."

Similarly, the notion of background is defined in the OED as the ground or surface lying at the back or behind the chief objects of contemplation, which occupy the foreground. The notion that there may be multiple objects that comprise the foreground is interesting, as is the notion of something lying behind or under the main object of consideration, perhaps forming its foundation to a certain extent or at least the context in which it is viewed or understood is implicit in the definition. A second definition is when something occupies a less prominent position so it is not readily noticed also has interesting implications relative to the soundscape.

It is perhaps helpful to distinguish between the notion of the ambient, background or residual sound as a neutral, characterless sound and a sense of acoustical ambiance which is the particular qualities that give a particular situation, locale or building it unique character or atmosphere, where the ambient is all that surrounds or encompasses regardless of its character. Schafer (1977) conceives of a soundscape where the individual sounds that exist in an area are thought of more as a musical composition composed in real time by the inhabitants and the activities they undertake. Using this notion of a soundscape, one must identify each of the constituent sounds in an environment; note their loudness, pitch, rhythmic patterns, sources and meanings; and design an ecologically balanced method to orchestrate their interactions to form a constructed soundscape. Schafer might subtract all of the sounds of interest in a soundscape that comprise the ambient and be left with no residual or background noise as commonly defined.

Interestingly, ASTM E1503 and E1779 Annex A1 consider many weather effects such as wind, moisture, humidity, acoustically reflective surfaces, aeolian strumming of power lines, temperature inversions, insects, wind blowing through vegetation and structures and other natural events to be "interferences" that must be minimized when taking outdoor sound measurements. Sounds from visitors to the site and from measurement operators walking on gravel, talking, using cell phones or radios and operating vehicle engines. How would these sounds be considered from a soundscape perspective?

The way a sound functions in a system depends not only on its level and other "objective" characteristics, but in the way in which it is understood by listeners and the community (Truax, 2001, p. 103). Northwood (1977, p.2) states that "the single unifying concept in architectural acoustics is the perception of a signal (wanted or unwanted) over a level of background noise. Most of what may be called "signals" fluctuate in level and in frequency content, and generally the information they carry is implicit in the fluctuations. The full understanding of speech, for instance, requires perception of sounds varying over about 30 dB in level and over the frequency range of 200 to 5,000 Hz. Thus, if speech is a wanted sound, the background noise should be below this 30 dB range of speech levels. Conversely, if speech is an unwanted sound, its peak levels should be below the background noise level."

Truax stresses the need to create positively functioning acoustical environments rather than just designing to reduce unwanted sound (noise) to levels that are just below those which cause hearing damage, health effects, annoyance or interfere with communication. While there are many books that discuss acoustical qualities that are desirable to achieve in theaters and concert halls (Beranek, 2004; Barron, 1993; Ando, 1998), there are few sources that develop criteria and design methods to achieve vital acoustical communities in cities, towns and rural areas (Siebein et al, 2006). Even the way most noise ordinances and municipal laws regarding noise propagation are written is telling as maximum allowable levels of unwanted sound that are considered as minimum thresholds for acceptability are usually the parameters used rather than acoustical attributes that are desirable or ideal for functioning communities. Interestingly ASTM E1686 *Standard Guide for Selection of Environmental Noise Measurements and Criteria* states that criteria for environmental noise are generally based on preventing problems for people including health effects, interference with speech or communication, sleep interference, task interference, annoyance, community reaction, aesthetics, land use compatibility and effects on wildlife. The section on aesthetics deals solely with sounds that are usually found to be displeasing.

3. ACOUSTIC COMMUNITY AND THE SOUNDSCAPE

It is interesting to note the root words for community and communication, while similar, are not identical according to the Oxford English Dictionary. The Latin root word for community is

communus meaning a fellowship or a community of relations or feelings. The word means life in association with others; an area or people with common character or identity; or a body of people who are organized in some way. On the other hand, communication is derived from the Latin communicat meaning to make common to many or to share. The definitions of the word have several interesting implications from a soundscape perspective. Communication means first to give, impart or transmit something intangible such as knowledge or information to another. This communication is perhaps at the root of forming a community. Second is to convey or exchange ideas by speech, writing or signs. The use of the word "signs" is very telling because it opens the door to thinking about the multiple ways a soundscape can form a community through layers of objective and subjective communication and the symbolism that links people in an acoustic community through multi-modal aural forms of communication and expression.The third meaning provides a hint of the physical structure of transmission of sound signals, symbols and signs in an acoustic community. It describes an opening or aperture in a vessel, space, room, (or community) by a common channel where one part of a vessel, space, room, (or community) communicates with another so the whole becomes one. It is easy to follow the arguments of Shafer and Truax when they arrive at the definition of an acoustic community as systems in which information is exchanged and where the information exchange is pervasive in the lives of the inhabitants.

Schafer defines a five part process for acoustical design that consists first as orchestrating the soundscape so that all sounds can be heard to advantage such as in a musical piece. Second, developing a respect for the ear and the voice as the instruments through which communication occur. Third is to artistically engage in sound symbolism to enhance the meanings of sounds and enrich the environment. Fourth is to understand and engage the natural rhythms and tempi of the environment and fifth to understand the balancing mechanisms in which an eccentric soundscape can be turned back on itself (Schafer, 1977, p. 238).

Shafer discusses a garden as a place where nature is cultivated and a soniferous garden as a place where sound can be cultivated. The 3 case studies that follow describe 3 aspects of the cultivation of sensitivities to the nature of the ambient, background and residual sounds in 3 distinctive environments and raise questions about the distinctions among these 3 types of sounds in actual settings.

4. CASE STUDIES

A. Case Study One: A Farmhouse in the French Countryside

The soundscape of a small farmhouse in the French countryside outside Pontlevoy, a small village in the Loire River valley in north central France, presents an interesting case study of the dynamics of the ambient. One rises in the morning to the sound of not one, but three families of birds, each of a different species with a different song, whose singing and fluttering about the large tree outside the open windows is plainly heard. A breeze rustles the drooping leaves of the willow tree while a large plane passes overhead in the far distance almost silently. A small car, obscured from view by the large tree, can be heard passing on the road. The low-pitched lowing of cows can be heard in the distant field to the east. The toilet in the downstairs bath flushes. The gurgling sound of water flowing in the pipes is heard while people are speaking quietly in the kitchen. Someone begins to speak in the kitchen while the cabinet door opens and closes quietly. The creaking of the wood floor tells that someone is walking across the hall. Plates are placed on the table and coffee is percolating in the kitchen below.

Figure 1. The farmhouse.

Figure 2. The environs.

All of the sounds are heard individually as specific acoustic events. Some are foreground sounds and are clearly noticed by an observer. Some may be thought of as background sounds and are heard only through background listening. The question arises as to how does one measure the time, amplitude and frequency content of the actual acoustic events superimposed on each other? Can one capture the information content and meaning of each sound? Often an acoustical metric such as the L_{50} or L_{90} or L_{eq} of the sounds is measured as an indicator for how loud the ambient, background or residual sounds are. Alternately, a day night average sound level (L_{DN}) or other composite rating ay be used which would be "rendered insufficient" or "otherwise eliminated" to allow the residual sound to be measured?

B. Case Study Two: A Walk Through A City Park

A second case study involves a walk through a natural park area in a small city that examines the acoustical transition that exists as one walks along a dirt path from the street edge into an area with dense vegetation. Sounds of cars driving on a nearby street, an airplane flying overhead, a person approaching riding a bicycle, sounds of animals and insects, sounds of a small stream gently falling over rocks and the wind rushing through the tree canopy are all measured at approximately the same sound level, but are all clearly heard and identified as what they are.

Figure 3. Photographs of the specific acoustic events along the path in the park.

C. Case Study Three: An Amphitheater Near a Major Highway

A third case study involves the sounds heard near a large amphitheater. The amphitheater is located near an interstate highway. Calibrated recorded .wav files of sounds in an apartment complex near the amphitheater show clearly identifiable words and music associated with amphitheater events, traffic on the interstate highway, the siren of an emergency vehicle passing at one point and various combinations of natural sounds such as insects and birds chirping. All are plainly audible. All are also clearly identifiable by the amplitude, frequency content, rhythmic patterns and information contained in their sound signals. Which are the ambient, the background and the residual sounds? How are these decisions "rendered" to use the terminology of ANSI 12.9? ASTM E1686 cautions against the use of time average sound levels that may disguise a wide variation in sound levels in a given situation.

5. THE CHARACTER OF THE AMBIENT

How does one describe the character of the ambient? How does one describe the soundscape of an event; a locale such as a town, a farm; a city; or a building - the outside or exterior of the building and the inside of the building? The metrics used to study sound should allow at least as much complexity as the acoustic perception or people with normal sensitivities.

One of the practical offshoots of this argument is defining the nature of acoustic impacts by comparing the loudness, pitch, time duration, rhythm, nature of the sound, etc., of the specific acoustic events that comprise the ambient with the same attributes of the specific acoustic events that are associated with a new or intruding sound. An initial list of possible ambient, background or residual sounds is presented in Table 1. The list can easily be expanded by a palette of specific acoustic events that occur in any given soundscape. However, the central issue involved in this discussion is which acoustic metric should be used to measure, record, detect or otherwise document the sound? What is the nature of each sound individually and in the various combinations that occur in any given soundscape? When is one sound "rendered" as ambient, background or residual and what methods are used in the "rendering".

When a number of specific acoustic events are identified in a soundscape and the comparisons are done on a sound source by sound source basis, there is the possibility for developing a quantitative method to assess "plainly audible" noise ordinance requirements during an acoustical modeling process conducted as part of an environmental acoustic assessment or to define a net zero noise impact where a new facility or process will not add to or detract from the existing soundscape. In other words, the source of interest becomes the residual sound. The metrics used in these evaluations would likely change depending upon the nature of each specific sound source and each specific acoustic context or ambient sound.

Table 1. Summary of various sounds that may comprise the soundscape of a given area usually categorized as ambient, background or residual sounds at various times.

Natural Sounds	Transportation	Entertainment	Household	Industry or commerce
Wind	Cars	Music	People talking	Construction
Birds	Trucks	People congregating	Air conditioning systems	Warnings
Insects	Motorcycles	PA at sporting events	Pool pumps	Loading docks
Weather events	Train	Crowd noise	Automobile	Police
Animals	Aircraft	Firearms	Garage doors	Firearms
Wind in trees or buildings	Stopping and starting	Boats	Children playing	Air conditioning systems
Water flowing	Accelerating	Jet skis	Noise from adjacent homes	Central plants
People visiting	Up hill or downhill	Dirt bikes	Music or television noise propagating out from house	Special equipment
Trees falling	Maintenance operations	Bicycling	Landscape activities	Industrial processes
Movement of animals	Construction noise	Picnics	Chores	Shipping goods

6. CONCLUSIONS

The conception of the ambient sound as the composition of a number of specific acoustic events is central to soundscape theory. Methods to measure, map, predict, simulate and design the soundscape and the acoustic communities that form them can be developed. These methods should also allow exploration of sound symbolism or expression of the very nature of the multiple modes of communication among people that form the underlying structure of their community to be a part of soundscape design methods and intentions. This expression, while based in architectural and environmental acoustical science, can be transformed into a *poesis* or an art of aural community design.

7. REFERENCES

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