Positive Soundscape in Urban Space

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Abstract | Today, sound and soundscape, as a major part of cityscape, is being neglected in urban design and planning. Meanwhile, cities are expanding at an increasing rate, and the emergence of traffic congestion and other environmental noise pollutants contribute to creating a disturbed landscape, accordingly. In order to achieve spaces with superior and pleasant auditory quality, this subject needs to be addressed. This study attempts to understand and fully examine the concept, its aspects, and factors influencing the soundscape, as well as methods used to study this subject. The method elucidated here for designing and redesigning a pleasant soundscape in urban spaces is a result of far-reaching studies and examinations in this field. Five key steps are suggested for designing a positive soundscape. A comprehensive designing would include all five steps concomitantly.

Keywords | cityscape, soundscape, urban space, design positive soundscape model.

Introduction

The quality of the auditory landscape has a considerable impact on other environmental qualities, such as image ability, legibility, identity, longing, and belonging. In contrast to the visual landscape seen and perceived by a person, the auditory landscape is heard independent of what a person wants or wills. What is heard today from different auditory sources in the urban spaces is the noise pollution such as sirens, car noises, commotion, and unpleasant sounds. Exposure to this unpleasant auditory environment may lead to distresses caused by noise, an unpleasant sensation of the space, and abandonment of the place, and may harm people at higher degrees of exposure. In order to achieve a positive soundscape, it is essential to design the soundscape in a location-based way and in accordance with auditory principles. With that in mind, this study asks the following queries:

What are the features of a positive soundscape?

What are the steps involved in designing a positive soundscape?

Hypothesis

A soundscape has effective elements and features that may be auditory or non-auditory. The steps involved in designing a positive soundscape include both the qualitative assessments of people's perception and the examination of sound indexes.

Research Methodology

This study is considered an applied research, and it is a descriptive-analytical research in terms of its nature and methodology. ITn order to reach a method for designing a positive soundscape, the needed information and data were collected using library resources; and, after being analyzed and examined by the researchers, they were formulated as steps involved in designing a positive soundscape.

Soundscape, Features and Indexes

Payne et al., define soundscape as "the totality of all sounds within a location with an emphasis in the relationship between individual's or society's perception of, understanding of and interaction with the sound environment" (Payne, Davis & Mags, 2009). From a linguistic perspective, "sound" + "landscape" result in a semantic paradox, since sound is heard but not seen; therefore, it would be more accurate to define soundscape as the diffusion of sounds in a landscape. Schafer and Delage have offered semantic criteria for their categorization of soundscape which allows us to differentiate between road traffic, other vehicles, music, presence of people, and nature. They remain object-oriented descriptions, however (Dubois & Raimbult, 2005: 343). The above definitions or categorizations are not based on origin, and, therefore, not quite comprehensive. According to the definition by Pijanowski et al., based on the auditory sources, soundscape is a result of the overlapping sounds from geophysical (wind, currents, sea waves, eruption), biophonic (songs, calls and warning calls, voices), and anthrophonic (industrial and urban activities, road, sea, air traffic) sources that are strongly dependent on the structure and function of the relevant geographical landscapes (Pijanowski et al, 2011). The major features are as follows:

Anthrophony

Biophony

Geophony

The most important qualities for soundscape include image ability and auditory comfort shown in Table 1.

Designing a Positive Soundscape

Whether the soundscape is positive or negative depends on how attending people perceive the space. These soundscapes are divided into two categories, hubbub and cacophony. Cacophony is the term used for describing a synthesis of sounds perceived positively, and it is related to the positive listening experience (Farina, 2014: 117). Different models have been proposed for assessing and designing the initial positive soundscape. Cain et al., have proposed an activity-oriented soundscape framework with two main parts; the first part includes place, type of space, and characteristics, and the second part comprises the temporal features, activity, and demographic features. Davies et al., in the Positive Soundscape Project (PSP), propose a model for assessing the positive soundscape. They utilized different methods, such as sound walking, laboratory listening experiments, etc. In spite of dealing with soundscape, previous models have not been focused on physical design. By examining previous models as well as a review of relevant literature, this study proposes the framework for assessing and designing the soundscape as follows:

Auditory and Non-auditory Features of Soundscape

The best method for knowing auditory sources is sound walking in short- and long-term periods on a constant basis. A recognition of auditory features helps determining dominant auditory sources in the space, knowing sonic rhythms, and diversification of auditory sources. Non-auditory factors influencing landscape include physical-structural factors (urban form, utilization, urban transportation, materials, visual quality), natural (climate, vegetation and foliage) and social (age, sex, social group, culture) (Salmons & Pont, 2012; Yang & Kang, 2005; Raimbult & Dubois, 2005; Viollon, Lavandier & Drake, 2002, Furrer & Lauber, 1990; Ghiabaklu, 2011; Schult- Fortkamp & Nitsch, 1999).

The non-auditory factors impacting soundscape are as follows:

- Geometric characteristics of space, namely length, width, height, depth of urban spaces, and the enclosures, as well as the form of the spaces and enclosures which includes convexity, concavity, flatness, undulation, porosity of the enclosures.
- Land use, such as commercial or residential use, as well as the functionalities at the time of utilization and the traffic in the vicinity due to utilization and functionality.
- Different materials used in the environment have different effects on the absorption or diffusion of diffuse sounds, due to their different coefficients of absorption. Porous materials absorb and smooth materials reflect sound.
- Color, brightness, lawns, waterscapes, urban monuments. The

Table1. Qualitative-quantitative criteria and indicators of soundscape

Type	Criteria	Index	Definition	Reference
Qualitative	Imageability	Keynote	A sound heard constantly by a certain crowd creating a background in contrast to other perceived sounds that helps perceiving all other sounds.	Vermir, Domecka & Rychtarikova , 2008 Payne, Davis & Mags, 2009
		Sound signal	Sounds that especially catch the attention.	Payne, Davis & Mags, 2009
		Sound mark	A sound with certain and unique qualities for a certain crowd, acting like a visual sign in the soundscape.	Kang, 2006
		Sonic rhythms	Sounds iterated at certain times and intervals.	Vermir, Domecka & Rychtarikova , 2008
		Sonic harmony	A general acoustic comfort that responds to sonic expectations, such as the expectation we have in a square or café; it can be people having a conversation over a drink.	Vermir, Domecka & Rychtarikova , 2008
Quantitative	Auditory comfort	qualitative	General satisfaction with the soundscape	Yang & Kang, 2005
		quantitative	The standard level of the sounds based on the auditory thresholds and environmental sound indexes	

higher the visual quality of the space, the more the positive effect on the pleasantness of the soundscape.

• The denseness of foliage, type of foliage, whether trees and shrubs are broad- or small-leaved. A dense foliage acts as a sound enclosure, small-leaved trees help absorb sound radiated at them and broad-leaved ones cause it to disperse. Using plants is effective only for reducing high-frequency sound levels (higher than 2000 Hz). The sound wave diffusing property of foliage is much more than its absorption property. Another advantage of foliage, especially tall trees, is reduction of wind speed and decreased conduction of sound waves towards the listener. A 30-meter wide strip of this foliage creates a sound reduction of 5 decibels (Ghiabaklu, 2011: 109, 110). Taking into account the target community, its auditory values, and its preferences.

Quantitative and Qualitative Measures of Soundscape

People's perception of soundscape completely depends on the psychological, cultural, and social factors and the background in which the sound is heard. Auditory values vary across different cultures, and this, in turn, affects people's preferences of pleasant, unpleasant or signaling sounds. Therefore, the qualitative measures are used for determining and examining people's preferences. Quantitative measures are used for evaluating logarithmic quantities of sound, and they are independent of people's perceptions. Qualitative and quantitative measures are shown in Table 1, and Diagram 1. The most prominent measures, however, for quantitative assessment are based on Laeq (average sound level in decibels equivalent to the total A-weighted sound energy measured over a stated period of time).

Soundscape Qualitative Assessment Methods

Qualitative approaches are used for assessing people's perceptions, and the quantitative methods for examining the physical measures of sound. Depending on the subject of the research, both quantitative and qualitative methods can be used in order to assess soundscape, but using an eclectic method can help the valuation of the results with similar outputs, and it can minimize the loss of some of the information caused by an exclusively quantitative or qualitative approach. The assessments of the soundscape has been always time-dependent, and, depending on the goal of the research, they may take a day, a year, or even more, to complete.

Qualitative methods: In order to understand qualitative measures via sound walking (Davis et al, 2013; Payne, Davis & Mags, 2009, 2009; Adams et al, 2008; Jeon & Jik lee, 2008; Polli, 2012; Baldinelli et al, 2012; Yang & Kang), interviews (Payne, Davis & Mags, 2009) and questionnaires (Baldinelli et al, 2012; Yang & Kang, 2005; Nyunt, 2004) are used. The questionnaire may include scales like Likert, Guttman, and semantic differential scale, open questions, or categorized responses. Quantitative methods: Quantitative methods of soundscape assessment include field assessments using sound meters, analysis of auditory records in laboratory, sound simulations, and people's responses (Lam et al, 2005; Polli, 2012). Synthetic method: This method is relatively more complete, because it gives a comprehensive view of the status of the physical indexes of sound and that of people's perceptions (Brambilla, Gallo & Zambon, 2013; Asdrubali et al, 2013).

Redesigning the Positive Soundscape

By generalizing the steps involved in urban design process, including understanding, analysis, sketching, inspection and monitoring, to other landscape studies, especially to soundscape, and with regard to the diffusive nature of sound, we can extract the major steps in the design process of soundscape as follows: assessment (understanding and assessing the quantitative and qualitative status of soundscape), analysis (comparing status quo with standards as well as the desirable quality of the soundscape, and determining the issues and problems), design (designing the soundscape based on quantitative and qualitative studies, and on the basis of the fluid nature of sound). With regard to the diffusive nature of sound in space, two major steps arise in the design stage: first, reduction of the background sounds to the standard and desirable levels, and second, protecting and locating pleasant sounds; because as long as the background sounds do not subdue, the pleasant and memorable sounds will not be heard, and only hubbub and commotion will be perceived (Diagram 1); (Table 2).

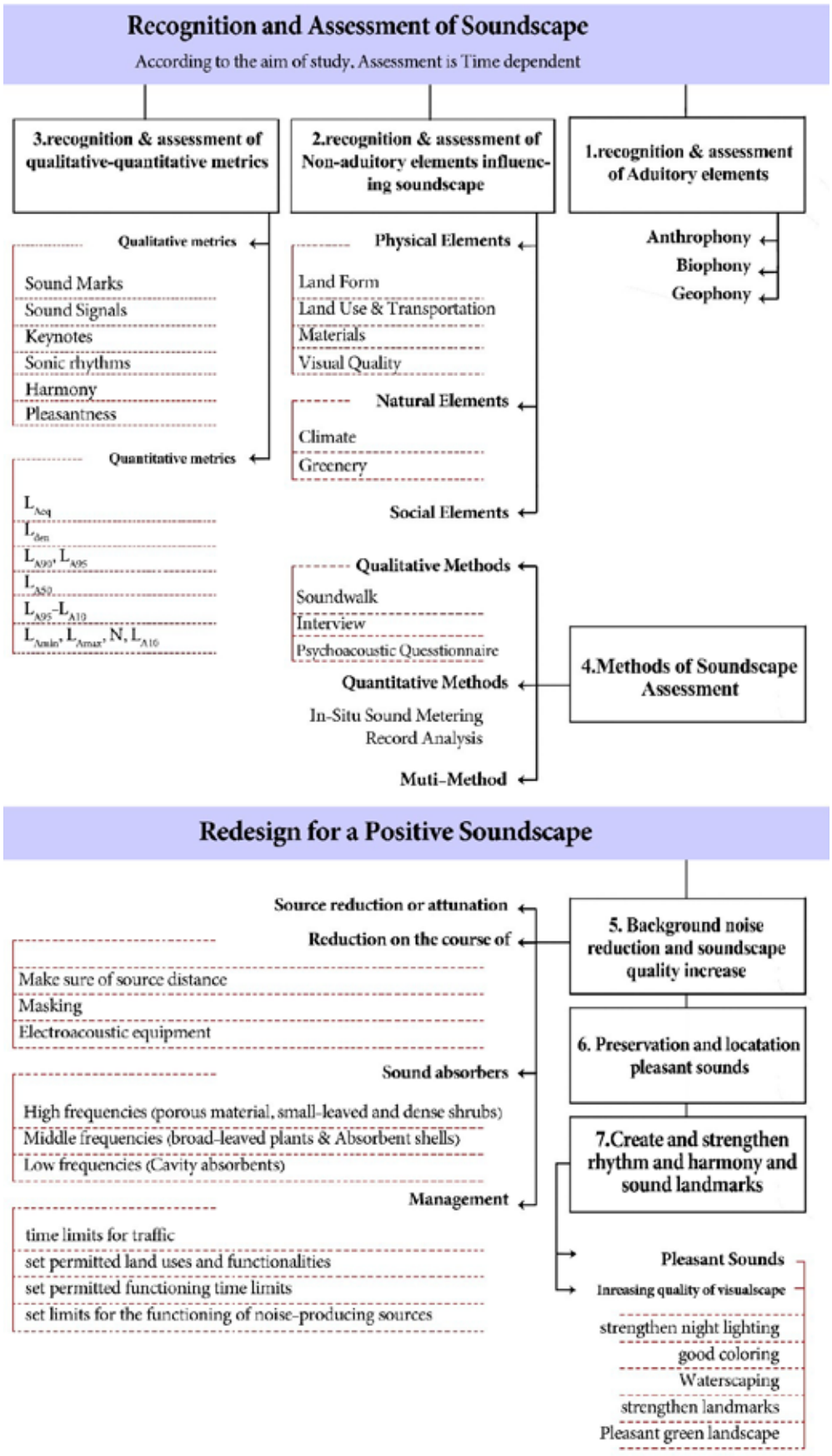

Diagram 1: Proposed framework for designing a positive soundscape. Source: authors.

Table2. Goals, strategies and policies for a positive soundscape design

Goal	Strategy	Policy		
Background noise reduction and soundscape quality increase	Source reduction	- insulating noise source or set standards for controlling noise production		
	Reduction on the course of diffusion	Make sure of source distance	- safe distance between source and hearing location	
		Masking	- covering with physical obstacles such as enclosures and acoustic barriers, acoustic walls, green walls, acoustic crystals	
			- acoustic masking, masks a lower sound with a higher signal - using the sound of water in different forms as a pleasant sound to cover unwanted sounds.	
		Electroacoustic equipment	Active noise control	- neutralizing noise using microphone and loudspeaker, by producing a sound of opposite phase.
			Noise source covering	- covering meaningful noise, like conversation, by meaningless noise using constant spectrogram like white noise
			Background music	- using background music to cover noise and reduce the distress it causes. When the noise is too high, background noise can itself turn into a cause of distress and become useless.
	Designing sound absorbers	High frequencies	- using porous or honeycomb concrete - using porous two-layered asphalt with noise reduction potential of 3-4 decibels - using small-leaved and dense shrubs	
		Middle frequencies	- using broad-leaved shrubs - storing elements and signs made of clay, unfired bricks, half-fired uneven bricks, and porous Plexiglas - using wooden urban furniture	
		Low frequencies	- creating concaves in enclosure walls, porous uneven walls	
	Executive actions	- time limits for traffic - setting permitted land uses and functionalities - setting permitted functioning time limits - setting limits for the functioning of noise-producing sources		
Preserve and locate pleasant sounds	Increase visual landscape quality	Improve lighting	- strengthening night lighting - using video mapping using emphasis and focus using light intensity -	
		Good coloring	- using frescoes on city walls using comprehensive color plans in city spaces -	
		make landscape with water	- using splash, spring, and spray water fountains - using water sculptures using water video mapping -	
		Strengthen urban monuments	- using sound art structures as urban monuments combining visual and auditory landmarks -	
		Pleasant green landscape	- using ornamental shrubs and plants - planting flowers increasing green surfaces and enclosures -	
	Preserve and strengthen pleasant sounds		- using concave walls to strengthen certain pleasant sounds - increasing presence of birds in the space using the sound of water -	
	Create and strengthen rhythm and harmony and sound landmarks		- protecting and create valuable auditory rhythms such as certain activities omitting sounds incongruent with the Identity of the space -	

Discussion and Conclusion

This study aims at proposing a methodical framework for designing a positive soundscape. With regard to the queries of the study on elucidating and explaining features of a positive soundscape, it can be said that a quiet sonic background, sound signals, rhythm, harmony, and standard sound levels are the major features of a positive soundscape. As for the first hypothesis of the study, it was approved that factors such as social and structural factors in addition to auditory features affect the perceived quality of the soundscape. As for the second query of the study regarding the steps involved in designing a positive soundscape, with a look at diagram 1, also based on the investigations done by the authors, the steps involved in designing a positive soundscape are as follows:

- Step one: determining the auditory potential of the soundscape of the space being studied
- Step two: understanding and examining the non-auditory features affecting the soundscape
- Step three: conducting quantitative and qualitative assessments
- Step four: summarizing the previous steps in the fourth step in the form of analytical results in detailed categories, and determining the quantitative and qualitative of the soundscape being studied
- Step five: examining the status quo and the desired status, and redesigning the positive soundscape based on the quantitative and qualitative analyses

Accurate quantitative assessments based on the examination of the physical sound levels against the standards, as well as qualitative assessment of people's perception as a whole, are inseparable parts of the design stages of a positive soundscape, and this affirms the second hypothesis of this study. In the steps described for designing a positive soundscape, aspects and factors involved in designing a soundscape are included as much as possible. Nevertheless, a study of each of the steps can be a cue for future research. Designing the positive soundscape in a space is a location-based project, because, based on the factors involved, each space has different auditory qualities. Any action requires an examination of people's perceptions, as well as the assessment of the physical-sonic measures in proportion with the goal in mind. The studies show that sketchy quantitative or qualitative examination does not suffice for redesigning, but what makes the design of a positive and pleasant soundscape possible is the simultaneous study of the physical sound measures and the quality of perception by people, along with the non-auditory factors involved in the soundscape.

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