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NOISE CONTROL FOR A BETTER ENVIRONMENT

Participative soundscape projects in Italian contexts

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ABSTRACT

One of the main environmental issues affecting modern urban contexts is noise. Consequently, in Europe cities have developed policies and technical actions addressing noise management, mitigation and control by means of noise levels' reduction. On the other hand, urban and extra-urban areas, not affected by high noise levels, can be characterized by an anonymous sound environment. In other contexts, sounds, that had historically characterized the identity of places, have been gradually lost.

Against this background, some experiments of sound enrichment of places have been carried out by the authors in the last years in two Italian cities (Firenze and Pistoia) and the applied methodology is expected to be replicated in the city of Pesaro and in the extra-urban area of the Maremma Park (pertaining to the city of Grosseto).

The idea behind these projects is to make the city or the park "sounding" and to collect, by means of adapted soundscape analysis methods based on soundwalks, the responses of citizens attending the spaces regarding the added sonorization.

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The project aims to designing and testing methods for contrasting noise pollution without excluding the life sounds that can enrich the perceived quality of public places, believing that an effective acoustic design combined with an aesthetically relevant design can involve citizens to a more conscious and fruitful use of the spaces and their soundscapes.

Keywords: Soundwalks, Participation, Active sonorization
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1. INTRODUCTION

We live in an era in which the habitat, meant as the place whose characteristics allow a given species to live, develop and reproduce, is mainly urban. As such, the habitat is linked to urban ecosystems and patterns of urban development and it influences the quality of life of the species that inhabit it.

The design of functional urban furniture and the introduction of elements facilitating citizens' perception of well-being in urban living spaces represents a new frontier to explore. It includes, among its characterizing data, the definition, correction and qualification of the sounds that contribute to enjoy the environment and protect it from disturbing noises. The definition of the sound space, as a significant part of a wider landscape and functional context, is one of the basic elements of holistic design, vision and methodology that favours integrated, sustainable and environmentally friendly solutions. Hence the need for an innovative approach to noise control in urban environments which goes beyond mere compliance with the acoustic limits set by laws and regulations, which often overlook cultural and functional dimensions of the regulated spaces, also according to the indications provided by the World Health Organization (WHO) which recognize the environmental noise an important public health issue [1]. The consideration of the acoustic well-being perceived by those who live and animate urban living environments is an emerging approach, useful for the correct evaluation of the acoustic quality and for an improved design of the usability of squares, urban green areas and public spaces. Here the acoustic experimentation based on the soundscapes analysis and on the aesthetic, holistic and serendipity parameters that characterize it and link it to the variables of global comfort, is producing truly remarkable results. Soundscape research has acquired considerable scientific relevance in recent years, going from just a few works published in international journals in 2000 to almost 400 publications in 2016 [2]. To confirm this importance, in 2014 the International Standard Organization [3] has provided a definition and a conceptual framework of the soundscape, explaining the relevant factors for the measurement and reporting of studies and research on this item, as well as for the planning, design and management of urban soundscapes while also crucial gaps in soundscape research and open research issues for future advancements in the field have been identified [4]. In the implementation of the LIFE+2008 HUSH (Harmonization of Urban noise reduction Strategies for Homogeneous action plans, www.hush-project.eu) and of the LIFE+2010 QUADMAP (QUiet Areas Definition and Management in Action Plans, www.quadmap.eu) projects in Italy, some traditional strategies for soundscape analysis have been applied. In the frame of both projects [5, 6], some interventions of environmental noise reduction in courtyards and outdoor areas of primary schools have been developed according to the participatory design. In all these case studies the results of acoustic measurements in ante-operam scenarios had shown the need to protect school gardens and outdoor areas from

traffic noise emitted by nearby road infrastructures. This need has been confirmed by the non-acoustic investigation carried out with the soundscape analysis.

In this context, also the definition of noise as "sound out of place", attributed to W. Clarkson Kaye [7], takes on a meaning that can be read as an analytical and corrective element of the soundscape of an urban scenario, where any possible judgement of objective quality is subordinate to the evaluation of perceived quality linked to cultural factors and life experiences of people.

In urban planning, to design outdoor and indoor spaces, it is not possible to ignore the "immersive" perception of the landscape that represents the viewer's perceived surroundings, that is, "the world around us" and not "in front of us" [8]. In this transition from an object of contemplation to a lived (or to be lived) space of life, perception is necessarily multisensory and the sound component becomes an important element in the fruition of the landscape.

The modern soundscapes, particular the urban ones, are therefore defined as the perceived surroundings of every living creature, which also becomes common surroundings when shared cultural models are used. As a real autopoietic system, it redefines itself and, within itself, it supports, modifies and reproduces itself, thanks to the contribution, voluntary or involuntary, of those who live there, no longer as observers but as elements of the dynamic systems that we call urban soundscapes.

Which sounds, which sources are part of the soundscape of a given urban space and modify it, to the point of creating a variant, perceived in a different way from the original? How are the sounds produced inside or outside the receiving urban environment, a space for listening and perception, propagated and modified? And how to catalogue urban sounds, harmonic and non-harmonic, and noises "out of place sounds"?

This article provides some ideas for answering these questions and it is organized as it follows: firstly, an outline of the previous projects carried out addressing urban soundscape is made, then the event “Urban sounds and soundscapes” recently organized in Pistoia is described by introducing the concept of “active sonorization” and presenting initial analysis of people’s responses to the questionnaires filled by the participants in the soundwalks. In conclusion, the new projects which will take place in Pesaro and in the Maremma Park are presented.

2. URBAN SOUNDS AND SOUNDSCAPES, THE CASE OF PISTOIA

In the last years Pistoia and its university centre (UNISER) have been protagonists of experiences and events concerning the urban landscape in its various forms and declinations, such as the seminar “The music that enchants and that cures – acoustic perception and soundscape’s quality” held in 2012, the seminar “If a lion could speak - physics and philosophy of voice” in 2013, the course “Acoustics and transport noise control” in 2014, the conference "The Porrettana railway - history and future" in 2014, “Philosophy and ecology of sound space design” in 2016 and “Ethics and aesthetics of the landscape” in 2017.

In this framework, the international event “Urban Sound and Soundscapes” was organized on 26th and 27th April 2018 considering the aspects of noise mitigation, the perception of comfort and the acoustic design of systems for the composition and correction of the perceived soundscape. The idea that inspired the organizers was to explore the sound soul of cities, from multiple angles, through the sounds and urban soundscapes that generate and characterize it. The workshop was structured into two days: during the two mornings the scientific sessions were held with the participation of

international speakers, during the two afternoons the soundwalks took place and they were concluded by two evening events During the different moments in which the workshop in Pistoia was articulated, it has been talked and then experienced how the sound footprints of a city can be studied and improved applying and adapting the soundwalk approach and through the knowledge of natural and artificial sounds of anthroocene [9, 10], the present geological epoch, where the impact of human activities and of the anthropophonies associated with them, is redefining the acoustic climate of the planet.

Annoyance is recognised as a reference parameter for the definition of perceived acoustic suffering. On the other hand, the perceived acoustic well-being can become a basic element for the correct design of urban spaces and for places for speech and listening. During the days of the "Urban Sounds and Soundscapes" event, methodological approaches and real case studies based on experiences including silence, relationship between noise and music, contamination between musical compositions and soundscapes, harmony of natural and everyday life sounds.

2.1 The sounding city

Following the above-mentioned approach, on 26th and 27th April 2018 Pistoia was the venue for an important multidisciplinary and interdisciplinary debate on urban noise, but at the same time it was a laboratory for the knowledge and direct experience of sounds and music that characterize places and become their sound footprints, according to the definition of soundscape analysis.

In the design of the urban space and the built environment, the rules of environmental acoustics, building and architecture often collide with the sounds that are part of the city landscape, increasingly immersive for those who live in it. Even interventions designed and then carried out to control noise, perceived as "sound out of place", could, and perhaps should be able, to transform the sound space, giving it warmth and animation without compromising or interfering with the needs for quiet. The idea of "let the city play", or “make it playing” was then developed moving from the applied research experiences of the authors, as a method to limit noise pollution without excluding the sounds of life that can enrich a public place, convinced that a good and effective acoustic design combined with an urban design aesthetically relevant, can involve citizens, inviting them to an active use of the spaces and their soundscapes.

The experience of some important architects and designers of urban spaces, including Ab Rogers, who actively participated in the event in Pistoia, teaches us that rather than removing noise as part of the acoustic design of a space, it is necessary to investigate the positive influence of the right sounds, the impact of soft sounds to mitigate the negative effects on health and comfort typical of acoustically difficult environments and integrate seamlessly into the interior design and urban architecture, the sensory programming of the space. The often-misunderstood designs of mitigations, intended as mere works aimed at reducing noise pollution below set limits, thus become strong points of urban regeneration, making the design legible and pleasant, "proudly showing - in the words of Ab Rogers - an acoustic treatment, instead of hiding it, leveraging on its surprising visual aspect". With this approach, the way a space sounds can be as important as its appearance in terms of user experience. This approach led to the idea of "the sounding city" [11].

2.2 The workshop and the events

The workshop Urban Sound and Soundscapes, sponsored by the Italian Acoustical

Association, was organized by UNISER in collaboration with Register of Engineers and Architects of the Province of Pistoia and Vie en.ro.se. Ingegneria on 26th and 27th of April 2018.

The scientific sessions gave the opportunity to experts in applied acoustics to discuss and exchange experiences with other experts dealing with different fields of connection with acoustic issues: engineers, architects, audiologists, musicians, urban planners and philosophers.

In other words, experts, researchers and designers were invited to take part in the event bringing their experience of working in different disciplines, but all developing the precise idea of giving evidence and significance to the acoustic identity of the city and of the soundscape characterizing urban areas. All the possible outcomes from their academic and professional experiences were considered: the covered themes ranged from the relationship between silence and annoyance to the analytical study of the natural sounds of anthropocene, from the "singing stones" to the history of silence and noise as part of the musical compositions of the twentieth century. The theme of soundscapes and soundscapes analysis was treated in a systematic way through the definitions that derive from the work of R.M. Schafer [12], up to the contemporary experiences of sound contamination of urban areas through experiences of sound masking and sound excitation.

An entire day was dedicated to the design of living spaces sensitive to the aesthetics of sound and the consequent cognitive experiences. Important architects and urban planner showed their projects regarding the design of urban spaces and places for speech and listening, with references to methodological approaches and case studies, considering the syntax of the soundscape and the relationship between musical compositions, natural sounds and sounds of everyday life. The events that, together with the scientific sessions, animated the two days in Pistoia were dedicated to urban sounds. They included performances, installations and concerts in twelve different listening points connected by soundwalks through the city centre of Pistoia, introduced and accompanied by experts in urban soundscapes and soundwalks, multisensory perception of the landscape and concrete music applied to places of life. The students of the schools of Pistoia joined the program of the International Noise Awareness Day 2018, coordinated by the Italian Acoustical Association, directly contributed to the illustration of the listening points of the walks, through descriptive cards of the place and its soundscapes. In this context, the event was also linked to the awareness initiatives "Nonno Ascoltami! (Grandpa, listen to me!)" that included information and free audiometric tests. Two important night events completed the programme of the Workshop. A lecture entitled "Magic of sound for the unity of culture", held by the Rector of the University of Florence, supported by a string quartet and a pianist, who treated the unity between scientific and humanistic cultures, through a narrative that merged in a kind of kaleidoscope: science, literature, art, music, dance, poetry, cinema, photography. Finally the show titled "Echoes - spectacle of sound disorientation" was a remake of "Pink Floyd - Live at Pompei" that played for one night inside ruins of the imposing Fortress of Santa Barbara with a path of lights and sounds resulting from a complex work of design and acoustic correction of the various spaces inside and outside the walls, inspired by the themes of the workshop.

2.3 Experimental soundwalks

The standard concept of soundwalk consists in a participatory and creative method of knowledge and evaluation of the territory, starting from sound with the aim of understanding how people experience the spaces of everyday life, how they perceive them

and what values and meanings are attributed to them by actively involve citizens in evaluating the acoustic environment where they live also by smartphone apps. In this way the analysis and evaluation of the city starting from the relationship between the inhabitants and the city itself through its sonic component is also made feasible [13].

During the experience carried out in Pistoia the authors tried to take a step ahead from the classic exploration of the soundscape of places, trying to "switch on" the city through "sound excitements", changing noisy or anonymous places into sounding places and asking people about the perceived difference between the original and the "activated" sounding places. In fact, the idea behind the activation of the listening points was to make more lively and attractive some urban areas located in the city centre, making more pleasant the acoustic perception of the places, emphasizing certain intrinsic acoustic characteristics of places in order to enhance their nature and their identity. Starting from this willingness, the authors wanted to make the city resonate with the help of musicians and soundmakers, able to excite special places of the urban sound landscape with their own executable unplugged instruments, including voices.

To this end, the musicians are involved as prototypical inhabitants of the urban space, able to inspire new and extra-ordinary models of urban relations, specifically bearers of further opportunities for historical and acoustic awareness in the city of Pistoia: suggestions then collected and intensified by the experience of reading and listening soundscaping, in the methodological perspective of offering a wider expressive endowment to the designers of the city of the future.

Specifically, two soundwalks have been organized in the two days of the workshops in the city of Pistoia, with two different routes, as illustrated in Figure 3. For each soundwalk six significative and representative places of the city have been selected (squares, churches, open-air market, court) as listening point.

The total duration of the soundwalk has been of about 1 hour and a half. Each soundwalk was structured as follows [13]:

- Introduction to the soundwalk and presentation of the participants and ear-cleaning exercises (10 minutes)
- Walk in silence with stops at the "listening points": brief introduction to the place (3 minutes), start of the event, listening of part of the event (5 minutes)
- Time taken from one "listening point" to another: 3/5 minutes
- Conclusion and final choral discussion: 10 minutes

After the listening they have been asked to fill a questionnaire mainly focusing on objective information about the nature of the noise source and about their feeling of perception. The following criteria were applied to design the soundwalk paths:

- The "listening points" and the relative places that host them have been classified according to the main function in religious, of civic life, of everyday life.
- The combination of the "listening points" making up the soundwalks has been determined by the willingness to offer participants a variety in terms of "places", soundscapes and acoustic experiences offered by choirs and musicians.

In Figure 4 some example of sonorization of the listening points are represented. Musicians, singers, historic cars, sounding objects of different kinds have been employed in the twelve sounding points of the city.

Figure 3: Day 1 (listening points 1-6) and Day 2 (listening points 7-12) soundwalks routes.

The activation of each point was given as the soundwalk stopped in the point proximity. According to the soundscape analysis method, adapted to the situation, different responses were collected in both the ante-activation and post-activation scenarios, aiming to collect the different perception of pleasantness that arise in participants as the sound excitements started to draw a new soundscape in the previously noisy or acoustically anonymous area.

Figure 4: Sonorizing activation by means of musicians, singers, historic cars, playing of different typologies of objects.

2.4 Preliminary outcomes of data collected from questionnaires

The questionnaire handed out to the participants to the soundwalks is structured in tree main sections, addressing:

- personal information of the participants (age, gender, relationship with the city of Pistoia, qualification)
- typology (road traffic, natural, anthropic, mechanical) and intensity of sounds heard to be evaluated on a scale from 1 (not heard) to 5 (predominant sound)
- quality of sound environment and landscape in each listening point on a scale from 1 (very negative) to 5 (very positive) and their relevance on a scale from 1 (not at all) to 5 (perfectly)
- comments/drawings about the "sound excitements"

About 50 questionnaires have been collected in the two soundwalks that visited all the twelve city sounding points. Some significant outcomes are reported hereinafter.

In Figure 5 a significant correlation is highlighted between the measured noise levels and the perceived soundscape: the higher is the LAeq the worse the perceived soundscape quality.

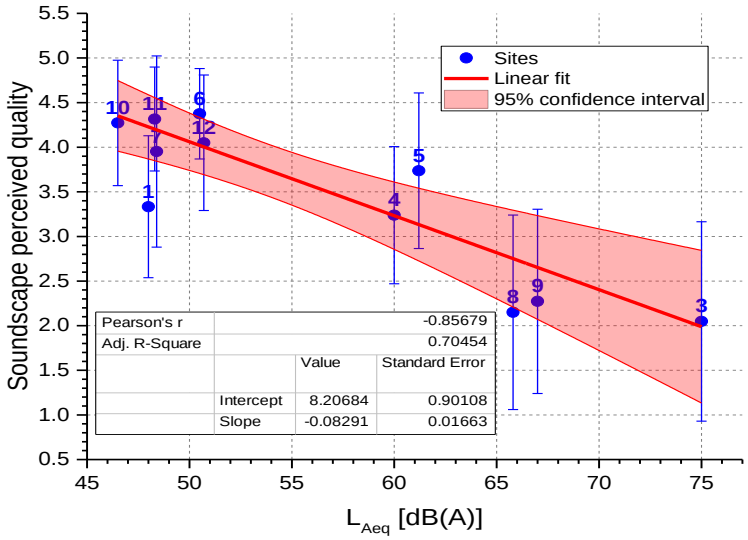

Figure 5: Correlation between the measured values of LAeq and the perceived soundscape quality (evaluated on a scale from 1– very negative to 5 – very positive).

It is also very interesting to highlight that for the most part of the respondents if the landscape is positively evaluated also the soundscape is well-rated (Figure 6). This is probably due to the fact that the visual and the sound aspects often influence each other in the evaluation of a urban space [14, 15]. However, in most of the sites the perceived landscape quality was higher than that of soundscape (above the equal perception light blue dashed line in Fig. 6).

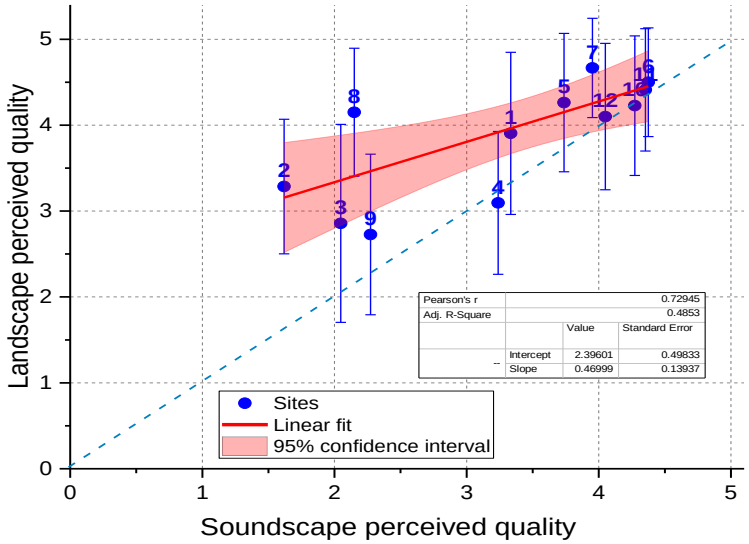

Figure 6: Correlation between the soundscape and the landscape quality perception (both evaluated on a scale from 1– very negative to 5 – very positive).

In Figure 7, for each listening point, the most perceived noise sources are reported (ratings of 4 and 5 on a scale from 1 to 5), versus the average rating given to the perceived soundscape quality. It is observed that where the quality of the soundscape is judged as poor or average (score from 1 to 3) the most perceived sources are mechanical or related to road traffic, while it is judged as good or excellent in presence of anthropogenic sounds

even if not perceived with very high intensity. It can be concluded that for the participants the human presence is important to define good soundscape quality of the considered listening points.

The comments given by the subjects on the sonorization events in each place, being structured as open-ended question, have been analyzed in terms of occurrence of words, as shown in Figure 8 by the corresponding word cloud. Generally, the comments were very positive.

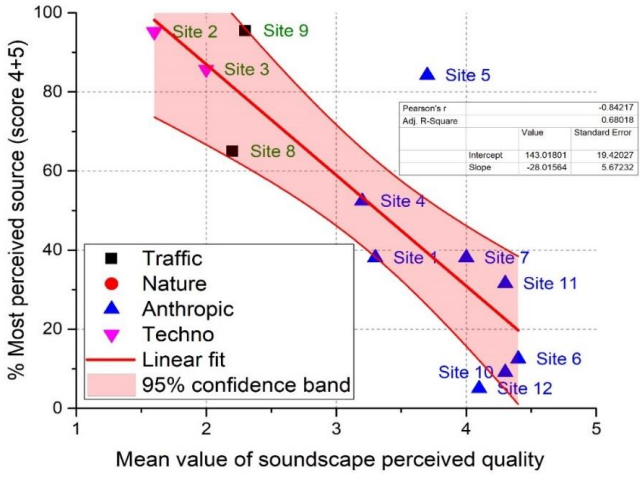

Figure 7: Correlation between the Soundscape perceived quality and the most perceived (in terms of intensity) noise source.

Figure 8: Wordcloud of the comments given by subjects to the sonorization events in all the 12 listening points.

3. FURTHER PROJECTS

Due to the positive feedbacks collected from citizens, local stakeholders and also international colleagues after the event organized in Pistoia, authors have received invitations to re-propose the event, organizing and managing: a second edition in Pistoia and two other similar projects in the urban context of the city of Pesaro (birthplace of the composer Gioacchino Rossini) and in the extra-urban context of the Maremma Park, located nearby the sea, in the south of Tuscany Region. These will be important occasions to test the method again in the urban scenarios and also in an extra-urban one and to collect further data to be analysed.

4. CONCLUSIONS

Contemporary cities are affected by several environmental stressors, such as noise pollution. Consequently, in the EU cities main policies and technical actions are devoted to noise management, mitigation and control via noise levels control and reduction. On the other hand, urban and extra-urban areas, not affected by high noise levels, can be characterized by an anonymous sound environment which can be reflected in a low level of attendance by citizens. In this frame, authors have carried out several participative soundscape experience and further experiences are expected in the near future. The first ones have been experimented during the LIFE HUSH and LIFE QUADMAP projects during which traditional strategies for the soundscape analysis have been applied. Subsequently, during the Workshop-event "Urban Sounds and Soundscapes" the authors have taken a step forward from the classic exploration of the soundscape, intended as a participatory and creative method of knowledge and evaluation of the territory as it is of places, trying to "switch on" the city through "sound excitements", changing noisy or anonymous places into sounding places and investigating the differences between people perception of the original and the sound "activated" places.

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