Chapter 15

Investigations on the Influence of Auditory Perception on Urban Space Design Through Virtual Acoustics

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ABSTRACT

The study investigates the influence of different façade materials on listeners’ space wideness perception on the basis of auditory stimuli, aiming at improving the awareness of how different façade designs can influence the outdoor environment under multiple aspects. The investigation has been conducted through a listening test with a 4-level factorial design in which participants had to rank different sound stimuli with respect to the perceived wideness of the space in which they were produced. The stimuli were obtained through auralisation of an impulsive sound in virtual scenarios in which different scattering and absorption coefficients of the building façades and different source and receiver positions were tested. Results showed that the absorption coefficient of the façades and sound source position significantly affect the perceived wideness of spaces while scattering coefficient and receiver position do not. Moreover, no correlation was found between the above-mentioned factors, and music experience of participants proved not to be an influential factor as well.

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INTRODUCTION

Auditory Perception of the Urban Environment

Visual perception is often considered as the prevalent way through which individuals collect information on the surrounding environment and interact with it. This is especially true for architectural and urban design practice, which - except maybe for some specifically dedicated spaces such as auditoriums or theatres - has always been mostly focused on how spaces shapes and geometries are visually perceived and on the information and messages that architecture can convey to users through a visual language.

However, the importance of the role played by other senses in our spatial experience is now widely recognized and visual perception is proved to be part of a larger network that combines sensory evaluation from multiple sources (Schams & Kim, 2010). Among those senses, hearing is maybe the most studied in its involvement in space perception and recognition. The interest towards sound in the environment has roots that go quite far back in time.

As reported by Radicchi (2012), references to acoustic environment can be found in the studies of the German psychologist Willy Hellpach who, in its book Geopsychische Erscheinungen in 1923, writes about the colours of the landscapes and the elements which are perceivable through hearing, smell and touch. However, it was in the sixties that the interest towards sound was developed in the field of urban studies, with the pioneer studies of Michael Soutworth at the Massachusetts Institute of Technology (Southworth, 1967).

Since those studies, closely followed by the introduction of the concept of “Soundscape” by Murray Schafer (1977), an ever-growing number of researches have concentrated on the auditory perception of outdoor environments. However, most of them have concentrated either on the “informative content” of sounds, i.e., the information that a sound can convey on the source that has produced it (see, for instance, the work of Brown, Kang, & Gjestland (2011) on the taxonomy of sound sources in urban environment, or the analysis of terms used to describe sounds and sound sources in Davies et al. (2013)) or on the perceived affective quality of soundscape (Axelsson, Nilsson, & Berglund, 2011).

On the contrary, very few researches (e.g. Calleri, Astolfi, Armando & Shtrepi, 2016) have investigated the influence that sound can have on the perception of the physical characteristics of the space itself (geometry, perceived wideness, etc).

Influence of Materials and Geometry on Sound Environment and Sound Perception

The sound that we hear in our everyday life is a combination of the direct sounds produced by the sources and the indirect sounds of the reflections from different surfaces of the surrounding environment. Therefore, one of the central topics in acoustics is how to affect such reflections, in order to control the way in which sound propagates and is perceived. Lots of studies have been performed on indoor environment for which the acoustic aspect is of particular importance. They mainly focus on defining the right volume, shape and surface treatment that should be applied in order to reach specific requirements (Astolfi, Shtrepi, & Van der Harten, 2014; Choy, Bradley, & Jeong, 2015; Méndez Echenagucia, Sassone, Astolfi, Shtrepi, & Van der Harten, 2014) and lots of efforts are being put also in the development of new sound absorbing materials (Asdrubali, Schiavoni, & Horoshenkov, 2012; Buratti, Belloni, Lascaro, Lopez &