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LOUDNESS AND PLEASANTNESS IN STRUCTURATION OF URBAN SOUNDSCAPES

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1. INTRODUCTION

When dealing with sound perception of environmental scenes, one has to identify and qualify how the sound space is structured, both physically and cognitively. From a cognitive point of view, the classical techniques used in psychoacoustics rely on *a priori* conceptions on sound perception, rooted in physical sciences. However, these conceptions are not easily adaptable to the characterization of perceived urban soundscapes. Psychophysics focuses on the evaluation of the subjective effect when sounds vary along one or more dimensions, these latter being defined by the experimenter beforehand on the basis of physical measures. For urban soundscapes, such laboratory studies hardly comply with the requirements of applied research and hardly lead to relevant prescriptions for environmental improvements. One methodological consequence of the cognitive approach developed here is to start with the meaningful situation, where the context of perception is taken into account as well as the sound itself. This approach requires to first identify the playroom of the numerous variables that constitute, for the subject, the relevant and meaningful acoustical phenomena, before isolating the effects of physical dimensions and parameters in more accurate experimental designs. Indeed, one specificity of mental representations is to make sense from a complex set of criteria taken as a whole. This complexity has to be first identified before reducing it to the dimensional physical parameters that are required for corrective purposes. In order to reach such an aim, we rely on the psychological theories of categorization: they make it possible to identify the relevant categories which structure the sound environment, that is the soundscapes considered as "same" or "different" by the subjects in their everyday life. This suggests shifting from an *a priori* description of sounds in

terms of intensity and annoyance to a conceptualization aiming at grasping "loudness" and "pleasantness" as the psychological correlates of physical phenomena.

2. METHODOLOGY

In order to establish a representative set of locations that have particular acoustic relevance for the subjects, a pilot inquiry was carried out in Paris [6]. A corpus of 16 urban soundscapes were identified and recorded with electrostatic microphones (Schoeps MK6, cardioid, 60 cm spacing, 110° spread) and a portable R-DAT (HHb Portadat), sampled at 48 kHz. They were played back on loudspeakers (Studer A723) in a fairly anechoic surrounding. Subjects were placed at an average distance of 1.5 m from the loudspeakers.
The recording and reproduction techniques have been validated previously [8] in order to create the best illusion inasmuch subjects react as if they are in an actual environment.
In order to identify the cognitive structures associated with these 16 sequences, 4 categorization experiments were carried out [3,4,5,7]. In each experiment, subjects were asked to group sound sequences into as many categories as they wanted, according to their similarities. Experiments 1 and 2 differ only by the instructions given to the subjects: to sort the sequences either on loudness similarity or on pleasantness similarity. Experiments 3 and 4 replicate experiments 1 and 2 respectively except that the soundscapes are equalized so that the maximum intensity of all sequences are the same and equal to the maximal intensity of the set. The reduction of the intensity variations between sequences was designed in order to neutralize the intensity parameter and to emphasize other parameters in the perceptive difference between soundscapes: sequences containing many sound events remained approximately at the same level; sequences containing less sound events became louder.
After the sorting task has been completed, subjects were asked to verbally qualify the categories they had formed.
The test was run on a PC Pentium 200 equipped with a Digidesign Audiomedia III card. The sequence durations were approximately 15 seconds. It took the subjects an average of 45 minutes to perform the test.

3. ANALYSIS AND RESULTS

Data were compiled into a similarity matrix where the critical value was the number of subjects sorting each pair of stimuli within a same class, and processed through an additive tree algorithm that represents similarity distances [1].
Independently of their sound level (original or equalized) and the types of judgment, sequences are generally grouped according to their analytic or holistic characteristic. That is, they include either discriminable sound events or no specific sound. Secondly, some sequences remain grouped together across conditions.