Portraying sounds using a morphological vocabulary

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Summary

Speaking about sounds is not an easy task. Although there are many words available in our language to describe acoustic sensations, there is no strong consensus on the meaning of sound descriptors. Whereas visual stimuli can easily be described by everyone using simple words such as shapes, colors and textures, the characterization of sound stimuli is much more delicate, especially for people who don't have a proper sound expertise. Therefore several practical domains are suffering from barriers in the communication of sound related matters. Sound practitioners such as sound designers, acousticians, composers, sound engineers… are using a very technical lexicon to talk about sound and music. Speaking to non-experts in such terms can easily lead to misunderstanding. On the other side, people from the industry often need to formulate requirements for a desired sound (either product sounds, digital sounds, soundscapes) in the early stages of a design process and they do not have a standard way to express themselves. In this study we tried to develop a common sound lexicon adapted for communication purposes based both on theoretical literature and on sound experts practice. A didactic software which presents 35 « sound words » along with their definitions and some sound illustrations has been developed and confronted to both experts and non-experts. The application of this educational tool for sound sensory evaluation purposes has also been investigated by the authors.

1. Introduction

In the past decades, the perception of soundscapes in train stations [1] [2] [3] and the acoustic comfort aboard trains [4] [5] [6] have been investigated by several studies focusing on sound quality. The emerging field of industrial sound design raises new challenges: what is the desired sound for future trains and stations? How can industrials manage to think about the way their product sounds will be perceived? Beyond auditory comfort or information, audition is a sense that can also be involved in brand perception: a consumer experiences not only the sound environment of a point of sale but also sounds emitted by the products of the brand. The sound is therefore becoming a more and more significant topic of interest for industrials, and there is an increasing need for communication on sound related matters. All the stakeholders that take part in sound design processes do not necessary have a proper sound expertise; therefore the interaction between them is often delicate. Some studies have underlined that the lack of common vocabulary was a major cause of misunderstanding in industrial sound design [7] [8] either when an industrial try to formulate requirements concerning sounds, or when the sound designer try to present answers to these requirements. The present work is a part of a large

study on sound verbal description as a way to communicate in early stages of a sound design process. A review of the literature concerning studies dealing with different ways of speaking about sounds [9] showed that some words are used more frequently than others to verbally describe sound features. These descriptors are common to a great diversity of sounds, from musical instruments to product sounds (such as car door closure sounds or coffee machine sounds). We thus conjecture that such words could be the basis for the construction of a common terminology adapted to communication between experts and non-experts, provided the fact that their meaning could be easily understandable and shared by anyone. In this paper we propose a selected set of sound verbal descriptors along with their definitions and sound illustrations, in order to provide both industrials and sound designer with a reduced vocabulary adapted to communication.

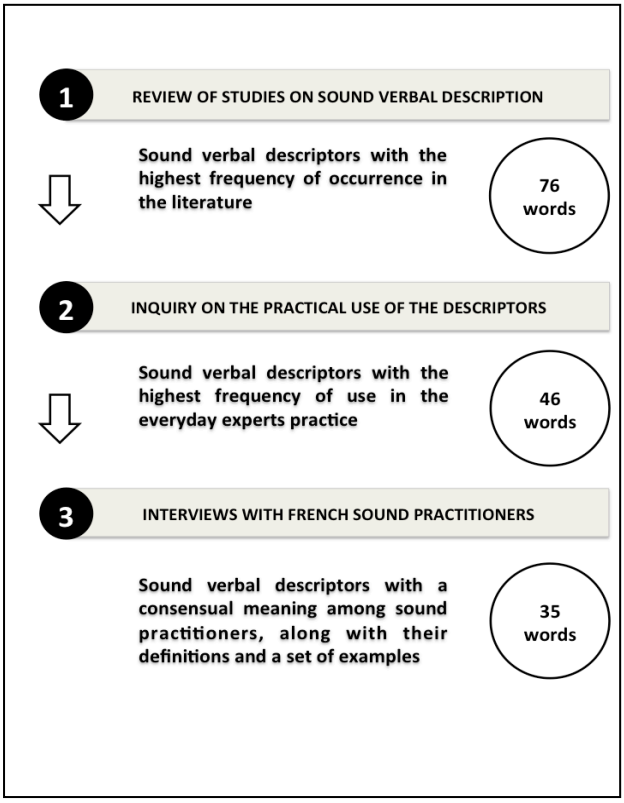
2. Elicitation of attributes and creation of the sound lexicon

As the corpus of 76 verbal descriptors presented in [9] is based on a theoretical meta-analysis, there is no evidence that such a set of words could be adapted to communication between experts and non-experts. Besides, a same word coming from different kinds of studies with different kinds of sounds could be understood very differently even by experts. Therefore confronting the lexicon with experts' practical knowledge was the next step of the present study. The whole process of attributes selection is shown in figure 1.

2.1 Electronic inquiry on sound semantics

A 76-items inquiry was elaborated to gather the opinion of several sound experts on each 76 words belonging to the previous selection. For each item, the participants had to answer two multiple-choice questions on its frequency of use ("*always*", "*often*", "*sometimes*", "*rarely*" or "*never*") and on its meaning ("*well-defined*", "*unclear*" or "*no meaning*"). The participants were also allowed to add some terms to the selection and to give answers for them as well. At the end of the questionnaire, a blank page was left for discussion and remarks. The whole inquiry was designed to last less than 20 minutes (including the reading of the instructions). Based on the answers of the 32 participants, the 30 words that obtained a median answer of "Never" or "Rarely" to the first question (frequency of use) were eliminated.

Figure 1. Ellicitation of consensual attributes.



2.2 Interviews with the sound practitioners

A shortlist of words was selected for each participant, according to their answers to the preliminary inquiry. Descriptors that were said by an expert to be used "often" or "always" and to have a well-defined meaning were assigned to that participant. For each word, participants were asked to freely verbalize on its meaning and its use in the context of verbal description of sounds. Interviews were conducted following a guideline. Three elements were asked for each word:

- *Non-technical definition, explanations, antonyms…*
- *Technical definition related to the expertise of the participants (if relevant)*
- *Examples of everyday sounds that illustrate the concept*

Figure 2. Overview of the didactic software interface. The term "Attack" is presented on the interactive page with 1) a short definition of the concept 2) an interactive sound sample which vary from "slow attack" to "fast attack" while moving the mouse 3) illustrations of everyday sounds with slow or fast attack

All interviews were recorded using a digital voice recorder and were transcribed on computer to constitute raw data for further analysis.

2.3 Illustrating sound concepts

Based on the interviews, we worked together with a French sound designer to provide each selected sound concept with a proper definition, an abstract sound sample that could illustrate the concept in an interactive way and a set of examples (mostly everyday sounds) that were representative of the concept. Antonyms were grouped together and synonyms were eliminated. The whole process conducted to a reduced lexicon of 35 words (Table I). This lexicon was implemented on a didactic software (figure 2), allowing people to explore all the sound concepts in an interactive way.

Basic Features	**Temporal evolution**	**Timbre**
High / Low	Continuous / Discontinuous	Rough / Smooth
Loud / Weak	Constant / Fluctuating	Bright / Dull
Noisy / Tonal	Ascending / Descending	Nasal
Short / Long	Crescendo / Decrescendo	Rich
Slow Attack / Fast Attack	Dynamic	Round
Natural / artificial		Warm
Mate / Resonant		Metallic

Table I. List of attributes in the sound lexicon.

3. Learning and use of the sound lexicon

In order to evaluate the pedagogical dimension of the software, a pair comparison experiment was conducted on both "experts people" (i.e. trained with the didactic software) and "non experts people". Stimuli were 24 pairs of sounds extracted from the didactic software, either from variation sliders or from concrete examples. Therefore each pair was specifically designed to be representative of one sound attribute. All stimuli were equalized in loudness, at the exception of the pair corresponding to the Loud/Weak attribute. 40 volunteer participants (20 women and 20 men; age 21-55 years) took part in the experiment. All of them were French native speakers and didn't have any musical training or sound expertise. None reported having hearing problems. They gave their informed written consent prior to the experiment and were paid for their participation.

3.1 Procedure

Learning sessions

Half of the subjects (10 women and 10 men) participated to a learning session before the test session. They were given 1 hour to explore the sound vocabulary through the didactic software. A questionnaire with 19 items corresponding to the 19 sound concepts presented on the software was given to the participants. For each item, participants were asked to rate during the learning session their understanding of the sound concepts on a discrete scale from 1 (I didn't understand) to 5 (I understood perfectly). In addition to the feedback given by the questionnaire, this task was a way to ensure the participants consulted each entry on the software.

Test sessions

The test sessions consisted in a pair comparison task. 45 pairs of sounds were randomly presented to the participants. A list of 29 semantic descriptors (presented in alphabetic order) was displayed on the interface. Participants were asked to select the word that described the best the difference of the two sounds in the pair, by completing the sentence **"The sound A is more ….. than the sound B"** displayed at the middle of the screen. Participants were allowed to listen to the pair as many times as they wanted before validating their answers. The whole session lasted approximately 40 minutes per participants.

3.2 Results

The average score of the two groups is presented on figure 3. The results show that there is a significant difference ($p < 0.001$) between the trained (57.6 %) and non-trained (32.2 %) participants.

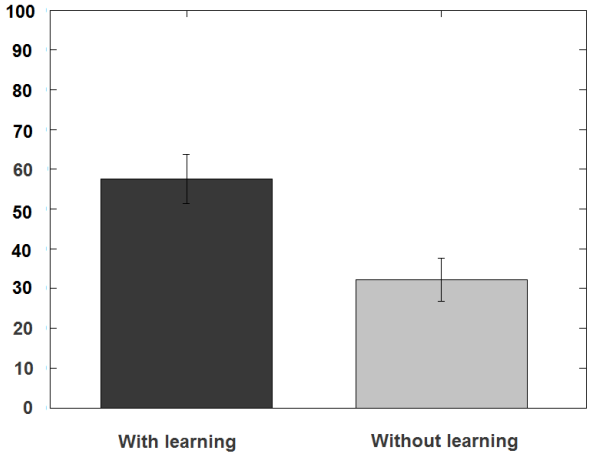


Figure 3. Average score of the participants in the pair comparison task

Both score are above chance (3.45 %), which shows that even non-experts people are familiar with about one third of the sound concepts in the lexicon. The trained subjects have an average score below 60 %, which mean that the efficiency of the training is not so high. We recommend thus to increase the duration of the training and to include some exercises with feedback. Indeed, allowing the participants to manipulate the attributes in a practical way during the training phase should improve the learning process [10]. An in-depth look at the individual results (i.e. the mean score among the participants for each pair of sound) allow us to see which attributes were easily understandable and which were harder to learn (e.g. round, warm, bright…).

4. Conclusions

Further work will concentrate on how the lexicon presented in this paper can be used to study the perceived similarity between groups of sounds. The didactic software is conjectured to be an

efficient way to teach people how to describe audio sensations; therefore it could be included in methodologies such as sensory analysis or semantic differential technique, in order to provide the participants with basic and easy understandable concepts concerning sound features.

Acknowledgement

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