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► **To cite this version:**

Nicolas Rémy. Sound Design of a technical object - proposal for a technical and sensitive approach. Conference "Stockholm, Hey Listen!", The Royal Swedish Academy of Music, Stockholm, June 9-13 1998, 1998, Stockholm, Sweden. 76-83 p. halshs-00087777

HAL Id: halshs-00087777

<https://shs.hal.science/halshs-00087777v1>

Submitted on 26 Jul 2006

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INTRODUCTION

This paper describes a collaboration, in 1995, between the CRESSON and the CERG (Research and Survey Center : ACB - GEC - ALSTHOM), in Grenoble (France).

This work could not exist without Jean-Paul Thibaud (CRESSON) and Vincent Lagarrigue (CERG) cooperation.

The CERG, expert in industrial acoustic, vibration, mechanic and outflow, has understood that the "decibels run" is reaching its limits, and that manufacturers won't spend more time and more funds to reduce noise of sonic objects. Even though work has been done, electric engines or computer fans, for example, will still be noisy for some time.

Therefore, another approach can be considered, which may interest manufacturers, which aims to modify, to change, in a word, the sound design of technical object.

My work was to conduct two sonic approaches at the same time : one, acoustic, based on measurements, and the other one, ecological, based on perception of sound *in situ*.

This work was essentially theoretical, we didn't have enough time to practice the results of the survey.

I attempted to go beyond classical studies which correlate subjective evaluation with acoustic parameters. Consequently, my purpose was to begin a sound design project, that is to say, bring to light the role of sound in the construction of our relationship with technical objects : what is the meaning of the sound of an object ? Is the sound well correlated to the use of this object ? How does the sound create, in the user's perception, a good or a bad evaluation ?...

Since 1982, the CRESSON has studied the role of sound in ordinary life, and conducts a great deal of research on the relationship between man and his sonic environment. As a multi-disciplinary laboratory, the CRESSON tries to incorporate architectural, acoustical and sociological results to understand users' sensitive behaviours, in order to include them in architectural conception.

So, my work was to read again Cresson researchers' theoretical works and was to see how I could be able to use them to the specific problem of sound design.

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The first part of this communication relates it. In the second part, I will explain a method to begin a sound design task. Finally, I will finish on necessary prospects of that kind of work.

1- THEORETICAL POSITION

Proceeding sound design, it's understanding the relationship between man and his sonic environment, that is to say, following an ecological position. You can have, of course, an artistical approach and perhaps, in some case, it will be better like that. Remembering that my work was to build a methodological framework for a industrial partner I had to choose a theoretical position.

I should have begin this work like a few european researchers in psycho-acoustic [1] : in laboratory, they make people listen different noises or sounds with acoustic parameters that they can follow and modify. Generally, people have to rate on scale their feelings about sounds. A lot of proceedings exist, like the "paired comparison method" or the "prototypical categorisation"... Finally, all kind of studies are very interesting because they begin to give some subjective evaluation corelated with objective parameters [2]. But, I think this kind of studies can't give large proposals for sound design. They are very efficient to reduce annoyance but they can't give the way to think back technical object sound.

So, how make sound design ? How understand ordinary sonic perception ?

I think we have to follow an ecological position, that is to say, describing not only the physical parameters of the sound and its perceptions, but also all the social practices *in situ* [3]. In this way, the context is essential and have to be described ; for example, sociological survey [4] has shown an unexpected role of the vaccuum-cleaner sound which could question a sound design project : it showed that the vacuum-cleaner noise is not so badly perceived because, for some people, it's a way to say to neighbours that your home is clean... that your family is respectable ! This example doesn't mean that we do not have to reduce or change vacuum-cleaner sound, but its shows the interest to describe sharply the relationship beetween man and its environment, in a word, adopt an ecological position.

If we are taking acount the context in every analysis, how generalize contextual perception to give tools for sound designers ? Cresson has been thinking about this questions since 15 years for the sound in building environment. They showed that it is possible to find interdisciplinary notions which describe the sound with its physical caracteristics and its effect in ordinary perception and using [7].

1-1 About the comfort idea

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Is the sound of microwave cooker more disturbing today than household electrical engines like juice extractor were yesterday ? And what about all the electronic rings which appear in our homes, our transports and in our offices ?

It's very difficult to answer this question, because all criteria that we can find today will be out-of-date tomorrow.

As G. Chelkoff says, "we can not think the comfort as a technical comfort, but as an active building processus : we can not only define the comfort as the addition of technical devices, but also, and principally, in all using that everybody have with them" [5].

For example, the new hi-fi stereo give more comfort than the old radio of our grand-parents, not only because all new options (tuner, CD, equalizer...), but also, because all usings you can have (or not) with them.

In fact, considering the comfort idea in this way allows us to think back this notion.

Futhermore, P. Amphoux in his "three comfort theory" explore the ability of the technical device (and I transpose it on technical device sound) to give to the user differents kinds of comfort.

For a good understanding of these notions, let's read what P.K. BAADE tells, with a certain sens of humour, in his letter to the Journal of Acoustical Society of America Editor, in 1971 [8] :

"the dishwasher, for instance, has the highest noise level : but my wife loves it. Why ? Because she hates to do the dishes. Besides, she does not need to run it while she is the kitchen and can turn it off before answering the telephone so that there is no interference . (...) somewhere in beetween is the room air conditioner, wich is certainly not audible, but my wife does not consider this as a real problem because the change in noise during the control cycle is slight, and she runs it only when she'd rather have it cool than quiet. Not only does she have this very important choice of either running it at lower speed and, hence, lower noise level, when she does not need the full capacity. It is quite obvious that the degree of control she has over an appliance is very important factor in how much noise she will accept. That's why central air-conditioning systems have to be quieter than room air conditioners"

We can read in this letter that the comfort is not only the technological object (dishwater, room air conditionner...), it's also to see, as P. Amphoux says, if the object gives :

- a "commodity comfort" : the ability of a technical object to offer an certain comfort level :

"dishwaters...has the highest noise level...my wife loves it...she hates to do dishes".

So, **for sound design**, I use this theory and ask this question : is the sound well correlated to the comfort given by the object ? If my microwave cooker could cook fast, which sound could be accepted ?

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- a "control comfort" : if I need, I can use my object in different ways :

" Not only does she have this very important choice of either running it at lower speed and, hence, lower noise level, when she does not need the full capacity"

For **sound design**, I ask if sound could be set up to have less or different sound, depending on the activity ?

" she does not need to run it [dishwater] while she is the kitchen and car turn it off before answering the telephone so that there is no interference

- a "reserve comfort" : the possibility - real or imaginary - to escape of the comfort level given by the object. For example : even if I never change the sound level of my vacuum-cleaner, I know that I can do it whenever I want. This third comfort is more difficult to understand. Let's take an another example : P. amphoux remembers us the number of compact discs we have in our house. How many CD do we usually listen to ? All ? Certainly not, we usually listen only 20 or 30% of them and we use to by new one. Is it incoherent ?

It's just the expression of the "reserve comfort" of all consumers : even if I never listen again my favorite CD, I know that I can do it, one day. It's the same think with all options in a hi-fi stereo. I buy them, but will I use them ? In fact, I do not care, I buy this comfort to be able, if one day I want to use this specific option, to do it.

For **sound design**, I think we can use this notion and questioning if sound could "carry" an expression of "reserve comfort".

1-2 Annoyance

This theme, which has been longly developed in lot of resarches, could be approached in a different way, in a more positive way : Jean-François Augoyard uses the ethological theories to think back the sonic disturbance theme [9]. He introduces the notion of territorial behaviours, and focuses on the struggle between sonic activities.

In a word, it's the fact to describe all activity in the **same sonic space** : people who make noise have their own reasons ; who is this "noise maker" [10] , who is disturbing and why ? That is to say, it is not sufficient to say that sound of this object is too loud, that it is disturbing : we must say who is it disturbing for ? and in which situations ?

I applied it for **sound design** in the same way : I try to understand how all sounding activities could be present in the same time with the minimum of interference : for exemple, cleaning a house while children are watching TV or having a phone call. So, if the noise of the vacuum-cleaner prevents us from hearing the phone ring, it will be interesting to move the emission spectra of the vacuum-cleaner to a range of frequencies that allows the trebble frequencies of the phone to have a better emergence.

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Wathever, note that theme could be linked with the "control comfort".

Describe these situations is describing a complexity which could be very interesting for sound design.

1-3 technical imaginary

Why do car constructors works the opening and closing clap of car's door ? Why did food industry think the sound of cereals that children will scrunch ? Why did cosmetic manufacturers change the opening and closing powder-box's clap ?

Because sound is meaning. The sound carries informations which establish our relationships with the objects. For example, the opening clap of car door is the firts sensitive information that we have when we go to buy a car. So, the sound is very important and have to wear the car's impression, the car's picture.

P. Sansot with Y. Chalas, H. Torgue (cresson's researchers) have studied this relationship and shown that symbolism grounds our ordinary relationship with technical object [11].

So, in most cases, the object is an unknown technical object. For example, we dont know how a microwave cooker really works. In fact, we do not care. This studies shows that it is sufficient for the users to have an indefinite idea of its working. Users prefer imagine their own working process and build a relationship more individual, less rational.

How to explain that we talk to our computer like to a friend or like to an enemi ? And why are we waiting one hour, one day to see if it will work again ? Is that not imaginary using ?

As the authors says, "ordinary user turns aside from technical object quality to better muse on it".

Therefore, understanding the role of sound in these relationship (wich is not only rational but also imaginary) gives proposals for **sonic design** : what does the sound means ? Does it express power, delicacy, modernity, high technology, old mechanical structure... ? And in wich way, the sound of this object give to the users a more individual picture ?

For all that, we have to be very carefully in sociological survey construction : as, the authors say it's very difficult to collect what people really want. For example, a lot of people like to have household technical object, like vacuum-cleaner, playing music when they run. It is not the expression of a real desire : it is a stereotype.

As the author does, we have to build the sociological suvey in a way which allows us to collect real expression about sound design.

I have not the time here to describe this necessary methodological framework, we must just remember that sociological survey is a necessary and hard step in a sound design work.

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Questionning the sound in these ways ("three comfort theory", "sonic territorial behavior", "imaginary technic") allows us to describe the relationship between man, sound and objects. and build a sensitive and technical approach for sound design.

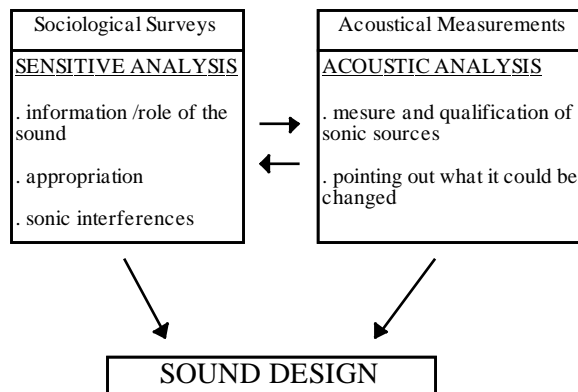
2 - SOUND DESIGN : ONE PROPOSAL

This proposal is the consequence of this bibliographical work. Its main principle is to confront sensitive and technical analysis. It is a synthesis of all we saw in the first part. I organised it in a diagram (see below) that could be operational. This diagram could be read like a work guide.

Before exposing this proposition, I would like to engage your attention on this remark : most of technical objets do not have to make noise for main function : vacuum-cleaner, microwave do not have to prioritarly produce sound, it's obvious. I just want to say that sound design could not be thought without the global consideration of the object.

You do not have to think sound design with the purpose to rectify all failings of the object.

For all that, sound design should follow the steps described below.



2-1- Sensitive analysis

. *Information and role of the sound*

We have to describe all the sounds that are present in the object when it is used : what are they ? Can we qualify them ? Can we recognize them ? Can the user easily correlate them to a physical phenomena ?

Wich information do they carry : beginning and the end of the using ? good or bad working ? Is there a different sound when you use it differently ?

Wich information the sound carry for people who do not use it ?

. *Appropriation*

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In this module we have to ask if sound could allow good or bad appropriation. There could be several level of appropriation described by the "three comfort theory" and "technical imaginary"

a- first level : "commodity comfort"

Is sound an element of comfort ? Is sound well correlated with comfort given by the object : is sound too loud, too hiss... ? it's noisy but I don't care or it is particularly noisy for the function this object....?

b- second level : "control comfort"

Is it possible to set a comfort level ? Do I have options ? Can I run it at lower speed and, hence, have different sonorities ? If not, how could it be proposed ? In wich situations ?

c- third level : "reserve comfort" and symbolic appropriation

Does the object sound give a reserve comfort ? Can I escape, through the sound, from the technical aspects of this objet ? Does the sound help me (or not) to build my own relationship with it ?

. Sonic interferences

Describe all the situations where the sonic activity could interfere with an another one. This is asking the sound of the object if it could give comfort or discomfort to the non-users.

2- 2 Acoustic Measurements

I would not describe what the CERG is able to do in acoustic measurements for a long time. Understanding physics phenomena correlated to sounds is the main topic of this module. You have to describe every sound and see what could be changed.

I prefer to insist on the necessary confrontation between sensitive and acoustic analysis : it's sure that perception could not find any easy equivalence with physical parameters, but the confrontation should make appear ways to elaborate sound design. A sound badly perceived is not necessary the most noisy in the object. In the same way, only few characteristics of a sound should be uncomfortable. We see that works made in psycho-acoustic [1] could be integrated here in my proposal.

I do not have enough time to study it, but the sonic effect, as it has been developed by the Cresson [7], should help designers at this step : imagining an effect is formulating physical characteristics of a sound plus its perception.

3 - CONCLUSION

I hope this papers shows to sound designers new tracks to explore. I do not think that my proposal deny all that has already been done.
Remy Nicolas - Sound Design of a technical object - Cresson - Grenoble School of Architecture
- June 1998.

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Most of my propositions should have already been discovered by designers who practically work on this subject.

Nevertheless, my work gives a methodological framework to think sound design in a larger way to take account of sound and its perceptions *in situ*.

I hope this papers demonstrates the strenght of a pluridisciplinary work : sound is too complex to be studied only by acousticians or sociologists... Even it's more difficult, confronting knowledges of each discipline can resolve complex problems related to sound and perception. The scientific community has to find ways to share their knowledges.

I hope this papers showed that research can give solutions to industrial requests. This type of collaboration should be developped in the future.

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[3] People who like to know more about the "ecology of perception" should read THIBAUD J.P. and AUGOYARD J.F. papers.

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