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Coming in and coming out underground spaces

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Abstract *: This paper deals with sonic perception in entries and exits of underground spaces. My purpose is to describe sonic qualities or sonic failures in these spatial transitions which are very important in the global appreciation of subterranean spaces. This paper shows how a specific methodology can be used to develop a catalogue which connects spatial forms, sonic sources and social practices. Firstly observations of the same place but with different sonic sources and different practices will take place. Secondly, observations of the same practices and the same sonic sources will be executed but in different places chosen to value the effects of built up spaces, materials used, architectural devices used to come in or out. For all of these configurations, sociological, acoustical and architectural surveys will lead to the understanding what users feel in these transitions. Sonic quality is approached through the development of new protocols of measurement between acoustical criteria and subjective evaluation of listening. This research will focus on entries and exits in the Parisian subway (Paris - Gare du Nord ; Paris – Gare Montparnasse ; Eole). Data collected are recaptured around interdisciplinary tools such as the concept of the Sound Effect [Augoyard, 95] in order to exactly describe sensitive transitions (sonic qualities) between two ambiences, an outside one and an underground one. Architects could use this methodology to improve the predictability of the sonic quality in their underground spaces projects.*

Keywords *: acoustics – underground spaces – sonic quality – social practices – predictability -*

Gare Montparnasse – Underground level / entry-exit of subway

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Introduction

To connect the city with the subway, to create commercial areas and sometimes to protect people from the climate, underground spaces constitute nowadays an architectural stake for most of the big cities around the world. The communications of the last conference on underground spaces in Montreal [1] showed the efforts made by architects, town-planners and engineers to improve comfort in that kind of spaces. One of the issues was to show that the main problem is the legibility of space. People are often lost in the underground spaces. My purpose is to improve sonic quality of underground spaces., which could lead the improvement of the comfort in general in these spaces.

During the architectural planning process, the architect is mainly orientated on the visual aspects. He lacks the sonic quality tools in the architectural planning process. My purpose situates beyond regulations and laws, and we plan to act in the ordinary sonic world, when it has not yet become synonymous with noise and annoyance. How could we listen to an architectural project, how could we imagine a sonic space when it is not yet built ? How could we anticipate the sonic performance of a form ? This project aims to give tools to architects in order to improve the sonic quality in public underground spaces.
Since there are already existing underground spaces, the main hypothesis of this work is to analyse the sonic quality of these spaces with the aim to create a reference tool for the architects. On this way, sonic quality can become an important tool in the architectural planning process.

This paper describes the theoretical background and the methodology used in my PhD research project. Case-studies are still being executed therefore, only one practical example will be shortly presented (Railway Station in Paris – Montparnasse). Perspectives will show how these case-studies will constitute a reference tool for architects.

Which definition is valid for the *sonic quality* of a space ?

Since the beginning of this century, acoustic researches of concert halls [2] have tried to correlate subjective perception with room acoustic criteria. These criteria can also be measured and sometimes predicted by software tools directly from architectural drawings. This project is to work on the ordinary acoustics of public underground spaces and it's commonly known that listening to music is quite different from walking in underground galleries. This research will carefully use results from this research field.
In the same way, in the field of environmental acoustics, it has been very interesting to see that lawyers in France and in Europe as well try to develop regulations which go beyond quantitative measurements (Leq day and night). These intentions aim to preserve sonic quality in rural and urban places. But during thirty years, this kind of studies have always confronted with the same type of problems : is it possible to define a certain sound level by which people will be annoyed or not ? Today we can see that every model which tries to correlate sound levels and subjective impressions fails in certain point of view [3] : if most of them are efficient in predicting sound levels, no existing models can predict residential reactions, because they can not integrate sociological data which are very important in our ordinary perception. In other words, understanding sound propagation in open spaces or inside buildings is a difficult problem but physicians have the right methodology to find solutions. But how is it possible to predict how people will react ? These kind of models are not be able to describe sonic quality because perception is depending on the temporal and cultural context.

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Since 1979 models and methodologies concerning environmental acoustics have been studied at Cresson in different ways : every sonic phenomena embodies itself in a space and in the relationship between people [4]. Cultural and sociological criteria have a great influence on our perception. It is why it's difficult to define which type of sound could be annoying or not. It's always depending on the context, your culture and what you're doing at the moment. Cresson is working with all these parameters and this is the only way to understand our ordinary perception of sounds in the city on the whole.

In other words, we cannot reduce all the complexity and the richness of the sonic world in a simple problematic which compare noise with silence. In this way, the theoretical position implies studying acoustical criteria of sounds, but also how the sounds are perceived and how sounds interact with our behaviours. *Sonic quality* is about the interactions between sensitive phenomena (perceived sounds) and people's activities within the space. *Sonic quality* indicates certain qualities of relationships between the sounds, space and social practices. *Sonic quality* is not a fixed criterion of the environment. It embodies itself differently with people and time. Consenquently, *sonic quality* of a space involves a cross analysis between space, acoustics and people's behaviours.

Besides the problem to define what *sonic quality* is about, another difficulty is to describe what you can predict or not. In which way builders can predict the sounds of the space and especially how people will perceive the sounds ? On accordance with our definition, we can say that the prediction of the *sonic quality* of a space means : (1) to predict sonic phenomena in a space ; (2) predict how this sound will be perceived, and (3) predict in which social context it will take place. Different kinds of prediction are involved in this project (acoustics, spatial and sociological) and this question will constitute a theoretical goal in this project. Thus, one of the outcomes of this project will be a synthesis of predictive tools applied to urban space.

Case-studies : underground spatial transitions in Paris

The description above shows the interest to study at the same time acoustics, spatial and sociological parameters. People involved in sonic perception studies know perfectly that it is very difficult to pick up information on sonic quality of an ordinary space from users' speech. People don't easily describe what is natural to hear. Consequently, this research follows methodology developed by Gregoire Chelkoff et J.P. Thibaud [5]. This research will focus on underground spatial transitions. It has been shown that it is easier for people to describe what they feel in a space by the way two spaces differ - the time before and the time after. Studying spatial transitions between two spaces is also a way for architects to make architectural planning process more dynamic. This research will show how it is possible to systematise the methodology developed by Gregoire Chelkoff and how it is possible to abstract results in a methodological guide for architects and town planners.

The project works on the underground infrastructure of the National Society of Railways in France (SNCF). The project will study different sorts of railway and subway stations : a traditional station of the beginning of the century *Paris – Gare du Nord* ; an old renovated station *with Paris – Gare Montparnasse* ; and a modern one *RER – Eole* [6]. For all these stations, the project will study the transitions within the underground spaces. Certain places have been selected with the aim to study different configurations where spatial parameters, social practices and sound sources are very different.

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For example, firstly, observations will be undertaken at the same place but with different sonic sources and different social practices. Secondly, observations will be undertaken with the same practices and same sonic sources but at different places chosen to value the effects of built space (materials used, architectural devices such as doors, stairs, etc.). For all these configurations, sociological, acoustical and architectural surveys might led to the understanding of what users perceive in these transitions. Sonic quality will be approached through the cross analysis between acoustical measurements, social practices observations and subjective evaluation of listening.
How can we describe the sonic qualities of space ? We need concepts which can describe not only sonic characteristics but also describe the way how people perceive sounds and the way users interact with the sonic environment in their social practices. All the vocabulary developed within the acoustics field of concert halls will be useful. In this study, the use the concept of the Sound Effect [7] will be examined. This interdisciplinary tool has been created as help for architects, acousticians and sociologists.

When writing this paper, it's too early to present results from surveys at *Paris – Gare Montparnasse*. However, with this first example, I can describe what could be expected at the end of this research.

One example : *Paris – Gare Montparnasse*

Entrée Gare Montparnasse – Place Raoul Dautry

First, from an architectural point of view, *Paris - Gare Montaprnasse* is a very interesting space. Modern architecture has been employed to connect different levels of circulation : at level -1, the underground one, pedestrians come out from the subway. They can climb to level 0 and go out from the building to take a bus in the street for example.

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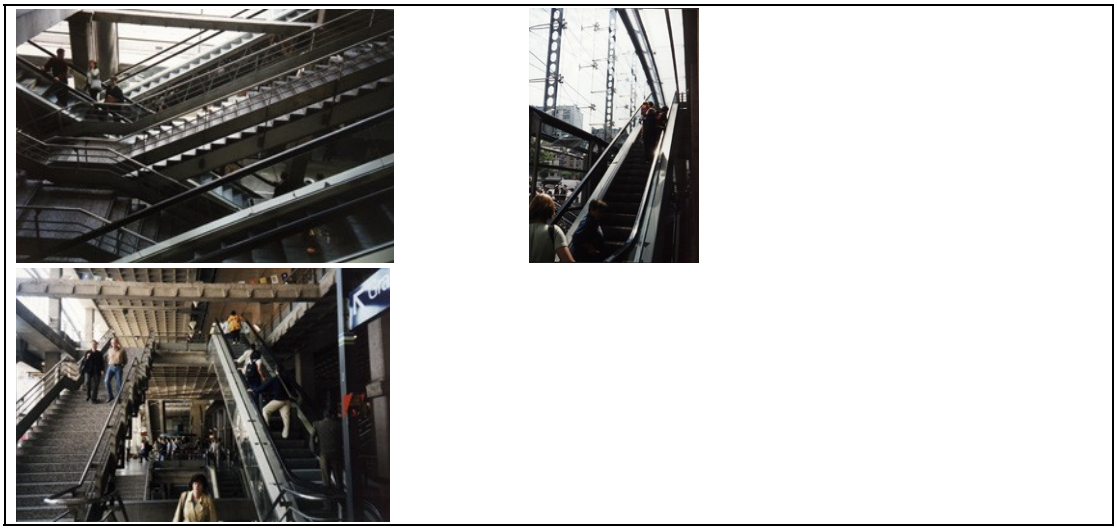
undergound level – Paris Gare Montparnasse

They can also continue to climb to level +2 to take a train to any big cities in France or in Europe. They can also go to level +1 and take a train for the suburbs – they have to climb again one level to use the platform. All these levels in concrete are connected with each other by stairs (ordinary and escalators ones).



ordinary and escalators between levels

From an acoustical point of view, the transition between the platforms and the entry of the subway is also very interesting. It is a complex space where each level is relatively open from an acoustical point of view even if, from a visual point of view, the spaces seems to be closed. Sounds from different levels are mixed and you can easily hear motorcycles from outside at every levels. Announcements can be

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heard everywhere in the station. Ambient music during all the day is also played. Some measurements made one morning during the week seems to show that sonic environment is quite uniformed.

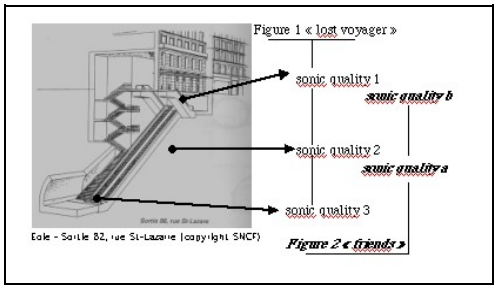
MEASUREMENTS AT GARE PARIS - MONTPARNASSE 23 June 1999 - between 10h et 11h in the morning		
	Leq (15 mn) dBA	Lmax (dBA)
. Level 0 (Level A - Place Raoul Dutry - outside)	75,0	90,0
. Level -1 (Level Y - underground)	69,8	77,0
. Level +1 (level B - suburbs -Porte Océane - inside)	69,4	76,0
. Level +2 (Level C - hall Vasarely)	71,7	81,0

Measurements at different levels at Montparnasse station

From a sociological point of view, past studies have shown that people on average stay one hour before taking their train. Of course, business men take their train five minutes before the departure. Whatever the way you use the station, surveys have shown that it's possible to describes social practices in different **figures** [7]. This *figures* are a way to create categories to describe social practices. For example, you surely can find the figure of the "*lost voyager*", or the one of "*the group of friends*"… All these figures, described by sociological surveys, can be a way to summarise most of the (sonic) behaviours that people can have in these spaces. I will choose them with the aim to describe : (1) the *"listening attitude"* [8], that means the way we are listening to the sonic environment (careful listening, inattentively listening, expert listening…) ; (2) the *"sonic action"*, that means the way we act within the sonic environment (being silent, speaking slowly, shouting, producing sounds with suitcases, etc.).

Perspectives

This work will show how it might be possible to use the above mentioned methodology to develop a catalogue which connects spatial forms, sonic sources and social practices. The results will be summarised in a reference guide which describe scenarios of transitions in underground spaces. For example, an architect decides to create an entry in an underground station using a tube form gallery with mechanical stairs. If a group (figure 2 *"friends"*) use this type of entry at the same time, this catalogue will indicate what kind of sonic qualities the architect could expect. It will show, for the same space, what the figure 1 (*"the lost voyager*") for example, will perceive during the same transition.



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prospective : create a reference guide

Architects could use the catalogue to improve the predictability of the sonic quality in their underground spaces projects. Furthermore, we think this kind of tool could be useful for architects and town planners to increase legibility of space and create comfortable ambiences in all spaces correlated to means of transport. This work will also contribute to improve our knowledge of the mastery of the sonic ambiences in urban space in general.

Thanks

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M. Brun, SNCF, *Paris-Rive Gauche* direction, *Directeur d'établissement adjoint*, Paris – Montparnasse.

Notes

[1] : cf. the proceedings of *the 7th international conference of the Association of research Centres for the Urban Underground Space (ACUUS)* , Montréal, Sept 1997 – http://www.acuus.qc.ca/indexan.htm

[2] : cf. researches made by l'IRCAM (Paris, France).

[3] : cf. FIORI, F. and REMY, N., 1998*, Intégration sonore de grandes infrastructures routières en milieu rural et périurbain*, Cresson, Grenoble.

[4] : cf. AUGOYARD, J.F., 1998, "Eléments pour une théorie des ambiances architecturales et urbaines" in *les cahiers de la recherches architecturale*, n° 42-43, Parenthèse, Marseille.

[5] : CHELKOFF, G. 1997, "Transitions sensibles et intériorité souterraine : disopsitifs et configuration" in *the proceedings of the 7th international conference of the ACUUS*, op.cit.

et cf. CHELKOFF, G. et THIBAUD, J.-P., 1996*, Ambiances sous la ville – une approche écologique des espaces publics souterrains*, Cresson, Grenoble.

[6] LEGRAND, R. 1997, "Eole, une architecture exigente" in *the proceedings of the 7th international conference of the ACUUS*, op.cit.

[7] : cf. AUGOYARD, J.-F. and TORGUE, H., 1995, *Répertoire des effets sonores*, Parenthèses, Marseille.

cf. AUGOYARD, J.-F., The Cricket effect – Which tools for the Research on Sonic Urban Ambiences ? in International conference on Acoustic Ecology *"Hör upp ! Stockholm Hey Listen"*, Henrik Karlsson Editor, Royal Swedish Academy of Music, Stockholm, June 1997.

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[7] : cf. LEE JOHN R.E AND WATSON R., 1993, "Regards et habitudes des passants [Pedestrians' ways of looking and acting]", in *Les Annales de la Recherches Urbaines, Espaces publics en ville [Publics spaces in cities],* n°57-58, METT.

[8] cf. CRESSON (under the direction of B. HELLSTRÖM and N. REMY), 1998, *seminar on sonic environment and musical research*, Cresson, Grenoble, (FR + ANG).

Nicolas Remy is involved in a thesis called *mastery and predictability of the sonic quality in the architectural planning process*. His field of survey is the underground public spaces (subway, underground malls…). He has also worked with an industrial partners on *sonic design* of technical objects (computer fans, engines, ventilation, fridge, microwave oven…). He's working on the *conception of a CD-ROM* which explain the interdisciplinary tool (Sound Effect) useful for the description of the sonic environment. He is also *tutoring and teaching* within the university sphere (illumination engineering and acoustics).