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In the circle of education and innovation

Teaching Sound-Design @ENSCI les Ateliers

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ABSTRACT

The purpose of this paper is to tell the story of teaching Sound-Design at ENSCI les Ateliers and to reflect upon the role Sound-Design practice and teaching has today and the original approach that we developed to teach designers how to work with sound.

In order to put into perspective the actual teaching practice at ENSCI les ateliers, this paper presents the actual context of this new discipline of design, show how it has recently become more important and give a brief overview of different domains of practice concerned by sound design education. Some questions emerge from the discussion. Are sound-designers designers, sound artists, or scientists, and what mix of these profiles should design education support? How can education make sound design become a more effective domain of design, and how can design education influence its growth in industry? Finally what role can education play in the virtuous loop of sound design development?

Novelty fitting into the industrial and social integration is in itself a virtuous circle, but the virtuous circle on which this paper focuses is the role of Sound-Design education in this process.

We do not pretend to give answers nor to study or compare different approaches, but presents an experienced point of view.

KEYWORDS

Teaching sound design. Sound-Design. Teaching. Training. Education. Experimentation. Prototype. Multidisciplinary. Teamwork. Project-based learning. New design paradigm. Multimodality. Accessibility.

Sound-Design and innovation: a virtuous circle

A PEDAGOGY BUILT AT ENSCI ?

In 2000, Thierry Defert (then head of the communications studio at ENSCI) hired me as part of an effort to create a "studio of the five senses"; but his really revolutionary idea was that teaching, like any other crafted object, needed to be designed. This idea appealed to me because it opened up numerous fields of exploration, for design and for teaching. We were the first French Design school to try and teach Sound, back when the discipline was much narrower than it is now. Our ideas were received with surprise: there was no demand for sound design in the industry and no user expectation. The domain has since known a rapid expansion; but even nowadays the few agencies in France specialised in Sound Design are struggling to find enough work.



figure 1
Nicot

At first, I offered projects around various domains in which sound devices are used such as: designing speakers or musical instruments, public audio installations, auditory scenography, interaction with sonorous objects in an artistic approach, or the particular "essai documentaire"¹. Soon, the popularity of my little department grew as students, designers and institutional or industrial partners got involved in Sound-Design. Now, many of our students envisage sound to be part and parcel of their practice as designers; while others chose to specialise as professional sound designers.

My department at ENSCI developed concurrently with a rise in public interest in Sound-Design (but unfortunately not enough industrial investment). Nowadays many designers and business managers believe that Sound-Design is a significant new field for Design, and that the demand for specialised knowledge and experience in Sound-Design will grow in the future. We must make sure to meet this need in Design education.

WHAT IS SOUND-DESIGN ?

Traditionally, Sound-Design is described as sound creation for arts and media as well as all applied sound domains. It includes sound effects for film, mixing,

¹ A documentary essay is a form of audio-visual or audio discursive documentary. An example of this exercise can be found here: <http://www.ensci.com/fr/creation-industrielle/cours/studios-de-creation/art-et-design-sonore/projet/article/4140/>

recording, acoustics, "musak"², etc. This is how it is mainly taught and practiced in most schools and universities. This definition³ is far too wide and approximate, because most of these activities already belong to existing professions such as Foley artists, mixers, sound engineers, field recording artists, composers, etc. It seems that this definition puts all sound creation, which is neither music nor pure sound art, in the same box.

My definition of sound design is more restrictive, simpler and more constructive. It is focused on *design* and not to any non-music sound creation: **Sound-Design consists in conceiving and creating functional sounds or functional sound systems.** By functional sounds, I mean mostly informative sounds for objects, services, spaces and interfaces. By functional sound systems, I mean sound devices or systems using sounds where a specific sound conception is needed - that is to say systems where Sound-Design determines the composition and ultimately the user experience. Like Design in general and unlike the Arts, Sound-Design does not give absolute creative freedom within a set context. The freedom it affords is constrained by functionality; but also offers a wide range of contexts and applications.

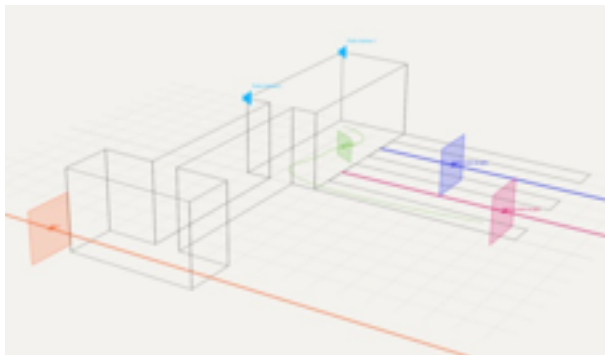


figure 2
sound in
motion

Science and design

The more complexity and technology became part of the design process, the more the sciences play an increasing role in Design which is also true for Sound-Design. For example in the domain of sound interfaces or more precisely auditory displays, since 1992 the ICAD⁴, a large community of scientist working in this domain, has organised conferences and produced numerous publications, related to Sound-Design issues. In order to be expressive, auditory interfaces must be precise, reactive, sensitive and compliant. But scientific expertise such as that held by sound engineers is not

² Synonym of elevator music. Musak Holdings was historically a brand of background music which name became a common name for functional music.

³ For an example of this type of understanding, see the definition offered by Wikipedia: "**Sound design** is the process of specifying, acquiring, manipulating or generating audio elements. It is employed in a variety of disciplines including filmmaking, television production, theatre, sound recording and reproduction, live performance, sound art, post-production, and video game software development." (http://en.wikipedia.org/wiki/Sound_design)

⁴ International Community for Auditory Display : <http://www.icad.org/>

sufficient for the industrial needs of Sound-Design. While Science and Technology can drive innovation in this field, so can a more qualitative and subjective approach of Design and Design teaching. The main benefit designers can bring to user interface science and technologies are formal relevance, usability and expressivity. Expressive interfaces are not only relevant, but also significant, sensitive, and stylish. Sound-Design can therefore give a critical added value to Human User Interfaces (HUI). Regular collaboration between scientists and designers is therefore essential. One of the most important aspects of the collaboration between sound-designers and scientists is psychoacoustics, for example to create iterative loops between conception, realisation, auditory user tests and analysis (Susini, 2011).⁵ While I acknowledge it is crucial for designers to become more technologically literate, and to move away from the drawing board and the conceptual work to take on the realisation; an Education in Design must go beyond teaching technique. At ENSCI, we work regularly in relation with the Perception and Sound Design⁶ and the Sound Music Movement Interaction teams⁷ of IRCAM and taught our students to do user tests in order to validate the functional efficiency of the sound they create; but we also teach them to bring their own artistic and creative added value to technological innovation or new uses for existing technologies. We are also working regularly with the LIMSI - CNRS⁸ on the visualisation, sonification and scientific popularization aspects.



figure
3

Integration and Social acceptance of new sounds

In the electroacoustic and digital world, sounds are no longer the random consequences of mechanical choices engineered by the visual design; but an integral part of their identity. Therefore, these new sounds have appeared in our auditory vocabulary and have been

⁵ *Définition et processus du design sonore*
<http://pds.ircam.fr/906.html>

⁶ Patrick Susini, Nicolas Misdariis & Olivier Houix: <http://www.ircam.fr/pds.html?L=1>

⁷ Norbert Schnell, Diemo Schwarz:
<http://www.ircam.fr/ismm.html?&L=1>

⁸ Christian Jacquemin LIMSI-CNRS <https://www.limsi.fr/index.en.html>
Julien Bobroff http://hebergement.u-psud.fr/bobroff/index_en.html
<http://hebergement.u-psud.fr/supraconductivite/productions.html>

integrated as parts of our sound culture. In order to be understood, sounds must be recognised or associated. Thus, we should learn to hear them in specific contexts in order to remember their meaning. For example, the sounds made by blinkers or indicators⁹ are easily recognisable nowadays by drivers and passengers, which took a number of years. In Sound-Design, there is a tension between the need for familiarity and novelty. Novel designs create new paradigms and new signs, which will only become usable when they become familiar. One of the important skills of sound designers is to play with already known auditory references in order to accelerate this integration process. For example, the iPhone locking and unlocking sounds resemble a padlock.

New sound causalities for new objects

New opportunities have emerged for sound-designers to create sounds for new devices, which do not produce any physical or auditory consequences to our actions and interactions. Sound allows us to rematerialize digital interfaces by sonifying artificial actions. This can be done with two types of sounds: (1) sounds that do not exist but have been purposefully created to be as significant or more significant than a natural sound effects and (2) by redesigning the mechanical sounds produced by those devices. It works because listening is a type of perception, which draws causal links to learn about our environment. In other words, when you hear a sound, you unconsciously try to understand where and how as well as by what or whom it has been produced, even before your mind can understand its content.

SOUND DESIGN: A NEW PARADIGM IN DESIGN EDUCATION

As a creative discipline, Design must be in constant reinvention; which is why designers are always on the lookout for new techniques, domains and applications, as well as new ways to add value to products. Sound-Design is a new way to fulfil this ambition; but the skill-set it requires is different to that of traditional designer. Sound shapes exist in time rather than in space but their structures can be out of time and can apply to music as well as architecture or design (Xenakis, 1976). Sounds are events and not static things. "Design" refers

⁹ *Cliquotant*: "tic tac" sounds playing at a standard pace still resemble to historical mechanism even if they are now electronic.



figur

etymologically to drawing; whereas sounds cannot be drawn. Lots of new objects, services and interfaces require sound and neither traditional designers nor musicians are able to fulfil the need. Unlike designers who are sound-illiterate, or composers who may not be able to master the functional aspect of the work, the sound designers we form at ENSCI have been specifically trained to meet this demand. At the same time, we are opening up a new frontier for education and research in Design.

Sound-Design teaching elsewhere

In other schools Sound-Design is rarely taught to designers; but to musicians, sound engineers and acousticians. Its main disciplines are: acoustics, audio engineering¹⁰, sound design for theatre and film, electroacoustic and electronic music composition, sound creation for fine arts and instrument making. These disciplines are scientific, artistic or practical. The *design* aspect of these activities is generally related to dedicated and already identified needs and does not require a creative design approach. For example, students are asked to design room acoustics, to conceive new technical sound equipment, to compose a piece for a quartet concert, or even to build an electric viola. Even in these of an assignment, and a place is rarely given to an inventive approach to functionality. As for the predominantly technical sound education activities (such as live sound management, recording and sound installation), design is merely absent.

Teaching sound in a Design school: an odd choice?

Sound in a Design school may seem out of place and it is certainly impossible to cover such a vast domain within the few hours dedicated to it. How would you feel about someone who taught "visual" in a music school? While I accept that we are giving visual designers an introductory rather than an exhaustive understanding of sound, I would argue that there is place for a specialised education in Sound-Design and that designers in general can benefit from a better understanding of Sound (Collins & Kapralos, 2014). Having taught Electroacoustic music composition for nearly 20 years at the Conservatoire, I have actually found teaching at ENSCI to be much more creative because my students provide a completely

¹⁰ One of the largest reference for sound education programmes, the Audio Engineering Society education directory: <http://www.aes.org/education/directory/programs.cfm>

naïve rediscovery of Sound alongside the creativity and object-orientated awareness that is particular to designers.

In this paper, I will go through some of the fields for which there is a real need for specialist sound-designers or designers with a greater understanding of sound.¹¹ To do this, I will start by giving some examples of areas where sound can be a crucial way for objects to fulfil their industrial functions and therefore cannot be excluded from the Design process. I will then explain some motifs in Sound-Design and demonstrate how their execution requires specialist knowledge. From this discussion I will turn to the role of Education and teaching as a drive for innovation in industry and Design: the beginning of this virtuous circle.



figure 5
Une

OBJECTS WHICH CAN BE ENHANCED BY SOUND: THE CASE FOR TEACHING SOUND AND DESIGN

Object interactivity using sound.

In the last 20 years, the digitalisation of most services or objects and the growing complexity of the digital world have opened up new fields for Sound-Design. Additionally, the idea that objects do not need to be static, but can interact with their users has become very popular. Sonic interaction (the use of sound as a medium for object interaction) is one of the most important aspects of both of these trends. What for years has been a little backyard experiment carried out by a select few is now becoming the subject of wider public and industrial interest, as well as research. Sound-designers have recently been developing better tools for sonic interaction (Farnell, 2011) and sound is taking centre stage as a frontier for the exploration of object interactivity (Susini, 2011; Franinović & Serafin, 2013). Elsewhere, Daniel Hug and Moritz Kemper have celebrated the opportunity presented by Sound-Design for Education in Design because it concerns many objects and offers Design educators a large and exciting new playground (Hug & Kemper, 2014).

Relieving visual attention

Functional sounds do not require visual attention. For

¹¹ As I will not be able to cover all the aspects of Sound-Design, more information about our projects is included in the appendix.

example, while driving, you can be attentive to sounds while keeping your visual attention focussed on the road. Sound can communicate additional information when other action/perception modalities are already busy, sometimes this can be done symbiotically.¹² Sound-Design allows us to reimagine vehicle interfaces and enhance these by researching crossmodal¹³ issues such as audio-graphic levels of detail (Ding, 2013) or the added value of sound to moving image (Chion, 2005).

Sounds as alerting devices

Sounds are timed events, they happen in time and usually indicate mechanical or electrical events. Sound events can either be the occurrence of a new sound, a reoccurrence of an already heard sound, or some changes in an existing sound flow. Sounds are not as good as text or image for giving precise descriptive or spatial information, but they draw attention to an event allowing the user to react to a faster than he may to another stimulus. This makes sound the ideal medium for communicating real time alerts of new data or changes in an existing flow of data.

Accessibility and diversification of use

As for any objects, new objects should be usable by anyone including persons with disabilities, who represent an sizeable part of the population.¹⁴ Historically, designers have been short-sighted with regards to providing for users with disabilities, considering accessibility as a constraints rather than a design challenge. Visually impaired people are more sensitive to sounds and able to perceive subtler distinctions in sounds than sighted people. Conversely, the elderly or those with hearing difficulties may require amplification and disambiguation. Children or those suffering from

¹² It is often important to transmit the same information through several modalities (touch and/or voice, light and sound, etc) at the same time, in order to adapt a device to various circumstances of use.

¹³ "Crossmodal perception or cross-modal perception is perception that involves interactions between two or more different sensory modalities. Examples include synesthesia, sensory substitution, and the McGurk effect, in which vision and hearing interact in speech perception." (Wikipedia)

¹⁴ 15% of the world population has some disability (WHO 2014 Fact Sheet N°352). Visual impairment worldwide represents 3.9% of the total 2014 population (WHO 2014 Fact Sheet N°282)

cognitive impairment may need a simplified sound scope. Multisensory design is a specific domain of Design where sound is essential. Sound-Design also offers new solutions to adapt the use of the object to fit various situations of use, by means of informational redundancy, such as mobility.

Sounds in a multilingual global culture

Non-speech sounds can also provide good solutions to communicate elementary information to multilingual audiences. For example, a guard in a museum might do better to ring a bell which is a more efficient and less hostile way to conduct visitors to the exit than announcing closing time in many languages. Finding innovative ways of communicating extra-linguistic meaning is another area Sound-Design can contribute to.

Importance of user perception of sounds

Some formal characteristics of sound can be universally significant; but auditory perception is mostly cultural and personal (Schaeffer, 1966; Bregman, 1990). This difficulty is an important issue for students who often presume their sounds clearly convey their ideas to the audience. In order to create human experiences of sounds, designers should consider the sound phenomenon globally: physical, physiological, psychological and cognitive (McAdams 1993).

To put it simply, if there is a need in our society and our industry for a more complex and adaptable approach to multisensory Design, sound has its place in a Design school. I will now look at the type of industrial applications which require specialist knowledge in Sound-Design.

EDUCATING DESIGNERS WITH SPECIALIST KNOWLEDGE AND SKILLS

The Proliferation of Sound as a Signifier

Within the last 50 years, electroacoustic sounds and music have spread among many everyday situations. In the 80's most people in western countries owned one or two speakers. Nowadays you would probably not have enough fingers to count the speakers you own personally. They flourish on telephones, computers, electronic and electrical appliances, connected objects, vehicles, furniture, doors, etc. These speakers communicate alerts, status, information, identity and

style. Simultaneously, new sound functions have appeared in our auditory scope, such as attention stimulation, touch feedbacks, feedback on typing, validations and errors. New tones have also become common, sounding like strange bells, various beeps and electronic sounds, as well as "earcones" (i.e. abstract musical sounds) and "auditory icons" (i.e. sound caricatures of the intended action the user is suppose to take) (Beale, 1998; Tajadura-Jimenez & Västjäll, 2008), as well as more sophisticated compositions (Hermann, Hunt, Neuhoff 2011). Specific functionalities require original designs. For example, warnings addressed to pedestrians need to be different from those aimed at drivers, one reason being that unsuitable sounds could provoke dangerous reactions when driving. The sound designer has been trained to keep functionality in mind when creating such sounds, an awareness that the composer may lack or resent.

Sound and interactivity

Within the digital audio domain, data sonification gives sound or sonic expression to non-sonic actions and events (Hermann, Hunt & Neuhoff, 2011). For example, electric devices could produce sound according to their consumption, helping the user to be more energy thrifty. Crucially, this domain is only accessible to specialised designers because it requires a good knowledge of real-time programming, data management and signal processing. Consequently an education in Sound-Design must be flexible in providing introductory or advanced teaching and varying specialisms.

Multimodality¹⁵ and interaction

Furthermore, for these new digital interfaces to be properly interactive, designers need to think in a multimodal way by integrating sound with visual or tactile/kinesthetic modalities (Bellik, 1995). Doing this requires the ability to draw together complex chains of actions and perceptions, including sound listening and (sound) production. New object interactions also need to articulate sounds, visualisation, gestures and other modalities generally creating dedicated architectures of sensors, software and actuators. Evidently, this ability is

¹⁵ Multimodality refers to the way our actions imply several modalities at the same time or consecutively. A modality is either perceptive or active. For example taking a glass on the table, implicates a chain of perceptions and actions: looking at the glass while moving a hand towards it, grabbing it and feeling it's haptic feedback, checking it follows the hand, then moving it with the arm, etc.

enriched by designers' great ability in the visual sphere. Our students are encouraged to design concurrently in visual and auditory modalities such as modelling relations between sound events and architecture (Ranc, 2013).

Working in teams of designers and sound designers

In 2008, we participated under the impulse of Didier Larnac, [ESBA TALM](#)¹⁶, in partnership with the [Ircam](#)¹⁷ and the [LAUM](#)¹⁸, to create the first French Master program in Sound-Design. This two years program trains young designers, sound engineers and audio artists to become sound-designers. In addition to a regular sound practice, this qualification gives them a good knowledge in arts and design, as well as acoustic sciences and audio techniques, in order to allow them to cover a wide range of subjects. Professors are artists, designers, engineers and researchers. After only three years it is still too early to evaluate the integration of our graduates in the professional context, but the experience is positive so far and the majority of feedback received indicates that our students give valuable answers to industrial and design issues.

Since 2011, an annual *applicative workshop* is organized with industrial partners¹⁹.

Distinguishing between sound for designers and Sound -Design

As most students of ENSCI les Ateliers have no sound background, Sound-Design educators' aim is not to pretend to transform designers into sound-designers, but to develop their reflexions on sounds and build Sound-Design experiences, which they can refer to when working on design projects. In their professional capacity, designers need to better understand the importance of sound, where sound can help, and how to include the auditory dimension in the conception and the core of their projects. All in all, Sound-Design has grown considerable at ENSCI even though most students only

¹⁶ Ecole Supérieure des Beaux Arts Tours, Angers, Le Mans

¹⁷ Institute for music/acoustic research and coordination of the Centre Georges Pompidou

¹⁸ Laboratoire d'Acoustique de l'Université du Maine

¹⁹ Sport machines (2011), Tramway (2012), Inside car sounds (2013), Positive energy building (2014)

interact with the department superficially.

Industrial development, a multifactorial loop

In order to develop the domain of Sound Design industrially, I believe that we need to think of its development as a multifactorial system: a loop, running from user expectation, going through research, knowledge, technical issues, problem-solving, business management and communication. The question is what role teaching and education play in this process and whether they can drive innovation in industry or whether their role is to use research to feedback into better forming designers for existing needs.

Communicating with designers and industry

To create favourable conditions for the development of Sound-Design, more communication between designers and drivers of industry is required. It is also up to educators to raise awareness of what Sound-Design can offer to design students and industrial partners, as well as innovating within the field to constantly offer new opportunities to both. Convincing industry to invest in Sound-Design is difficult, because industrial interest is culturally limited to the areas in which it perceives an immediate need and ease. This creates a vicious circle in which Sound-Design does not benefit from the necessary industrial foresight or investment; and therefore cannot adequately make its case as to what it can add to the finished product. This is why sound-designers and Sound-Design educators must show the way to turn this vicious circle into a virtuous one. We have to prove that our contribution produces positive effects on product marketing, user experience and expressivity. Our best answer at the moment is to organize industrial partnerships on projects where we intend to prove that Sound-Design is necessary. This is already the case in some domains such as automobile production: we regularly work with PSA (Peugeot Citroen)²⁰ for example.

Evangelizing industry

As for most design schools, at ENSCI les Ateliers,

²⁰ About PSA OpenLab: <http://www.psa-peugeot-citroen.com/fr/medias/communiqués-de-presse/medias/communiqués-de-presse/psa-peugeot-citroen-et-les-grandes-ecoles-francaises-du-design-innovent-pour-la-mobilite-de-demain>
Sound design at PSA: <http://voituredefutur.blogspot.fr/2012/02/psa-mise-sur-le-design-sonore.html>

industrial prototypes are quite rare and student projects do not very often reach industrial production until long after they have left the school. We are very concerned to encourage networking between students and the industrial world, as well as accompanying their insertion into professional life during and after their studies. Therefore ENSCI is part of the Satt Lutech technology transfer accelerator system,²¹ an organisation seeking to accompany students' industrial projects. However, very few Sound-Design projects find development opportunities. If there is a lack of awareness of sound in most industries, we believe it probably comes partly from a lack of sound culture, because sound applications and uses seem often difficult to understand for non sound professionals. As a comparison, sound was not very developed in cinema until the 80's; but has become a more important part of film production costs and an increasing marketing argument. So there is hope for sound in industrial design and I believe that this change of culture is inevitable if we play our part right.

Conclusion

Sound-Design appears nowadays as a new significant paradigm for Design, particularly in the digital domain, but has not yet sufficiently reached industry. Better sound culture adapted to design schools and more advanced sound-design education could give an impulse to its development and make a huge difference in its cultural assimilation. Teaching Sound-Design is therefore part of the virtuous circle of its evolution, especially if it is closely linked with research, communication and industrial production. But *in fine* only users can press play to run the loop. Such a cultural impregnation needs time.

²¹ <http://www.sattlutech.com/>

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Appendix:

Some sound-design works at ENSCI les Ateliers

(can be accessed http://rolandcahen.eu//ENSCI/Sound-design_at_ENSCI-les-Ateliers.html)

Teaching activities

Introductory course
Creation studio (applied artistic project)
Experimental studio with partners (industrial or institutional)
Long-term projects in teamwork with designers and industrial partners
Research projects
Student projects
Personal initiative
Other design project including sound
Diplomas
Thesis

Workshops

Le Mans & Ircam & ENSCI les Ateliers Sound-design annual applicative Workshop with industrial partners
Sport machines (2011)
Tramway (2012)
Inside car sounds (2013)
Positive energy building (2014)

Subjects

Sound icons and signals
Sound fonts workshops
BipBip <http://ensci.studio.free.fr/BIPBIP/>

Musical instruments

Corps Vibrants <http://www.edouardchassaing.com/fr/projets/serie/450/corps-vibrants/index/?of=0>
Kit Cor des Alpes <http://www.juliengroboz.fr/Kit-Cor-des-Alpes>
Organum21 <http://www.waldkircher-orgelbau.de/orgelgalerie/marmoutier.html>

Interactive sound devices

[AAA](#)
[Objets musicaux sensibles au toucher](#)

Sounding objects

[Corps Vibrants](#)

Real-time audio and audiographic interaction
Max MSP courses and workshops: real time audio,
audiographic interfaces and other multimodal interaction

Auditory and multimodal interfaces
SmartCity+ <http://www.smartcityplus.com>

Music composition
[Corps Vibrants](#)

Sound Navigation
ENIGMES projetenigmes.free.fr 2006-2007
TOPOPHONIE <http://www.topophonie.com> 2009- 2012
SMARTCITY+ [http://locusonus.org/publi/
2014_LS_sympto%238-proceedings.pdf](http://locusonus.org/publi/2014_LS_sympto%238-proceedings.pdf) p158...
“Sans les mains, sans la vue“ ([http://www.ensci.com/createur-
industriel/cours/workshops-habilitations/habilitation-sonore-mars-2013/](http://www.ensci.com/createur-industriel/cours/workshops-habilitations/habilitation-sonore-mars-2013/))

Audiovisual
Films and project communication

Radio systems and contents
Radio Molles Experimental Studio 2014
Musical Interactive Webradio MMI-2003

Radio programmes
NosFuturs
Fiction d'objets
Paroles de Design 2004

Digital audio broadcast
Radio Opening day -> Radio Talkie
RadioTalkie: [http://www.ensci.com/radiotalkie/
radiotalkie.com](http://www.ensci.com/radiotalkie/radiotalkie.com)
RadioMolles: experimental studio 2014
[http://www.ensci.com/blog/eudesignradio/2015/03/04/
radiomolles/](http://www.ensci.com/blog/eudesignradio/2015/03/04/radiomolles/)
EuDesignRadio
[http://www.ensci.com/blog/
eudesignradio/](http://www.ensci.com/blog/eudesignradio/)

Sonorisation and sound systems
Fiction d'objet

Sound Spatialization
Entendre l'Invisible
<http://hebergement.u-psud.fr/supraconductivite/studioson.html>
[http://www.ensci.com/creation-industrielle/cours/studios-experimentaux/
projet/article/18889/](http://www.ensci.com/creation-industrielle/cours/studios-experimentaux/projet/article/18889/)

Data Sonification
SmartCity+

Sound on the Internet

[Une entrée sonore pour la matériauthèque](#)

Son octobre 2014: Bruits de chaises

Son mars 2014: Serveur vocal romanesque

Son octobre 2013: Radio Talkie

Son mars 2013: Sans les main sans la vue

Son mars 2011: L'escalier

Son octobre 2010: Signalétique des objets

Son mars 2010: BipBip

Other design subjects

Time objects

Real time and time scaled interaction

Attention and accessibility

Usage scenarios

Integration of sound (input & output) in objects

Vocal systems (TtS StT)

Touch and gesture Sonification

Accessibility for visually impaired