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The sounding side of materials and products. A sensory interaction revaluated in the user-experience

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Abstract: The new trends in the world of materials and products, growingly focused on a new eco-friendliness and interaction with nature – yet still distinguished by a strong anthropocentrism – lead to the development of materials, systems, technology, and smart, interlinked, expressive, communicative, alive, and hybrid products. A world in which it is almost difficult for designers to find their bearings: how can one interact with such materials and products What is their reaction to touch and smell? What are their distinguishing visual traits? What are their sounds? There is a vast number of tools to analyse and assess such aspects: this article will focus on the "sound" element of materials and products, and using one tool in particular, the SounBe, used to qualitatively assess the acoustics of materials and artefacts.

Keywords Material Design - Multisensory Design - Sensory Design Tools - Sound Design

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1. Changes in user behaviour: the sensory aspect of materials and products

The touch, the sound, the scent of a product, its sensory properties represent a real opportunity in the product design and takes on an important role in product interaction and in the experience people make when they come into contact with it (Garrett, 2010; Norman, 2004). In fact, according with Schifferstein and Desmet (2008) "during user–product interactions, […] sensory impressions obtained through hearing, seeing, touching, tasting

and smelling may all contribute to the user's product experience". As already underlined by many authors, the look, the visual appearance of a product is one the principal character for a good user experience, but is not the only one to be taken into consideration: as Munari (1981) told in the far 1981, "many designers still design only for the sense of sight, they only care about producing something beautiful to see and they do not care if this object is unpleasant to the touch, too heavy or too light, if it is cold to touch, if it has not formal relationships with human body [...]". In the last two decades an improved interest has marked the sensitive and communicative properties of products (Fig. 1 and 2): in fact, new and improved sensual and expressive features of products in different fields, from cosmetics to packaging in general to the automotive, amplify the user experience in different ambits. As underlined by Karana et al. (2015), the materials in user experience fields assume a new role and are in fact consider a fundamental vehicle to create a meaningful experience for the users.

As underlined in many and various researches over the past thirty years (Manzini, 1986; Ferrara & Lucibello, 2012; Karana et al. 2008; Lerma et al., 2013; Lerma, 2014; Rognoli & Levi, 2011), materials have been subjected by a growing increase in terms of number (hyper-choice of materials), properties, performances, applications, etc. Designers can access to an infinite series of solutions: always new and hybrid materials are added to the traditional ones. Materials are now designed on demand to respond to specific requirements and perform defined functions; innovative materials are able to modify the borders of the traditional material families; they can change the application fields of traditional materials. Polymers are strong as metals, metals are soft as silk, we can use flexible concrete and luminescent inks, etc.; innovative materials "evolve through the development of new structures, offering new capabilities and enabling innovative design, or redesign, in order to obtain the product's best advantages (Matos and Simplicio, 2006). Materials are characterized by more and more interesting properties, not only technical, but also by sensorial and expressive ones: materials can be iridescent, soft touch, hard, anti-fingerprint, stiff, rough, flexible, clinking, sharp, silent, textured, matt, stick, etc.: designers must take into account such features as softness, hardness, flexibility of materials; although these characteristics are difficult to be objectively defined, and so a number of complex analysis and measurements are then required. Designers from all over the world developed interesting and meaningful sensory-designed projects putting in evidence different and always various expressive properties.

Many projects have been designed looking to their "sight" side, such as the pendant lights by David Trubridge that produce particular light and shadow effects or as the furnishing accessories transformed into light sources (the Tube chair or the Nuevo light armchair by Natevo). In other cases, smell and taste are at the centre of the projects: from sensory cutlery (for example the Sensory Spoons by Jinhyun Jeons or Food Rings by Ekaterina Shchetina, designed to enhance the eating experience) to "smelling projects" (analogical or digital such as microencapsulated packaging to anticipate an experience – for specific aroma, for example- or as Cyrano, a "digital scent speaker" that produces olfactory playlists). From the sound point of view, we can cite products characterized by particular and

recognisable process sound, objects that produce a feedback/alarm sound and also silent or silencer product: from the crick croc of the Pringles potato chips to the digital sound that characterized Nokia phones, to the kettle by Richard Sapper for Alessi, with its melodic whistle produced when steam comes out.

2. The Sound in Design

This article will be focused on the "sounding" side of materials and products, often not taken in a big consideration by designer, and to approach to sound developed in the last years by a multidisciplinary research group of Politecnico di Torino.
In recent decades, but also in the Sixties and Seventies, many big industries manufactured products with particular attention to their sound, products that have been in a short while considered as "sound icons", such as, for example the Harley Davidson motorbikes, with their rumbling of ignition engine or the "distinctive crack of the chocolate breaking as one bites into a Magnum ice cream" (Ferreri and Scarzella 2009). Moreover, the subject of sound in design has been object of national and international exhibitions, such as Sound Objects: the invisible dimension of design" (2009, Triennale di Milano, Italy) by Marco Ferreri and Patrizia Scarzella, focused on the acoustic quality of everyday objects or the "Word is Sound" (2017-2018, The Rubin Museum of Art, New York), dedicated to animate and intensify the experience of art in the Rubin's collection, thanks to sounds.
According to Dal Palù (Dal Palù et al., 2018), the sound can be considered in the most conscious category of "behavioral" design (Norman, 2004). Therefore, sound is a vehicle of information: it helps the consumer to check the correct functioning of a product (feedback sound) or can help to define the quality of a product (an economic sound returns an image of a delicate, fragile product).

2.1 Sound as project requirement. The exploration of Sound by young students in Design

Hence, a product can be able to communicate its characteristic also by the sound that it produces itself. These subject has been chosen for the 2013-14 academic year of the Exploring Design laboratory of the degree in Design and Visual Communication at the Politecnico di Torino (3° year) was Sound: "I am the way I sound. Designing sounding objects".
During the Exploring Design laboratory, the students are asked to answer to the question "*where*? (to design)", by analysing a wide and open ambit, such as, for example, Fire, Air, Water, that are dealt with by means of a transversal observation of case studies involving products, semi-finished goods, and materials giving life to innovative solutions (exploring designers are able to point out areas of the project – answering to question where? – "that have not yet been explored and which would be unlikely to emerge through standard procedures") (Germak and De Giorgi, 2008). The students are requested to outline new design research fields, by broadening the horizon of innovation, without a specifically commis-

sioned request, without the traditional customer. They can analyse new sectors, new user and market inclination, new technology, new production processes, new interaction, etc. The first phase of the laboratory involved an exploration of the Scenario (a critical mass of information, references and case-studies defining the ambit in which design will operate) identified as a first step for the analysis of the broadened -ambit: the students were presented a series of Scenarios (process sound, sound as alarm, sound to be eaten, non-sound, sound and other senses, etc.), which were then expanded (sound to be eaten, technological sound, recreated sound and places, sound as an energy, emotional sound, etc.) following the contributions of experts. A cognitive ergonomist and an expert of sound design have been invited to help students to analyse and study in deep the meta-ambit of sound.
During the laboratory sound have to be considered the protagonist of the project, and was transformed by the teaching staff in a project requirement to be considered by all the students. The students present about 50 quite different proposals, in which the sound was the main character: a harmonica for electric cars so that they can produce a sound instead a dangerous (for pedestrians) silence; systems to listen to the "history" of products; websites to hear the sounds of the world from the comfort of your home; sounding and tranquilizers jewels; furniture to decrease and raise awareness on the topic of noise pollution; personal effects designed to prevent the perception of loud noises; silent food packaging for stealthy snacks.
Sound has been read from many points of view, drawing attention to the various roles that this sense can play: sound in fact is recreated to avoid dangers deriving from the silent electric car and vehicles in general, especially in urban zones. This proposal is consistent with the new law with which the National Highway Traffic Safety Administration define that all the all the electric and hybrid vehicles must emit a sound that allows remote sensing at least up to 30 km/h.1 Other examples put in evidence the voice of products that can be able to produce a communicative functioning sound or a to tell a history, using QR code or reproducing the sound of places very far from us. Sound can be a feedback of a functioning process, can be recreated, can allow us to travel the world or on the other side can be avoided, by using specific silent or noise-absorbing materials: from emotional sound (mean of emotions and memories), to recreated sound to non-sound.

3. A tool for designer dealing with sound products properties

As put in evidence in the previous paragraphs, products are able to communicate thanks to the materials that will constitute it, their shape and colours, the tactility of surfaces and also tanks to the sounds that they will be able to produce. Sound is a sensorial message that products can produce and designers have to consider it during the design process, in an empirical and in a scientific way.
Over the last decade, "a heterogeneous and multidisciplinary research team from Politecnico di Torino has developed SounBe, a patented tool and method (De Giorgi et al., 2011a) conceived to support designers and researchers in the selection of the most suitable materials within the possible hyper-choice, taking sound into consideration as a project requirement" (Dal Palù et al., 2018a).

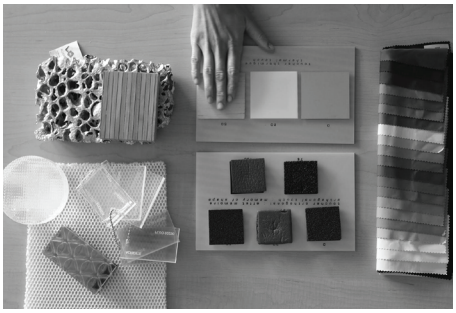

Fig. 1 - Sensory properties of materials: touching characteristics measured by using Sensotact tool by Renault

Fig. 2 - Feeling the textures of a product

Fig. 3 - SounBe tool: a zoom view

Fig. 4 - Some examples of the different solicitations currently possible by using SounBe tool

SounBe is a method and device for acoustic sensorial analysis of materials, that allows to compare different material samples from an auditory point of view. SounBe (Fig. 1) is a "toolkit" that permits to stress in repeatable way different materials, starting from everyday mechanical solicitations: the toolkit can be used by different people and in different sound design contexts. More in details, the gestures (solicitations) (Fig. 3) currently possible with the use of the SounBe tool are the following: knocking with a percussion stick (for foil and plates, section bars and pipes and, eventually, for finished products); falling to the ground (for granules, flakes or powder); flapping (for sheet materials); sliding an object on a surface (for grids, nets and materials with 3d surface); crushing (for sheets and films); breaking (for foam and expanded materials); rubbing (for textiles); knocking with a knuckle (Fig. 4): for foil and plates, section bars and pipes).
For some solicitations is possible to avoid the tester (human) variability (knocking with a percussion stick and falling to the ground), for others is necessary the presence of a tester and his human interaction (for example for rubbing, that simulates the scraping of dress fabrics).
The characteristics of sounds produced by a product or by a material can be verbalized thanks to a specific and shared vocabulary: after the sound has been generated with SounBe, in fact, a group of tasters describe the sound using a shared vocabulary (the descriptors known in literature as "Von Bismarck's adjectives has been adopted by researchers, but it's possible to define a new list of adjectives) (Von Bismarck 1974); after this step, the labelled sounds will compose a sound database in support to the project. A database has been built in MATto (Materials library of the Politecnico di Torino), where every tested material-descriptor match was collected (De Giorgi et al. 2011b): a descriptor-adjective of the sound produced was associated with each material-configuration form-solicitation combination. The database is an ever-growing catalogue of sound, because the size and the complexity of the collected data grow with the catalogue of new materials.
On the contrary, if the goal is to design a new sound, it's necessary to define the wanted sound attributes (e.g.: a fresh sound); then, thanks to a group of tasters, it's possible to identify the sound qualities using a shared vocabulary; after these steps, the researchers compare the identified descriptors with those of the sounds which are present in the database, in order to define materials, shapes and gestures to be used to obtain the chosen sound.
The SounBe tool and method have undergone extensive experimental validation, that have been analysed carefully in a recent publication (Dal Palù et al., 2018a) dedicated to designers to develop the product identity through sounds.
SounBe can be a valid tool and method to be used by designers and companies in different fields and for various aims. For example, thanks to it, it's possible to analyse the sound profile of an existing material/semi-finished product/product and to create a database of possible sounds for a specific field (in other words, defining the future sound background of a product) or to create a sensory sound vocabulary for future speculations on sounds of a specific product line.
Moreover, SounBe can be useful for the development of product identities in high quality sectors but also in everyday life products: from food to packaging, to cosmetic, to automotive to transportation in general, the sound has to be considered a project requirement.

4. For a good soundscape

Soundscape, according to Schafer (1969), describes the acoustic landscape that surrounds us: every product of everyday life produces a sound which contribute to form the soundscape in which we live. For a good sensual and expressive experience of products in different fields, sound has to be considered by designers.
Designers can count on a wide selection of tools, useful to define and design the sensory aspects of materials and products. SounBe allows the sound perceptive qualities of a product to be estimated, from its generating variables (Dal Palù et al. 2018b). Moreover, the sound of a product can be tested before the prototyping phase: already in the meta-design phase of the design process, materials can be chosen in a correct way by considering their acoustic properties. The tool can be used, not only, to describe and understand how a product can be perceived from its sound, but also in a predictive way, as a preview of the perception of future products. Furthermore, SounBe can be an instrument useful for companies that would like to communicate specific values (from luxurious to sustainability) of a product taking starting from its sound. The sounding side of products is an aspect that have to be consistent with the identity of the product, to improve a good man–product interaction, for a correct user experience.

Notes

1. www.theguardian.com/environment/2018/may/06/new-law-combats-silent-menace-electric-cars (consulted on June 8th 2018).

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Resumen: Las nuevas tendencias del mundo de los materiales y de los productos, caracterizadas cada vez en mayor medida por una nueva atención hacia el medio ambiente, por la interacción con la naturaleza, pero al mismo tiempo todavía dotadas de un fuerte antropocentrismo, conllevan el desarrollo de materiales, sistemas, tecnologías y productos inteligentes, interrelacionados, expresivos, comunicativos, vivos, híbridos. Un mundo en el que para el diseñador es casi difícil orientarse: ¿cómo se interacciona con estos materiales y productos? Al tacto, al olfato, ¿cómo se comportan? ¿Cuáles son las características ópticas que los distinguen? ¿Cuáles son sus sonidos? Son diversos los instrumentos para analizar y evaluar estos aspectos: el artículo se focalizará en el aspecto "sonoro" de materiales y productos, y en particular en el SounBe, un instrumento para realizar la evaluación acústica cualitativa de materiales y objetos.

Palabras clave: Diseño de materiales - Diseño multisensorial - Herramientas de diseño sensorial - Diseño de sonido.

Resumo: As novas tendências no mundo dos materiais e produtos, cada vez mais caracterizadas por uma nova atenção ao meio ambiente, pela interação com a natureza, mas ao mesmo tempo dotadas de um forte antropocentrismo, implicam o desenvolvimento de materiais, sistemas, tecnologias e produtos inteligentes, inter-relacionados, expressivos, comunicativos, vivos, híbridos. Um mundo em que é quase difícil para o designer se orientar: como você interage com esses materiais e produtos? Ao toque, ao cheiro, como eles se comportam? Quais são as características ópticas que os distinguem? Quais são seus sons? Existem vários instrumentos para analisar e avaliar estes aspectos: o artigo incidirá sobre o aspecto "som" de materiais e produtos, e em particular sobre o SounBe, um instrumento para realizar a avaliação acústica qualitativa de materiais e objetos.

Palavras chave: Design de materiais - Desenho multissensorial - Ferramentas de design sensorial - Design de som.

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