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ABSTRACT

Everyday products are asked today to satisfy far more performances than in the past, starting from their ability to communicate on different levels, consciously or spontaneously, to the user. This attitude of the human centred project defines new requirements such as friendliness, affordance and a global satisfactory experience of the product itself, achievable by acting not just on the user experience, but also on the whole perception of the product, conveyed mainly by the five senses. This paper presents a novel design approach more attentive to the multisensory theme, providing it with the suggestion of a set of possible quali-quantitative tools able to support designers since the early phase of the good sensory design process. Furthermore, several innovative tools driven from the marketing research will be proposed for verifying the outputs of the design process. Finally several case studies of the possible achievements obtained with this approach in current researches in the field of multisensory product design adopting the disclosed tools will be presented.

Keywords: meta-design, perception, sensory research tools

1 INTRODUCTION

Products are no longer asked to perform only in function as they mostly did in the past; they are now expected indeed to consider contemporary social changes and deliver “soft” and un-visual performances, such as greater sensory expressivity and complex performances, in order to improve the quality of the user experience (Forlizzi, Disalvo & Hanington 2003; Ho & Siu 2012).

The theme of multisensory product experience appears to be today very up-to-date in the design research (Lerma, De Giorgi & Allione 2011), as well as in consumer science (Norman 2004). The experience of any product, physical object, service or space, derives from the multisensory reply by the subject that comes into contact with the product itself. For many years, the immediacy and spontaneity of the visual approach in perception has supported several theories (Berendt 1988) affirming living in a real “eye culture”. Nowadays, these theories are overtaken thanks to the proved collegiality of every sense in the perception process (see *Figure 1*); indeed in real life it is very difficult to delimit its own perceptive experiences, uninterrupted and often unconscious, to one single sensorial channel (Bandini Buti et al. 2010).

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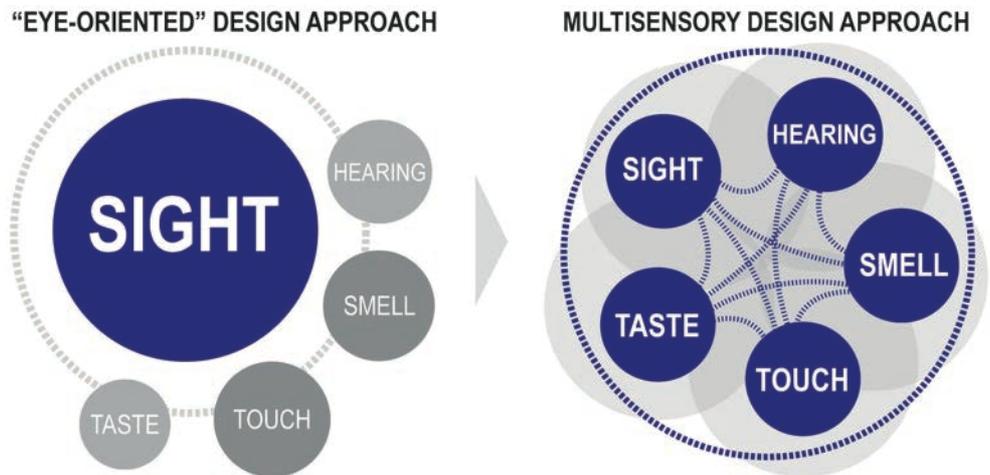


Figure 1 - A graphical representation of the transition from an "eye-oriented" design approach to a multisensory design approach

Thus, the senses of touch, smell, hearing and taste have been rediscovered in the design phase, giving birth to more or less valid examples of products able to interact with a holistic sensory level with the user (Lévy 2013; Wastiels et al. 2013). This renewed care to the "invisible aspects of design" (Ferreri & Scarzella 2009) generates a room of scientific interest in the design domain (Celaschi 2008), focusing on the need to learn, develop and spread the most suitable tools to support the sensory-oriented project, and integrate this fundamental requirement at the early stage of the design of the product (or service), in other words in the meta-design phase (Germak 2008) (see Figure 2).

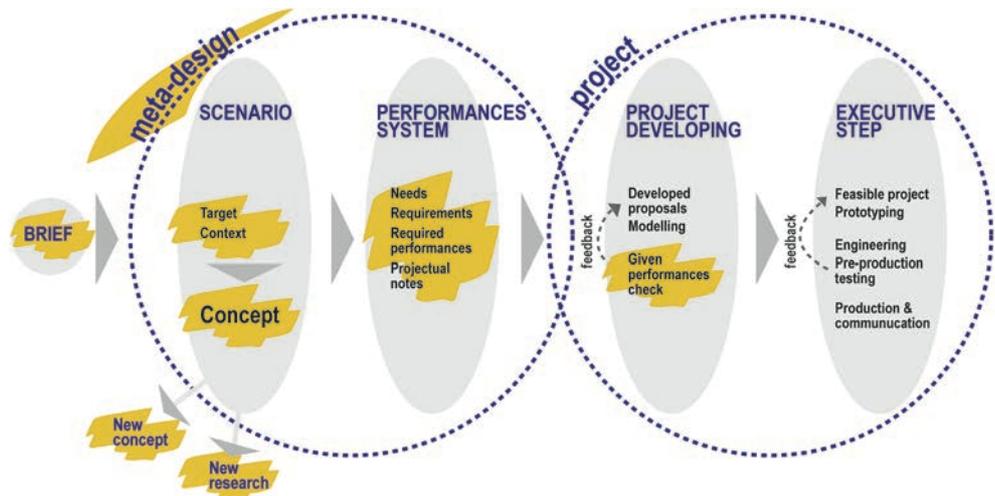


Figure 2 – The influence of the sensory-oriented project approach, from the brief to the testing phase, along the entire meta-design phase

So the question is: can sensations and perceptions be measured and evaluated to strengthen the meta-design phase? The aim of this work is to investigate this theme, and how perception can help designers during the product creation process, taking into account "soft" performances and user experience (Karana, Pedgley & Rognoli 2013).

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2 MATERIALS AND METHODS: THE RESEARCH APPROACH

This work presents a complex shared and transferable evaluation methodology for sensory perception in the meta-design phase.

The common denominator of the methodology is involving a qualified sensory panel of people (the tasters) trained to detect and record sensory perceptions in standard test conditions. Similarly to a measuring instrument, the trained assessors provide accurate and statistically representative results.

The evaluation of the “*perceptive dimension*” (Germak 2013) of products consists of methods and tools (qualitative and quantitative) to measure the consumer’s “*quali-quantitative*” perception of the sensory characteristics of different products. The advices are always used in the presented methodology in combination with questionnaires, focus groups and semantic differentials: tools for sensory analysis are used as an additional instrument for assessing meta-project or product concepts to reinforce or weaken judgments, anticipating what could be the indications of choice made by the public for whom the product is intended.

2.1 THE “TASTER” FIGURE

Qualitative and descriptive analyses are strongly connected with human perception (Berglund et al. 2011). This assumption discloses the matter of soft metrology. Soft metrology is defined as the set of measurement techniques and models, which enable the objective quantification of properties which are determined by human perception.

What characterizes the complexity in perception is really the intrinsic multidimensional nature combined with a subjective attitude. Recently, sensory evaluation techniques have been developed to reveal detailed information about perception of products (Pagliarini 2002). Both in soft metrology and in sensory evaluation, the human being is accounted as the measuring instrument, thanks to his involvement in focus group and testing sessions.

The testing panel (also called “*tasters*”, e.g. a group of experts, appropriately guided in acoustic sensorial analyses) becomes in this research the real qualitative judge of the perceptive characteristics of the material in question.

2.2 AVAILABLE TOOLS FOR SENSORY ANALYSES

The sensory analysis methodology allows describing products and materials from visual, auditory, olfactory, tactile and gustatory points of view, by the use of, sensory vocabulary, value scales and a specific tool for each sense (see Figures 3, 4, 5, 6 and 7):

2.2.1 Tools for analysing sight qualities

— Gloss scale[®]: developed by the Natural Color System (NCS), this scale is a tool that measures the qualitative brightness/opaqueness of surfaces (direct comparison between the material to be tested and the various samples provided) and their quantitative brightness/opaqueness (thanks to the measurement on the back of each sample provided with the tool). The gloss

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level can vary from 0 to 100: level 0 corresponds to a totally opaque surface, and 100 to a shiny glossy black sheet of glass¹;

— Lightness meter[®]: always developed by NCS, this tool represents an evolution of the Gloss scale[®], visually recording colour luminosity. It has 18 samples of neutral grey taken from the 1950 standard NCS colours. The NCS notation, the NCS lightness, and the value of the luminous reflectance factor is provided for each of the samples²;

— Pantone scale[®]: proposes an excellent method to describe a colour based on sample comparison; it provides special colour selection tools including comparative tables and descriptions of the identified colour. In fact, the Pantone system works by comparing the material to be tested with samples provided by the company itself: once the chromatic reference is established, it is described using the code for each colour sample³.



Figure 3 – The tools for analysing sight qualities: the Gloss scale[®], the Lightness meter[®] and the Pantone scale[®]

2.2.2 Tools for analysing hearing qualities

— Sound Design Toolkit[®] (SDT): an open source software package suitable for research and education in Sonic Interaction Design, as well as in musical context, including polyphonic features and connectivity to multiple external devices and sensors in order to facilitate the embedding of sonic attributes in interactive artefacts (Delle Monache, Polotti & Rocchesso 2010);

— Modalys: this physical model-based sound synthesis environment has been developed by IRCAM, the French Institut de Recherche et Coordination Acoustique/Musique. It is used to create virtual instruments from elementary physical objects such as strings, plates, tubes, membranes, plectra, bows, or hammers. It is also possible to create objects with more complex shapes out of 3D meshes, or using measurements, bringing them to life and making them sound⁴;

— Xylophone: developed by Materioteca, an Italian material library, this tool is a nearly ordinary xylophone composed by different equally shaped polymeric samples that allows comparing the acoustical behaviour of each material with something similar to a drumstick. Thinking to the already presented tools, this one appears to be closer to the product designers needs in terms of immediacy and ease in the meta-design phase;

¹ www.ncscolour.com

² www.ncscolour.com

³ www.pantone.com

⁴ www.ircam.fr/product/modalys

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— SounBe[®]: a toolkit and a methodology both developed in Politecnico di Torino as a support tool for those designers aiming at the right choice of the most suitable material to his design project (Dal Palù et al. 2014). Following this methodology, they will be able to split the sound matter in main factors and gather some useful meta-project advices related to their needs. Finally, a new planning approach to sounding objects will generate new planned soundscapes, avoiding the increasing noise pollution.



Figure 4 – One of the tools for analysing the hearing qualities: the SounBe[®] tool

2.2.3 Tools for analysing smell qualities

— Aroma Wheel[®]: developed by the American Society for Enology and Viticulture, this tool classifies on three levels the aromas found especially in wines: very general terms are located in the centre, going to the most specific terms in the outer tier (for example: fruity aroma → citrus fruits → lemon; fruity aroma → soft fruits → black currants; woody aroma → resinous wood → oak; vegetal aroma → plants → eucalyptus, etc.)⁵. Tools like the Aroma Wheel[®] have been developed to facilitate the description of aromas by assessor 'judges';

— Electronic nose: the electronic nose is a tool, which tries to replace the human olfactory system and make measurements objective. The sophisticated software developed for these 'recreated noses' is able to file and preserve the incredible number of perceived smells classified by the electronic nose⁶;

— Sensory Box Explorer[®]: developed by the Italian Centro Studi Assaggiatori, the Sensory Box Explorer[®] is a toolkit born to stimulate the active scent exploration, through which everyone can train his olfactory abilities. It consists in twenty olfactory standards which reproduce aromas present in ordinary life experiences of our society and that are representative of the main aromatic families (floral, fruity, green, spicy, etc.)⁷;

— Odothèque: the French research centre on the sensorial technologies CERTESENS owns a collection of odorous molecules that complements the collection of materials, providing the opportunity to work on the flavours and odours in addition the other design senses⁸.

⁵ www.asev.org

⁶ www.enose.nl

⁷ www.assaggiatori.com

⁸ www.certesens.fr

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Figure 5 – Some of the tools for analysing the smell qualities: the Aroma Wheel[®], the Electronic Nose[®] and the Sensory Box Explorer[®]

2.2.4 Tools for analysing touch qualities

— SensoTact[®]: a tactile reference frame developed by France-based automaker Renault that analyses and classifies the tactile perceptions of materials. This tool is being used in a variety of industries including textiles, toys, packaging and automobiles, among others. It provides a common language that enables designers and suppliers to communicate using clear, precise definitions of tactile qualities. It also is used to measure tactile sensations, certify the conformity of an end product with its prototype, and determine which tactile qualities are most likely to influence a customer to buy a product⁹. Currently, the tool has been further developed by the French ExpertiSens, and it's known as TouchFeel[®];

— BioTac[®]: the BioTac[®] mimics the physical properties and sensory capabilities of the human fingertip. Initially developed by researchers at the University of Southern California, the BioTac[®], with its advanced human-like tactile sensing, is the leading product in machine touch. Identical to human touch capabilities, it is capable of sensing force, vibration and temperature¹⁰.



Figure 6 – The proposed tools for analysing touch qualities: SensoTact[®] and BioTac[®]

2.2.5 Tools for analysing taste qualities

— Electronic Tongue: is a new technical tool, one of the many that can be used to identify organoleptic properties. A sommelier recently tasted fifty-three wine samples: without making even one tiny mistake, he guessed the grape species, the region the bottles came from, and the organoleptic properties of each sample (fresh, fruity aroma, high acidity, intense ruby red colour, and the insidious presence of mould in the cork)¹¹;

⁹ www.textileworld.com

¹⁰ www.syntouchllc.com

¹¹ www.alpha-mos.com

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— Scoville Scale[®]: is the recognised measurement of the pungency (spicy heat) of chilli-peppers or other spicy foods as reported in Scoville heat units (SHU), a function of capsaicin concentration. Unlike methods based on high-performance liquid chromatography, the Scoville scale is an empirical measurement dependent on the capsaicin sensitivity of testers and so is not a precise or accurate method to measure capsaicinoid concentration¹².



Figure 7 - The proposed tools for analysing taste qualities: the electronic Tongue and the Scoville Scale[®]

2.2.6 Global reaction assessing tools

Furthermore, sensory analyses are sinestesyally ex-post validated through the use of specific equipment, which offers some important data regarding the user's attention to the observed product (submitting real or virtual prototypes to tasters). This phase can be once more time carried out using the previously presented tools or, specifically, adopting one of the following new tools to verify the consumer's response to the submitted stimulus (see Figure 8).

The tools presented below deriving from different fields (psychology, visual systems, product, educational and market research) are proposed as support tools for design phases and a validation method for the sensory analysis completed by using the visual, auditory, olfactory, tactile and gustatory tools, also thanks to the use of qualitative and analytical methods such as questionnaires, focus groups and semantic differentials.

— Eye tracking: it provides robust data quality and state-of-the-art visualizations and metrics showing where, when and what people look at. The instrument is composed by special glasses following the sight movements, and a software decoding the data. All raw eye tracking data is easily exported to get deeper in the analysis¹³;

— The Observer[®]: developed by the Dutch company Noldus, this software has been developed to allow the observation of the behavior of a subject in a specific circumstance (for example in the purchase phase). Through the use of a webcam, the software allows to collect data about the gestures that the subject does, the observation time, the phase of reflection on the product by comparing them with the trend generated by the set of subjects analyzed. It is a particularly significant part of the marketing, but may be used in general to evaluate the subject's response to any stimulus¹⁴;

— Face Reader[®]: also this software has been developed to observe the instinctive response of a subject to a stimulus, but focusing specifically on the

¹² www.scovillescale.com

¹³ www.srlabs.com

¹⁴ www.noldus.com

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answer given by the facial expression. Thanks to a virtual network of 500 points, the software evaluates the relative position of points and the results in six expressions encoded using a shared meaning (amused, incredulous, angry, etc.). Even in this case, the software can be used to test the instinctive response to the stimulus from a point of view of both quality and quantity¹⁵.

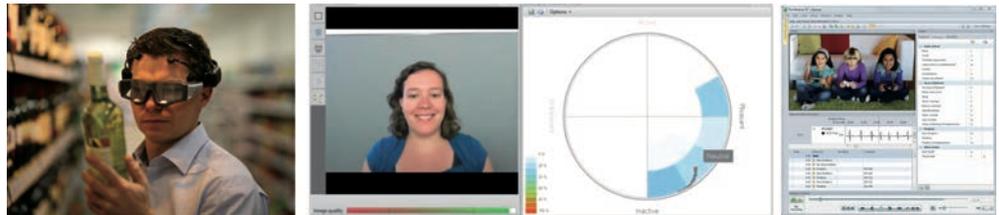


Figure 8 - The proposed tools for assessing the global reaction to the stimulus: the Eye Tracking, The Observer[®] and the Face Reader[®]

This fast overview wants to recall just some of the design tool available to the designers in order to face with the theme of multisensory products. Of course, every tool has specific strength and weaknesses, some of them are more "designer-oriented", others could not be so easy to be used, but the main purpose of this collection is make the reader meditate on the range of possible investigating path on the theme of perception.

In the following paragraphs we will present some applications of several of these tools in the projectual phase, proving how the product overall quality can be increased integrating this aspect since the beginning of the project.

3 APPLICATIVE CASE STUDIES

In the following paragraphs a short hint to four different researches involving the theme of multisensory since the projectual phase will be proposed. These applicative case studies will be just sketched, in order to provide an idea of the influence of this approach, but every research includes a deep analysis that we won't debate in this paper. All the references to those researches will be indicated in the text for further in-depth analysis.

3.1 CAR INTERIORS: POSSIBLE INTERACTIONS SIGHT-TOUCH

Several researches have already been carried out aiming at a perceived global quality in the car cockpit (Gentner et al. 2012). The first experimentation here cited reveals the importance of the interaction sight-touch in the perception of the global quality in car interiors. The research was carried out starting from several concepts of car seats, developed by the students attending the third year of the degree program in Industrial Design at Politecnico di Torino, during the ReSeat project (a.y. 2008/2009, Industrial Design III course in collaboration with Fiat Research Center CRF). The goal of the project was to identify the upholstery proposals that were most attractive to the user-observer. To proceed with the sensorial analysis of these concepts it was necessary, first of all, to select the potential fabrics to evaluate, among those available in MATto, the material library at Politecnico di Torino (Allione et al. 2012). The research was

¹⁵ www.noldus.com

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focused on the new car seats concepts assumed as case studies, paying attention on the sensory perception and, in particular, on the use of Eye tracking and SensoTact® tools (Lerma & De Giorgi 2011) to evaluate the seat and the interiors textiles. Specifically, by the use of the Eye tracking device it has been possible to verify whether the results obtained through the method of sensorial analysis of materials (previously investigated with the aid of SensoTact®) correspond or not to what is perceived by the user "at first sight".

3.2 LEATHER AND ECO-LEATHER: OLFACTORY EVALUATIONS

Another very interesting research conducted in Politecnico di Torino was aimed to devise a design methodology for the evaluation and the selection of materials exclusively based on the scent. The goal was to investigate, both from a sensorial and an instrumental point of view, the scent perceived by the user. Also this study was focused on the automotive field, an enclosed environment with frequent temperature leaps, where the user is in very close contact with materials. Studying the most critical areas of the car, the dashboard and the seat cover, twelve materials have been selected on the basis of technical characteristics and intrinsic scent. A part of these are traditionally used, such as polyurethane, leather imitations and microfiber, the others represented several innovative materials used in other fields (recycled materials and materials from renewable resources).

Each material was subjected to a sensory analysis, performed by a panel of 25 car users who performed several tasks based on the odour perception: liking test, CATA-test with evocative terms, evaluation of the overall intensity and olfactory recall associations (such as for example: odour - old/modern, odour - artificial/natural, etc.). Materials were also analysed by means of an electronic nose. The combined analysis was necessary to draw useful correspondences between the instrumental and the subjective data based on associations. By crossing the results of the dual analysis, it was possible to derive the perceptual responses of each material, hence obtaining a comparison between the traditional and innovative materials. The results confirmed that the scent could be considered a requirement in the project phases, supplying different meanings to the product. The methodology goal was to support designers in the material choice during the project phases (Lerma et al. 2014).

3.3 FOOD INTAKE: FORETASTE A PRODUCT THROUGH THE AUDITORY PERCEPTION

A novel approach to food is set on the overall perception of it, in a multisensory perspective. A recent research pointed out which are the current main criticisms and the most important opportunities to enhance the food experience through the sound design (Dal Palù, De Giorgi & Lerma 2014).

Thanks to SounBe® methodology and tool, designers dealing with sounding foods, packaging, processes and, eventually, products in general, have available an instrument in order to create new sounds or to evaluate and redesign the existing ones: it will be possible to split the mechanical sound matter in its three main generating factors and to verbalize the sound characteristics thanks to a group of tasters, in order to gather some useful meta-project advices related to the project needs. This new point of view on this up-to-date theme allows producers, designers and customers to share and better understand every own requests and needs. Furthermore, several possible opportunities appear now to be possible, such as predicting a food sound in the design phase, or let

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consumers foretaste a product by the sound of its packaging. Finally, this overall new conscious approach to sounding objects will generate new designed soundscapes, avoiding the increasing of noise pollution and poor sounding objects.

4 CONCLUSION

Sensory assessment by human tasters strengthened by "single-sense" qualitative tools before, and "global perceptive" tools later, help to identify the users desires, improve the product final friendliness, affordance and experience, and verify the final outputs of the design process.

Due to its universal characteristics, designers can apply the presented approach in different productive fields where sensory qualities represent a key point for the global quality of the product. Over the years, this methodology has supported the evaluation of car seat prototypes, chocolate bars and wines packaging, taps and fittings, jewels. This research method highlighted strengths and weakness points of the different meta-projectual solutions in terms of users perception of specific given requirements (such as freshness, sustainability, hygiene, preciousness...) and supported designers in the projectual phase choices with objectives perceived quality indications.

Furthermore, the presented methodology allows the designer to consider the consumer's point of view since the very beginning, giving him a preview during the meta-design phase, and a validation on the projectual choices in relation to both usage and communicative functions. This aspect of the "human oriented design" represents today a key point in order to develop products really satisfying a request of full sensorial quality.

5 ACKNOWLEDGEMENTS

The authors wish to thank professor Claudia De Giorgi, first supporter of the multisensory design approach, and all the students and tasters which have taken part to the researches and the sensory trials.

6 REFERENCES

- Allione, C, Buiatti, E, De Giorgi, C & Lerma, B 2012, 'Sensory and sustainable strategies in the methodological approach to design' in *Proceedings of the 8th International Design and Emotion Conference*, London, 11–14 September 2012.
- Bandini Buti, L, Bisson, M, Boeri, C, Gellini, G & Zingale, S 2010, *Progetto&multisensorialità. Come gli oggetti sono e come ci appaiono*. Franco Angeli, Milan.
- Berendt, J.E 1988, *The Third Ear - On Listening to the World*, Henry Holt, New York.
- Berglund, B, Rossi, G. B, Townsend, J. T, Pendrill, L. R 2011, *Measurement with Persons - theory, methods and implementation areas*, Taylor & Francis, New York.
- Celaschi, F 2008 'Design as Mediation Between Areas of Knowledge' in *Man at the Centre of the Project. Design for a New Humanism*, eds Germak, C, Umberto Allemandi & C., Turin, pp. 19-31.

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- Dal Palù, D, De Giorgi, C, Astolfi, A, Lerma, B & Buiatti, E 2014, 'SounBe®: a toolkit for designers dealing with sound projects' in *International Design Conference – Design 2014*, Dubrovnik, 19-22 May 2014.
- Dal Palù, D, De Giorgi, C & Lerma, B 2014, 'SounBe, an innovative sound project tool involving sensory analysis: new possible applications in food consumption' in *Eurosense 2014 – A Sense of Life, 6th European Conference on Sensory and Consumer Research*, Copenhagen, 7-10 September 2014.
- Delle Monache, S, Polotti, P & Rocchesso, D (2010) 'A toolkit for explorations in sonic interaction design', in *5th Audio Conference - A Conference on Interaction with Sound*, Piteå.
- Ferreri, M & Scarzella, P 2009, *Oggetti sonori, la dimensione invisibile del design*, Electa, Milan.
- Forlizzi, J, Disalvo, C & Hanington, B 2003, 'On the Relationship Between Emotion, Experience and the Design of New Products', *Design Journal*, vol. 6, no. 2, pp. 29-38.
- Gentner, A, Bouchard, C, Esquivel, D & Favart, C 2012, 'Mapping a Multi-sensory Identity Territory at the Early Design Stage', *International Journal of Affective Engineering*, vol. 12, no. 2, pp. 191-200.
- Germak, C 2013, 'Il progetto Poliedro. Modello di valutazione multicriteria di sostenibilità e qualità del prodotto alimentare tipico' in *Sustainable packaging? A multicriteria evaluation method for food packaging*, eds De Giorgi, C, Umberto Allemandi & C., Turin, pp. 16-29.
- Germak, C eds 2008, *Uomo al centro del progetto: design per un nuovo umanesimo – Man at the centre of the project: design for a new humanism*, Umberto Allemandi & C, Turin.
- Ho, A. G & Siu, K. W. M 2012, 'Emotion design, emotional design, emotionalize design: A review on their relationships from a new perspective', *Design Journal*, vol. 15, no. 1, pp. 9-31.
- Karana, E, Pedgley, O & Rognoli, V 2013, *Materials Experience. Fundamentals of Materials and Design*, Butterworth-Heinemann, Oxford.
- Lerma, B & De Giorgi, C 2011, 'The Critical Exploration of Materials for the Design Project. A Method of Analysis below the Levels of Consciousness', *Design Principles and Practices*, vol. 5, no. 6, pp. 81-92.
- Lerma, B, De Giorgi, C & Allione, C 2011, *Design e materiali. Sensorialità sostenibilità progetto*, Franco Angeli, Milan.
- Lerma, B, Torri, L, Buiatti, E, Costamagna, D & Pagin, E 2014, 'Designed scent: tools and methods for olfactory analysis in automotive field', in *Eurosense 2014 - A Sense of Life, 6th European Conference on Sensory and Consumer Research*, Copenhagen, 7-10 September 2014.
- Lévy, P 2013 'Beyond kansei engineering: The emancipation of kansei design' *International Journal of Design*, vol. 7, no. 2, pp. 83-94.
- Norman, D. A 2004, *Emotional Design: Why we love (or hate) everyday things*, Basic Books, New York.

THE VALUE OF DESIGN RESEARCH

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Pagliarini, E 2002, *Valutazione sensoriale*, Hoepli, Milan.

Wastiels, L, Schifferstein, H. N. J, Wouters, I, & Heylighen, A 2013, 'Touching materials visually: About the dominance of vision in building material assessment', *International Journal of Design*, vol. 7, no. 2, pp. 31-41.