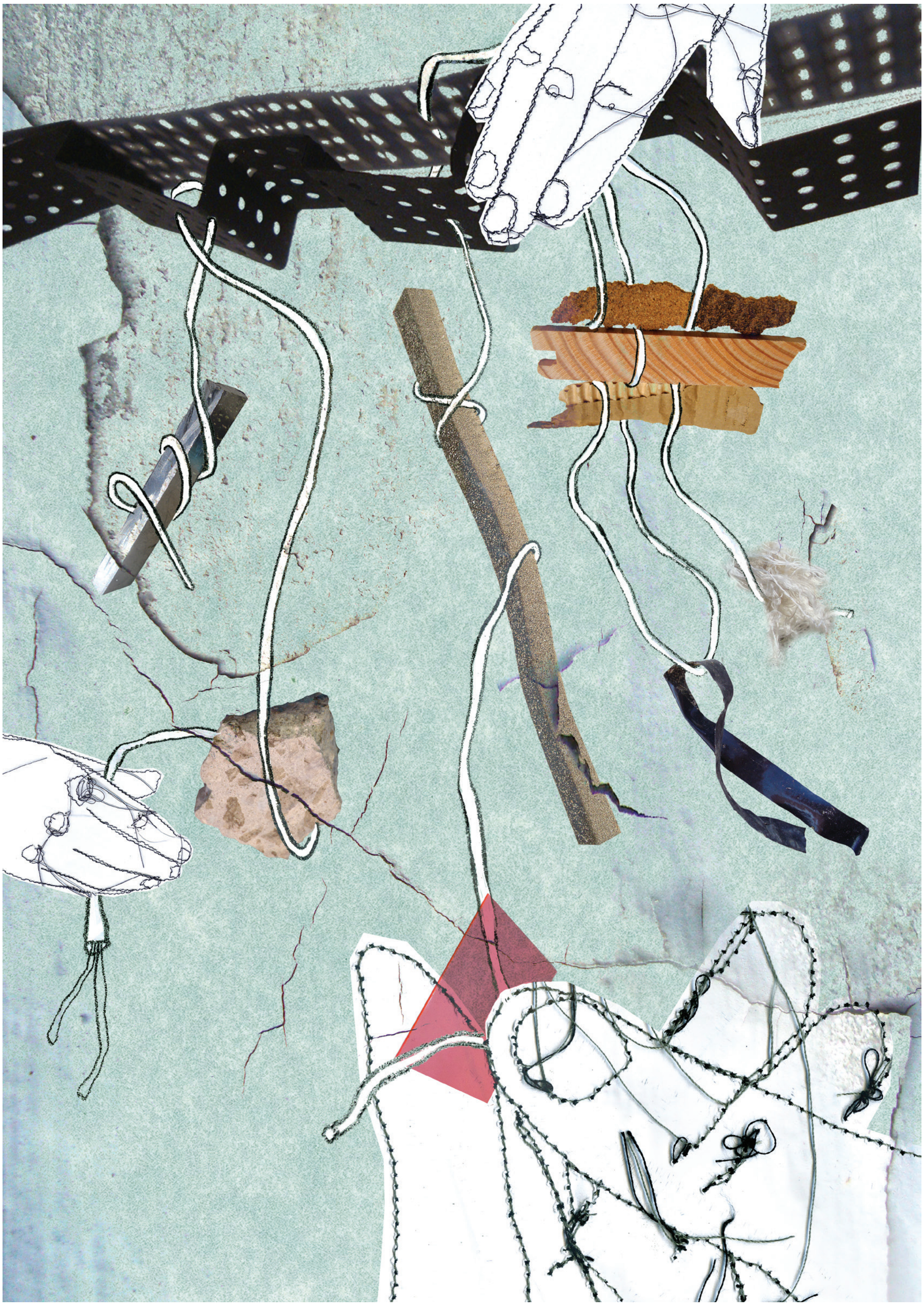

Tangible Means

EXPERIENTIAL KNOWLEDGE THROUGH MATERIALS

EKSIG 2015 – KOLDING

International Conference 2015 of the Design Research Society Special Interest Group on Experiential Knowledge

Conference Proceedings
Full Papers

Design School Kolding
University of Southern Denmark
25-26 November 2015

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Tangible Means

Welcome

ESKIG 2015 – Tangible Means

Welcome to EKSIG 2015: Tangible Means!

EKSIG2015: Tangible Means, International Conference 2015 of the DRS Special Interest Group on Experiential Knowledge (EKSIG) is hosted by Design School Kolding and the University of Southern Denmark.

EKSIG2015: Tangible Means – Experiential Knowledge Through Materials aims to provide a forum for debate about materials as a means for knowledge generation by professionals and academic researchers, exploring the role and relationship of generating and evaluating new and existing knowledge in the creative disciplines and beyond.

These proceedings contain the papers accepted through double blind review for the EKSIG2015: Tangible Means held on 25th and 26th November 2015 at Design School Kolding and University of Southern Denmark.

Conference theme

In recent years many creative disciplines have shifted focus from what is produced to why it is produced and how it is used. This includes a growing interest for combining craft traditions with design and other related issues such as sustainability.

As early as 1983 Schön defined designing "as a conversation with the materials of a situation" (Schön 1983: 78) and the designer as a maker of things even though it is acknowledged that the concept of design can be broader than 'making things'. Also in the 1980s Manzini (1989: 17) pointed out a need for further development of cognitive tools and cultural references in order to catch up with the technical and scientific development of materials. Recently Karana et al. (2014) have expressed a need to study not only the functional but also the experiential side of materials. Thus, material knowledge is not only about 'scientific' facts such as functional and technical properties. It also encompasses personal, experiential, cultural, emotional, environmental and social aspects. In many disciplines, materials pervade all parts of practice, from the processes to the creation of artefacts and/or other kinds of physical manifestations and the interpretation through other professionals, such as curators, critics, historians etc.

With this conference, we wish to explore different ways in which experiential knowledge through materials can be given more appropriate consideration within the framework of research. This may include for example investigations into the nature, aims, validity, evaluation and/or necessity of different modes of communication and exchange.

References

- Karana, E., Pedgley, O., & Rognoli, V. (2014) (eds.). *Materials Experience: Fundamentals of Materials and Design.* Oxford: Butterworth-Heinemann.
- Manzini, E. (1989). *The Material of Invention: Material and Design*. Cambridge, MA: The MIT Press.
- Schön, D. (1983).*The Reflective Practitioner. How Professionals Think in Action.* London: Ashgate.

Questions of interest are for example:

- What do we mean when we say 'material knowledge'?
- What are the current understandings of material as a knowledge generator?
- Why might materials be important for any research conduct?
- How can materials be utilised within the framework of research?
- How can we articulate material knowledge, which might be tacit and embodied within the process of research?
- What frameworks are there to guide the communication of material knowledge?
- What differences are there between the pure sensing of materials and sensing of materials in a context?
- What means and methods can be utilised to transfer and replicate material knowledge?
- How can knowledge about materials be integrated and used within the framework of research?
- How can we articulate and/or communicate material knowledge within the process of research?
- What contribution can the use of creative practices make to the understanding and communication of material knowledge in research?
- What means and methods do we have to transfer and iterate material knowledge?
- What and how can we know from materials through research regarding the aspects of personal, experiential, cultural, emotional environmental and social issues?

Responses

As in previous years, the conference call received a great international response with submissions from 20 countries including Australia, Belgium, Brazil, China, Denmark, Finland, Greece, Indonesia, The Republic of Korea, Italy, The Netherlands, New Zealand, Norway, Portugal, Singapore, Spain, Sweden, Switzerland, UK and USA.

Submissions were interdisciplinary and stem from a variety of disciplines and discipline areas including design, fine art, applied art/craft, architecture, design engineering, museology, film making, knowledge management, education, philosophy and social sciences.

For the conference, contributions were selected in a one-stage process, comprising full paper selection, through a double blind review process by the conference's international review panel of 52 reviewers. From the contributions, the following eight sessions emerged: Means, Touch, Elements, Hands-on, Materials, Building, Patina and Oxymorons. Each session deals with one aspect of material knowledge and in total the sessions cover the widest possible understanding of experiential knowledge through materials.

EKSIG

EKSIG is part of a program of Special Interest Groups set up by the Design Research Society (DRS) to facilitate international exchange and advance in relevant areas of design. EKSIG is concerned with the understanding and management of knowledge in research and professional practice in design and design related disciplines in order to clarify fundamental principles and practices of using practice within research, both with regard to research regulations and requirements, and research methodology. The EKSIG conferences are part of a regular programme of the EKSIG group. They serve to bring together researchers and practitioners from different disciplines and to promote understanding and best practice concerning the integration of different forms of knowledge within design research and practice.

The EKSIG conferences are part of a regular programme of the EKSIG group. They serve to bring together researchers and practitioners from different disciplines and to promote understanding and best practice concerning the integration of different forms of knowledge within design research and practice. EKSIG promotes a multidisciplinary approach to engender multi-vocal debates and cross-fertilisation between the creative disciplines and other practice-led disciplines, including contributions from the design disciplines (design, engineering, craft, media etc.), philosophy, education, health and knowledge management that are concerned with methods and methodology in research and in creative and professional practice; with the nature, role, and management of knowledge within research; and with the role and use of creative practice (both as process and outcome) as a means by which to develop and manage experiential/tacit knowledge within research.

For EKSIG 2015 grateful thanks are expressed to: Design School Kolding and University of Southern Denmark for supporting the conference, the keynote speakers, the 52 members of the Review Team who facilitated the rigorous paper review process and finally the delegates who made the event possible.

Kolding, November 2015
Anne Louise Bang, Jacob Buur, Irene Alma Lønne & Nithikul Nimkulrat

Organisation

Organisers and review team

Conference Organisation

EKSIG 2015 is organised by members of the DRS Special Interest Group on Experiential Knowledge, and supported by the Design Research Society. The conference is hosted by Design School Kolding and University of Southern Denmark. Estonian Academy of Arts and University of Wolverhampton co-organised the conference. The conference is further supported by the Cumulus Association.

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KEYNOTE SPEAKERS

The Socio-materiality of Creativity

Prof Lene Tanggaard
University of Aalborg, Denmark

Biography

Lene Tanggaard is Professor of Psychology in the Department of Communication and Psychology at the University of Aalborg, Denmark, where she serves as co-director of The International Centre for the Cultural Psychology of Creativity (ICCPC), and co-director of the Center for Qualitative Studies. She has published several books and papers in the field of creativity and learning. Recent publications include Tanggaard, L. & Stadil, C. (2014). Showering with Picasso – how to spark your creativity and imagination. London: LIU Publishing and Tanggaard, L. (2014). Fooling around: Creative learning pathways. Charlotte: Information Age Publishers.

Abstract

This keynote takes its point of departure in an investigation of the potentials of looking at creativity from a socio-material analytical point of view. A socio-material perspective underlines that creativity is much more social and everyday like than has hitherto been acknowledged; materiality and arte-facts are to be seen as substantial components of creativity in itself (Tanggaard, 2013). In relation to current research on creativity within psychology and beyond, this is a rare point. It is still very common to state that “creativity is assumed to be present within every individual, although geniuses are rare” (Zeng, Proctor & Salvendy, 2011, p. 25). The source of creativity is time and again seen as residing within individuals. Furthermore, the result of creativity is often celebrated as a more or less individual achievement and creativity is still closely aligned with the exceptional and the genius (McDermott, 2006). As recently stated by Moghaddam, much psychological science, and I would claim psychological research on creativity, suffers from the ‘embryonic fallacy’ meaning that the independent individual is seen as the source and center of psychological experience (Moghaddam, 2010). This presentation aims at developing the socio-material perspective in more detail, which requires that theoretical elaborations and empirical studies go hand in hand. Examples from a recent study of a designer’s work will be presented as part of the keynote. —

Design for Material Experiences

Dr Elvin Karana
Delft University of Technology, The Netherlands

Biography

Elvin Karana is an Assistant Professor in the Faculty of Industrial Design Engineering (IDE) at Delft University of Technology (DUT), The Netherlands. She undertook her PhD research at DUT, where she developed a 'Meaning Driven Materials Selection Tool' to support designers in their materials selection activities. Since then, she has been leading a number of research projects focusing on design for material experiences. In her work, she proved the notion of 'materials experience' to be actionable in design thinking and applicable to both in design practice and design research. Elvin is the main editor of "Materials Experience: Fundamentals of Materials and Design" (2014, Elsevier).

Abstract

Materials research constantly evolves to offer novel, superior materials as 'better' alternatives to convention (e.g. bio-based plastics, piezoelectric textiles, temperature sensitive polymers, advanced ceramics). As a priority, the pursuit of 'better' in newly developed materials should make sense from the perspective of bringing a utilitarian and environmental advantage. Yet, when embodied in daily products, a new material also brings the possibility of new sensations, thoughts, feelings, and behaviors. In search of a proper application through such an understanding, designers may arrive at an embodiment that as far as possible not only meets the practical demands of the design but also offers intangible sparks (Karana, Pedgley, & Rognoli, 2015)* that captivate people's appreciation and affect the ultimate experience of a product in and beyond its utilitarian assessment. I propose that designing with emerging materials through the lens of 'materials experience' is a powerful strategy to introduce those materials to societies through applications that make sense and give sense, and hence possibly shorten the gestation time of a materials innovation. However, this is far from straightforward. The potential experiences of the unfamiliar, the unusual and the rare emerging materials are often challenging to envision and to design for. In my presentation, I will introduce a method we have recently developed to facilitate 'designing for material experiences' when a particular material is the point of departure in the design process. I will illustrate how the method is applied in practice through a number of material driven design cases conducted within our research group over the last couple of years. —

* Karana, E., Pedgley, O., & Rognoli, V. (2015). On materials experience. Design Issues, 31(3). 16-27.

Harvested and Grown: The Rise of a New Bio-materiality

Prof Carole Collet
Central Saint Martins, University of the Arts, UK

Biography

Carole Collet is Professor of Design for Sustainable Futures and Director of the Design & Living Systems Lab at Central saint Martins, University of the Arts, UK. She has dedicated her career to develop a new vision for design, and pioneered the discipline of Textile Futures at Central Saint Martins fifteen years ago. She is now a full time Professor and her current research work is focused on biodesign, biofacturing and high-tech sustainability. Collet operates within a long-term framework and her research targets the year 2050 and beyond. By anticipating on future key socio-economic factors and technological timelines, she aims at impacting today's design directions so as to enable a more resilient and sustainable future. Her design vision fosters an integration of the design process in scientific arenas so as to develop meaningful sustainable future products and services. Collet's ambition is to elevate the status of design to become a powerful tool that contributes to developing innovative paths to achieve the 'one planet lifestyle'. Her recent curation of 'Alive, New Design Frontiers' (www.thisisalive.com) questions the emerging role of the designer when working with living materials and technologies such as synthetic biology and clearly establishes a new original framework for designing with the living. It is in this key area that her contribution to new knowledge is recognized at international level. One of Collet's characteristics is that she straddles different research roles, from designer, to curator and educator. This enables her to develop an informed critique of both the design outputs and the design contexts, from making knowledge to framing knowledge. Her work has been featured in international exhibitions and she regularly contributes to conferences on the subject of textile futures, biodesign, biomimicry, synthetic biology, future manufacturing, sustainable design and climate change. Collet is a prolific design researcher and works at local, national and international levels.

Abstract

We are in the midst of a transition from the industrial revolution to a biological revolution and this will have a great impact on what and how we design in the future. Not only we can acknowledge the advantage of biological systems in terms of zero waste, minimum use of energy and materials, but with synthetic biology, we can now 'biofabricate' like Nature does. Leather grown in a lab, yeast reprogrammed to produce silk, bacteria that grow a shoe, are but a few examples of current biotechnological breakthroughs. This keynote will map out the current landscape of biodesign and examine the rise of this new bio-materiality and its implication on design research. From botanical experiments to synthetic biology propositions, this paper will present a series of design case studies that question the notion of 'knowledge making' in the context of working with living systems. What becomes of the design process when working with living materials? If we can turn a yeast into a living factory, what language will designers need to learn? Could the intersection of design and biology lead to novel sustainable fabrication processes? What are the ethical implications of biofabrication? —

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PLENARY SESSION – OXYMORONS

Materials, Time and Emotion: how materials change in time?

Eline Nobels, Ghent University, Belgium

Francesca Ostuzzi, Ghent University, Belgium & Politecnico di Milano, italy

Marinella Levi, Politecnico di Milano, Italy

Valentina Rognoli, Politecnico di Milano, Italy

Jan Detand, Ghent University, Belgium

Abstract

During their lifecycle, objects shift from their initial state of perfection, in which they are conceived by designers and industrial production, and approach an imperfect status. This is shown by changes that impact shape, surface and material properties, due to usage and time. In this paper we focus on the passage of time and its consequences. For some materials ageing is negatively addressed as decaying, for other ones it may have a positive effect to be defined as evolution or maturation. What are the factors that lead to a positive or a negative perception of ageing objects? In other words, what parameters and emotions are ultimately bonded to the idea of evolution or decay? Our main intent is to move the first steps needed to answer these questions to support designers during the phase of material selection. Thanks to an experiment conducted on 25 persons, this paper validates a method to identify the properties subject to time and quantify their variations, which influence the varying user's perception. During the experiment it stood out that materials and their change in time play a crucial role.

Keywords:

properties of materials; time; material experience; selection of materials; expressive characteristics

Change is everywhere. Everyday objects are subject to evolution as they mutate and grow older. They move away from their initial state of perfection, in which they are conceived by designers and industrial production, and approach an imperfect status. This is shown by changes that impact the shape, the surface and material properties. The agents responsible for this are mainly time and usage.

Industrial design usually produces objects to be used in the future, but rarely investigates how these objects will change in time. Some interesting researches did take into account this important variable [1] but only on a theoretical level [2]. To get more practical we focused our attention on materials as they play a crucial role in the products ageing dynamics. Nowadays designers select materials based on various engineering parameters (for example: optical, mechanical and processing properties) and on, for example, the expressive and sensorial characteristics [3]. Several studies have evaluated the importance of material selection in the design process [4 - 8]. Time is here considered, but only as an expression of durability whereas it is really an important agent in the mutation of some properties that influence the user's perception.

The goal of this paper is to validate a method to identify the materials properties subject to time and quantify their variations, which are influencing the changed user's perception. In our opinion, in the future these properties variations should be included in the materials selection process. On one hand it has become more important, in an environmental sustainability perspective, to design consistently with the objects lifespan. On the other hand lifespan is often a function of the obsolescence, especially if psychologically driven. In literature there are many studies focused on the evaluation of aging-obsolescence relations.

Wooley [9] has already correlated life cycle phases with users' changes in satisfaction levels. In his study pleasure is closely linked to satisfaction. He found that it is extremely difficult to separate physical decline of products over time from growing dissatisfaction. Furthermore the emotional evaluation of products [10, 11] has been studied for the past 15 years, also in relation to materials [12]. These studies have had the merit of focusing on the user's emotional mechanisms and have brought significant results, including a catalogue of emotions that influence design and the addressing of specific tools able to qualitatively evaluate these emotions. In addition we can also find important examples in literature where ageing and durability have already been analysed together [13].

This is our studies' starting point, we will further focus our practical investigation on the specific aspects of materials' time ageing and its relation with user perceptions. The next two paragraphs present the theme of time in design and analyse the benefits of including it in the design process. Following that, we evaluate the links between materials, time and emotions with the purpose of conducting the first estimate of the chosen method and tool in our pilot study.

Time in design

One of the major challenges for designers today is to give the right consideration to time, especially in our fast-replacing goods society. It may be aimed to an enhancement of the product's life span or to maintain consistency between a material and the intended usage [14]. But it does not necessarily mean making objects more robust or easier to repair. By focusing only on the mechanical/constructive optimization of product design, the risk is having to deal with long-lasting junk rather than longer-lasting products [15]. To avoid product obsolescence, a possible approach is to allow products to evolve together with their owners, enabling them to reveal their beauty with time [16]. Many objects lose value in time because they lose newness, which is the attractive factor in the purchase phase. Newness is a complex mixture of different sensorial properties like odour, shiny colour and the integrity of surfaces.

Many objects are already designed this way. A copper dome for example will gain value in time by turning green exposed to air oxidation. It will not lose its importance or public appreciation for that. This is an example of *patina*. Patina shows the passage of time and is the balance between the functionality, the material choice and the meaning of the object. Despite these gross inconsistencies patina is, indeed, a necessary – if not imperative – design consideration to assist the extension of product lifespans in graceful and socially acceptable ways [13]. Designers should value such material ageing properties.

Value of time

For some materials ageing is negatively addressed as decaying, for other ones it may have a positive effect that can be defined as evolution or maturation. But speaking of materials and their relation with time, what is actually driving our judgment? What are the factors that lead to a positive or a negative perception of ageing objects? In other words, what parameters and emotions are ultimately bonded to the idea of evolution or decay?

Decay is intended as the passage from an optimal initial situation to an inferior condition. In this common understanding, time and usage leave traces or defects on the products considered. This is an association that generally involves artificial materials such as metals or polymers, which tend to deteriorate, losing their original mechanical and aesthetical properties. Among the negative consequences of ageing, decay includes spots, rust, scratches, turning yellow, losing brightness and so on [17]. On the other hand, *maturation* is usually associated to natural-based products, like those made of stone, paper, wood, leather, which in time gain new fragrances, colours and consistencies. These newly gained properties confer an added value, a sense of preciousness. An old leather purse, a painting on an aged frame or an oxidized bronze statue: these are all examples of tangibly aged objects that have not lost their beauty and keep on attracting us. Both artificial and natural materials are subject to a similar chemical and physical degradation in time (exposure to the atmosphere, UV rays, humidity). It would be wrong to associate a positive evaluation of a certain class of materials with their ability to be positively affected by time.

The negative aura of artificial materials being old is related to the idea of failure. They are materials created by us, meant to shine and saturated in colours. If they get old, their decay is our failure. In 2004 the Eternally Yours foundation launched a survey, Proud Plastics, in order to understand what was the common perception of plastics [1, 18]. "It is OK for wood to become old and dirty. You can't blame it; it is its nature. But plastics were invented. So when they become ugly, when they melt or crack, you blame the inventors. They should have done a better job."

The challenge for designers could be to handle not only natural-based materials but also artificial materials in a more conscious way, especially when it comes to time passage. This could also lead in the future to a less critical (if not positive) perspective on ageing compared to the present one described. We therefore decided to focus our research on polymeric materials. Plastics are the materials associated with design, thanks to their versatility, which opens fields to creativity. "Plastics technology strongly helped design to grow as a profession. On the other hand industrial design contributed to shape plastics into products, their end-form and also by promoting their image through the invention of new cultural codes" [19]. We've chosen polymers also because they perfectly represent this dilemma between ageing and artificiality. Moreover, from a sustainable and environmental perspective, it's important to remember how plastics account greatly among "dismissed" products every year [20]. Waste production represents an important loss of material and energy resources and for this reason it's essential to avoid or delay as much as possible the number of products that are sent to waste.

Finally our main focus is firstly on the qualitative understanding of the user-product relation with old products and materials, and secondly to develop an analysis able to inform and eventually inspire designers while starting a new design process. In this study our attempt is to validate a method (composed by a series of tools) useful to relate material parameters with users' perceptions and emotions in time. For our investigation we used the following polymeric materials: ABS, PC, PET, PMMA and PP.

Tools

It was necessary to identify the analytical tools for the sensorial properties evaluation (called S*ensorial level*). In order to identify the most suitable tools we proceed with a literature review, specifically focusing on the evaluation of the user's emotional variation towards new and aged products. Emotional variations bonded to the *Product experience* [21] were also analysed. Product experience is defined as the research area focused on individual experiences and the user-product relation.

We investigated the role of materials and their emotional impact, also known as *Material experience* [3], which is a part of the product experience and plays a fundamental role in how products are lived. Material experience is defined by the effects involved in the user-product bond – limited to a specific context. Today there exist many tools that allow an evaluation of product and material experiences. Desmet [10] offers a broad classification of those tools, grouping them into two categories. Firstly, there are verbal evaluating tools, where the user is asked to share his individual emotions through evaluation scales or written protocols, for example the Kansei Method [22], Self-Assessment Manikin [23] and the SEQUAM Method. Secondly, nonverbal tools determine affection bonds through the analysis of the physiological or expressive reactions the tester shows against different products. Examples of such tools are EMG (facial electro-myographic activity) and Face reader [24, 25]. The limit of these tools is that they do not allow consideration of contrasting emotions at the same time.

The tool we selected for our research is the software PrEmo developed by Pieter Desmet [26]. It allows us to combine the pros of both verbal and non-verbal methods, measuring emotions even if they are contrasting among each other and without requiring a verbal emotional analysis to the tester. This tool has been developed for *Product experience* evaluation but has also been validated for its use in *Material experience* by Gaia Crippa [12], who has used it for an emotional evaluation of different material samples.

Study

We carried out two different tests on a panel of 25 participants. The goal of the first test is evaluating the ageing effects on products (characterized by different shapes, colours and functions) made of different specific materials. The second test is focused on the same materials, but now taken as samples. The scope of the second test is to evaluate the ageing of the material itself more precisely. This is possible by changing the material variable but fixing shape, dimension, function and colour.

The main goal of these two tests is to verify the usefulness of the chosen tools, when used to check the influence of materials decay on emotional and sensorial perception.The tests are meant to set a first step in understanding the physical and emotional variables that influence the perception of being old (linked to a specific material). In this first step we set the base to understand which is the best method to identify all these variables. To design products more situated in time, this knowledge identification will be useful for designers by supporting the material selection process.

Method

Participants

Our panel is made up of 25 Italian subjects, aged between 20 and 60. Gender equality was taken into account, with 12 females and 13 males. The age distribution of the respondents was 72% people aged between 20 and 30, and 28% aged between 30 and 60. We also considered the cultural background, which turned out to be the most important variable [27].

We divided the subjects into 2 categories:

- *Naive* (12 persons) who don’t belong to the design field and without specific knowledge about materials.

- *Professionals* (13 persons) selected between students from the master in Design and Engineering in xxx University.

Stimuli

As mentioned before, 5 different polymeric materials were selected, two transparent and three opaque:

- PC (polycarbonate)
- PMMA (polymethyl methacrylate)
- ABS (acrylonitrile butadien styrene)
- PET (polyethylen terephthalate)
- PP (polypropylene)

These materials can worthily represent the designer's world of materials. They are also enough differentiated in terms of optical, structural and sensorial properties. Elvin Karana demonstrates in her study [28] that the shape of a product can influence its evaluation. In particular the perception varies considerably between round- and sharp-cornered objects. Also the context of use influences the product experience and perception. One material can create different emotions depending on the context of use (kitchen products or office products). Furthermore, dimensions are also important, for example small products stimulate more sensorial description than bigger objects because we interact more with them. [28].

Following requirements were taken into account while choosing products for the Test 0:

- Formal simplicity, little details, constant thicknesses and homogeneous geometry;
- Single-matter products, allowing evaluation of only one material per time;
- Small dimensions: to stimulate interaction and handling of the products;
- Uniformity on the context of use.

The artefacts we selected for the first test are kitchen products (see Fig. 1):

- a potato peeler in ABS;
- two glasses in PC and PMMA;
- two small containers in PC and PET.

Maximum dimensions are 130 x 130 millimetres and all products present round-cornered shapes and constant thicknesses.

For Test 1 we limited variables as chromatic aspect and geometry. The samples are all squares of 100 x 100 mm, with a constant thickness of 3 mm (see Fig. 2).

Fig 1. Artifacts used in Test 0

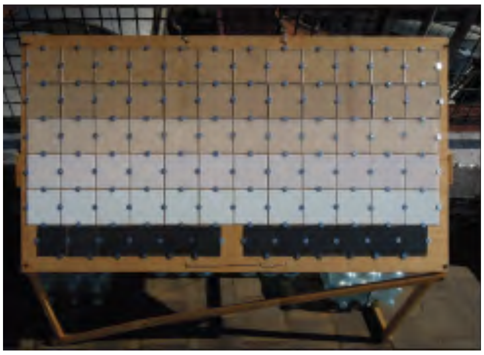


Fig 2. Aging set up of polymeric samples for 5 different materials, used in Test 1

Ageing process

The objects from Test 0 have been artificially aged via UV-rays exposure – Helios Italquartz high performance UV lamp with mercury vapours source [29], 500 W electric group, exposure duration of 120 minutes. All samples' surfaces were treated with fine "glass paper" (M622 type) to simulate the product's impact abrasion in a normal life cycle. This choice was made to focus on the material rather than the product. The objects have been aged in accordance to ASTM D1435 [30] and the *Natural Weathering* technique. The samples form Test 1 were exposed in Milan on a wooden frame inclined by an angle of 45° degrees facing south for hundred days (between June 24th 2012 and September 21st 2012). During the whole period of exposure, temperature was monitored daily (maximum and minimum recorded) along with humidity (maximum and minimum recorded), wetting and global irradiation. An example of the samples of the new and aged samples can be seen in figure 3 and 4.

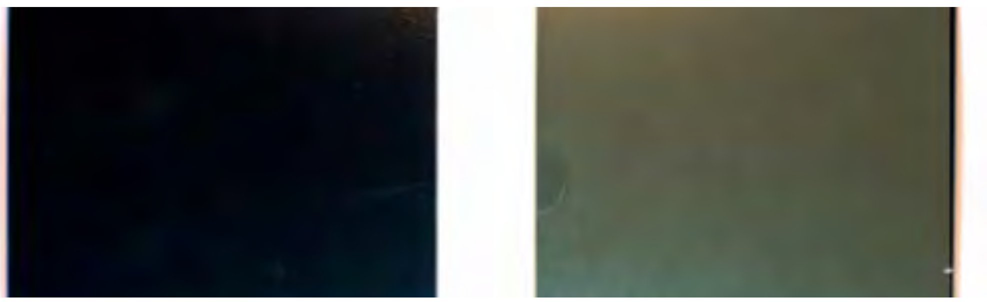


Fig. 3 Example of new (left) and aged (right) ABS

Fig. 4 Example of new (left) and aged (right) PP

Procedures

We then conducted Test 0 (on artefacts) and Test 1 (on samples) in two sequential phases:

- Phase 1: the emotion evaluation with PrEmo [31];.
- Phase 2: the sensorial evaluation with a 1 to 5 scaled questionnaire.

Phase 1

Participants had to evaluate five sample pairs. For each pair one material was aged and the other one was new. The test was conducted with PrEmo [10], a tool especially designed to evaluate product-generated emotions. PrEmo is aimed to comprehend and evaluate emotional responses to products. It evaluates twelve emotions – six positive (desire, satisfaction, pride, hope, joy, fascination) and six negative (disgust, dissatisfaction, shame, fear, sadness, boredom). Each emotion is pictured as an animated character and the emotional intensity level is graded on a five points scale. Each participant has evaluated the samples individually and in the following sequence: new ABS, aged ABS, new PC, aged PC, new PET, aged PET, new PMMA, aged PMMA, new PP and aged PP. All samples were lying on a table and participants were entitled to look and touch the samples during the evaluation. Instructions were shared verbally in Italian with the aid of a short tutorial video. An average evaluation time of 10-12 minutes per participant has been recorded even though no time limit was imposed.

Phase 2

Participants were asked to evaluate the sensorial properties of the materials based on a questionnaire developed by Elvin Karana in her study Meanings of materials. This was done through sensorial properties and manufacturing processes [32]. The questionnaire presents a list of 13 sensorial properties (hard/soft, smooth/rough, matte/glossy, reflective/non-reflective, cold/warm, non-elastic/elastic, opaque/transparent, tough/ductile, strong/weak, light/heavy, washed-out/colourful, pleasant-/unpleasant-sounding, scented/odourless) consisting one page per material. Each parameter is linked to a representative icon and a brief description of the relevant property. The participants were asked to evaluate the intensity of each property on a scale from -2 to +2.

Results

The collected data were analysed on three different levels:

- the correlation between emotions and aged products,
- the perception of aged materials;

• the correlation between perceptions and emotions.

The analysis was abstracted from the materials themselves. Consistently with the aim of this research, our analysis is based on mathematical methods rather than statistical ones. Our intention was to propose a method to obtain time-, perception- emotion- and material-related data and an analysis of the above. Not to obtain data directly usable by the designer. This is a topic that we intend to address in the future. Our results show clearly how emotions (and their variation) are strongly dependent on the link between the user and the differently aged products. This function, calculated for each emotion, reaches its maximum at 30% (fear – PMMA) and has a minimum at 1,25% (shame – ABS). This is shown in figure 5. The results are in accordance with previous studies' hypothesis [13, 33]. We therefore had a confirmation of the reliability of our tool with the hope that in the future it will return objective and quantitative data relevant to measure these perception-variations.

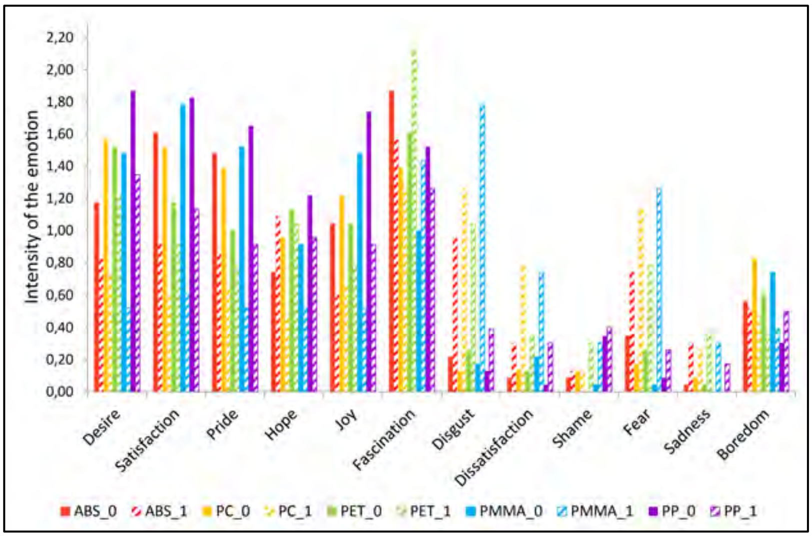


Fig 5. Results of Test 0

The two tests are comparable. From our data analysis it is clear how emotional and sensorial variations are proportionally related to the ageing shown by materials. More specifically, among the materials in both tests the emotional variations average is directly comparable to the sensorial variations' one. This comparison is 0,44 versus 0,48 in the products test (see Fig. 6) and 0,22 versus 0,22 in the samples test (see Fig. 7). An increase in the material decay directly implies a variation in the user's emotional reaction.

TEST 0	ABS	PC	PET	PMMA	PP	Average
Desire	0,35	0,83	0,3	0,96	0,52	0,59
Satisfaction	0,7	0,91	0,26	1,17	0,7	0,75
Pride	0,61	0,74	0,22	1	0,74	0,66
Hope	0,35	0,48	0,09	0,39	0,26	0,31
Joy	0,43	0,57	0,26	0,96	0,83	0,61
Fascination	0,3	0,13	0,52	0,43	0,26	0,33
Disgust	0,74	1,13	0,78	1,61	0,26	0,90
Dissatisfaction	0,22	0,65	0,22	0,52	0,26	0,37
Shame	0,04	0	0,3	0,26	0,05	0,13
Fear	0,39	0,96	0,52	1,22	0,17	0,65
Sadness	0,26	0,17	0,35	0,3	0,17	0,25
Boredom	0,04	0,35	0,26	0,35	0,2	0,24
Average	0,37	0,58	0,34	0,76	0,37	0,48

TEST 0	ABS	PC	PET	PMMA	PP	Average
Cold-warm	0,22	0,22	0,04	0,09	0,26	0,17
Hard-soft	0,17	0,17	0,26	0,17	0,04	0,17
Smooth-rough	0,56	1,39	1,09	1,35	0,14	0,91
Light-heavy	0,17	0,13	0	0,26	0	0,11
Tough-ductile	0,26	0,09	0,26	0,26	0,13	0,20
Not elastic-elastic	0,22	0,04	0,13	0,09	0,09	0,11
Strong-weak	0,09	0,17	0,17	0,04	0,16	0,13
Opaque-transparent	0,05	1,13	0,52	1,17	0,05	0,58
Matte-glossy	0,52	1,29	1,32	1,57	0,2	0,98
Not reflective-reflective	0,41	0,74	0,68	0,5	0,3	0,53
Faded-saturated	1,57	1,41	1,77	1,13	1,31	1,44
Nice sound -unpleasant sound	0,17	0,04	0,04	0	0,22	0,10
Odorless-odorous	0,64	0,41	0,32	0,05	0,05	0,29
Average	0,39	0,56	0,51	0,51	0,23	0,44

Fig 6. Results of Test 0

TEST 1	ABS	PC	PET	PMMA	PP	Average
Desire	0,32	0,27	0,55	0,18	0,23	0,31
Satisfaction	0,41	0,18	0,55	0,41	0,14	0,34
Pride	0,09	0,18	0,5	0,32	0,05	0,23
Hope	0,14	0,23	0,36	0,05	-0,5	0,05
Joy	0,36	0,41	0,23	0,55	0,41	0,39
Fascination	0,32	0	0,18	0,23	0,45	0,24
Disgust	0,32	0,36	0,32	0,14	0,82	0,39
Dissatisfaction	0,18	0,23	0,09	0,09	0,64	0,25
Shame	0,05	0,05	0,05	0,09	0	0,05
Fear	0,05	0,18	0,14	0,09	0,41	0,17
Sadness	0,05	0,18	0,09	0,05	0,23	0,12
Boredom	0	0,23	0,14	0	0,09	0,09
Average	0,19	0,21	0,27	0,18	0,25	0,22

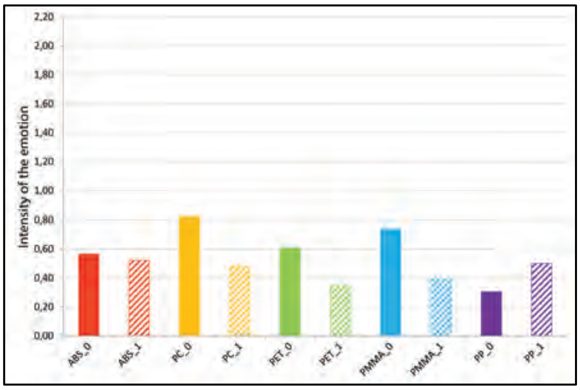
TEST 1	ABS	PC	PET	PMMA	PP	Average
Cold-warm	0,18	0,5	0,09	0,14	0,5	0,28
Hard-soft	0,64	0,05	0,18	0,05	0,09	0,20
Smooth-rough	0,18	0,14	0,27	0,14	0,27	0,20
Light-heavy	0,23	0	0,07	0	0	0,06
Tough-ductile	0,09	0,05	0,32	0,23	0,05	0,15
Not elastic-elastic	0,14	0,09	0,05	0,09	0	0,07
Strong-weak	0,18	0,23	0,14	0,14	0,14	0,16
Opaque-transparent	0,09	0,09	0,05	0,09	0,05	0,07
Matte-glossy	0,64	0,03	0,05	0,19	0,73	0,33
Not reflective-reflective	0,73	0,32	0,36	0,14	0,41	0,39
Faded-saturated	0,95	0,52	0,52	0,47	0,29	0,55
Nice sound -unpleasant sound	0,05	0,18	0,05	0,05	0,05	0,07
Odorless-odorous	0,18	0,05	0	0,05	1,05	0,26
Average	0.33	0,17	0,16	0,14	0,28	0,22

Fig 7. Results of Test 1

Following Russell's model 'circumflex of emotions' [34], where each emotion is defined based on the perception intensity (exciting - not exciting) and on its pleasure, we can note that disgust and satisfaction, which are each other's opposites, are more often related to new and old products. The emotional variation involves all levels of sensorial perception. Without generalizing the obtained data in an absolute way, it is significant to note how disgust grows passing from the new to the old product and satisfaction decreases in every sample pair. From the analysis on sensorial variation (Level 2) it is clear that with product ageing all four photometric properties also vary: transparency, brightness, reflectance and saturation. Six of the seven textile properties remained constant, like all sound properties of the objects.

The tests confirmed how sight is the most important of our sensorial perception abilities and it dominates the process of emotional evaluation of products with different ageing degree. These results are in accordance with the scientific community leading opinions and confirm how through sight we evaluate the universe around us [35]. A particular clear link is shown with the research of Shifferstein [36], relative to 45 industrial products where, through the development of a few tests, it is highlighted how products' sensorial evaluation happens first through sight, followed by touch, odour, hearing and taste. Sight is the dominating sensorial mode because it is the first step in our experiencing. Textile properties furthermore have the capability to maintain the emotional bond generated within the user in time, as opposed to sight properties, which are related to more formal and superficial aspects that tend to dissipate their importance in time.

The results obtained confirm tendencies already investigated by others. Only some cases are of more particular interest and may be somewhat astonishing (refer for example to boredom and fascination shown in figure 8 and 9).



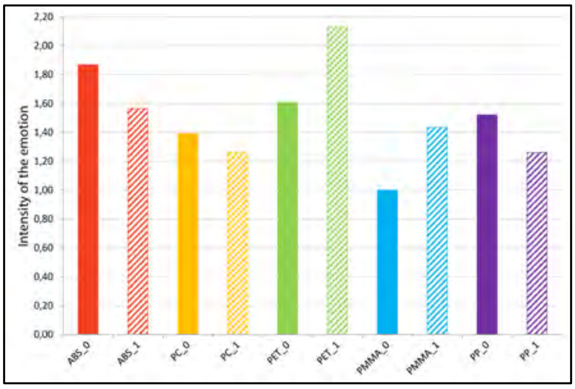


Fig 8. Results of Test 0: Boredom

Fig 9. Results of Test 0: Fascination

Firstly this means that it's important to consider the dependence on time as this has an actual impact. Secondly that the selected tools are consistent for obtaining a quantitative analysis of the phenomena related to product ageing. It is crucial to consider such parameters, their variation and their emotional impact in early design phases, especially for products that are intended for an extended life cycle.

Conclusion

The study shows how time acts on materials by changing their meaning and their expressive characteristics. Our goals have been in summary:

- Focus on materials to understand what role materials play in product's ageing and how they influence the user's perception by acting on his emotions;

- Extend this analysis (product and material experience) tying it to real products, used and aged – not new or abstract ones.

The intent was to comprehend, first in a qualitative way, if these ageing phenomena can cause a variation on the user-product emotional bond. The aim has been to highlight the relationship between materials, structural properties, perceptions, emotions and time. This done, our future intention is to deepen this issue to inspire future research. The experimental part of this paper aimed to identify and validate a method able to include time among the parameters useful in material choice, basing this choice on an expressive-sensorial base (qualitative analysis). Even if limited for their number, the data obtained through our testing show clearly how perception (emotional and sensorial) varies greatly between new and old products. This change depends on the type of emotion involved and the material ageing entity. This means that in time the user-product bond varies as a function of the material's specific properties. In our opinion this is an aspect of great interest also for future developments in the field of design. Thanks to the tests developed it has been confirmed how shape, function and colour of the product influence its ageing and the perception of it significantly [37]. A direct comparison among the different test results (test 0 and test 1) seems therefore irrelevant. Also, the participant's panel size is too small to extend generically the quantitative conclusions of our results. We also didn't want to focus on a statistical analysis before having validated a method thoroughly.

The tools used, PrEmo [31] and the iconographic questionnaire [32], have proven to be adequate for evaluating the material experience on objects exposed to different ageing stages. In the future we intend to obtain quantitative data through the execution of the tests presented in this paper to an extended number of participants, adding a statistical evaluation to our analysis. We also want to reorganize the results in order to define them better as a tool for designers and companies, a tool useful in a long-term perspective of product design.

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