HOW DO MATERIALS OBTAIN THEIR MEANINGS?

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Product designers are expected to create products transferring certain 'meanings'. Materials of products are used for supporting the intended meanings in product design; one material may convey luxury, another material can be associated with a particular culture. Designers who aim to select a material that will contribute to the meaning they intend to convey in a product are confronted with the difficulty that the materials universe is immense. Moreover, traditional sayings such as 'wood is cozy', 'metal is aloof' or 'plastic is cheap' are less relevant and strict in today's design practice. Without a doubt, having insights into the role of materials for creating particular meanings has become more and more relevant in the domain of design.

It is to be expected that materials are attributed different meanings in different products and contexts, affected by certain key variables. How do we experience materials around us? When do we think that a certain material is modern, elegant, sexy, feminine, or professional? This paper focuses on the main findings and implications of a Ph.D. research on 'meanings of materials'. In this paper, the following two questions are addressed: (i) can a meaning be embedded in a material? and (ii) what are the key variables affecting the attribution of meanings to materials? In answering these questions, results from a literature review and a study conducted with 32 Dutch and Chinese participants are discussed. The paper ends with a discussion on existing materials selection sources and materials education in design.

INTRODUCTION

Products require a set of parameters to be met by materials (e.g. handles of kettles are made of nonconductive materials to protect people's hands). Mayall (1979) talks about the 'psychology of materials', which refers to the kinds of affordances a material offers. Norman (2002, 9) directly explains the affordances of materials: "Glass is for seeing through, and for breaking.

Figure 1. Silicone garlic peeler: garlic cloves are rolled in the silicone to remove the peel.

Figure 2. Examples of materials used for creating tactual experiences in chair design: Blow Lounge Chair, made of polyurethane foam, by Foersom and Hiort- Lorenzen; and Vermelha, made on a steel frame and bound with acrylic based rope covered with cotton, by The Campana Brothers.

Figure 3. Wooden iPod (middle and right) designed by Joshua Driggs.

Figure 4. Foam Bowl designed by Marcel Wanders.

Figure 5. Plug container produced by inflating polished stainless steel without molds, designed by Stephen Newby.

Wood is normally used for solidity, opacity, support, or carving… ". Thus, every material fulfills a particular function and this inevitably affects designers' material choices. Materials can stimulate designers to create new shapes, new solutions and new mechanisms for existing needs (see **Figure 1** for example).

Designers use materials to create sensorial experiences with products. Materials, for instance, have been a convenient tool for designers in designing chairs to create sensorial experiences particularly to gratify tactual senses (**Figure 2**). Materials are used as the symbols of beliefs; they convey meanings and elicit emotions.

A number of product examples exist for which the designer's material preference is led mainly by conveying an idea of 'self identity' for the user, even though the chosen material is not the most convenient for the intended form, use or ease of production. The 'Wooden iPod' exemplifies one of these cases (**Figure 3**). The designer Joshua Driggs specified African Padauk wood for the product. When he was asked if it was still possible to "scroll" with the click wheel, by dragging one's finger over the new wood surface, he answered, "I used a very thin and strong double-sided

tape to hold the click wheel and select button in place. Also a good air-less contact is necessary to ensure that the touch-sensitivity of the click wheel is preserved though the thicker coating on top". Apparently, 'wood' neither provided an added functional value in comparison to the original material specified by Apple, nor was it the most appropriate material to reproduce an iPod from, since the original form of the product was particularly given for 'ease of production for plastics'.

Materials can be symbols and legacies of design approaches to support form and function. Wood, ceramics and stone, for instance, are very often used in Zen design, which is considered as a balance between detail and ease of use, particularly in East Asian cultures such as Japanese, Chinese and Korean. Moreover, materials can be used for conjuring up different associations. Marcel Wanders designed the *Foam Bowl* which was created by dipping a sponge form into fluid porcelain clay. After drying, the piece is fired in an oven where the sponge burns away leaving only the porcelain in its place. The physical properties of porcelain enabled the designer to successfully implement this production technique and to create a sponge association with the aesthetic properties of the material (**Figure 4**).

The material used in a product can elicit various emotions such as surprise, disgust, disappointment, curiosity etc. Ludden (2008), in her doctoral research, focused on surprise experiences that are elicited by incongruent sensory information in products. In several experiments, she explored 'visual - tactual incongruities', which are elicited mainly through choices of product materials. An example product with visual- tactual incongruities is a vase that looks like a crystal vase but is in fact made out of plastic (polycarbonate). Owing to its material, the vase is much lighter than people would expect. Materials can also drive technological developments in manufacturing processes, directed at enhancing the form possibilities that can be achieved with those materials. The plug container in polished stainless steel designed by Stephen Newby presents metal in a form that we are not used to seeing, which might elicit surprise (**Figure 5**).

To sum up, materials affect various aspects in product design such as form, function, manufacturing technologies, etc. and they are used for creating sensorial experiences. In addition to these aspects, materials are used to convey meanings and elicit emotions. Designers tend to invent their own ways (or just use their intuitions) in putting these (intangible) concerns into practice in their material decisions (e.g. selecting materials for emotional experience), because there exists no common systematic approach for supporting designers in involving these concerns into their selection processes (Arabe, 2004; Hodgson and Harper, 2004; Karana and van Kesteren, 2008; Ljungberg and Edwards, 2003; MacDonald, 2001; Sapuan, 2001; van Kesteren, 2008; Zuo et al., 2005).

The starting point of my Ph.D. research (Karana, 2009) stemmed from the following statement: designers need insights into the role of materials for creating particular meanings attributable to products. This statement required a deep understanding of the key variables affecting the meanings we attribute to materials. The goal was to explore how materials 'obtain' their meanings and how materials 'cooperate' with other elements of product design (such as form, function, use, and target users) for expressing certain meanings. This paper summarizes the main findings of the Ph.D. research. The following section discusses whether a material can have an inherent characteristic (or a meaning). Then, the 'interactional' approach in meaning attribution and the key variables having roles in

attributing meanings to materials are explained. The paper ends with a discussion on a need for an 'integrated method' for supporting designers (and design students) in their materials selection processes.

CAN A MEANING BE EMBEDDED IN A MATERIAL?

Several examples can be given where the meanings conjured by a material 'act as if' they are intrinsic characteristics of that material. The value and durability of dinnerware, for instance, was associated with the rigidity, coldness and weight of 'ceramic' for a long time. Ceramic still seems to be the most hygienic, long-lasting and valuable material for dinnerware (Lefteri, 2006). Metal connoted precision and was used to emphasize technological superiority and high-level engineering for years (Arabe, 2004). Wood is warmer and cosier than many other materials and carries associations of craftsmanship. Ljungberg and Edwards (2003) also talk about the specific qualities expressed through materials. They state that a plastic remote control does not give the feeling of high quality compared to a heavier version with a metallic case. In all these examples, meanings are conventionally attached to materials by people. Recognition of a material and a prevailing use of it stimulate the emergence of those meanings to behave as if they are a material's intrinsic qualities.

Certainly, materials have a history, which helps us to assign meanings to them even when they are not embodied in products. In the past, manufacturing technologies were limited. A certain material was used in products with generally similar forms and functions (such as ceramics prevailingly used for dinnerware, or metal embodied in sharp edge forms for machinery). Improvements in manufacturing technologies and materials science have stimulated new materials and forms in product design. Now, metal can appear in organic forms and high-tech ceramics are used in electronics. As a result of this, a material is "like an actor, it can assume many different personalities, depending on the role it is asked to play" (Ashby and Johnson, 2002, 73).

According to Manzini (1986), there has become a 'loss of recognition' of materials since the introduction of plastics. Many new kinds of plastics have emerged in the last decade. Each has different properties and is used in a variety of products. Lefteri (2006) explains how the definition of plastics has changed, from being an environmental 'criminal' to a material that comes from nature and returns to nature with the emergence of ecological plastics. In brief, the meanings fixed to a material have loosened. Histories of materials are shifting. As stressed by Wilson (1988), children whose first experience of the world comes from Toys 'R' Us may develop a different set of material values than adults who grew to maturity surrounded by wood, stone, and metal.

Materials do not have meanings unless we interact with them in a particular context. And without a doubt, any material can inherit any meaning in a particular context. This thought gave rise to a very important question: how can designers manipulate the creation of meanings in materials selection when working in an era of such a booming number of materials and products? In order to answer this question, we first needed to find the key variables in attributing meanings to materials.

KEY VARIABLES IN ATTRIBUTING MEANINGS TO MATERIALS

Key to our understanding of meaning is the recognition that people distinguish materials in everyday experiences not only by technical functions but also according to what the materials mean to them. In other words, we attribute meanings to materials around us: a material may look modern or traditional, feminine or masculine to us. Meanings of materials in this research consist of expressive/semantic and specific associative characteristics, both of which are used for defining the qualities of materials. 'Meanings of materials' are what we think about materials, what kind of values we attribute after the initial sensorial input in a particular context.

There are many definitions of meaning stemming from different disciplines, each dealing with language, psychology, behavior and experience. The proponents within disciplines do not always agree with each other, with the result that many more definitions within a single domain become engendered (Osgood et al., 1957). Nevertheless, definitions of meaning, in general, are apt to simplify how humans tend to relate one thought to another. In linguistics, meaning is the content carried by words or signs exchanged by people when communicating through language. One who is interested in meaning creation encounters three main perspectives in literature: (1) a perspective taking the object as the center of meaning creation, (2) a perspective taking the individual as the centre of meaning creation, and (3) a perspective taking the interaction between object and individual as the centre of meaning creation.

According to the first approach, meaning is in the object and it is expressed through formal characteristics of the objects such as shape, lines, size and colour etc., whereas in the second approach, meaning is in the head of the individual and constructed in a mental process, in which the individual's memories, associations and emotions play a primary role. Central to the third and last approach was Dewey's notion of experience (1980), which says that meanings are constructed in our interactions with objects, and both an object's formal properties and the individual who perceives the object play a role in the construction of meanings. Following this last notion, in our view the meaning of a material is constructed on the basis of material properties, the product the material is embodied in, how we interact with it, and the context in which the interaction takes place. An individual's previous experiences, memories, associations, emotions, cultural backgrounds and so forth can all be influential in particular situations. These components of a situational whole (e.g. material, product, context and individual) for a particular meaning- material relation are central in the construction of a meaning evoking pattern (Karana, 2009).

The aim of the work that followed this definition in my PhD research was to show the appropriateness of the interactional approach in attributing meanings to materials. For this aim, we looked for the main factors that play a crucial role in our experiences of materials. We had a couple of tentative ideas about these factors based on the related literature (e.g. on meaning, materials selection, product design, etc.) and the seven descriptive categories in materials experience presented in an earlier study (Karana et al., 2008) (**1**). For instance, in 'materials selection' literature, sensorial properties of materials, shape, function and manufacturing processes are recognized as the most important factors affecting designers' material decisions (Ashby, 2005; Ashby and Johnson, 2002; van Kesteren, 2008). In 'meaning' literature, the role of user, use (interaction) and context
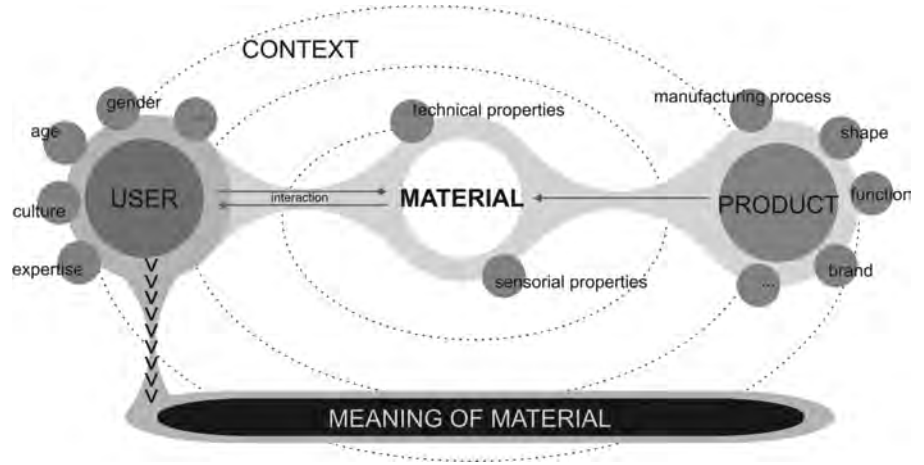
1. The first attempt in this research was to look for 'the aspects playing an important role in experiencing materials' in people's verbalizations. For this aim, we asked people to describe materials (materials as words, material samples and materials in products). In addition, we explored several sources (design magazines, materials selection books, etc.) in order to collect items used for describing materials. We came up with 687 descriptive items and classified them into seven descriptive categories: (1) use descriptions, (2) manufacturing process descriptions, (3) technical descriptions, (4) sensorial descriptions, (5) expressive/semantic descriptions, (6) associative descriptions, and (7) emotional descriptions.

Figure 6. Meanings of Materials Model.

Figure 7. Sensorial properties that are more commonly used for attributing meanings to materials.

is emphasized in the attribution of meanings to artifacts (Johnson, 2007; Krippendorff and Butter, 2008). The seven descriptive categories also covered the mentioned factors (e.g. sensorial properties, manufacturing process, use, etc.). Keeping them in mind, we conducted a set of qualitative studies (Karana and Hekkert, 2008), in order to look for these factors (and for others if they existed) in people's explanations of materials expressing certain meanings (**2**).

Consequently, we developed the Meanings of Materials Model (**Figure 6**). The Meanings of Materials (MoM) Model depicts the dynamic action between a user and a material in which the material obtains its meaning. A user with his/her particular characteristics interacts with a material of a product, appraises it and attributes a meaning (or meanings) to it. The attributed meaning will be (partly) based on the material's technical and sensorial properties and is affected by aspects of the *product* in which the material is embodied. A material's meaning can change, depending on the user-material interaction, which is affected by use and time. The model shows that each component has a number of aspects (e.g. shape, manufacturing process, gender, expertise, etc.) that can influence the meaning attribution to materials. Finally, the context in which the material of the product is appraised may have a considerable effect on meanings attributed to materials, and is therefore shown as enclosing the entire process of user attribution of meanings to materials.

After developing the MoM Model, we conducted a number of studies in order to further understand the interrelationships between certain variables of the model, which also show the main components of a meaning evoking pattern. In the following paragraphs, the main findings regarding the key variables in the attribution of meanings to materials and their implications are briefly discussed.

Sensorial Properties

In the field of product experience, a number of studies have been conducted to explore how various sensorial modalities shape our experiences (such as Cardello and Wisse (2008) on taste and smell, Sonneveld (2007) on tactual experience, van Egmond (2008) on sound). Even though in these studies the focus is mainly on a particular sensory modality, it is emphasized that richer experiences can be achieved by the stimulation of a greater number of sensory modalities at one time
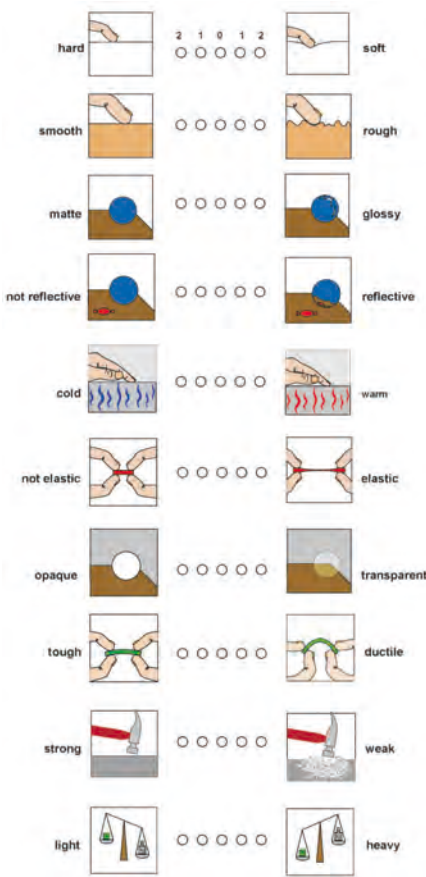
Figure 8. Stimuli used in a study to explore user-material-product interrelationships.

(Schifferstein and Spence, 2008). In our research, after conducting a number of studies, a set of sensorial properties grouped under different sensory modalities was listed (**Figure 7**), and promoted as the properties that are more commonly used for attributing meanings to materials (Karana et al., 2009). In literature, it is revealed that visual and tactual information are primarily important in user-product interactions (Nefs, 2008; Schifferstein and Spence, 2008; Sonneveld, 2007). In parallel, our list of sensorial properties showed that materials experience is also dominated by visual and tactual information. In order to provide designers with a manageable list of properties, we needed to select the properties that are relatively common or prevailingly used by designers. For instance, certainly, designers use *smoothness* more often than *odour* to convey meanings through materials. Nevertheless, a particular property that was not present in our final list could still be effective in a specific circumstance (e.g. the odour of a wooden object played an important role in one participant's selection of a *nostalgic* material). Schifferstein (2006, 60) emphasizes that "the role of senses is likely to depend on the specific products used, the frequency with which they are used, and the importance attached to the activities performed". Thus, how we interact with a material can have an important effect on our appraisal of that material. The importance of a sensorial modality may also be different before and after purchase. While vision is primarily dominant during the acquisition of a product, the importance of other modalities often increases significantly after purchase (Fenko et al., 2007). Even though we assume that knowledge regarding the relative importance of certain sensorial properties is important for designers, future research is recommended with a particular emphasis on the effect of the properties of different sensory modalities on materials experience.

In another study (Karana and Hekkert, in press), we saw how two different types of materials (families) can affect the overall impression of a product. The role of two product aspects (shape and function) and two user aspects (gender and culture) in attributing meanings to two materials, plastics and metal, was tested in that study. The stimuli were 'waste baskets' and 'lighters' made of the same types of metal and plastic (**Figure 8**). The participants (sixteen Chinese- eight male, eight female; mean age 25.4 years, range 23-30 years and sixteen Dutch- eight male, eight female; mean age 24 years, range 21- 28) were presented with the eight products one by one. Together with each product, the participants were given a page

2. A previous study was conducted in order to select a number of meanings which are relevant for material appraisals, and which are clear and understandable for measuring spontaneous responses of users on stimuli. The meanings used in this current study were selected from five conceptually different sets of meanings, which were extensively reported in a previous paper (see Karana et al., 2007a): aggressive-calm, cosy-aloof, elegant-vulgar, frivolous-sober, futuristic-nostalgic, masculine-feminine, ordinary-strange, sexy-not sexy, toy-like-professional. These meanings were used in different phases of this research across four years.

with 7-point scales presenting nine meanings with their opposite poles (aggressive-calm, cosy-aloof, elegant-vulgar, frivolous-sober, futuristic-nostalgic, masculine-feminine, ordinary-strange, sexy-not sexy, toy like-professional). In the study, we consciously focused on main material families (i.e. plastic and metal). It should be recognized that different types of a certain material family, for example polypropylene, titanium, etc., can create different meanings in similar products. Moreover, the meaning of a material can change in different products; it can be different for different people of different cultures, in different contexts, or at different times. Therefore, it is difficult to generalize the findings of the study in order to propose definite ways for creating particular meanings through materials. However, the results of the study (which are discussed in the following paragraphs) showed that the concept of meaning requires designers to understand how people experience materials in daily life, instead of making material decisions based on gut feelings.

Metal was perceived as more 'elegant', more 'futuristic', more 'frivolous', 'sexier' and less 'toy-like' than plastics in the overall evaluation. Interestingly, plastic products were perceived as more masculine than metal ones. This unpredicted result showed that a material can create impressions that differ from its usual or enduring image (which very much supports our main assumption). All other aspects, such as shape, function and culture, can be effective in this unexpected result. What we found in informal discussions with people was that the differences between two materials as noted through their sensorial properties had an important effect on people's evaluations.

Shape and Function

In shape-material relations, we focused mainly on an evaluation of rounded and sharp-edged geometries. The main reason behind this was the related literature and our findings from previous studies (Karana et al., 2007b). We found that there is a relationship between geometrical shapes and the meanings people attribute to materials. Generally speaking, all the main effects of shape on materials' meanings were as expected in this research. For instance, the materials of rounded shape products were evaluated as cozier, sexier, more elegant and less masculine than the materials of sharp-edged products.

In function-material relations, we found that 'function' had main effects on almost all meanings raised in the research. The materials of lighters were found more 'elegant', more 'futuristic', more 'frivolous', 'more aggressive', 'sexier' and less 'ordinary' than the materials of wastebaskets. However, these findings did not explain if shape and function affected particularly the materials' meaning or they affected the overall impression of the products. Without a doubt, we know from experience that we cannot always easily look beyond a whole product and evaluate its individual aspects such as its shape or material. However, in controlled experiments, we can see how these aspects interact with each other. MATERIAL-SHAPE interaction, for instance, reached significance on attributing the meaning 'futuristic'. Rounded shaped plastic, for example, was perceived as more futuristic than sharp-edged plastic, whereas metal was perceived more futuristic when it is shaped into a sharp-edged product. The change in the type of material affected the main effect of FUNCTION on attributing the meaning 'toy-like' to materials. Materials both of wastebaskets and lighters were perceived as more toy-like when they are made of plastics rather than metal. This effect, nonetheless, was higher on wastebaskets than

on lighters. These findings clearly showed that both shape and function interact with materials when seeking to express certain meanings (see Karana and Hekkert (in press) for detailed explanation).

User Aspects

Gender and culture were the two user aspects that we focused on at different stages of this research. Most studies focusing on gender reveal that there are significant differences between men and women in their experiences of the world (Cardello and Wise, 2008; Dalton et al., 2002; Mojet et al., 2001). Gender differences are, therefore, important to consider in product development and evaluation (Cardello and Wise, 2008). In our study conducted with metal and plastic lighters and waste baskets, we saw that females were more sensitive to variation in the materials than men. In other words, whether a product was made of metal or plastic made a greater difference to the evaluations of females. The GENDER-MATERIAL interaction was significant for the meanings 'futuristic', 'sexy' and 'toy-like'. Whether a product is made of metal or plastics is more important in attributing the meanings 'futuristic', 'sexy' and 'toy-like' for females than for males. A significant gender difference was also observed for the meaning 'ordinary': females found the materials used in our study in general more ordinary than males.

Culture, on the other hand, generated the most interesting and strongest results among user aspects. CULTURE-MATERIAL interaction was uncovered for the meanings 'elegant' and 'sexy'. Chinese participants, for instance, found plastic products sexier than metal products, whereas Dutch participants thought that metal products were sexier than plastic products. We made a speculative discussion on these findings. Understanding 'why people differing in culture or gender attribute different meanings to materials', however, requires a more thorough study which falls beyond the scope of this research.

Type of Meaning

Throughout this research, we saw that when people were asked to select materials that they thought expressed particular meanings (such as aggressive, professional, nostalgic and sexy, etc.), their selections indicated that any material could be attributed any meaning (e.g. metal can be professional and aggressive, as well as nostalgic and sexy). Nevertheless, we also saw that some materials are more easily associated with some meanings than other materials (e.g. people tend to select metal products for the meaning professional). The meanings on which people highly agree with each other are more easily linked to (or associated with) formal properties of materials and products. In other words, as mentioned before, there are user-product relationships which stimulate us to assign meanings to materials in particular situations. In this research, we saw that there are situations in which a meaning is attributed to a material primarily on the basis of an individual's own experiences, memories or associations. On the other hand, we also saw patterns expressing a particular material-meaning relationship shared by members of a group.

This stimulated us to run another statistical test to explore which of the meanings generated a high 'level of agreement' among Chinese and Dutch people, and which of the meanings produced differences between the two

cultures. Agreement among Chinese participants on all meaning scales was very low in general and it was consistently lower than agreement among Dutch participants. This result indicated that the meanings were not recognized and easily associated with materials by Chinese people. Johnson (2007) stresses that meanings are often social and carried out by more than one individual organism. In Krippendorff's words (2006, 175), "the medium in which culture is in a continuous process of being negotiated is language, conversation, and discourse." Following these references, we explained the findings of the study with two main rationales: (1) the 'meaning' of a particular meaning and the patterns evoking this meaning can be more lucid for a specific culture; (2) certain cultures are more familiar with some materials than others, thus the more the individuals of a culture are familiar with a material, the more they agree on the meanings that the material evokes. Another interesting result of the study was that levels of agreement in the overall evaluation of some meanings were very high, which means that the patterns that evoke these meanings were similar for both cultures. 'Ordinary', 'sexy' and 'elegant' were three of these meanings. Our attempt was to show that some meanings are more easily associated with material and product features, and on some meanings people of two different cultures can significantly agree with each other. To explore in detail the meanings of materials that are universally accepted (or agreed upon), or those that significantly differ between cultures, can be a valuable contribution to the design domain.

Interaction, Use and Context in Meaning Attribution

Hekkert et al. (in press) emphasize that the user-product relationship is part of a larger context which consists of all kinds of factors, e.g. social patterns, technological possibilities, and cultural expressions, that affect the way people perceive, use, experience, respond and relate to products. These actions constitute the nature of 'human-product interaction' (Hekkert, 1997). The effects of these contextual factors on the interaction are mediated by the concerns of the user in terms of goals ('what we want'), standards ('how we believe things ought to be'), or taste ('what we like') (Ortony et al., 1988). One of the theories of meaning coined by Krippendorff (2006) is concerned with artefacts in use and explains how individuals understand their artefacts and interact with them in their own terms and for their own reasons. The theory is grounded in Ludwig Wittgenstein's (1999) suggestion to locate the meaning of artefacts (for Wittgenstein: words) in their use. It also builds on Gibson's (1979) ecological theory of perception but goes beyond it by focusing on users, interactions and the dynamic nature of use, and not only on what objects essentially afford. During the studies conducted for this research, we observed that how we interact with materials and the meanings we attribute to them could change as a result of previous use. The attribution of meaning is a dynamic and continuous process (Johnson, 2007; Krippendorff, 2006; Osgood et al., 1957) and our understanding of artefacts and the emotions that they elicit change through use and over time (Desmet, 2002; Ludden, 2008).

Any theory on meaning reflects the role of context, which refers to a situational whole from which we ground the meanings we attribute to our world. Krippendorf and Butter (2008, 362) explain 'context' as:

> "It denotes the surrounding conditions of something that shed light on its meaning. Regarding texts, most words are ambiguous by themselves – note how many meanings a dictionary typically lists for a single word. In the context of a larger discourse, however, word meanings are usually singular

and clear. Similarly, by themselves, artifacts may not mean much unless they are placed in a particular environment in which they play recognizable roles."

We encounter a particular material in different contexts in daily life. Without context things could not makes sense to us. Meanings we attribute to a porcelain tea pot would be different when it is in our own kitchen, in our grandparents' kitchen, on a console in a living room, in an antique shop's window, under a dim lighting of a restaurant, or on a picnic table, etc. Thus, there are a number of contexts in which we experience artefacts. A decent example is given by Krippendorff and Butter (2008, 365) referring to a movie titled *The Gods Must Be Crazy*. They explain the Bushmen's first experience with an empty Coke bottle thrown from a plane. Having never seen a glass bottle before, the Bushmen look for all kinds of contexts of use for it in order to attribute meanings:

> "In a place without rocks, the hardness of the bottle encourages its use as that we would call a pestle for smashing roots. Its smoothness is seen to aid the flattening and stretching of snake skins. Its opening finds its use as a stamp for decorating a garment with circles".

The point of the anecdote is that artefacts used in various contexts present us with rich and diverse experiences in real life. In this research, we came across several examples in which people explained their meaning-materials relations by referring to their contexts (e.g. materials used in an office environment, materials used in factories, etc.). However, it is difficult to estimate in which kinds of context a particular material is used by an individual in his/her daily life. In literature, it is emphasized that context is limitless in size and therefore it is recommended to communicate with people and find out in which context their artefacts are used and what those artefacts mean to those people in their contexts of use (Krippendorff and Butter, 2008; Poole and Folger, 1988; van Rompay, 2005).

DISCUSSION

The meaning of a material is a relational property involving interactions between users, products and materials. These interactions cover many aspects such as technical, functional, aesthetic, etc. Product designers are responsible for considering these interactions in order to use materials efficiently to transfer certain meanings. In other words, materials are selected for creating certain experiences with their physical entity as well as intangible characteristics. In brief, as discussed throughout this paper, too many variables are simultaneously effective in selecting materials in a design process. On the other hand, materials are still predominantly taught as a separate (and technical) domain for design activity and material knowledge is usually transferred without considering user experiences and user contexts. The sources aiming to support designers in their material decisions are dominated by technical (or engineering) information; thus designers primarily use their gut feelings or their common senses for conveying meanings through materials.

In informal discussions with design students, we saw that students also find it difficult to integrate their technical material knowledge in design practice. Scholars in the domain emphasize that since design students find it difficult to integrate technical materials selection into their design processes, they usually leave their material decisions to the very last phase of their design processes or they avoid using new materials or learning new material applications or manufacturing processes (Ashby and Johnson,

2002; Karana, 2009; Pedgley, 2009; Rognoli and Levi, 2004; Sonneveld, 2007; van Kesteren, 2008). Without a doubt, the industrial design discipline approaches materials selection differently than engineering or applied science disciplines. A new method for materials selection, which involves different variables in materials experience (as explained in this paper) is needed for teaching materials in design.

CONCLUSION

No simple rules exist for explaining meaning-material relationships. In other words, it is not possible to locate a design method that will guarantee material 'x' will evoke meaning 'y' in product 'z'. In order to understand the roots of a material's meaning, designers should look beyond obvious properties and avoid constructing one-to-one relationships between material properties and meanings. They should understand how certain aspects interact with each other in order to create a particular pattern for expressing a certain meaning. To sum up, designers, for an appropriate selection of materials, should be able to comprehend the dynamic character of the issue and find the meaning evoking patterns for a specific user group, in specific contexts and at a certain time. For an effective selection of materials in design, an integrated approach should be followed which incorporates both tangible (i.e. technical) and intangible (i.e. meanings) aspects of materials.

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MALZEME ANLAMINI TAŞIMAYA NASIL BAŞLAR?

Ürün tasarımcılarından belli *anlam*ları yüklenebilen ürünler tasarlamaları beklenir. Dolayısıyla ürün malzemeleri amaçlanan anlamları desteklemek açısından kullanılır; bir malzeme lüks durumunu iletirken, ötekisi tikel bir kültürel durumla ilişkilendirilebilir. Ürünün anlamını ürünün malzemesine yükleyerek katkıda bulunmaya çalışan tasarımcılar, seçtikleri malzemenin (anlam) evreninin geniş olması gibi bir zorlukla karşı karşıya kalırlar. Bunun yanısıra, *ahşap sıcaktır*, *metal uzak durur* ya da *plastik ucuzdur* gibi geleneksel kabulleri yansıtan deyişler, bugünün tasarım pratiğinde daha az anlamlı ve daha az kesin olduğu akılda tutulmalıdır. Kuşku yoktur ki, tikel anlamları yaratmak ve iletmek için malzemenin rolüne ilişkin öngörüler geliştirmek tasarım dünyasında giderek daha da önemli bir yere sahip olmaya başlamıştır.

Ürünlerin türleri ve bağlamlarına göre malzemelerine farklı özellik atıflarında bulunmanın, belirli anahtar değişkenlerin etkisi çerçevesinde oluştuğu söylenmelidir. Çevremizdeki malzemeleri nasıl deneyimleriz? Bir malzemenin modern, zarif, seksi, kadınsı ya da mesleki olduğunu ne zaman düşünebiliriz? Bu makale 'malzeminin anlamı' üzerine yapılan bir doktora tezinin belli başlı bulgu ve izlenimlerine odaklanmıştır. Bu çerçevede yazıda, a) anlam malzemeye içkin olabilir mi?, ve b) malzemeye anlam yüklememizde etken olan anahtar değişkenler nelerdir? gibi iki soru gündeme getirilmektedir. Bu soruları yanıtlarken, 32 Hollandalı ve Çinli katılımcı ile yapılan bir araştırmanın sonuçları ile arkaplan teorik tartışması kullanılmaktadır. Yazı günümüzde yapılan malzeme seçiminin kaynakları ve tasarımda malzeme eğitimi üzerine bir tartışma ile sonlanmaktadır.

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