
ABSTRACT

The materials used in the manufacture of consumer products become the media by which the interface between the consumer and the designed product is perceived. The consumer perception of these products is strongly influenced by their sensory interaction with the materials through the different sense perception.

Hence the selection of a material in the design for a manufactured product is influenced greatly by the user's perception of the material based on sensory properties such as color, texture, smell...

This paper will present a « sensorial profile » as a technique for designers based on sensorial properties of leather product. This tool can be used to characterize the consumer preferences, the material selection by designer.

In this study after developing some descriptors affecting leather sensory perception, we have proposed a method representing those lexicons to compare different leather's samples and finally, we have used those diagrams to compare some leather finishing.

KEYWORDS: Leather, sensorial properties, tactile, visual, olfactory perception.

INTRODUCTION

A major concern of designers of consumer products is how their products will be perceived in the market place. Hence the selection of a material for a manufactured is influenced not only by the physical properties but also by the user's perception of the material based on sensory properties such as color texture and smell.

The sensory design is a design that affects the five senses of the human being. This sensory design highlights from the buyer the use of different meanings to cause the act of consumption and improving the sensory properties of the product.

Material characterization and sense perception become with big importance. In this context, many studies enhance the design of new tool, Karana et al. 2010 [1] described the development of a new materials selection tool which considers certain aspects such as product personality, user-interaction, meanings and emotion.

Sonderegger and Sauer [2] examined the effects of product aesthetics on several outcome variable in usability tests. Many designers consider such tools as an important part of their idea development process. Visual and tactile, olfactory assessment is considered by many as an essential part of the experience of physical interaction with form and material.

Products on today's markets are technically mature. A differentiation by conventional criteria is increasingly difficult or even impossible for the customers. Subjectively influenced factors replace clearly defined technical attributes as criteria for differentiation. Therefore it is necessary for manufacturers to identify those product characteristics which are perceived by the customers and influence their quality rating. This paper presents a sensory method to detect the customers' leather perception and rating of leather and artificial leather surfaces.

Leather is used in this study because it is a material that has characteristics that affect the senses of the human being with its original smell, touch and textures.

In this research, we will analyze the perception of leather: the tactile, visual and olfactory perception to assess the leather material, by designing a leather sensorial profile.

Designers can appreciate the subtle, tactile distinction between synthetic leather and genuine leather, but it is important to be aware of the variance in their versatility, application and maintenance. Sensory characterization of such materials can use designer in selecting material.

MATERIALS AND METHODS

Method: The sensory design

Background

Engineering design is systematic and follows well-established and widely accepted procedures. The selection of suitable materials is based mainly on the physical properties and other factors, such as cost and density, meeting the design specification. Methods for the selection of materials are well documented [3, 4] and a number of software aids to material selection are now available.

Ashby and Johnson [5] argued that contemporary product design is achieved through an integration of good technical design to provide functionality, proper consideration of the needs of the user in the design of the interface, and imaginative industrial design to create a product that will appeal to the consumers at whom it is aimed. To overall character of a product is a combination of aesthetics, associations and perceptions that product carries [6].

In this context, integrating "sense" in design allows improving aesthetic and functional product's properties. Sensory design is based on consumer's perception, on his well-being, comfort...

Sensory design interprets a transformation of design which considers the visual sense, to a "multisensory" design. It is a design that gives perceive focused on the human approach is to measure, observe, understand, and identify how a product will be felt positively or negatively by the consumer on all sensory aspects of his entourage (colors, touch, smell, sound, brightness).

Sensory design is an approach that focuses on observing and analyzing user behavior and to invent an object that is suitable to them, taking into account the user experience in the design of a product.

Sensory design is becoming aware that the consumer sensory perception of product is a key element to be taken into account in all production process. Thus, sensory design takes into account the quality involved in the creation of a product concept that comes to enrich the intrinsic quality [7]. Indeed, the contributions of sensory design are numerous and allow a just creation, and understood, perceived, in connection with use and meaning.

Designers use sensory design because they consider it as a real opportunity to create value, differentiate and improve business performance, "Sensory design increases the emotional impact of the products and focuses on variables perceived sensations by the consumer". Indeed, we note that the sensory design, new engine for the company, can meet a quality requirement, seen as a driver of innovation in materials.

Some research was done by using sensorial properties, for example, the aim of a study reported by Vergara and al. [8] was to determine the influence of multisensory (visual-haptic) interaction and the level of interaction on the perception of products, including perceived ergonomics.

MacDonagh and al. [9], discussed an industrial designer's approach to eliciting user perceptions and emotional responses to products through visual evaluation and stimuli.

A fundamental interaction between a user and a product is physical touch and a significant amount of a perceived value of a product results from the initial touch experienced by the potential consumer.

The effect of material properties on the judgment of consumer products via the sense of touch was recently reported by Chen and al. [10].

According to Jones and al. [11], by carrying out controlled experimental research on texture, it has been possible to identify a way in which people subjectively describe a material by touch using a system of dimensions and texture lexicons. Texture lexicons are pairs of texture descriptive words, where each pair of words has bipolar meanings (e. g. warm- cold). It was proposed that subjective responses to a material texture can be described using different dimensions.

A successful product is not necessarily the one that arrives first on the market, but one that most affects our senses. Thus, to meet the requirements of a potential consumer, it is needed to fascinate, in reviving his moods, putting his senses and making him live strong sensory experiences.

This type of design can be applied to all types of materials and especially natural materials such as leather support our research.

Sensory design applied on leather

A strong concept demands the integration of many considerations. A single material or finish can inspire a design concept of the product development. The inherent poetry of a material can imbue a strong design concept with the powerful sense of experience and meaning, natural materials, including leather. Beyond the selection of materials lies an equally important consideration of use, application and detail of materials can reinforce design principles such as rhythm and repetition, scale and proportion, and unity and variety, thereby creating ideological links among material, spatial experience, and design intention.

In this sensory design framework applied to the leather we will try study sensorial properties of leather product to conceive a tool permitting to assess the leather sensorial perception and permitting to designer and consumer to select the suitable material.

According to Anne-Laure Guilleriet [12], today, the leather industry is valued at \$ 50 billion worldwide. The growth of industrialization has created a demand for new soft leathers ranges, flexible, and colorful leather with a fashionable appearance.

Indeed the importance of the leather market and the originality of this material for modern and traditional design, this paper presented « product personality profiling » as a new technique for designers such as “mood boards” helping to select the appropriated sensorial properties.

In this part we will deconstruct the senses (tactile, visual and olfactory perception) relating to leather to try to reconstruct those senses to design multi-sensorial profiling tool for assessing sensorial effect of leather material.

The first part of this research is to identify and research sensory descriptor by the results on prepared samples of natural and simulated leather. Leather was selected as it is generally regarded as a key material used in luxury products and brands.

First, participants were asked to perceive the texture, olfactory and visual aspects of the prepared sample via sense such as vision, touch and smell.

By this method it has been possible to identify a way in which people describe a material by sense using a system of dimensions and sense lexicons. Those lexicons are divided to lexicons describing touch perception, lexicons describing visual perception and lexicons describing olfactory perception, there are pairs of descriptive words, where each pair of words has bipolar meanings (e. g. warm- cold).

During the tests the participants were asked to complete a questionnaire based on the perceptions which are listed as follows:

1. Tactile perception based on Temperature sensation, friction characteristics, hardness.
2. Visual perception based on deformation, brightening, natural aspect, Surface / topography, regularity in structure,
3. Olfactory perception based on naturalness and freshness smell.

In these test the subjects stated their perception of the surfaces' characteristics as well as their visual perception and olfactory overall quality impression on a scale from 1-10. The descriptors used for the evaluation of the selected surfaces were previously identified, selected and defined.

Nevertheless, it has been possible to determine perception thresholds of 9 descriptors for the leather materials. Hence, there is still potential in the evaluation of the surfaces in terms of the remaining descriptors. Thereby human perception and the personal ratings of the subjects could be detected for each surface.

With these descriptors, a questionnaire is designed and tested at least 100 subjects according to the following figures:

- Consumers

One hundred persons (50 males, 50 females, age range 13–36 years) were tested.

- Stimuli

The stimuli for consumer comprised three types of leather; these were labeled with their digit identification numbers.

- Procedure

Consumers were tested individually. After the establishment of rapport and the collection of demographic details, the experimenter instructed the consumers in the experimental procedure. The experiment only begun when consumers had thoroughly understood their task and understand lexicons by leather sample references.

Therefore reference samples, which show the minimum and maximum value of each descriptor, are provided to consumer.

The first test was to compare sensory perception of real leather and artificial leather.

The second test was to compare leather finish.

- The tactile perception

It is the sense that allows us to know the textures (smooth, rough, bumpy ...). The texture is valued and appreciated almost entirely by touch, it is the memory of tactile experiences allowing us to appreciate the texture.

Touch remains one of the most important senses, because it is by far the most concrete. It is crucial to provide the texture and quality of the leather. When contact is established between the fingers and leather, among many parameters into account: if it is soft or rough, hot or cold, hard or soft, heavy or light...

A fundamental interaction between a user and a product is physical touch and a significant amount of a perceived value of a product results from the initial touch experienced by the potential consumer. The effect of material properties on the judgment of consumer products via the sense of touch was recently reported¹⁰.

The limits of touch require the physical presence of the product because it is the key to gain loyalty and develop sales saw the need for the customer to feel reassured and to better know the products they buy. But we see that there are companies that use technology in their sales Novels, such as the use of online shopping, in this case it is impossible to touch the product that you buy. So it is a necessity to design a sensorial profile for each product.

In this study, the used descriptors of tactile perception are: rough (smooth), warm (cold), dry (moist), Hard (soft).

- The visual perception

Leather is an attractive material by its different colors because the choice of colors influences the perceptions, emotions and cognitions; it is a means of communication. Thus, the visual perception adapts to customer requirements.

Furthermore, leather attracts the client's vision by the effects of their surface: polished, perforated ...

In this study, the used descriptors of visual perception are: shiny, natural looking and modern.

- The smell perception

The olfactory sense is the only one who can awaken memories deeply, these olfactory memories are acquired are stored in memory in early childhood and last a few years. So this perception awakens emotions and memories. The olfactory sense on the leather smell that is very tough and very strong. This natural smell is still in the same leather is old, some descriptors for leather smell are grouped under term, like amber. Indeed, the consumer discovers the quality of leather with its smell.

The used Descriptors of olfactory perception are: amber smell, fresh

The used descriptors for the different used sensorial properties are represented in the table 1

Material

This study was focused on leather material. The thereby developed methodology can subsequently be transferred to specify other kinds of surfaces (e.g. textiles). The determination of the human evaluations and ratings was carried out by using scientific methods from the field of sensory science and product research.

The compiled results will be used for quality evaluation and anticipation of possible human sensations, in order to ensure a customer-oriented and resource-efficient product development [13].

The originality of leather is one of its characteristics, this material that combines natural, versatility, toughness, ease of maintenance, beauty and sensuality. Leather over the years has produced products that reflect historical value with the contemporary and modern elegance.

The aesthetic appearance of the leather one of its characteristics is essentially based on respect for the natural characteristics, granular, roughness or smoothness, softness to the touch ... its color variations or united aspects, and textures. Indeed, these different sensorial descriptions the consumer can choose the leather that makes feel at ease and comfortable.

These characteristics make it unique. Adding to that, the great diversity of leather and each model is unique due to race, age and sex of the animal, but also his food and farming method.

Real leather and artificial leather samples

For the first aiming to compare real leather with artificial leather sensory perceptions, in total 3 surface variants were selected and analyzed: real leather, vegan leather and leatherette.

- The real leather

The real leather is a natural product and when choosing leather products, there is a trade-off between natural appearance, resistance, ease of care and comfort.

Leather material offer a unique and sober aspect, a soft and sensual touch and warm, natural smell. It brings comfort and reassurance.

- Vegan leather

The vegan leather is a man-made alternative to traditional leather obtained from animals. This type of material is often chosen for ethical reasons or as a material having a different way of use.

- Leatherette

The leatherette is a form of artificial leather, often designed using recycled plastics. The manufacture of this type of leather uses natural or synthetic fibers having added a PVC layer.

Leather finish samples

For the second test aiming to compare leather finish effect on sensory properties, in total 3 surface variants were selected and analyzed: aniline leather, semi-aniline leather and pigmented leather treatments.

Natural looking and durability can also be assessed for the studied samples.

- Aniline leather is defined as leather that has not received any coating of pigmented finish. The finish is transparent.
- Pigmented leather is leather whose surface has a finish containing pigment particles that render the finish completely opaque.
- Semi-aniline leather: is defined as leather which has been aniline dyed or stained.

RESULTS AND DISCUSSION

The work reported in this paper addresses material perception within the sensory domain and focuses on the user's perception of the material based on sensory properties which are: visual, texture and smell. Using specially prepared

samples based on the consideration that these materials are extensively used in the world and hold and hold particular cultural references.

Combining those senses allows a better material characterizing for selecting the suitable leather according to consumer perception.

Designed leather sensorial profile

Sensory profile of a product results in the establishment of a sensory map to locate the sensory characteristics of a product with different descriptors. For this sensorial profile a radar diagram is used.

Thus, we define for each descriptor a scale of 0 to 10 according to table 1:

- 0 corresponds to the total no satisfaction of the senses in question;
- 10 corresponds to a complete satisfaction of the measured direction,
- The values between 0 and 10 correspond to partially satisfactory sense of perception values.

Other descriptors may also be used such as those used in sensory analysis with panels and based on experts of touch, smell and appearance..

Comparison of real leather and artificial leather sensory perception

The designed sensorial profile permits to compare the sensory properties of the different samples real leather, vegan leather and leatherette, as shown in the figure 1.

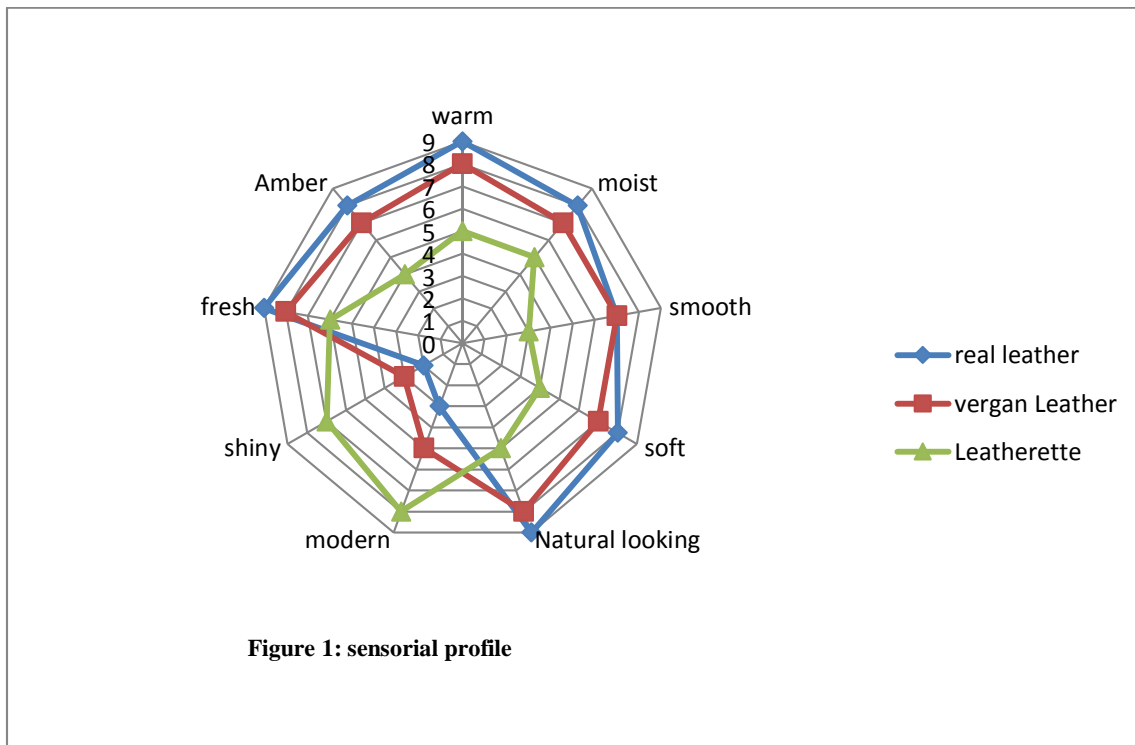


Figure 1: sensorial profile

This diagram indicates that Vegan leather and real leather has the almost tactile descriptors value, so the same texture and same tactile perception. So, the vegan leather which is a man-made can be an alternative to traditional leather obtained from animals. The olfactory perception is different but the visual perception is almost the same.

Tactile leatherette is different from the previous samples, this sample is not flexible, because the the manufacture of this type of leather uses natural or synthetic fibers having added a PVC layer. This material does not allow air to

pass. The leatherette is a form of artificial leather, often designed using recycled plastics. The olfactory peception of real leather is different from the other samples, so more research need to be done in this direction to improve this sensorial perception.

We can also, calculate for each leather' samples a tactile, visual and olfactory score.

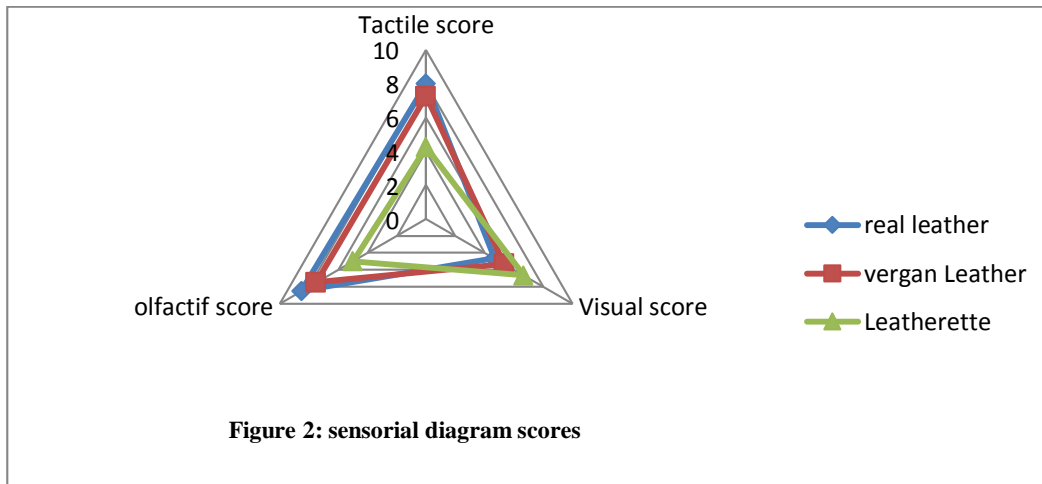
The sensory scores are calculating as follow:

$$\text{Tactile Score (TC)} = \sum_1^4 \frac{Ti}{4} \text{ where } Ti \text{ is the } i^{\text{th}} \text{ tactile descriptor value} \quad (1)$$

$$\text{Visual Score (VC)} = \sum_1^3 \frac{Vi}{3} \text{ where } Vi \text{ is the } i^{\text{th}} \text{ visual descriptor value} \quad (2)$$

$$\text{Olfactory Score (OC)} = \sum_1^2 \frac{Oi}{2} \text{ where } Oi \text{ is the } i^{\text{th}} \text{ olfactory descriptor value} \quad (3)$$

Those scores can be drawn in a sensorial diagram score as represented in the figure 2.



Finally, this diagram allow us to better evaluate these leathers products according to their sensorial properties, it indicates the better sensorial score for real leather, followed by vegan leather and the leatherette sample.

Comparison of leather finishing

This designed method is used to study the three leather finishing applied on the same leather material. The results of this comparision are represented in the figure 3.

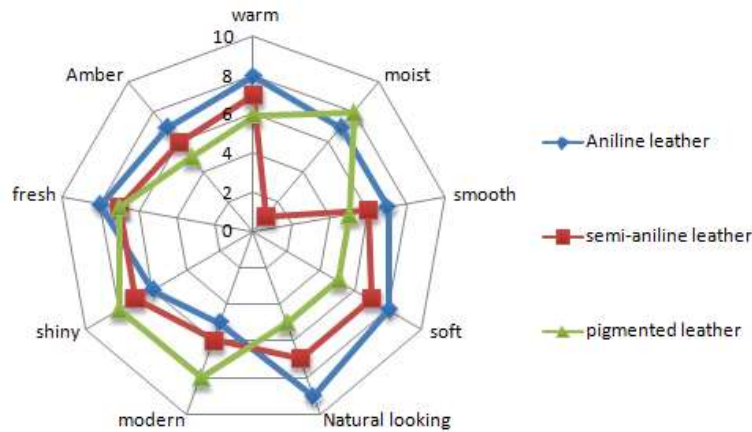


Figure n°3: sensorial profile

Figure 3 indicates that:

- Aniline leather which is defined as leather that received transparent finish is most natural looking because the original grain surface can be seen through the finish and it is the smoothest.
- Pigmented leather which is leather that received finish containing opaque pigment particles, is the most durable rough but is less natural in appearance.
- Semi-aniline leather that received aniline dyed finish, incorporating a small amount of pigment but not so much as to conceal the natural characteristics of the hide, has on one hand, natural appearance less than aniline leather but better than pigmented leather. On the other hand is smoother than pigmented leather, but rougher than aniline leather.

The results presented in this paper are the preliminary results of comparing leather sensory perception of different leather.

Extensive further testing is required to fully validate the results and those diagrams can assist in the selection of optimal material sensory properties

This study relating to leather will contribute to the development of a new database which will make it possible for designers and engineers, through innovative treatment and application of existing and emerging materials, to create artifacts more effectively by matching human perceptual, sensory and emotional expectation.

Finally the leather results can be included in a “sensorial profile” which can be accessed by designers and engineers.

This research presented a starting point for determination of sensory attributes associated with different leather samples and a lexicon that can be used for future research. Since this is a limited study of only three leather samples, more attributes may become apparent in future studies of other samples.

CONCLUSION

The engineered properties of materials, sensory properties, perceived images of a material in the human-product interface, referred to as the material representation, are investigated by sensorial approach with leather samples.

Our senses are both a weapon and a tool to evaluate a product and make a choice. These senses are in direct connection with our memory and their mission is to use our past and present emotions. They appeal to our memories to generate an emotion. The senses: tactile, visual and olfactory senses are related to the perception of leather that gives this material a touch of elegance and luxury. With the tactile sense we can discover textures, treatments ... This

sense of touch is very important, it allows the consumer to touch the leather to know his qualities and experience (smooth or rough example).

Different sensorial descriptors for tactile, visual and olfactory perception are proposed to leather sensorial characterization. Sensory diagrams are proposed in this framework, they can be used as tools to characterize the sensorial perceptions of leather material, and they permit also to compare real and artificial leather and the different leather finish effect on the sensorial perception. Those diagrams can be considered as sensorial profile of material that helps both designer and consumers to select the most suitable leather according to the wished sensorial properties. The designed sensorial profile can be used to inform even if the product is not directly perceived by the consumer.

Thus, leather is a complex sensory universe, having a profile and a particular sensory identity that designers have used as inspiration in a sensory approach.

These sensory properties of leather can be exploited to create products inspired leather and playing with the illusion of the senses.

The developed method has to be tested and optimized in a further research project by adding more descriptors.

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