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# Ergonomic aspects related to materials

Regina Álvares Dias[1], Leila Amaral Gontijo[2]

[1]Escola de Design (School of Design), UEMG. Av. Pres. Antonio Carlos, 7545, Belo Horizonte, MG. Brazil, CEP 31270-010

[1]regina.alvares@gmail.com, [2]leila@deps.ufsc.br

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## 1. Context

The product is composed by many elements – form, scale, volume, color, material, texture, brightness, sound, smell and others – that, in an indivisible way, conform the final artifact. One of the most important elements is the material, that "allows the immediate interface between the artifacts and man" (MANZINI, 1993). Materials have an essential role in the process of products conception, since they define the product's functions, durability, costs and final appearance. The users' experience has a preponderant role in this process, since when interacting with the product, they establish sensorial relations that can be determinant in its conception.

The material present in the artifacts used by man, therefore, is the central theme of this study, which originated the elaboration of the Permatus Method (Perception of Materials by Users), with the objective of studying how the users perceive the meanings of the materials present in the products of their daily life (DIAS, 2009). The method is composed by six stages, being the four first ones about the issues related to the product to be studied and they work as the preparation of the necessary information for the subsequent stages of evaluation and specification.

The first stage, defining the elements of the product, allows us to know the product in detail, relating the elements that compound it, the most important characteristics, as well as the main, esthetics and ergonomic functions. It works as a type of decomposition of the products with elements that are perceptible for the user.

The second stage, cycle of interaction, has as objective knowing and analyzing the process of the inter-relation between the product and the user during the cycle of use. We base on the principle that each product has its own life cycle, but a cycle of interactions with its users is also established. The most important thing for this stage is the implication of the cycle of interactions in the affective evaluation of the users, since the emotions change during use (Jordan, 2002; Meyer e Damazio, 2005).

In the third stage, the analysis of the sensorial process has the purpose of verifying the sensations that happen during each stage of the cycle of interactions product-user, emphasizing all the implication of these interactions in relation to the materials pre-

sent in the product. This stage was adapted in the Method SEQUAM (Bonapace, 2002) and it works with the five sensations usually applied: visual, tactile, auditory, olfactory and gustatory, plus the haptic, thermal and functional sensations.

The fourth stage, profile of the material, corresponds to the initial definitions of the objective and subjective attributes that are required to cover the needs of the project and of the materials' selection. The subjective profile of the material is defined by the intangible characteristics, that is, the attributed meanings and the evoked emotions, that cannot be purely identified with numerical values nor quantified.

The second phase of the Permatus has two stages – subjective evaluation and objective specification. The fifth stage, subjective evaluation of the materials, consists on the realization of research with the users in the cognitive, affective and conative dimensions. Finally, the last stage aims to trace guidelines for the project, based on the subjective information obtained in the evaluation of the users.

## 2. Materials and ergonomics

The activity of products' development involves many professionals of different areas, among which there are engineers, designers, ergonomists and professionals of market. Each area is responsible for determined domains, but the ones with the greatest proximity with the users are design and ergonomics. The materials area also works in a similar way. It groups knowledge of chemistry, materials science, biology, physics, engineering and design. This way, the interdisciplinarity is necessary when we aim to attend to the need of all interested parts: client, producer, supplier, designer and user of the final product.

From the 58 attributes of the materials defined in the method, we chose for this discussion the ones that make reference to the ergonomic aspects of the product, that are the esthetic and practical attributes.

The esthetic attributes of the material have a direct relation with the esthetic impression that we feel about an object throughout the senses. They are equivalent to the physiological pleasure (Jordan, 2002) and to the visceral level of design, Norman (2005). The esthetic attributes of the materials that have a relation with ergonomics are: form, color, transparency, brightness, tactile aspects and touch, textures, sound emitted by the material, smell, taste, temperature, physical and mechanical properties.

The practical attributes of the material are directly related to the use, handling and experience of the users with the objects, resulting in pleasure and effectiveness, they are equivalent to the psychological pleasure (Jordan, 2002), which has a relation with the cognitive, mental and emotional reactions of the individuals, and to the behavioral design of Norman (2005). The practical attributes of the materials related to ergonomics are: the identification of the materials by people, usability, anthropometric, affor-

dance, context of use, comfort, safety and protection, cleanliness and hygiene, health and salubrity, and reliability.

## 3. Experimental study

An experimental study was carried out with 50 volunteer users to evaluate cooking pans fabricated with different materials, described in Dias (2009). 13 models of products were selected, with the same typology (round casserole with two side handles and lid), with similar dimensions (20 to 24 cm of diameter) and of national fabrication.

From all tests carried out, we separated for this article some results referent to the semantic evaluation of the pans. The ergonomic attributes considered in the study are directly or indirectly introduced in the concepts of cleanability, hygiene, health (that were evaluated in relation to the material of the body of the pan, where occurs the contact with the food); and safety, thermal insulation and comfort (that were evaluated in relation to the handles and the lid's grip).

The attributes related to the handles and the lid's grip – thermal insulation, safety and comfort – were analyzed together. These elements must allow the comfortable and safe handling, for the conjunct of the casserole as for each peace separately, and they must be in accordance to the norm NBR 14630:2000.

The result of the evaluation of the thermal insulation attribute showed that the majority of users knows how to distinguish the more insulating materials from the less insulating ones. In relation to the safety attribute, the casserole that is considered the safest one corresponds to the firmest and widest handle. For that same reason, it is also considered the most comfortable one. The most unsafe and uncomfortable handles correspond to the ones close to the pan's wall and that have a size that is not proportional to the pan's size and weight. The answers about the comfort indicate that the users perceive this quality based on the dimensions, form and tactile aspects of the pressure.

## 4. Conclusions

The discussions showed in the article demonstrate that the materials used for the artifacts' production have relevance for the discipline of ergodesign. Based on the doctor's degree research in the area of materials, the researcher showed a cutting, not only of the proposed method, but also of the experimental study. From the Permatus Method, we extracted, from the subjective profile of the material, those attributes that make interface with ergonomics, that were detailed, giving the proper emphasis to the ergonomic aspects. To finalize, a part of the experimental study carried out with cooking pans was showed to demonstrate that it is possible to apply the proposed

method in cases of new products' projects, and also in ergonomic project or intervention.

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