Proposition of a Model for Elucidating Emotions:
A Tool in Project Development

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Abstract: In the last years, several aspects related to product features other than good operation and usefulness have been discussed. Studies regarding this topic enlighten the importance of user-product emotional interaction. There was an increase in design studies on this subject in the last years, covering product aspects that trigger emotional responses, however, models regarding these interactions are still in their early stages. Thus, this work presents literature research on Design models and emotion, supplying the development of a model that aids emotional decision making in product experience. The studied models are compared, resulting in a new model. This model is part of a broader research that aims to clarify the role of shape and material in product Design; the other aims of the research – which are not discussed in this article – consist of searching for models for material selection and verbal attributes.

Key words: Product Design; Design and Emotion; Cognition.

1. Introduction

To understand how an individual chooses a product in a store is a complex task, considering the several variables involved, such as dozen products with similar quality, specification and price. The investigation of these aspects leads us directly to the material culture of mankind, which, although also complex, is fundamental for developing product projects more connected with psychic aspects of the individuals. According to Löbach, "the aesthetics perception of the surroundings and its effect on the human mind has not been properly studied yet" [1, p.176]. Industrial products are very important in this context, since they are manufactured over and over, and derive from specific designs.

> Due to the lack of knowledge about basic and universal principles of the relation between human beings and material culture, products are designed and sold according to preferences determined by subjectivity, which is connected to the fashion standards of specific social groups. These products are not produced taking into consideration the particularities of individuals, who have, at best, few options regarding personal adjustments, what is known as customization. [2, p. 62]

In that sense, the focus of studies in this area should be more user-oriented. The user, accordingly, is driven by subjectivity, due to his unique objectives, interests and perceptions of the world. The lack of comprehension about user-product interaction originates from the predominance of a traditional vision on design methods, which is supported by most contemporary design schools, and is focused on creative process, ergonomics, engineering, materials and marketing [3]. In general, these are the main topics of interest for designers and design schools, “probably because sociological, psychological, and semiotics subjects are considered too 'blurry', meaning that they are misjudged as too complex to be part of the creative process" [3, p. 30].

Consequently, there is a vast field for researching about subjective fields, such as semantics and emotion, which professionals from different areas have been covering in their studies lately. Cognitive scientists, for instance, showed how emotion makes people smarter, since "emotion is constantly making value judgments, showing instant information about the world: here lies a potential danger, there lies a potential shelter; this is good, that is bad" [4, p. 30]. Also, these professionals state that when relaxed and happy, people expand their reasoning process, making them more creative and imaginative, which gives an idea of the role of aesthetics on product design: attractive objects make people feel better, so, consequently, they think more creatively [4]. Thus, emotion is vital in life, since it affects how human beings feel, behave and think, and it may, for example, affect decision-making when acquiring a product [4]. This reasoning leads to a possible explanation for the lack of comprehension about user choices, exposed in the beginning of this topic.

The concern with user-product interaction has recently lead to the development of a new field in the study of Design, called Design and Emotion. The basis for this new approach is the idea that products are made to establish emotional relations and cause enjoyable experiences for its users [2]. Therefore, following this line of thought, objects have meaning in man's life. Damazio [5, pp.49] summarizes the importance of products:

> [...] they play an active role on day-life, and people use them to achieve a meaning about themselves and their life as a whole, up to the point that occasionally these objects start to conduct their social relations. These objects, which are deeply connected to other gears, guide individuals though the world, organizing and determining social relations, affecting behavior and leading to practical and diversified effects.

Thus, it is important to clarify the variables involved in the interaction process between humans and products, especially those regarding emotions. Lindstrom [6, pp. 160] theorizes about the complexity of this relation:

> Emotion is a complex set of interactions between subjective and objective factors, determined by neural/hormonal systems, and capable of: (a) originating affective experiences such as feelings and excitement, pleasure/displeasure; (b) generating cognitive process such as perceptive effects that are emotionally relevant, evaluations, labeling process; (c) activating the physiological adjustment when facing excitement; and (d) leading to a behavior that, although not always, is usually adaptive and aimed for a specific objective.

Norman [4], Desmet and Hekkert [7], Fenech and Borg [8] and Person [9] proposed models for clarifying the emotion elucidation process, however, each one considered just parts of a bigger scheme, remaining the necessity of a unifying vision. Thus, a new model is proposed, taking into account the essential variables involved. To this end, this work was based on the models mentioned above and considerations from several other authors, such as Minim [10], Löbach [1], Niemayer [2] and Csikszentmihalyi [11]. As a result, new possibilities emerge for the study of related issues, prior or posterior to the generation of emotions.

2. Characteristics of Products and Materials

There are many possible classifications for the peculiarities of products and materials, which change according to the object of study. Among the analyses from several other authors, the classification proposed by Karana [12] is of particular importance for this study, especially: physical properties, manufacturing properties, usability and functions, aesthetics or sensorial properties, perceptions, associations and emotions. The author states that the three last − perceptions, associations and emotions − are the intangible characteristics of materials. However, it

is important to add that this classification have some drawbacks, especially regarding the lack of a general classification for variables not covered by intangible characteristics. As a result, this study proposes the following classification: tangible or technical characteristics (technical properties, manufacturing process, usability and functions), intangible or subjective characteristics (perceptions, associations and emotions) and sensorial or aesthetic characteristics. Figure 1 graphically displays the classification.

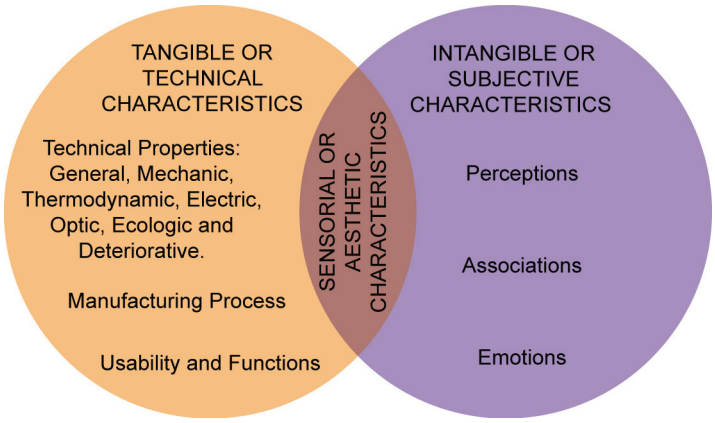

Figure 1: Materials and Products Characteristics.

When fully understanding tangible or technical characteristics, the designer elaborates, mostly, the proper functionality of the product, flawlessly executing and calculating its technical functions, safety and costs. Nowadays this field is supplied with solid methods and advanced computational tools [13]. Conversely, the intangible or subjective characteristics involve certain design issues that cannot be easily formulated according to a method. They are related to the significance of the product or, in other words, the unique and personal perception of the product's personality by each individual [12].

According to Ashby and Johnson [14], the sensorial or aesthetic characteristics represent how human senses – sight, hearing, touch, smell and taste – capture the stimulus caused by the product, or the tangible characteristics. The authors [14, p. 68] provide a good explanation regarding this: “[...] a polystyrene cup is visually indistinguishable from a glass cup, however, people feel the former warmer, lighter and softer when touching it; the sound of knocking at it is completely different [...]”; “[...] the impressions caused are so different that, when in an expensive restaurant, people find unacceptable to have a plastic cup". Consequently, sensorial or aesthetic characteristics act as a link between technical or subjective characteristics, as they have at the same time tangible and intangible characteristics. Apart from obvious limitations, designers can use this knowledge to conceive the impressions they want from people about their products, making use of colors, textures and other elements.

3. Elucidating Emotions

3.1. Norman's Model

When describing the emotion, in relation to the brain organization of information, Norman [4, p. 41] lists three levels or layers of processing: "the automatic, prewired layer, called the visceral level; the part that contains the brain process that control everyday behavior, known as the behavioral level; and the contemplative part of the brain, or the reflective level". All three levels reflect the biological origins of the brain, from primitive organisms to more complex ones (Figure 2).

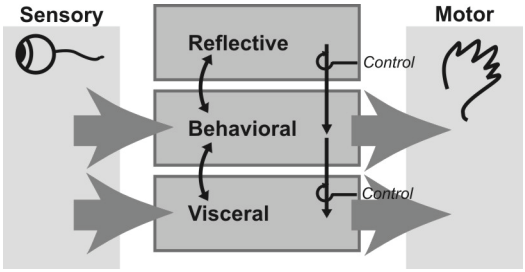

Figure 2: All Three Levels of Brain Processing [4].

The highlight of Norman's model [4] is to explain, using the three level concepts, several questions related to the internal process of users caused by emotion elucidation process. The author also lists a set of variables related to this process, although he does not graphically compile that information, being that his flaw.

3.2. Desmet and Hekkert's Model

Desmet and Hekkert [7, p. 58] clarify some variables related to user-product experience:

> Experience is materialized through user's characteristics (personality, ability, background, cultural values and motivation) and product's characteristics (shape, texture, color and functionality). All process and actions involved, such as physical actions, perception and cognitive process (evaluating, discovering, using, remembering, comparing and understanding) contribute to the experience itself. Experience is always influenced by the interaction context (physical, social, economical) it is inserted in.

For Desmet and Hekkert [7, p. 59] the "experience is a multi-faceted phenomenon that involves manifestations such as subjective feelings, behavioral reactions, expressive reactions, and physiological reactions". According to them, subjective feelings from experimentation are a conscious warning about changes in the core affect. Physiological manifestations (e.g., pupil dilatation and sweat production) are caused by the changes of activity in the autonomic nervous system that accompany affective experiences. Expressive reactions, in example, are the facial, vocal, and postural expressions that accompany affective experiences. We can tell by a persons' facial and bodily expression that he or she is sad, grumpy, or cheerful. Behavioral reactions (e.g., running or seeking contact) are the actions one engages in when experiencing a change in core affect. Additionally, the authors state that affective experiences initiate behavioral tendencies like approach, inaction, avoidance, and attack. In example, fear comes with a tendency to flee, anger with the tendency to attack, and fascination with the tendency to explore. A product that evokes anger will be pushed aside, one that evokes fascination will be explored, and one that evokes boredom will be ignored.

Desmet and Hekkert [7] distinguish three components or levels of product experience: aesthetic pleasure, attribution of meaning, and emotional response (Figure 3A). Thus, the authors define product experience as "the entire set of affects that is elicited by the interaction between a user and a product, including the degree to which all our senses are gratified (aesthetic experience), the meanings we attach to the product (experience of meaning) and the feelings and emotions that are elicited (emotional experience)". According to the authors, in appraisal theory, the most know nowadays, emotion is elicited by an evaluation of an event or situation as potentially beneficial or harmful. Based on this theory, Desmet [15] introduced a basic model of product emotions, as shown in Figure 3B. The model applies to all possible emotional responses elicited by user-product interaction.

Also, it identifies three universal key variables in the process of emotion elicitation: (1) concern, (2) stimulus, and (3) appraisal.

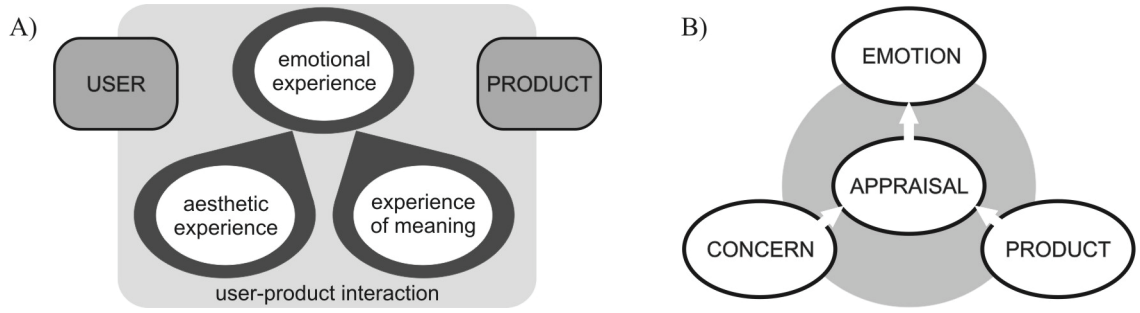

Figure 3: A) Components of Product Experience [7]. B) Basic Model of Product Emotions [15].

The basic model indicates that emotions arise from encounters with products that are appraised as having beneficial or harmful consequences for the individual's concerns. To understand the emotional responses in user-product interaction, it is vital to understand the user interests according to the context of interaction with the object. At the level of meaning, we recognize metaphors, assign personality or other expressive characteristics, and assess the personal or symbolic significance of products. Just like any other type of significance, these responses can be related to the shape or other determinants, such as value, marketing strategies, opinions that are relevant to the user and previous experiences.

The highlight of the model proposed by Desmet and Hekkert [7] is how it explains several questions related to the internal process of elucidating emotion, especially the answers provided for reactions resulted during the process, before and after it. The model's drawback is (likewise Norman's [4]) its graphical representation. Both authors use two distinct graphics and don't indicate on them plenty of variables mentioned in their arguments.

3.3. Fenech and Borg's Model

Fenech and Borg [8, p. 6] proposed a model called DemoHS (Design for Emotion Support via Human Sensations). This model (Figure 4) is built on past experiences, showing a wider picture of the product-emotion elicitation process.

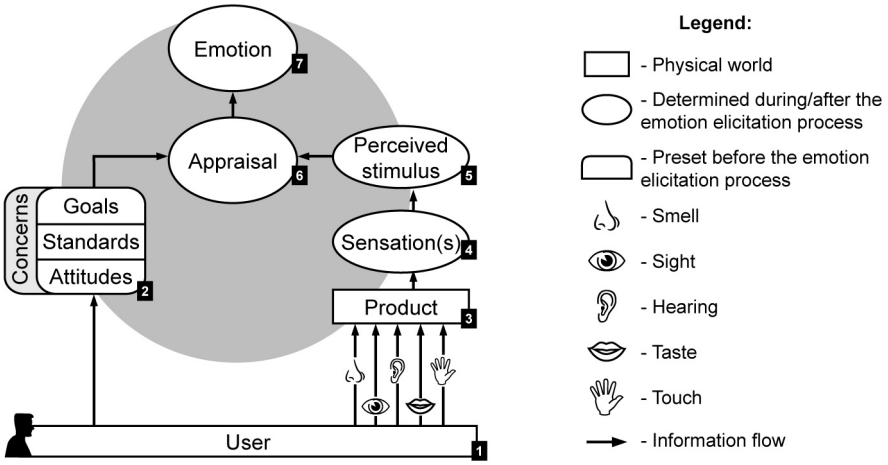

Figure 4: The DemoHS model [8].

According to the authors, the DemoHS model is based on the theory that upon interaction of the (1) user (having his/her own personal (2) concerns) with the (3) product via senses, (4) sensations are generated. These result in the (5) perception of the stimulus after comparison with knowledge/experience in the user's brain. The (6) appraisal of the perceived stimulus with the user's goals, standards and attitudes, that gives rise to the final elicited (7) emotion.

The model is therefore based on the hypothesis that emotional responses to products are largely influenced by the degree to which the product appeals to our senses. Some drawbacks in the theory are the lack of information about other aspects related to how emotion is generated, such as physical and behavioral responses, and degree of environment influence during interaction. The author focuses on emotions generated in a visceral level [4] and aesthetic appraisal [7].

3.4. Person's Model

Person [9] proposes a user-product interaction model in which interaction is extremely relevant for generating the emotion (Figure 5).

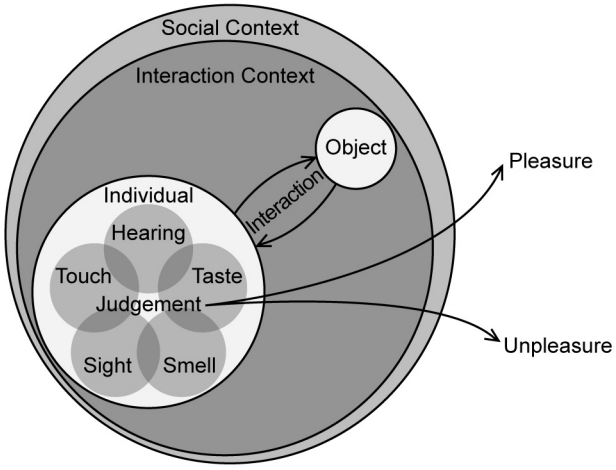

Figure 5: Functional Model for Describing Emotional Response towards Products [9].

Similarly to the Fenech and Borg [8] model, Person [9] refers to the senses as agents in the user-product interaction. The author denotes the relevance of designer comprehension about how the interaction context works and how it is related to the product. The interaction context, for instance, is inserted in a social (or cultural) context that also affects the emotional experience. In comparison to Fenech and Borg model [8], Person's model [9] lacks even more information about the aspects related to the generation of emotion, and also focuses on the visceral level [4] and aesthetic appraisal [7].

4. Model for Elucidating Emotions

Based on the works of the mentioned authors, we propose an original model for elucidating emotions (Figure 6) focused on individuals. It's exposed individual's idiosyncrasies, cognitive and perceptive process, reactions, physical actions and other manifestations of the process. This model also focuses on materials and shapes of the objects, since they generate stimulus through their technical and aesthetic characteristics. The individual and object are both inserted in the interaction context, which is also part of the cultural context. Another interesting

feature is the interaction and the possibility to evaluate it by classifying the experience, based on different methods and field research.

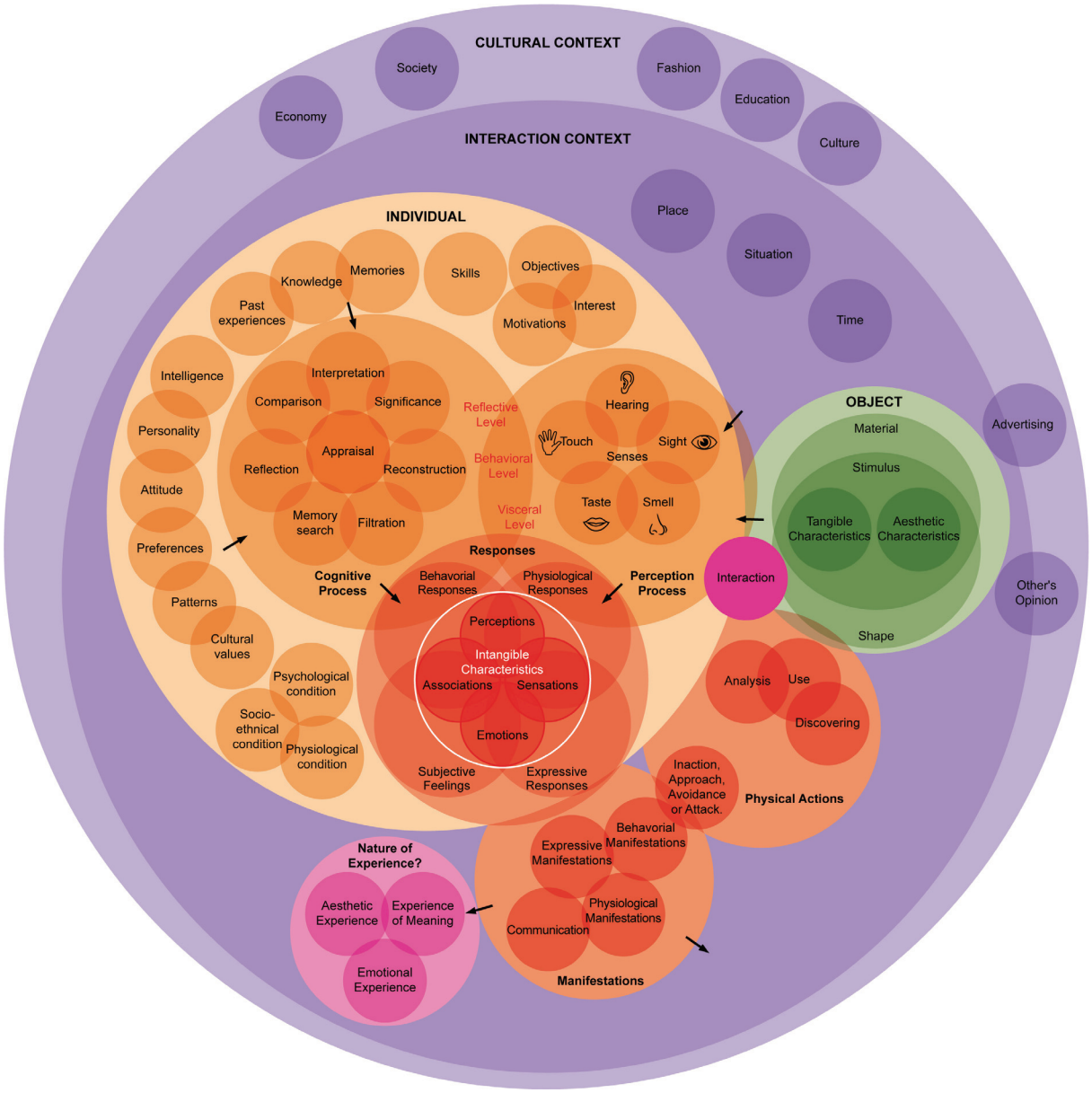

Figure 6: Model for Elucidating Emotions.

The proposed scheme, using bubbles, is more adequate for the representation of dynamic and chaotic processes, since the interrelation of factors is not linear or standardized. This makes it easier to understand how an allegedly initial process happens at the same time as the others under its influence. Another important characteristic of this representation is how it fits the Design and Emotion assumption that designing should focus on the user. Each aspect of Figure 6 is detailed in the following topics.

4.1. Interaction

Human-product interaction is classified in three distinguish forms – instrumental, non-instrumental and non-physical; followed by different variables [7]:

- Instrumental interaction – examples of this interaction are using, operating, and managing products. One can, for example, experience irritation when the TV does not respond to the remote control.
- Non-instrumental – interactions that do not directly serve a function in operating a product. Someone can be delighted by the brilliant shine of a car.
- Non-physical interaction – refers to fantasizing about, remembering, or anticipating usage. One can anticipate interaction, for instance, when expecting compliments from colleagues because of a new suit.

4.2. Context

Cultural context is the macro environment in which culture, economy, society, education and fashion are inserted in. According to Norman [4], "cultural views have huge impact here: what one culture finds appealing, another may not. Indeed, teenage culture seems to dislike adult things solely because adult culture likes them". Place, situation and time are prime characteristics in the interaction context. Situation can alter the core affect of an individual; a cause for a bad mood, for example, might be a traffic jam or a bad climate [7]. When conceiving an appropriate environment for user-product interaction, more sensorial points can be triggered, thus raising the user's interest and appraisal [6]. Two variables are relevant for both contexts, right next to the product: advertising and other's opinions. These variables are related to the significance of products [7] and can play a decisive role for the commercial success of a product.

4.3. Object

The object is composed of its shape and material. Both trigger the individual's stimulus through its tangible and aesthetic characteristics. The observation of some aspects might be difficult because usually one or more aspects detaches from the others. People usually relate their sensorial experiences to the main sense involved: the food tastes good, the sound quality of the sound system are great, the shoes are comfortable [6]. When using a product design, it is up to the designer to stimulate accordingly the sensorial contacts of the user.

The objects are deeply connected and related to the materials they are made of; these materials work as some sort of interface for human interaction with products. Thus, through the material's attributes – usability, processing, morphology, durability, cognitive perception, cost, environmental impact, among others – objects acquire meaning, sustain associations or even become symbols of more abstract ideas. Ashby and Johnson [14] propose two main functions for the materials: "[...] to provide technical functionality and to create products with personality".

4.4. Individual

The individual – as shown separately in Figure 7 – is constituted by a set of idiosyncrasies that influence its interaction with the product; they are determined along with time and according to social and cultural aspects of the environment the person belongs to, and in most of the cases, they were previously noted and cognitively processed. These characteristics were grouped according to its similarity, in order to facilitate the comprehension.

Past experiences, knowledge and memories constitute the information basis of an individual. They influence all other characteristics and work as a basis for cognitive process, reason why they are placed close to each other in

the Figure 7 scheme. Personality, intelligence, attitude, preferences, cultural values and patterns express who the person is and how others judge him/her, because they are strongly connected to the reflective level. The products consumed and lifestyle of a person aid in the representation of the image that other people create of that individual [4].

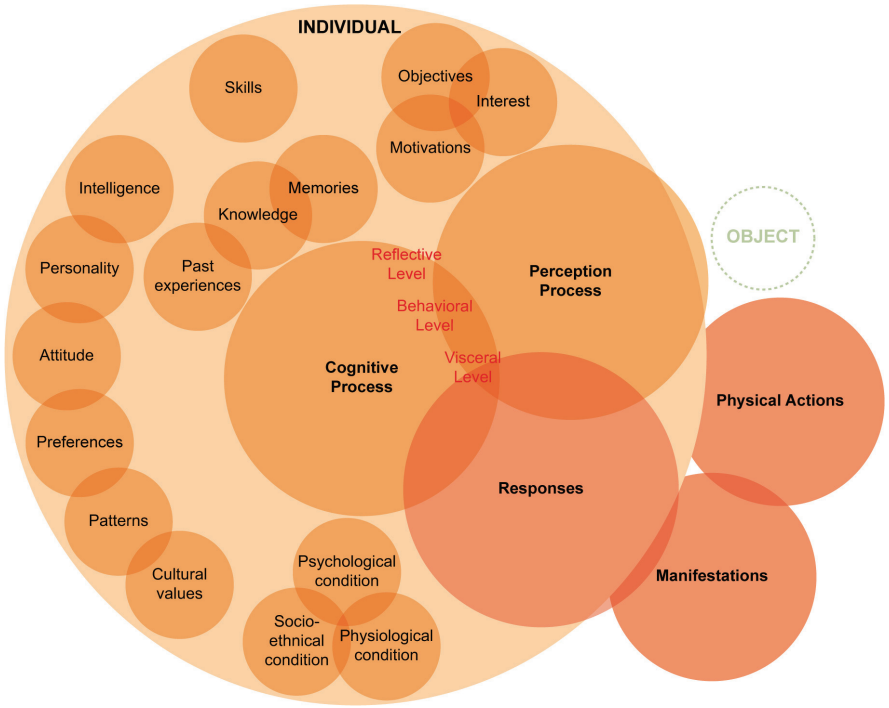

Figure 7: Individual.

The socio-ethnical conditions comprise other series of aspects: age, sex, education and profit. When working together with physiological and psychological conditions [10], they may favor or not the interaction. If the person is physically exhausted, in example, he or she will probably not have any interests in the experience offered by new sports equipment.

According to Csikszentmihalyi [11] studies, individuals who have different necessities, objectives and social experiences judge products differently, for particular reasons. This variation is bigger when individuals with different age and gender are considered. According to the author, it is clear that younger individuals are emotionally connected to certain objects due to its potential usage, and at the same time, older individuals look for memories triggered by the feelings they have in relation to a certain product. A similar variation happens when relating answers from individuals from opposite genders, indicating that sexual stereotypes are influential in the perception regarding objects.

The individual has short and long term objectives, motivations and interests. The long term objectives aid in the projection of a persons view of the world and is very influential to other characteristics. When thinking in a short term and according to an interaction context, the judgment of objectives, motivations and interests relate to the product and are very influential over physical actions. This is the reason why it is very close to these variables in Figure 7. Individual abilities are also influential to the interaction with products, especially in relation to its usability and the behavioral level of brain processing.

The levels of brain processing – visceral, behavioral and reflective [4] – are also very important aspects of the model. The disposition of this information looks complex inside the scheme, as they interfere into all information process. The levels appear at the core of these processes. Its localization was organized according to its complexity – from the more complex (reflective) to the less complex (visceral) – and also according to the proximity to more influential processing systems.

The human perceptive system is composed of sight, hearing, smell, taste and touch (Figure 6). These senses interact with each other, in a way that an object with multisensorial appeal will probably attract more attention and trigger a deeper level of interaction with the user if compared to another object that has only two means of sensorial appeal [6]. Usually the individual notices the object through his long range senses – sight, hearing and smell – thus justifying why these are closer to the object in the Figure 6. After identifying the object, the individual starts a behavioral manifestation of approach, inaction, avoidance or attack [7]. These actions happen at the same time as the reactions and manifestations explained later in this study. As they are influenced by the object aesthetics, they become deeply connected to the visceral level. Other levels and emotions might also act over such actions. In circumstances involving approach, the physical actions of use, discover and analysis are triggered, so that's why they are placed next to the object. During physical interaction, touch or taste can be triggered.

The stimulus received are processed by cognition (Figure 6), which is responsible for the operations of comparison, interpretation, significance, reflection, reconstruction, filtration and memory search. These process aids in appraisal, which consist of the evaluation of properties of the stimulus, the context of occurrence and properties of the individual itself.

As shown in Figure 8, the perception and cognitive process conduct the user, along with the processing levels, to the behavioral, expressive, physiological responses and subjective feelings [7]. The responses result in sensations, associations, perceptions, emotions, manifestations and physical actions, remembering that all these process take place at the same time and are mutually influential. Thus, this study considers responses as brain signs directed in order to trigger different kinds of manifestations, called expressive manifestations, physiological manifestations, behavioral manifestations and communication.

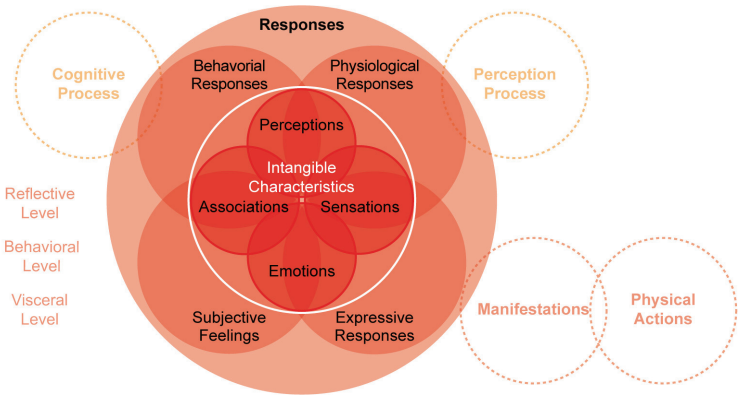

Figure 8: Responses.

Physiological manifestations may cause pupil dilatation and sweat production; expressive manifestations may cause someone to smile or frown; behavioral reactions may cause inaction, avoidance, attack; the subjective feelings may announce changes in core affect [7]. Intangible or subjective characteristics of products appear in Figure 8, divided into sensations, associations, perceptions and emotions. The route of the figure displays how these characteristics belong to a personal construct, leading to the conclusion that they are not attached to the object, but to the subjectivity of individuals.

4.5. Nature of Experience

One can tell by the analysis of physiological and behavioral manifestations, along with facial and body expressions, if a user is sad, grumpy or cheerful. It is possible to ask how he or she feels. Thus, if an individual is monitored and questioned before and after the interaction with an object, the designer can collect precious data about that experience. Several research techniques are used to discover the intangible characteristics, such as questionnaires, interviews, semantic differential and video monitoring [3]. These experiences are categorized as aesthetic, meaning or emotional [7]. Figure 6 displays the different types of experience and its relation to the information sources, namely, the manifestations and physical actions of the user.

5. Conclusion

The literature research showed that the existing theories regarding user-product emotional interaction have reached advanced levels, although the proposed models could be enhanced, as each one focus in fragments of the entire process. This observation led to the development of a wider model, which integrate the different approaches studied.

The proposed model for elucidating emotions clarifies the variables involved in user-product interaction process, resulting in a substantial contribution for designing products and researching in the field. This study identifies the importance of emotion, which is crucial in the configuration of all human relations. The proposed model is based on the main authors in the field, and it is explained in a clear presentation. Clarifying these relations enable the establishment of new procedures in product design, thus creating new possibilities of approach and method creation. This model also clarifies that new approaches must come with different methods for compiling intangible characteristics in collaboration with the target individual. This method must be constant and crucial in the Design process.

The model has some limitations: it does not provide extra information about the core affect of individuals [7] and fails to explain in details how the processing levels of the brain [4] relate to the other variables. On the other hand, it does have strong points: it is developed using a bubble scheme, denoting how dynamic and chaotic is the entire process, without being linear at all; highlights the main flows of information; stresses the importance of cultural context as well as the context of user product interaction; clarifies that emotions can be triggered by certain characteristics of objects; takes into account the user's characteristics, internal process and correlations; denotes the manifestations and physical actions originated from process reactions; displays the nature regarding interaction experiences comprehension.

Also the model reassures the idea that intangible characteristics of objects and materials are internal concepts of the user: emotions are not triggered by the aspects, but by the significances resulted from them. In short, the results of human experience are originated from reactions caused by internal process of the user, and not by the object itself. Consequently, emotions are a particular construction, thus making it difficult for the designer to design products solely based in his or her own constructions, since they would probably not correspond to the users. Therefore, it is necessary to develop projects focused on the user, in which research on intangible characteristics are part of the design activity and not only a preparative process.

Besides literature research, field researches were carried out in order to provide evidences for the new model, which are discussed in other studies. In further works it is important to test the model for elucidating emotions according to methods for intangible characteristics research, aiming to test its potential to explain results originated from product experience. The authors suggest the validation of this model through deterministic models, dynamical systems and catastrophe theory.

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