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WHAT USER PRODUCT EXPERIENCES IS IT CURRENTLY POSSIBLE TO INTEGRATE INTO THE DESIGN PROCESS

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ABSTRACT
Nowadays much of the discussion about innovation in products is related to the user's affectivity. Emotions, affection, pleasure, kansei, the senses, etc. generated by the product, are frequently the salient arguments (benefits) of products. There are appropriate theories and methods in existence today for finding these arguments. Nevertheless, within all these theoretical developments, there is no unifying concept existing that allows one to compare concepts and the purpose of the methods. The bibliography of these theories and methods is vast and diverse since they are different phenomena, which are conceptualized and investigated in different ways and which, additionally, sometimes interact. The purpose of this paper is to recognize what types of user product experiences can currently be integrated into the design process. On the one hand, the methods used to integrate user product experiences in 38 projects of innovative design were researched. On the other hand, more than 100 articles on these methods of integration of the user product experiences were reviewed. In both cases content analyses were made to find out which product experiences it is currently possible to integrate into the design processes. In order to implement the contents analysis it was necessary to solve a problem: How to determine what is the product experience faced by the method? Two lists of terms that represent diverse user product experiences integrated in industrial projects, as by the literature methods, were obtained. These lists constitute a summary with which it is possible to know exactly what are the possibilities for integrating different product experiences within the design process. Integrating user product experiences into the design process is important because it has three beneficial impacts: first, it allows one to identify benefits for the user generated by the product; second, it guarantees that the designers arrive at their objectives of design; and third, the designers can seek to deliberately influence the experiential impact of new designs [1].

Keywords: experience design, affectivity, innovative design, design and emotion, pleasure with products, kansei engineering, user's affectivity, content analysis.

1 Introduction
Today the interest in the quality of the relationship between the product and the user product experiences (i.e. the affective response of a person who interacts with a product [2]) has inspired researchers to study a lot of affective phenomena. These product experiences are used in many products as the salient innovation arguments, in other words as benefits for the user (pleasant consequences of their use [3]). Some of these approaches developed by researchers are [4]: *affective computing, affective ergonomics, engineering of senses, experience design, design for emotion, Kansei engineering, user centred design, pleasure with products, subjective evaluation, sensorial marketing and sensorial metrology.* Consequently the literature presents many concepts related to product experiences developed by the field of product design or borrowed from other fields [2]. The result is a research agenda where there is a multitude of experiential concepts which differ in terms of the described affective phenomena, in terms of theoretical backgrounds, in terms of research objectives and in terms of design possibilities [2]. Although interesting for the field, this multitude of experiential concepts prevents the formation of a common ground for the discussion [2]. As the Engage

Consortium [10] says "The factor that most conditions the current situation [of design for emotion] is the great number of approaches that merge in it".

The industrial practice makes it possible to make a first verification: the types of user product experiences that can be integrated are many and varied. A second verification comes from the observation of the methods: each method conceptualizes in a different way what it understands as "product experience", i.e. the constructs concerning product experiences all appear, at least from the beginning, to be different (a "construct" is an idea built by the researcher to explain events or objects observed [5]).

By "integrate user's product experiences in the design process" we mean to relate a user's affective experience with a physical characteristic of the product (for example: "I prefer (affective experience) the blue colour of the chair (physical characteristic))".

But, in more detail, what is a product experience? Hekkert [6] gives a complete definition as "the entire sets of effects 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 experiences)." In connection with the user's experiences Cagan and Vogel [8] say: "*People use products to improve their experiences while doing task. They relate these experiences to their fantasies and dreams. Successful products fulfil a higher emotional value state ".*

The objective of this work is to review which are the types of product experiences treated by the methods to integrate them into the design process. This review can lead to a comprehension of what is considered as a product experience in those methods. This comprehension of the "product experience" construct can also provide a structure for classifying the methods of the field, which in its turn, is significant for enabling one to have access to these methods. This paper is justified by the final interest of how to assist the designers in choosing the methods for integrating the affectivity of the users into the design process. Another motivation is intrinsic to the first: how to contribute to developing products increasingly closer to the user.

There is consequently a research question: for the methods used to integrate user product experiences into the design process, which are the terms used by those methods, in industry and the literature, to designate product experiences?

2 Method

The method followed comprises on the one hand the literature methods and on the other hand the industry methods, see figure 1. For the two types of methods a general problem arose: how to identify such a product experience? To answer this problem a large set of reference terms concerning user product experiences was created and used, §2.2. This review carried out took us by very diverse fields of knowledge, §2.3. For the literature methods the implementation of the content analysis was simple and direct (the information units-the methods' objective- was short), §2.5. For the literature methods, first at all we had to identify the publications concerning user product experiences. After that, we then proceeded to build a repertory of objectives of these methods, §2.3. Given the relative profusion of the objectives of literature methods (normally a method comprises several objectives), we had to identify the main objective of each one of these methods (the objective that comprised the product experience); to be able to do it in a non-subjective way, a technique of reduction to essence was implemented, §2.4. After that, the contents analysis was carried out on the methods of the literature,§2.5. Finally, the two content analyses were compared. In the next paragraphs we will describe in detail the method used.

2.1 Questionnaire to 504 industrialists.

To answer to our problems we had several possible choices of research methods. Initially we planned to carry out a participating observation in order to build a case study. The participating observation is a technique of collection of data where the researcher becomes a member of the work team which he or she is researching, the whole while keeping a certain distance. This possibility of participating

observation was not retained because it would have given us a very narrow vision of the problem, at the level of only one company and a limited number of projects, and we wanted to know rather what was the behaviour of the variables at the level of the manufacturing industry. We also considered doing interviews, but these have the disadvantage of taking a long time with a lot of coding and analysis. Finally we considered the method of questionnaires. This one has the big advantage that one is able to ask at the same time for information on variables with closed and opened answers, or answers of a qualitative and quantitative nature. The questionnaire also has the advantage of being able to reach a large population if it is carried out on the Internet. We were also aware of the disadvantage of a questionnaire on the Internet: it is not taken into account by the people being questioned; we thus submitted it to 504 people knowing that the rate of response would be weak. Finally, another advantage of questionnaires is that their coding can be automatic if they are connected to a data base as was the case for us.

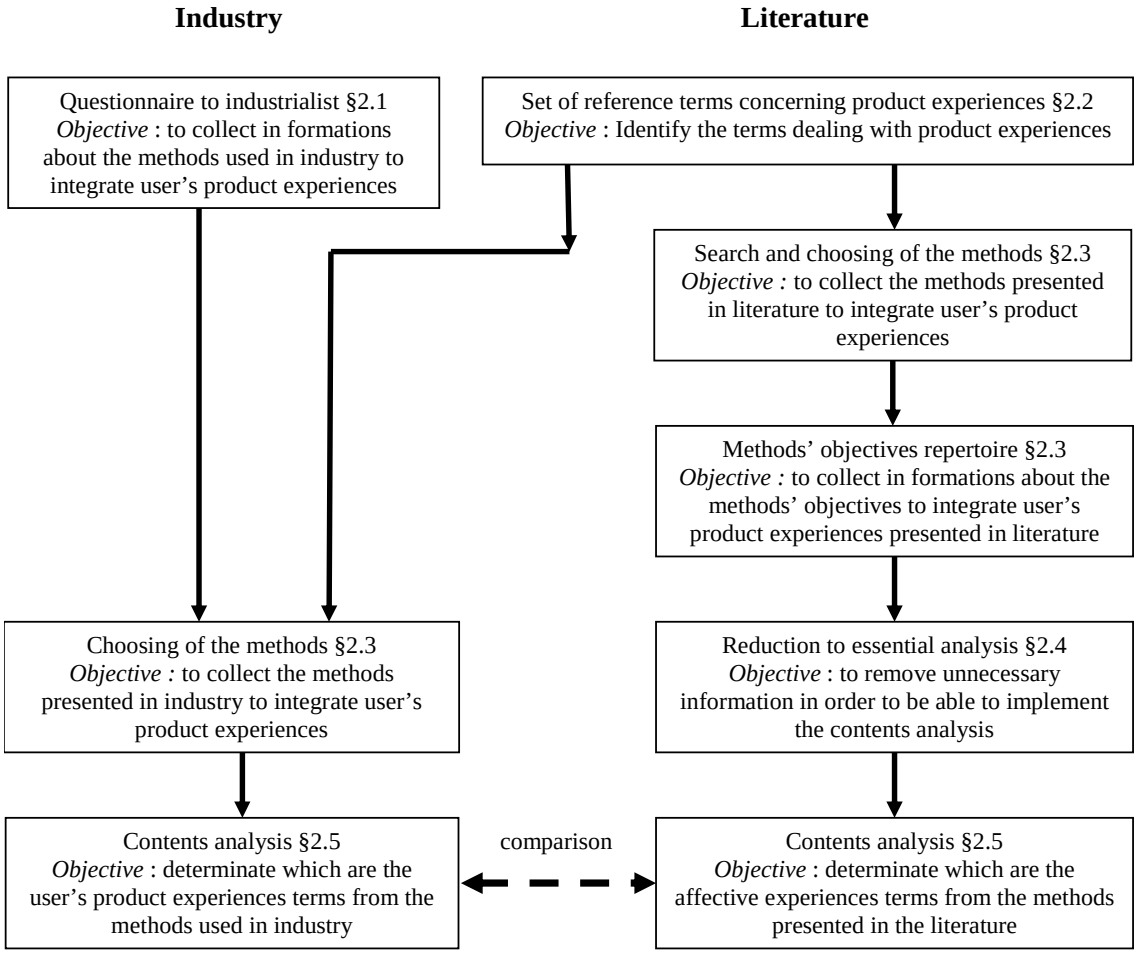

Figure 1. the method followed during the present study

For the methods used in industry we carried out an investigation of the designers who make the designs for various types of products (car interiors, electric household appliances, cabins of helicopters, cleaning products, automobiles, backpacks, toys, mobile phones, etc.) in France. Only one question was posed to the industrialists: "which methods were used by you in the last design project? With which objective?". It was hoped that by posing this last question about the objective, the designers would express what could be the user product experience treated by the method. We then operationalized this variable as "sensory analysis", "quantitative studies", "qualitative studies", "kansei engineering methods" and "others".

First of all, the answers were translated into English. Answers comprising the methods used to design the functionality of the product (for example: the choice of materials from a mechanical point of view

or the choice of technical components) were separated because they were not of interest for our objectives (once the evaluation of the §2.1. realized). The methods of management of the project were also separated. The sample included industries of various sizes, from one to more than 500 employees, and different responsibilities in the respondents' positions.

2.2 Construction of the set of reference terms concerning product experiences

We developed this set by using a procedure with four parts: by reading articles written by the main researchers on the subject ([2], [1], [6]); by searching the meaning of the terms and by again seeking the meaning of the words which conform the meaning [16]; by using dictionaries of synonyms and antonyms and by visualizing the semantic fields of the words [17]. In building this set one realized quickly that its construction would require very significant flexibility. Some of the terms of the set are: affect, affection, experience, emotions, pleasure, feelings, sentiments, sensations, mood, luxury, taste, preference, liking, fondness, Kansei, senses, aesthetics, personality, perception, comfort, …etc.

2.3 Search and choosing of the methods. Construction of the repertoire of methods objectives

To choose the industry methods for integrating user product experiences we had the answers to our questionnaire. First we had to differentiate the methods that concerned us, from other methods used in product design. In order to do that we took the results, table 3, and we underlined these methods on this table. We identified them thanks to our set of reference terms, §2.2. Even if sometimes they are not structured or known methods, they are still very significant insofar as they represent the answers to particular needs (methods "arranged" or adapted from other methods), or response methods to advanced problems still not recognized in the totality of industry. All the remaining methods are in fact methods used to design the functionality of the products (ex: "technological tendencies", "analysis of physical behaviour of the solutions", etc), we do not show the latter methods. In table 3, the methods are classified according to the operationalization of the variable. For the category "Kansei engineering methods" we had no answers. After the dash "-"we found the aim of the method.

Sensory analysis	**Quantitative studies.**	**Qualitative studies.**	**Trend Boards**	**F Other methods.**
Questionnaire, determine satisfaction with the sensory aspects Analysis to determine the sensations -touch, catch, balancing, cleanliness, not slipping, safety Observation - to determine sensory description, to identify not used sensory expression fields. Sensotact (Renault)- To quantify level of comfort, to evaluate the components of the user's product perception.	Determination of- the price, colours, name of the product. Subjective evaluation- Determine an affective Appreciation of the product. Design test- make a segmentation of the product. Purchase behaviour – to determine the behaviour of the customer.	Key to success factors - to determine the innovative degree of the product. Value analysis-to determine the value of the product' components from the point of view of the user. Semiotics, interview - to understand perceptions and practices. Development of the sensory aspects-to determine sensory characteristics of the product .	Trend Boards - to stimulate the creativity, to determine colours, finishing, textures, forms, to get closer the desired universe to the perceived feeling, to personalize the product, , to allow the positioning of the product, to allow the decision makers to apprehend the aspect of the future product. Semantic Mapping of competing product- positioning image, functionalities, to define assumptions of positioning.	FMECA- to identify all catastrophic and critical failure possibilities. SADT- to gather the requirements of the product and its environment. Micro psychological Analysis – to determine senses load . Perception Test- determine the importance of sensory aspects.

Table 3. (partial).Summary of the methods used in industry allowing to integrate user's product experiences in the design process. After the dash "-" we find the objective of the method

To search and choose the methods in the literature, we used only literature from product design, and not from other sources (we have only the exception of some psychology methods for recognizing the expressive component of an emotion). In order to identify these methods we compared the titles, abstracts and keywords from each paper or book chapter, against the set of reference terms. In each article or book chapter concerning a method we identified the method's objectives. We tabulated all this information. We paid attention to the heterogeneity of each objective: to be considered a valuable

objective it must be different from the others. Table 2 shows an example of the repertory of methods for integrating user product experiences in the design process. The complete tables comprised more than 80 methods. 8.4% (7/83) of the reviewed publications were in French.

Identification Number of the method	Name of the method (Bibliography)	Objectives that the method faces
32	A user's kansei evaluation system based on product form features and feature composition [11]	- To affect user's Kansei using the form element features and feature composition together - To analyse the relationship between the users' feeling (Semantic Differential evaluation) on these designs and the design features of the products - To explain how the elements features and feature composition together affect user's perception
33	Design optimization of product forms using neural networks [12]	- To examine the optimum combinations of form elements of a product using neural networks - To predict and infer the design optimization in the future using neural networks - To determine which product element has greater influence one the image of the consumers?

Table 2. (partial). Repertory of methods to integrate the affectivity of the users in the design process.

2.4 Analysis of reduction to the essential

Initially we found that each method always comprised several objectives. How then could one decide which of the objectives to use for the contents analysis? We found that the principal objective, corresponding to the main objective of the method, was the one that comprised the user product experience that was treated by the method. It was with this objective that the contents analysis could be carried out. But how could one decide in a non-subjective way which was the principal objective? We chose then to make an analysis of reduction to essence [7]. We extracted from each method which makes its essence, this being the paramount aspect of composition of the method, and what ensures that the method is recognized one way and not another. Let us look at an example:

"Method for aesthetic design improvement" [8]. The objectives that this method faces are:

I. to evoke specific target customer responses
II. to trigger definite aesthetic responses to the product by observers
III. to relate these aesthetics responses to the characteristics of the product
IV. to describe how aesthetic intents can be related to the shape of a product

First at all, proposals "III" and "IV" must be identified as redundant, then it does not matter which one is selected. Then, we must consider the remaining proposals by asking the question: is the finality of the method to answer to this objective? The answer to this question was negative for proposals "I" and "II", then we kept only proposal "III" (to relate these aesthetic responses to the characteristics of the product) as the essential question of the method. Finally, with this essential objective we were always able to identify a part in the proposition which corresponds to the user product experiences with the product (in this case "aesthetic responses") and a part which corresponds to the physical product ("characteristics of the product"). It is with this first part that we will be able to make the contents analysis. We had to carry out this analysis for the totality of the methods in the literature (more than 80).

2.5 Content Analysis

The content analysis is a technique of data analysis. It seeks to determine the presence of certain words, word groups or concepts in a text [9]. The texts can be books, articles, audio-visual productions or any other communicative form of the language. The content analysis can have two forms: conceptual analysis, which seeks to determine what is the occurrence of the selected terms, and the relational analysis, which goes a step beyond the conceptual analysis by examining the relations between the concepts in the text. We were interested in the first form of the content analysis, i.e., the conceptual analysis. The principal stages during a conceptual analysis of contents are as follows [9]:

- To decide what is the level of analysis, for example if it is a word, or a set of words (in our case).
- To decide how many concepts there are to codify: this implies the development of a set of concepts and categories. With this set the researcher must decide whether she will codify only the words which appear in the set or whether, with a certain flexibility, she will also codify words and significant categories which do not appear in the set of references. In our case we developed this set of concepts to codify. The set of concepts which interests us is the set of concepts in connection with the affective experiences in the context of product design. We have previously developed this set in the §2.2.
- To decide whether coding will be made by existence or frequency: this is a key question because the possible interpretations of the results in both cases are rather different. In our case we decided that coding would be made by frequency because what interest us are the relative "weights" of each term compared to the set of the terms.
- To decide how one will differentiate the concepts: this is in connection with the level of generalization, i.e., it should be decided whether the concepts will be codified exactly as they appear or whether they will be codified as the same one, even if they appear in different forms. It is also necessary to decide the level of implication, i.e. the researcher can not only code the words, but can also code words which imply the first word (example: jargon, technical words, euphemisms). In our case we decided on the broad level of implication (to code words which imply the first word) and of generalization (to code the words as different or the same one; in our case as different) because what interest us are the nuances that can exists between the terms.
- Developing rules to codify the texts guarantees not only the effectiveness of the process but it also guarantees that the process is done in a consistent and coherent way through time. For example, the rules developed throughout §2.3 and §2.4. are coding rules.
- To decide what to do with the information "which is not relevant": whether it can be ignored or used to re-examine the way of coding. In our case it can be relevant if after the content analysis one wants to structure the set of methods.
- To codify the texts: this can be done manually by writing down the occurrences of the concepts or with suitable software. We did it manually.
- To analyze the results to establish conclusions and generalizations if possible: it is possible to see tendencies which are an indicator of much more complex ideas.

The main requirement in implementing the content analysis is to have concise information units. For industry methods the implementation of the content analysis was straightforward because the units of information (the objective of the method) were very concise. On the contrary, for literature methods we first had to do the analysis of reduction to the essential §2.4.

3 Results

We received 38 answers from industry. Then with these answers we carried out the content analysis. From the content analyses of the methods of the literature and industry we obtained two tables (Tables 4 and 5) respectively representing the objectives of the methods in terms of a user's product experience. These frequency tables are two lists of terms concerning the product experiences. For the industrial projects the list comprises 53 terms, in table 4, and for the methods in the literature 83 terms were indexed, in table 5. The results of the content analysis of the methods of the literature enable us to represent graphically, in figure 1, what is comprised as a product experience in the field of the methods for its integration in the design process.

4. Analysis and discussion

In the paragraphs below we compare the results of the content analyses carried out. To begin, normally an analysis of this type must show which are the repeated terms or not and at what frequency. In our case, as was already shown in the former point, §3, the level of repetition is so low that it is rather, on the contrary, the diversity of the terms which it is necessary to retain (52 different terms in industry and 64 for the literature). Why such a diversity? It is perhaps an indication of the disciplinary level of

development: there is not much consensus on the terms to be used to express product experiences. On the other hand, there is a fact: the number of product experiences experienced by the user is relatively vast. Then, are they experiences of a similar nature? There is no way to answer this. However, we can highlight two facts: firstly, there are product experiences concerning all the three components explained by Hekkert [6] (aesthetic, meaning, emotion) and each experience "weight" more or less on each of the components; secondly, for some of the product experiences there are scientific theories to support them (for example, for the emotions, the theory of mixed emotions of Ortony, Clore et al.[10]) which must have consequences in the way of integrating them into the design process or into the way of researching them.

We compared the two content analyses. With this intention we asked: in what ways are they different? In what ways do they coincide? We took each term of each table (tables 4 and 5) and examined whether it was present in the other table. For the table corresponding to industry, table 4, we listed a total of 13 terms with a frequency of 16 (after weighting of the terms having a frequency distinct of one), which makes an overlap of 30.8% with the table of the methods in the literature. Regarding the table of the methods in the literature, table 5, we listed a total of 14 terms with a frequency of 35 (after weighting of the terms having a frequency distinct of one), which then makes an overlap of 35.7% with the table of the methods in industry. The two percentages being very close enabled us to conclude that there is a symmetry in the quantity and the type of product experiences to be integrated, in industry and in the literature. On the other hand, for the terms which are different in each of the fields, literature and industry, the situation is very different: 64.3% of the terms in the literature methods deal with product experiences which are not mentioned by the people surveyed in industry. Similarly, 69.2% of the terms of the methods in industry deal with product experiences which are not mentioned by the methods in the literature.

Frequency 5	Frequency 3	Frequency 2	Frequency 1	Frequency 1
- colours	- purchase behaviour	- bad habits - comfort - feelings - aesthetics - product image - pleasure - personality of the product	- real use - abnormal use - practices of use - scenes of use - not-expressed practices - certain practices - simpler use - gestures - finishing - textures - forms - symbols - desired universe - perceived sensation - cultural references - influential currents - cultural universe - sensations - unused sensory fields of expression - senses load - expectations in terms of touch - more qualitative sensory characteristics - sensory aspects - sensory components - bad functioning during use	-emotions - top-of-the-range aesthetics - level of comfort - components of perception - perceptions - perceived quality - desired quality -subjective evaluation - key factors to success - spending patterns - warranty period - brand name - preferences - values of the product components - social values - new benefits - concerns - functionalities

Table 4 List of terms expressing user's product experiences resulting from the content analysis of the industrial methods used to integrate these product experiences in the design process.

Frequency 8	Frequency 6	Frequency 4	Frequency 3	Frequency 2	Frequency 1	Frequency 1
- Customer or user preference [11] [12] [13] [14] [15] [16] [17] [18] [19] [20]	- Emotions [21] [22] [23] [24] [25] [26] [27] [28]	- values [29] [30] [14] [15] [31] [32] [33]	- Customer needs [18] [22] [20] -Pleasure [34] [35] [36] [37] - Displeasure [34] [36] - Taste [30] [38] - Impressions [39] [40] [41]	- Perceived quality [42] [43] - Perceptions [22] [39] - Personalities [44] [45] - Customer affect criteria [46] - Feelings [47] [40] - Customer kansei [48] [17] - Kansei words [48] [26]	- Physiological signals of emotions [49] -perceived values [50] - Pleasurable feel [51] [52] - emotional responses [53] [22] - mixed emotions [54] - settings of subjective attributes [55] - emotional experiences [56] - emotionally rich interactions [24] - consumer values [30] [57] - local norms [30] - universals [30] - subjects' evaluations [13] - user's feelings [58] - kansei appreciation [17] - emotional responses [59] - Fun experience [60] - aesthetic criteria [61] - influence on the consumer [62] - aesthetic factor [63] [64] - emotional message [65] [66] [67] - appreciation [63] [64] - consumer evaluation [68] - emotional perceptual qualities [55]	- Desires [47] - Signs [69] - Oral language [70] - kansei [71] - subjective evaluations [72] - Subjective Expectations [39] - inspirational material [17] - Subjective meanings [17] - Subjective terms [73] - pleasurable sensations [51] - social space [30] - cultural associations [74] - expressive component of an emotion [75] [76] [80] [77] [78] - Style images [70] - Affection [79] - Personality [45] - Aspirations [22] - Aesthetic responses [8] - Sensitivity [44] - Designer's feelings [17] - Impression words [72] - Opinions [28]] - symbols [80] - users' kansei [58] - desired aesthetic properties [65] [66] [67] - trends [32] [33] - imaginary [80]

Table 5 List of terms (64 different) expressing product experiences and resulting from the contents analysis of the methods of the literature to integrate the user's product experiences in the design process.

5. Conclusions and prospects

Initially, affectivity is seen in a compartmentalization: it is understood as small pieces that sometimes interact and sometimes don't, i.e. sometimes in a project one or two users' affectivity experiences are integrated. In industry there is no unified vision of the phenomenon, neither at the terminological level nor at the methodological level.

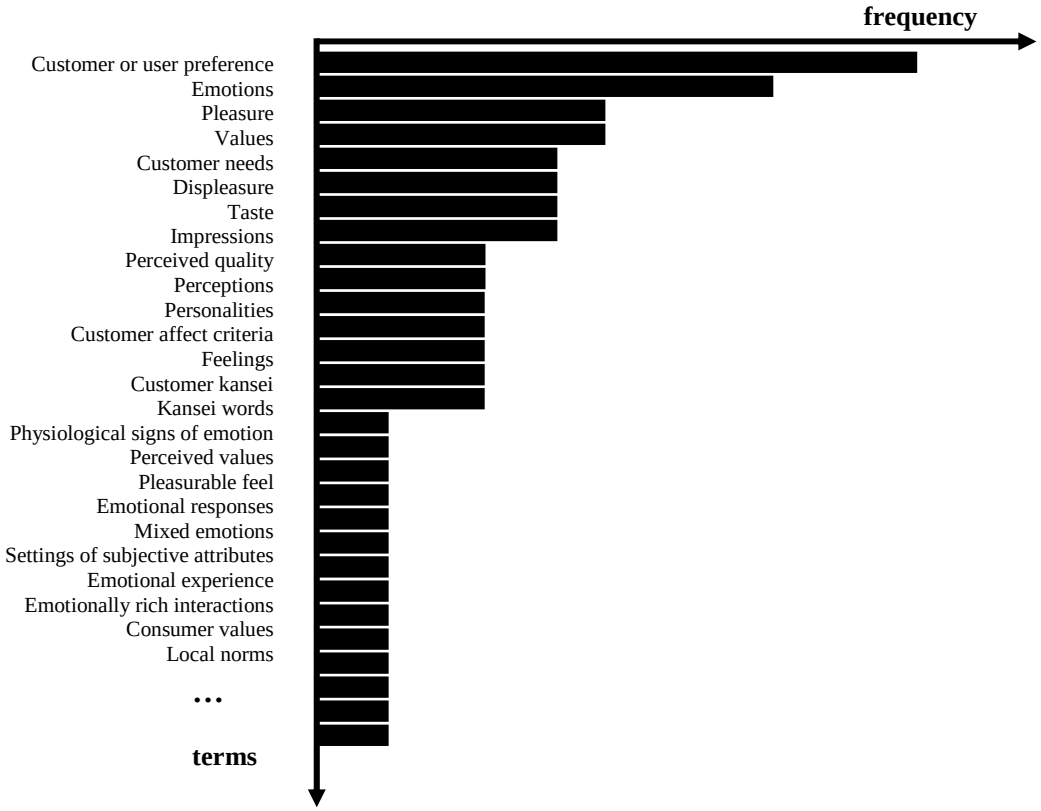

Figure 1. Representation of the frequencies of the user's product experiences according to the methods of the literature. The highest frequency is of 8, the lowest is 1.

We found that there is no unicity of language: 65 different terms concerning product experiences were listed for the methods in the literature. On the other hand, the type of objectives that the methods face (§2.3., table 2.2.) are shared to high degree: just three kinds of objectives occupy 68% of the publications (83 publications which included various book chapters, conference proceedings and journal papers). At this moment there is no unicity on the level of terms but there is unicity on the level of the objectives that literature methods face.

The broad use of the term "product experience" makes it possible to cover in the same term a quantity of phenomena which are (however) very different from each other and, which, moreover, interact. This broad use does not contribute to a better comprehension of the objectives concerning the actual and current use of the methods. Let us recall that among these objectives, to minimize the gap between the projected benefit of the product (by the designers) and its perceived benefit (by the users), i.e., to appreciate if the designers reached the desired effects, is especially relevant for industry.

We found that product experiences in the methods in industry are, in a small part, already integrated with tools and adequate methods to do it (especially sensory aspects). We found that in a project of product design, the integration of only a few product experiences is made at the same time (one or maximum two). All the product experiences are not forcing important for the designers.

The lists of terms obtained are a synopsis of what is possible to integrate accurately in terms of the product experiences linked to the user in the design process. Other researchers have already made

classifications of these product experiences [2].These experiences are the result of a complex whole of processes such as the emotions, the feelings, the values, perceptions, etc. of the person. Integrating user product experiences into the design process is important because it has three beneficial impacts: first, it allows one to identify for the user benefits generated by the product ; second, it guarantees that the designers arrive at their design objectives; and third, the designers can seek to deliberately influence the experiential impact of new designs [1]. These user product experiences can be of the types presented in tables 4 and 5.

- Prospects

Today, given the profusion of methods and tools available for its implementation, it is becoming increasing important to integrate the user product experiences into product design. It is hoped that the improvement in the understanding of the term will make it possible to better use the tools and methods for integrating the user product experiences into the design process and to better understand the complexity of the term (i.e. the simultaneous use of the different terms).

In the future a method must be developed for assisting with the choice of the methods for integrating the user product experiences into the design process (c.f. the method proposed by the Engage Project [81]). With this method it would be possible, firstly, to identify and find the suitable method; secondly, it would allow one to make the correct identification and choose the most appropriate moment when it is necessary to apply the method; thirdly, it would allow one to take into account all the conditions of the product design project and enterprise (planning periods, budget, cost, resources needed, tools to be implemented, type of results, etc.). We also think that these tables, 4 and 5, will allow the methods user to classify methods concerning product experiences.

From a closer study of the methods, it is necessary to differentiate two cases present in the tables resulting from the content analysis (i.e. in the terms expressing the affective experiences): the first, where there is an analytical theory (scientific) for the term indicating an emotional experience (for example, for the "emotions" [10], for the "touch" [82], for the "social values" [31]), and the second, where this theory does not exist (for example, for the “aspirations” or for “inspirational material” to our knowledge). It should then always be asked whether an analytical theory exists for the affective experience, in support or not. We think that for the positive case the remarks of Desmet [83] are valid and generalizable, as is the case for emotions. The affective experiences "*are often considered intangible and therefore impossible to predict or design for*"; however, for the affective experiences where there is an analytical theory in support, we think that, even if the affective experiences are idiosyncratic, "*the conditions that underlie and elicit them are universal.*" [83]. Unfortunately, these analytical theories on affective experiences are relatively rare.

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