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HOW TO COMPREHEND AND ASSESS PRODUCT SEMANTICS – A PROPOSAL FOR AN INTEGRATED METHODOLOGY

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Abstract

Product semantics, the "*study of the symbolic qualities of man-made forms in the context of their use, and application of this knowledge to industrial design*" [1] is an important challenge in product design. Because of subjectivity, this particular dimension of the user's need is difficult to express, to quantify and to evaluate. This paper presents a general approach to assess product semantics in a solid way. It is based on users' tests, and involves several classical methods in marketing and decision theory, as multidimensional scaling, semantic differential method, factor analysis, pairwise comparison and Analytical Hierarchy Process. As result, our approach provides designers with a tool which helps the definition of the semantic part of the need, it rates and ranks the new product prototypes according to their proximity to the "ideal product", and it underlines the particular semantic dimensions that could be improved. To illustrate our approach, we have performed users' tests and applied our methodology to the design of table glasses. For clarity, each stage of the methodology is presented in detail on this particular example.

Keywords: Product semantics, multidimensional scaling, pairwise comparison, AHP.

1 Introduction

The user's perception of a product is by essence subjective and difficult to express and assess with mere evaluation criteria. Product semantics, related to how a person perceives the appearance, the use and the context of a product, is an important problem in industrial design [1]. In order to predict the success of a product, to control or to optimise its performances, many tools and methods have been developed in engineering design so as to deal with objective/usage functions. But there is a lack of such a methodology when one addresses subjective/esteem functions (including aesthetics or styling attributes) and more generally product semantics. Indeed, product semantics is often nothing else but a style of design, depending in practice much more on the designer's taste than on real customers' trends, as some studies clearly showed [2]. This is due to the fact that subjective functions and criteria are often neither named nor objectively assessed. To be more competitive, we think that it is now a challenge to develop products semantics in a more rational and scientific way [3].

In this context, we propose a methodology which combine methods and techniques derived both from engineering design and marketing. From engineering methods, we keep the fact that users' needs are expressed in advance with design specifications, and that design solutions or concepts are assessed according to evaluation criteria. From marketing, we use techniques which allow one's to comprehend user's perceptions and to grasp consumer's feelings and assessments.

Our methodology addresses, in an integrated manner, the four following design stages:

1. Understanding the need related to product semantics
2. Finding relevant criteria to characterise and express the need
3. Specifying the requirements of a new product
4. Assessing the performances of new solutions

This work is motivated by the fact that there is always a gap between designers' and users' perception [2]. Furthermore, design is a pluri-disciplinary activity, and product design within a company has to be carried out in a more transmissible and rigorous manner.

2 Backgrounds

To study the product semantics, researchers in marketing propose various methods [4]. Perceptual maps are commonly used to take perceptions into account and to control the product positioning. The basic idea is to build a multi-attributte perceptual space in which each product is represented by a point. Two main methods are used to construct the perceptual space: The semantic differential method (SDM) and multidimensional scaling (MDS). In addition to these methods, we propose a short description of pairwise comparison techniques, which are relevant to grasp subjective assessments.

2.1 Semantic Differential Method (SDM)

Semantic differential method (SDM) [5] consists of listing the semantic attributes of the product to analyse, and carrying out user-tests in which the user must assess the product according to these attributes. The attributes are often defined by pairs of antonymous adjectives which lie at either end of a seven point qualitative scale. A semantic space, Euclidean and multidimensional, is then postulated. *Factor analysis* and *Principal Components Analysis* may be used to reduce the dimension of the space and to find the underlying dimensions. They are used for the analysis of families of products or for the detailed analysis of a product.

2.2 Multidimensional scaling (MDS)

Multidimensional scaling uses dissimilarity assessments to create a geometrical representation of the perceptual space related to a family of objects. This method, developed initially for psychometric analysis [6], is a process whereby a distance matrix among a set of stimuli is translated into a representation of these stimuli inside of a perceptual space. Taking all the possible pairs of stimuli (here pairs of products) into account, each subject evaluates their degree of similarity on a quantitative scale. Technically, the MDS technique amounts to locate the products considered as points in a k-dimensional space such that the Euclidean distances between them correspond as closely as possible to the perceived dissimilarities in the input matrix. Dimension k of the need space is the lowest dimension respecting an optimisation criterion called *stress,* which represents the "badness of fit". The main advantage of this method is that the tests are based on instinctive dissimilarity assessments, which do not impose any criteria or predefined semantic scale. This method provides a space for a visualisation of the perception of products. It is well suited to study the relationship between products.

2.3 Pariwise comparison (PC)

Instead of assessing a particular *score* for the performance of a product on a scale in an absolute manner, the idea is to estimate for some pairs of products the relative importance of the scores for the given criterion. A ratio scale must be defined for each criterion for this purpose [7]. This leads to a pairwise comparison (PC) matrix, which can be processed to extract a realistic normalized vector of scores. Pairwise comparisons are known to be easily administrated because decision makers (DMs), or customers assessing the products, in our case, only focus on a pair of products and on a criterion instead of brutally facing the whole multi-attribute issue. So as not to compel DMs to fill the overall PC matrix like in the well known eigenvector method [8], we used the *Least Squares Logarithmic Regression* (LSLR) PC method proposed by De Graan and Lootsma [9]. Sparse PC matrix are then tolerated, which is preferable for the relative assessment of numerous products (more than eight). Once the scores attributed for the products under a set of decision criteria, an additional PC assessment between the criteria themselves results in a *weight* vector for the criteria. Next, the *Analytical Hierarchy Process* [10] method merely consists in calculating global rates for the products by the weighted sum of the criteria weights by the corresponding product scores. Despite a number of known shortcomings, among which a difficulty of interpreting the meaning of *score* scales and of the *weight* ratios [11], the AHP is considered as a valuable method for selecting a preferred alternative in a short-list while no obvious objective means of measurement exists, no obvious objective function exists, and we are in the presence of a wealth of information and interpretation. This situation is exactly the one of our *design selection* issue. In addition, the PC methods provide a measure of the judgment inconsistency, allowing the DMs to highlight their personal misunderstandings or imprecisions and consequently to enter in a virtuous loop to improve the quality of assessment [12].

3 Brief overview of the stages of our methodology

In order to assess product semantics, we propose a methodology decomposed into several stages, each of them including users' tests performed by a panel of subjects. Here is a brief description of its stages:

1. Definition of the semantic attributes. The starting point is a set of representative existing products which all answer the same usage functions, but differ from a perception point of view. Subjects are asked to describe their perceptions about the product freely. A list of relevant semantic criteria is extracted from this description.
2. Determination of the perceptual space. So as to grasp the perceptual differences between products, the *Multidimensional Scaling Method* (MDS) is used to build a k-dimensional Euclidean perceptual space, in which all the products are located. Several perceptual dimensions are found and a visual clustering of products can be observed.
3. Raw determination of the semantic space. So as to investigate the subjects' perception of a product and to explain the reasons for product differentiations, the *Semantic Differential Method* (SDM) is used, with the list of semantic criteria established in stage 1. A *principal component analysis* (PCA) is performed on the raw data of the SDM. The role of PCA is first to detect adjective pairs perceived as synonyms, in order to reduce the dimension of the semantic space (some adjective pairs are highly correlated and underlying dimensions are revealed), and secondly to find out which adjective pairs contribute very few into the variance of the assessments. Such adjective pairs are designed as irrelevant for a

description of the semantic of the given set of products. This allows the definition of a sub-list of semantic attributes, which are relevant to assess the product semantics.

4. Fine determination of the semantic space. From this reduced list of semantic attributes, a finer multi-criteria comparison of products is performed by the subjects. With the aid of an AHP multi-attribute rating approach [11] using an inner LSLR Pairwise Comparison (PC) method [10], the products are weighted under each semantic attribute (giving the *scores*), more precisely than in SDM.
5. Definition of semantic part of the need. The need corresponding to a new product is specified in two ways. First, a product positioning is proposed in the perceptual space. The idea is similar to product positioning strategies in marketing, where perceptual maps are used for product cannibalisation or competitive positioning (research of new market). Next, the specifications of a new product, named the "ideal product", is performed by *Pairwise Comparisons*, relatively with the set of existing products. In addition to this ideal product description, the need for the targeted market segment is also expressed by the determination of *weights* of the semantic attributes with the aid of the *Pairwise Comparison technique*.
6. Design stage. Starting from the specifications, new *potential product* solutions are defined
7. Assessment of the *potential products*. The scores of the new *potential products* are assessed under the semantic attributes by pairwise comparisons (see stage 4) relatively to the existing products.
8. Rating of the products. Given the assessment of each product according to the evaluation criteria, the products are rated according to their distance to the "ideal" product, through conventional AHP procedure.

4 A case study: Table glasses

We have applied the above methodology to the assessment of glasses, which are very interesting products from a semantic and esteem point of view. A study on such products (wine–glass) was proposed in [13], where the authors presented a method for form generation. For our study, we imagine a company, which build a range of glasses (shapes given figure 1), and which wants to design a new glass in order to diversify its products portfolio. We propose to show in this paragraph how our method can be used to assess in a solid way product semantics of several design solutions.

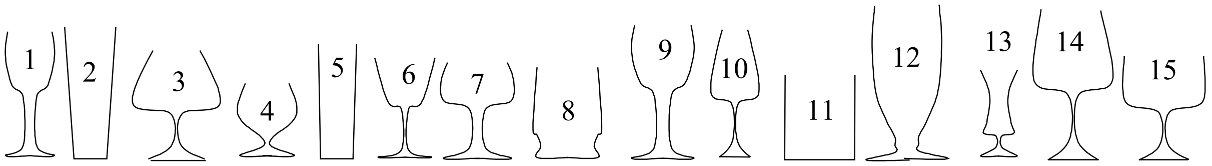

Figure 1. shapes of the 15 glasses proposed for the study

Stage 1: *Extracting semantic attributes*. The 15 glasses have been physically proposed to 11 subjects (10 males, 1 female) for a detailed evaluation. Subjects were asked to verbally express various characteristics of their perceptions of the glasses. An analysis of their descriptions has led to the setting up of 17 adjective pairs (**v1** to **v17**) (table 1).

Stage 2: *Building of the perceptual space with MDS*. For each pair of glasses, subjects were asked to sort the products into mutually exclusive groups based on their similarities. No constraint is given on the number of classes to make. The assumption underlying this method is that products occurring in the same group are more similar than products occurring in different groups. The sorting data for any subject consists of a matrix of 0 and 1, indicating whether the subject grouped two glasses together or not. Individual dissimilarity matrices are then summed for all subjects, leading to the group's dissimilarity matrix. Here, one assumes, for the moment, that the group members behave in a somewhat similar manner, i.e. we do not deal with clustering considerations of the group. With this matrix as input, non metric MDS has been used to calculate the perceptual coordinates of the glasses. A 2-dimensional configuration, with a stress value equal to 0.1 (considered as a correct "badness of fit") has been retained (figure 2).

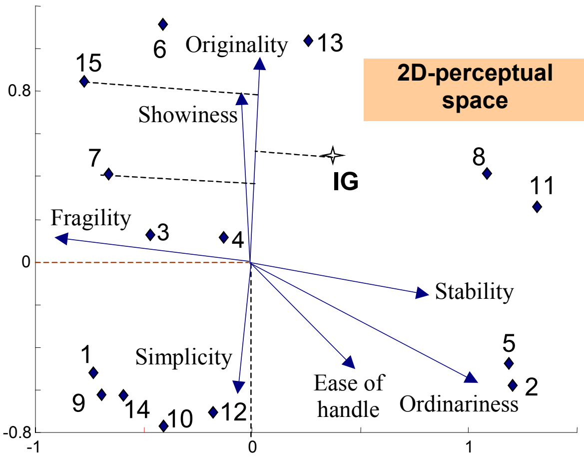

Figure 2. Position of the glasses and the determining semantic attributes in the perceptual space

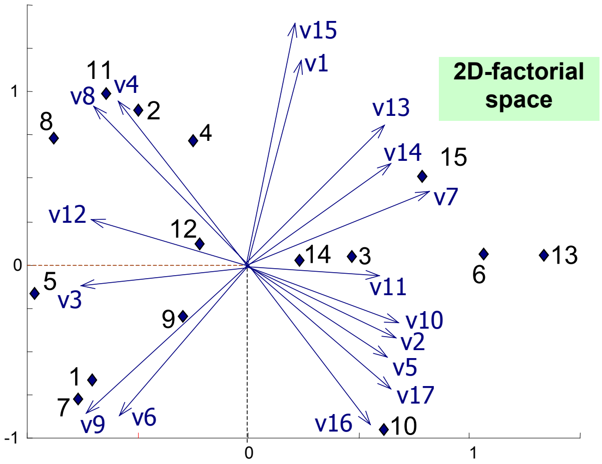

Figure 3. Positions of the glasses and the adjective pairs in the factorial space

Table 1. The 17 adjective pairs used in the SDM test, and their corresponding semantic attributes

Adjective pair	Semantic attribute	Adjective pair	Semantic attribute
v1: Traditional-modern →	Modernity	v12: Classy-vulgar →	Smartness
v2: Easy for drinking/not… →	Ease of drinking with	v7: Common-particular →	Originality
v3: Decorative-practical →	Decorativeness	v13: Unoriginal-creative →	
v4: Unstable/stable →	Stability	v14: Existing-new →	
v6: Complicated-simple →	Simplicity	v15: Good perceived quality-bad… →	Quality
v10: Multiusage-occasional →	Ordinariness	v16: Strong-fragile →	Fragility
v8: Easy to fill-not… →	Ease of filling	v5: Masculine-feminine →	
v9: Flashy-discreet →	Showiness	v17: Coarse-delicate →	
v11: Easy to handle-not… →	Ease of handle		

Stage 3: *Raw determination of the semantic space with SDM*. Subjects were asked to assess each glass on a 7 levels Likert scale [5] according to the list of adjective pairs proposed in table 1. A cluster analysis has been performed on these data in order to find the panel as much homogeneous as possible. One subject, whose the assessment was very different[1] to the rest of the group's assessment, has been removed. We have then calculated the average of the assessment for 10 subjects only. A principal component analysis on the average data allowed the research of underlying dimensions of the semantic space (figure 3). Axis 1 and 2 account for 64% and 17 % of the variance respectively. So, 91 % of the variance is accounted by a two-dimensional factorial space. Each adjective pair is represented in the factorial space by a "vector", the scalar product between 2 vectors being the correlation coefficient between 2 adjective pairs. After an analysis of the correlations between adjective pairs (colinearity of the vectors), we have extracted a minimal list of semantic attributes (table 1). For example,

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[1] The subject's understanding of the meaning of several adjective pairs was "opposite" to the group's one.

adjective pairs **v16**, **v5** and **v17** have been merged because they are highly correlated (see figure 3), and they are furthermore synonyms.

Stage 4: *Fine determination of the semantic space*.

First, each semantic attribute is assessed (scores) more precisely with pairwise comparison tests. By this process, for each attribute, a percentage of 100% of importance is shared among the set of 15 glasses. In practice, each of the 10 people is asked to fill at least 30 pairwise comparisons in each of the 13 comparison matrices (corresponding to semantic attributes) of 15×15 size (for the 15 products) on a 7-levels scale (<<, <, <~, =, >~, >, >>). Next the LSLR pairwise comparison method [10] is used to calculate the scores relative to a given semantic attribute from the superimposition of the 10 corresponding PC matrices.

Secondly, in order to infer the meaning of the perceptual axis, and to find which semantic attributes are determinant for the perceptions, the semantic space is mapped onto the perceptual space. This is done by a multiple regression, using the perceptual axes as independent variables and the semantic attribute as the dependent variable. The outputs of this method, called PROFIT (for PROperty FITting), are the correlation coefficients and the direction cosines (rescalings of the regression coefficients). The attributes for which the multiple regression is significant (according to Fisher-Snedecor table with P-value = 0.05) are called the *determining semantic attributes* (in grey in table 1); it is assumed that they play an important role for user's perceptions. The vector model of these attributes is plotted in the perceptual space. The origin of the vector is located arbitrarily in the origin of the frame, the values of the direction cosines give the orientation of the arrow, the arrowhead points in the direction of increasing attribute values and the norm of the vector is proportional to the regression coefficient (figure 2).

Stage 5: *Definition of the semantic part of the need*.

First, a positioning of the new glass has to be proposed in the perceptual space. This perceptual positioning, proposed by the company or its product supervisor, must take the following considerations into account:

- avoiding the cannibalisation of its own product, or trying to fight against a competitor,
- determining from which product the new glass is perceptually close,
- using the vector model in order to roughly define what kind of product the company wants to develop, and assisting the specification.

Next, the specifications for the new glass (called the "ideal" product) are proposed by comparison with the existing set of glasses. This is one of the strong point of the methodology: It's easy and intuitive to give specifications by comparisons, particularly when we have to deal with semantic attributes. For example, an absolute value of "originality" = 8/10 doesn't make much sense. On the other hand, a specification of "originality" formulated as "less original than glass #8 but more than #2" is interesting and more easily understandable. A group session is particularly suitable for this specification stage, where each participant can bring a particular light on what could be the new product: The perceptual space and the vector models give for that a convenient support for discussions. We propose to compare the ideal product to the existing set of glasses for each semantic attributes: A new row and a new column are then added to the pairwise comparison matrix, established in stage 4. But our chosen PC method allows to omit some comparisons when no particular specification has to be made. Again this last facility strengthen the flexibility of our methodology. In order to control the perceptual positioning, the vector model can be used to suggest a relative rank of the new product according to the different determining semantic attributes. It has to be noticed that an efficient way to control and predict with accuracy the perceptual positioning of a new product is to control with care its performances according to the determining semantic attributes. This is a classical marketing technique, which is subjected to limitations in the case of very innovative products. Indeed, we must keep in mind that the predictive power of the linear model (PROFIT) may be in certain cases very weak, because the models have been established on the basis of a set of given products, and could be for this reason little accurate when used with a new innovative product. This can even be a track to stimulate innovation[2]. Nevertheless, we consider for this study that the perceptual space and the linear models are valid for a new design.

We propose the following orientations for the new glass: A creative and original glass, for occasional usage, which suggests a feeling of solidity, but neither massive nor rough. The corresponding positioning **IG** (for Ideal Glass) is proposed figure 2. To show how the vector model must be used, for attribute "originality" for example, the vector model indicates that the originality of "**IG**" is "less than #15 but more than #7". The result of the pairwise comparison is given in table 2.

Table 2. Scores of products relative to semantic attributes for the initial set of glasses and the ideal glass **IG**

Scores (%)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**IG**
Stability	7,2	6,8	7,4	7,6	8,1	4,4	4,8	7,8	6,1	4,3	8,9	5,9	3,7	5,2	5,9	6,1
Fragility	7,6	1,8	7,8	3,0	5,0	9,9	7,4	1,4	8,8	9,7	2,9	5,9	8,4	6,7	7,6	6,0
Quality	5,2	6,2	7,3	7,4	4,9	6,4	4,9	6,3	6,2	4,9	7,7	6,5	6,9	5,7	7,8	5,6
Originality	3,0	6,4	7,1	5,7	3,6	10,0	3,6	5,1	3,6	4,8	5,4	6,4	9,9	6,7	9,7	9,0
Smartness	4,7	5,5	10,6	2,3	3,6	10,9	1,9	2,6	7,6	11,0	6,4	2,6	11,0	6,7	9,6	2,9
Ease of handle	6,7	7,2	4,6	5,0	8,2	5,4	6,9	8,1	7,3	5,4	6,4	7,1	4,2	5,2	6,6	5,5
Ordinariness	7,2	9,6	3,2	4,5	10,9	3,2	8,7	11,1	6,8	3,4	11,6	5,6	1,3	6,6	3,1	3,2
Ease of filling	7,1	8,6	5,4	7,1	8,3	5,7	5,8	8,3	8,2	2,3	7,6	6,5	2,1	6,1	6,9	3,9
Showiness	3,4	6,7	6,6	7,7	4,7	8,8	4,1	5,0	4,8	5,6	6,0	6,1	8,1	5,9	8,8	7,7
Simplicity	9,5	4,3	5,4	8,3	8,1	2,0	9,1	7,2	9,2	7,7	5,5	7,3	4,4	6,1	3,6	2,4
Decorativeness	3,9	6,0	7,0	3,9	3,3	10,5	3,7	4,2	4,6	7,7	4,6	6,0	10,1	6,7	10,3	7,6
Ease of drinking with	6,7	8,0	5,0	6,0	7,9	5,0	6,8	7,6	7,9	3,4	7,6	7,6	2,5	7,3	5,7	4,9
Modernity	3,8	6,8	5,4	5,7	6,0	5,9	3,5	8,5	4,9	5,9	7,5	5,4	8,9	8,4	7,0	6,4

Finally, in order to adapt the product to the market's segment, pairwise comparison is used to weight the importance of each semantic attribute. This step is classical in value analysis where the importance of functions is weighted so as to take various aspects of the customer need into account. The processing of the pairwise comparison matrix has led to the semantic attributes' weights w_i presented in table 3 (penultimate column).

Stage 6: *Design stage*. Two prototypes (a real and a virtual glass) are proposed as candidates for the new design (figure 4).

Figure 4. Glasses candidates for the new design: **N1** (right) and **N2** (left).

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[2] For example, according to figure 2, it could be interesting to try to design a new glass with a high level in both originality and simplicity too

Stage 7: *Assessment of the candidate products*. The new glasses **N1** and **N2** are added to the pairwise comparison matrices and relative assessments are provided by the subjects. For each semantic attribute, the previous evaluations, performed in stages 4 and 5, are completed with assessments concerning the new glasses. After calculation, the new relative scores are given in table 3. Note that the scores have changed for the initial set of glasses since they totalise 100% for all the glasses, including **IG**, **N1** and **N2**.

Table 3. Evaluation of the glasses

scores (%)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**IG**	**N1**	**N2**	w_i **%**	***type***
Stability	6,5	6,1	6,7	6,8	7,3	4,0	4,4	7,0	5,5	3,9	8,0	5,3	3,4	4,7	5,3	5,5	4,6	5,0	12	**1**
Fragility	6,8	1,6	7,0	2,7	4,5	8,8	6,7	1,3	7,8	8,7	2,6	5,3	7,5	6,0	6,8	5,4	5,4	5,4	7	**3**
Quality	4,8	5,6	6,6	6,7	4,5	5,8	4,5	5,7	5,6	4,5	7,0	5,9	6,3	5,2	7,1	5,1	5,1	4,1	5	**1**
Originality	2,6	5,6	6,2	5,0	3,2	8,8	3,2	4,5	3,1	4,2	4,7	5,6	8,7	5,9	8,5	7,9	6,8	5,6	12	**3**
Smartness	4,4	5,2	10	2,2	3,4	10,3	1,8	2,5	7,2	10,4	6,0	2,5	10,4	6,3	9,1	2,7	2,7	2,7	5	**3**
Ease of handle	6,3	6,7	4,3	4,6	7,6	5,1	6,4	7,6	6,8	5,1	5,9	6,6	4,0	4,8	6,2	5,2	3,4	3,4	10	**1**
Ordinariness	6,8	9,0	3,0	4,2	10,2	3,0	8,1	10,4	6,3	3,2	10,8	5,3	1,2	6,2	2,9	3,0	3,0	3,3	6	**2**
Ease of filling	6,6	8,0	5,0	6,6	7,7	5,3	5,4	7,7	7,6	2,2	7,1	6,1	2,0	5,7	6,5	3,6	2,7	4,1	6	**1**
Showiness	3,0	5,9	5,8	6,7	4,1	7,7	3,6	4,4	4,2	4,9	5,3	5,4	7,1	5,2	7,7	6,7	6,7	5,8	6	**3**
Simplicity	9,0	4,0	5,1	7,9	7,6	1,9	8,5	6,7	8,7	7,3	5,2	6,9	4,2	5,7	3,4	2,2	2,2	3,4	9	**3**
Decorativeness	3,5	5,3	6,2	3,5	2,9	9,4	3,3	3,7	4,1	6,9	4,1	5,3	9,0	6,0	9,2	6,8	5,7	5,1	10	**3**
Ease of drink.	6,1	7,3	4,5	5,4	7,2	4,5	6,2	6,9	7,2	3,1	6,9	6,9	2,3	6,7	5,2	4,4	4,4	4,4	7	**1**
Modernity	3,3	6,0	4,7	5,0	5,3	5,1	3,1	7,4	4,3	5,1	6,5	4,7	7,8	7,4	6,1	5,6	5,6	7,0	5	**3**

Stage 8: *Rating and ranking of the products*

The first step of this process is to define, for each semantic attribute and each product, a quantity which is maximum when the need is perfectly satisfied (when the score of a given product perfectly matches the score of **IG**), which is null when the need is not at all fulfilled, and which is even higher that the performance is close to the specified value. In other words, one has to find, for each attribute, a value which represents the "closeness" between a given product and the ideal product. We have called this quantity the "satisfaction", and we have defined 3 types of satisfaction curves (figure 5), in order to confer different specification types to the attributes.

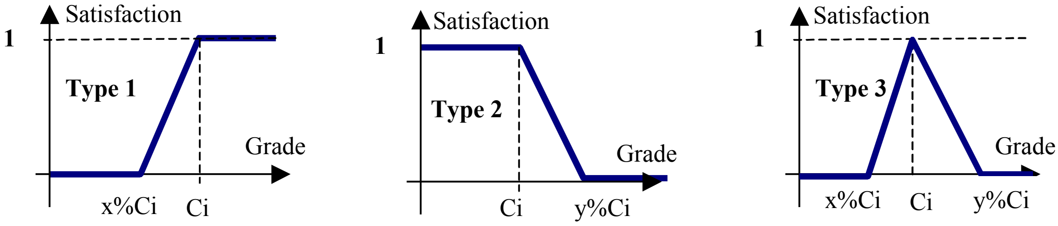

Figure 5. Definition of the 3 types of satisfaction curves

In figure 5, *Ci* is the "target value", which represents the performance (the score) of the ideal product. The values are given in column "**IG**" of table 4. x% and y% allow the definition of limits of validity and flexibility, classical in functional analysis. Different values of the percentages x% and y% for each semantic attribute allow the definition of appropriate satisfaction curves. The affectation of the type of satisfaction curves to an attribute depends on the meaning of the attribute and affects how the need is formulated. The affectation that we have chosen is given in the last column of table 3. Starting from the scores, the weights and the specification types, new scores are calculated in a *satisfaction table* (table 4) through a basic spreadsheet. Note that **IG** obtains satisfaction grades of 1 everywhere. For the final grade of each product, a classical multicriteria evaluation procedure, adapted from the A.H.P, is used [11]. Let *Sij* be the satisfaction for product *j* and semantic attribute *i*, let *sij* be the normalised score of satisfaction, N the number of products:

$$s_{ij} = S_{ij} / \sum_{j=1}^{N} S_{ij} \tag{1}$$

Let w_i be the relative weight of semantic attribute *i*, M the number of attributes: The final evaluation of product *j*, *grade(j)*, is given by:

$$grade(j) = \sum_{i=1}^{M} w_i . s_{ij} \tag{2}$$

A rank of the products can then be established, the ideal product being of course ranked number one. In our case, the new design **N1** is well ranked by the group, glass **N2** has to be improved (table 4). With the evaluation procedure, one can easily determinate according to which criteria the glass **N2** has to be optimised. Various propositions can be made with CAD systems and virtual prototyping during group sessions.

Table 4. Satisfaction's grades and final rank of the glasses

Satisfaction Sij	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**IG**	**N1**	**N2**
Stability	1	1	1	1	1	0,11	0,33	1	1	0,06	1	0,89	0	0,5	0,89	1	0,44	0,72
Fragility	0,11	0	0	0	0,47	0	0,2	0	0	0	0	0,93	0	0,6	0,13	1	1	1
Quality	0,78	1	1	1	0,6	1	0,6	1	1	0,6	1	1	1	1	1	1	1	0,33
Originality	0	0,05	0,29	0	0	0,62	0	0	0	0	0	0,05	0,67	0,14	0,76	1	0,52	0,05
Smartness	0	0	0	0,33	0,17	0	0	0,67	0	0	0	0,67	0	0	0	1	1	1
Ease of handle	1	1	0,44	0,67	1	0,94	1	1	1	0,94	1	1	0,22	0,78	1	1	0	0
Ordinariness	0	0	1	0	0	1	0	0	0	0,83	0	0	1	0	1	1	1	0,67
Ease of filling	1	1	1	1	1	1	1	1	1	0	1	1	0	1	1	1	0,17	1
Showiness	0	0,57	0,52	1	0	0,52	0	0	0	0,1	0,29	0,33	0,81	0,24	0,52	1	1	0,52
Simplicity	0	0	0	0	0	0,5	0	0	0	0	0	0	0	0	0	1	1	0
Decorativeness	0	0,28	0,72	0	0	0	0	0	0	0,94	0	0,28	0	0,61	0	1	0,44	0,17
Ease of drink.	1	1	1	1	1	1	1	1	1	0	1	1	0	1	1	1	1	1
Modernity	0	0,75	0,5	0,67	0,83	0,75	0	0	0,25	0,75	0,42	0,5	0	0	0,67	1	1	0,17
grade	2,16	4,44	6,62	4,54	3,52	6,72	1,9	3,39	2,36	4,78	2,89	6,31	4,54	5,02	6,56	15,9	12	6,31
rank	17°	12°	4°	11°	13°	3°	18°	14°	16°	9°	15°	7°	10°	8°	5°	1°	2°	6°

5 Discussion and conclusions

Our method gives promising results: It is efficient to grasp subjective assessments of people and to integrate them into a multicriteria decision procedure. But our method is doing more: It provides a logical, coherent and grounded frame for the specification and assessment procedures, and it allows a capitalisation of subjective evaluations. E.g., the pairwise comparison matrix could serve as a database and be enriched according to new projects. It takes time to complete the tests. Fortunately, the pairwise comparison method used runs without all the comparisons, letting believe that our method is tractable in practice. This evaluation procedure is particularly suitable to use in a group session, during which a unique answer of the group is recorded for each comparison, after discussions and negotiations.

We have presented an integrated methodology dealing with product semantics. The first point is that this method is generic and can be applied to various products. Starting with the comprehension of the perceptual space of a set of existing products, it provides some aid to specify requirements for a new product. The second point is that it performs a multicriteria subjective evaluation of new design solutions. This allows a better control on the predicted performances of the product. It is a first step for a more rational treatment of product semantics. The next step will be to incorporate synthesis tools of products, like in *Kansei* Engineering approaches [14], so as to support the design stage itself.

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