# Identification of sensory core factors to optimize product quality and customer satisfaction

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## Abstract

"Being focused on the essential" or "reduce to the max" - this attitude, which is not only lived in the Asian culture, is also finding more and more followers in the Western world. The recently experienced lockdown has disruptively promoted the focus on the essentials in our society's life, even possibly in a sustainable way. Would it not simplify the development process of a product such as questions about "Which product characteristics, which expectations of effectiveness really exist through the target group?", the marketing and advertising concept "Which "wording" is understood and expected by the target group?". Wouldn't it be enormously time- and resource-saving if you could only concentrate on the essentials? Noriaki Kano of the University of Tokyo also asked himself this question in the 1990s and published his findings in 1984 in the Journal of Japanese Society for Quality Control.

Customers' expectations are changing - which product features must be adapted to their needs; which features are particularly important? What does it mean for the sensory properties of a care product and is there a kind of hierarchy in the expectations of the individual attributes?

With which sensory methods could the three categories of customer satisfaction described by Kano ("must-be", "one-dimensional", "attractive") be identified and assigned accordingly? One possibility is to compare descriptive product profiling by trained panelists with the overall acceptance by the consumer target group. According to MacFie an external preference map is created ("PREFMAP" method). For the target group, a CATA questionnaire was combined with a preference test. The consumers were able to indicate sensory product characteristics by means of five Just-about-right (JAR) questions or 11 sensory and additionally 17 emotional/qualitative Check-all-that-Apply (CATA) questions. After statistical analysis (XLStats 2019) data were assigned to the above mentioned three categories of customer satisfaction according to the Kano model. The category "attractive" can lead to a surprising "wow-effect" for the consumer. Here, sensory correlated "refreshing", "silky-smooth" and were translated qualitatively and emotionally as "premium", "activating" and "feminine". The Kano model meaningfully complements the CATA and penalty analyses (JAR) in this feasibility study.

## 1. Introduction

Customers' expectations are changing - which product features must be adapted to the needs; which features are particularly important? What does it mean for the sensory properties of a care product and is there a kind of hierarchy in the expectations of the individual attributes? This research question was subject within the framework of a master's thesis, whether the optimization model according to Kano can also be applied to a consumer product such as care products? Noriaki Kano of the University of Tokyo published his findings in 1984 in the Journal of Japanese Society for Quality Control (1).

The three categories of customer satisfaction described by Kano ("must-be", "one-dimensional", "attractive")
(2) can be understood as follows:

- The «must be» requirements must be fulfilled; the customers takes them for granted. They constitute the basic criteria for a product.
- The «one dimensional» requirements are explicitly demanded; customer's satisfaction "growth" with the level of fulfillment
- The "attractive" requirements mean nice to have or even can lead to a surprising "wow-effect" for the consumer. The attractivity of the product gains disproportionately with these attributes.

With which sensory methods could the three categories of customer satisfaction described by Kano be identified and assigned accordingly?
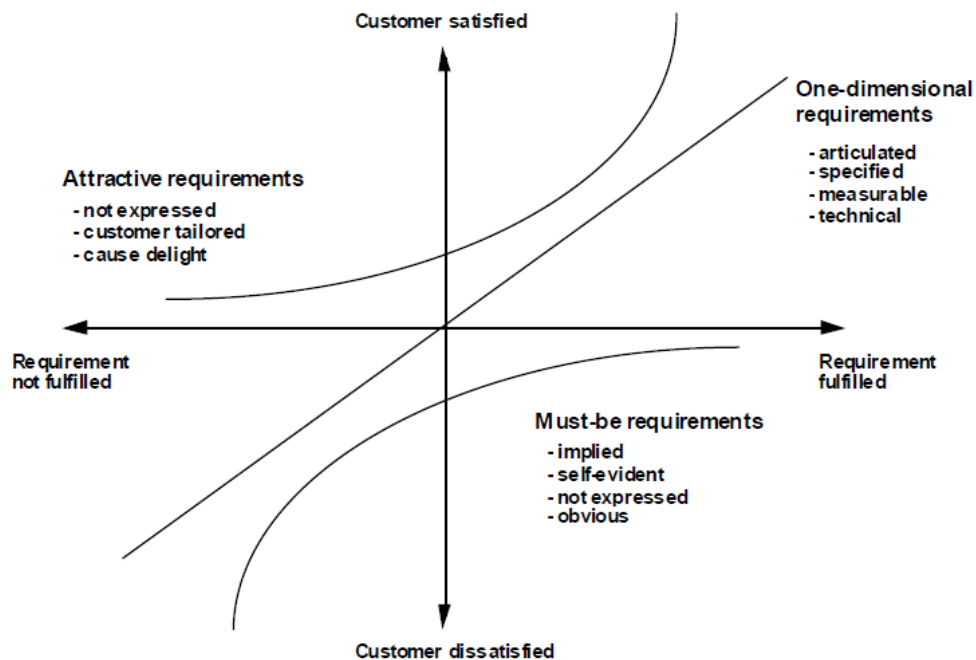


*Fig. 1: Kano's model of customer satisfaction (according to 3)*

One possibility is to compare descriptive product profiling by trained panellists with the overall acceptance by the consumer target group. According to MacFie (4) an external preference map is created ("PREFMAP" method). This

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procedure was mainly used by research groups in the food sector (5, 6). For the target group a CATA questionnaire was combined with a preference test (with Just-about-right (JAR) questions).

## 2.    Materials and Methods

Eight emulsions with different sensory profiles (refer to fig. 2 for the six unperfumed samples) were developed, with two identical emulsions being perfumed and unperfumed. The samples were assessed by a trained cosmetics sensory panel (n=7) of the Zurich University of applied science ZHAW (Switzerland) according to a descriptive test protocol. They were familiar with the requirements of the test, evaluated the attributes in accordance with a modified ZHAW standard method (version adapted according to ASTM (1997/2003)) (7). The attributes were evaluated against a reference sample on a linear scale, where 100 was the highest, most intense and 0 the lowest, least intense value. All tests were conducted in the sensory testing booths of the ZHAW sensory facility.
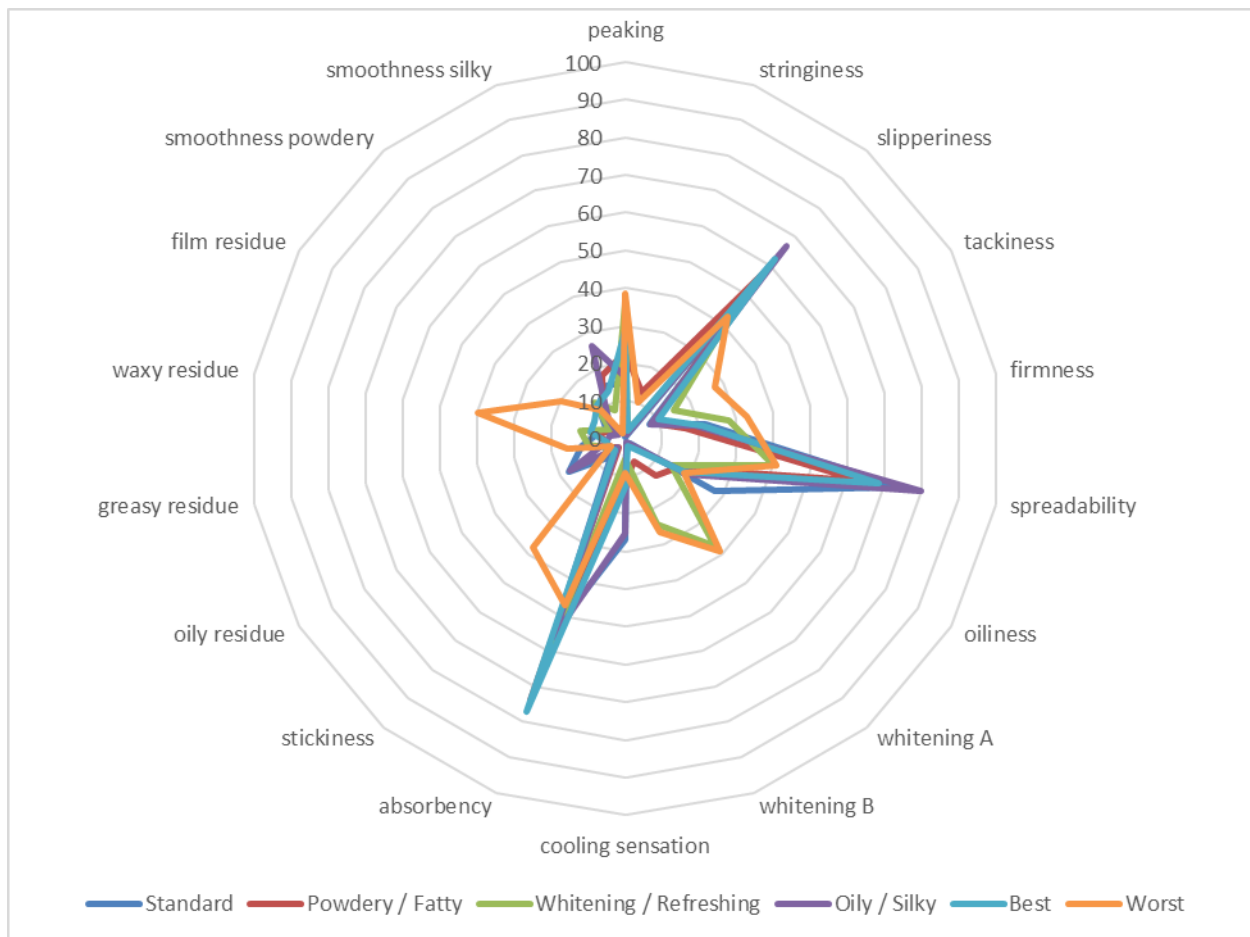


***Fig. 2: Sensory assessment (descriptive profile) on a scale of 0-100 (0=few, 100=intense value), average rating (done in repetition) of 7 trained panelists for the six unperfumed emulsions.***

The subsequent acceptance test of the emulsions (type face cream) was carried out with a consumer panel (n=50) aged between twenty and thirty-five years (target "Millennials"), mainly Swiss students. Both the profiling and the consumer test were carried out in the sensory booths of the sensory food department of the University (fig. 3)

*Fig. 3: A closer look into the sensory booths at the University (ZHAW, Switzerland) during the consumer testing.*

Based on the chosen protocols, the consumers were able to indicate sensory product characteristics by means of five Just-about-right (JAR) questions or 11 sensory and additionally 17 emotional/qualitative Check-all-that-Apply (CATA) questions (for some of them please refer to Fig. 4 in section results). After statistical analysis (XLStats 2019) data were assigned to the three categories of customer satisfaction ("must-be", "one-dimensional", "attractive") according to the Kano model (2) and to MacFie (4).

## 3.    Results

It was interesting to note in the pre-evaluation that 62% of the target group would prefer unscented products. The most popular emulsion (point average 6.64) was perfumed (0.2% fragrance concentration) and even the least popular (3.52) was perfumed (4.64), which improved acceptance compared to the identical, unperfumed one.

In Fig. 4 the influence of an attribute or term on the overall popularity is shown. The overall popularity is represented as an average value of all tested emulsion patterns. Only those attributes or terms are listed which had a significant influence. The attributes and terms were originally based on 11 sensory and additionally 17 emotional/qualitative Check-all-that-Apply (CATA) questions. Attributes in the lower part of the figure reduced overall popularity, while attributes in the upper part improved overall popularity. Sensory attributes associated with a high overall popularity among the target group of female millennials were "good spreadability" and "quick absorption" (blue columns in the upper part), which was equated with "pleasant" and "caring" in the qualitative-emotional area.
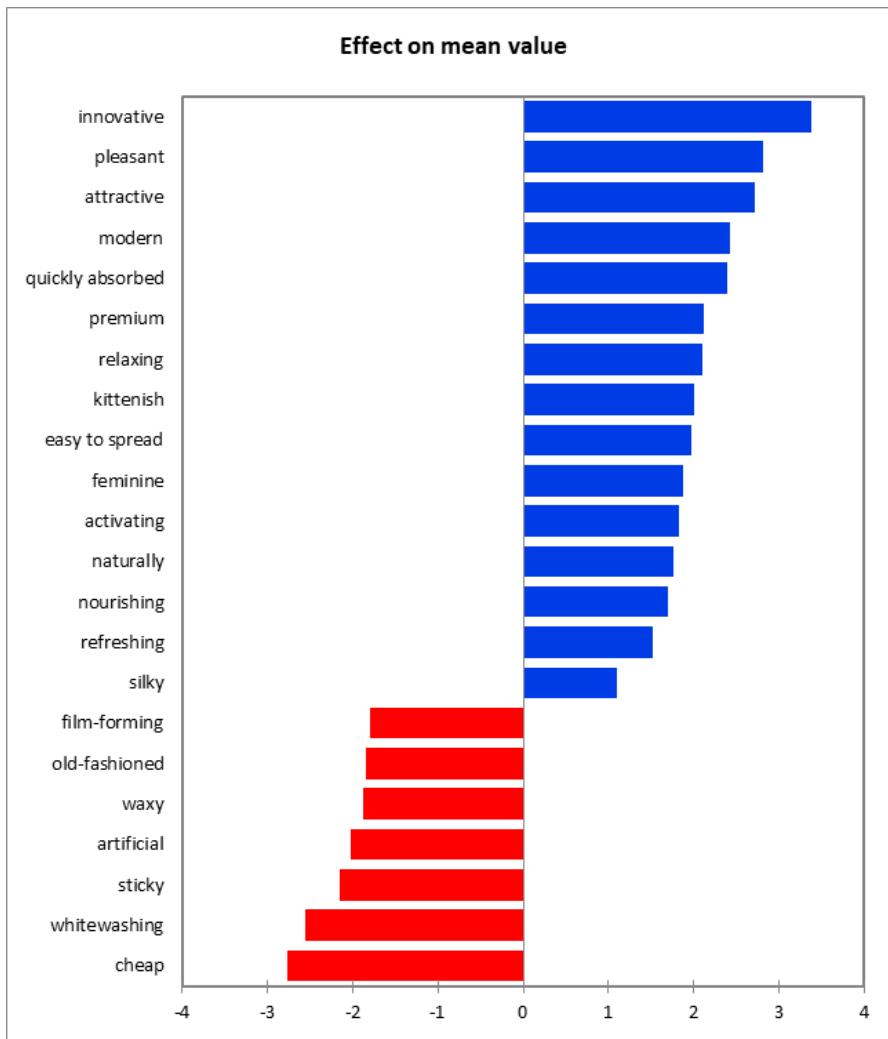
**Effect on mean value**

*Fig. 4: Influence of an attribute/term on the overall popularity, represented as an average value of all tested emulsion patterns. Data originated from the consumer test using CATA questionnaire.*

In relation to the categories according to Kano, these properties correspond to the "one-dimensional" effect on the overall product. This means that the expression of these attributes influences a positive evaluation in a linear way, the more pronounced the more popular and the higher the satisfaction. The category "attractive" means nice to have and can lead to a surprising "wow-effect" for the consumer. Here, sensory correlated "refreshing", "silky-smooth" and were translated qualitatively and emotionally as "premium", "activating" and "feminine". Sensory attributes that correlated with a deep/low overall popularity and thus should be avoided were, as expected, "whitening effect", "stickiness" and "waxy residue". The latter correspond to the category "must-be" or "must not have", equated in emotional-qualitative terms with "cheap" and "artificial".
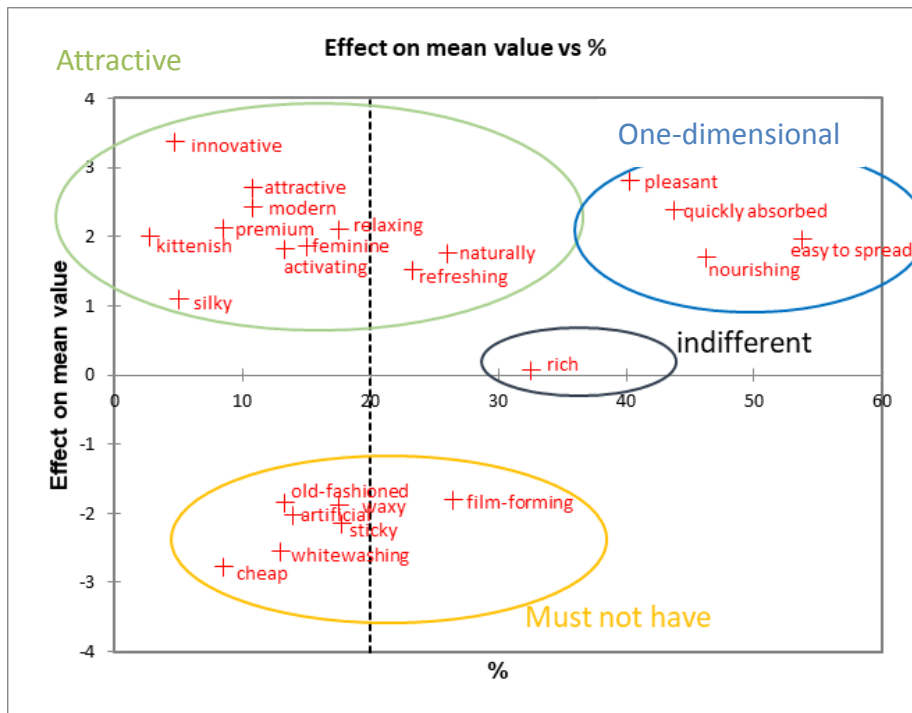
*Fig. 5: Attributes respectively descriptions from the CATA questionnaire divided according to the different customer requirements categories according to the Kano model. In blue the "one-dimensional" requirements, in green the "attractive" requirements, in orange the "must-be" characteristics or their denial "must not have" and in grey indifferent characteristics.*

Thus, the expected preferences and unpopular attributes, among others (8) could be confirmed. The study also points out the discrepancy between a survey and the subsequent performance of sensory acceptance tests by consumers (e.g. perfume). Trained panelists did not let themselves be influenced by scent in their haptic evaluation.

## 4. Discussion

The methods used have their own advantages and disadvantages. CATA is fast, simple and easy for consumers to understand. Various studies on the sensory characterization of foods have also shown that CATA can be used to produce sensory maps like those obtained with a classic profile test (6, 9). CATA provides a reliable insight into how products are perceived by consumers (assuming a sufficient number of cases!). In the present study, the number of cases was at the lower limit due to resource constraints. In addition, one must be aware that an attribute checked with CATA is an unambiguous answer (Yes, applies), if an attribute is not checked, there are different interpretations and the unambiguity decreases: 1. actually "No, does not apply"; 2. ignored / overlooked; 3. does not know the term; 4. "Do not know" .

In addition, the terms and attributes should appear randomized per test person in CATA, as consumers usually give quick answers. This is because attributes/terms at the beginning of the list are more likely to be ticked off (10).

With a larger product range, one can usually derive better models and achieve a better significance, since most of the relationships are non-linear. Therefore, a factorial experimental design is useful. An increasing number of factors

(properties) combined with different factor levels (here intensities or concentrations) leads to complex systems with correspondingly increasing effort in preparation and execution. As a further optimization suggestion, a focus group discussion should be done at the beginning to "pick up" the terms used to describe different face creams. This is also conceivable as an online survey. The advantage of a focus group discussion is that it is possible to ask questions and provide clarity about which terms the Millennials use for which product features in their language.

The present study shows which properties of a face cream are generally positively received by Millennials. When it comes to developing an "ideal" formulation, these statements are the basis for this but do not yet provide any information on the intensity or the characteristics of a property. This could be specified more fully by using a factorial experimental design.

## 5.    Conclusion

The Kano model meaningfully complements the CATA and penalty analyses (JAR) in this feasibility study. This enables the product developer and marketing specialist to emphasize the product attributes important to the consumer more efficiently. The structural weakness of the model, which intensity level would be ideal for each attribute, should be supplemented by an extended JAR analysis, ideally starting the study with a factorial design.

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