Comparison of methods for generating sensory vocabulary for further use in CATA studies with consumers

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Abstract:

Present study compares three methods (n=311) of generating sensory vocabulary for chocolate bars for further CATA studies. In addition to generating sensory terms by semi-trained participants in form of an individual qualitative sample description and generating attributes by napping with untrained consumers, a selection of terms out of an existing vocabulary list of chocolate products were used for the third CATA variant.

For the evaluation of the data, CA and Cochran´s Q tests were used. Our results can indicate that the generation of sensory vocabulary by consumers is comparatively best suited to generate attributes for further CATA analyses with consumers.

Keywords: CATA, Cochran´s Q, generating vocabulary

1 Introduction of paper

Sensory profiling, serving the purpose of defining and quantifying sensory characteristics on which products differ, has been an established and essential tool for food scientists and food manufacturers for a long time. The numerous applications of traditional descriptive profiling techniques include classical “sensory” tasks, such as product development, product improvement, and quality control (Valentin, Chollet, Lelièvre, and Abdi, 2012), however, also expand to the fields of marketing and consumer science, involving advertising claim substantiation (Lawless & Heymann, 2010) and the understanding of consumer preferences (Greenhof & MacFie, 1994).

Though being referred to as “one of the most powerful, sophisticated and most extensively used tools in sensory science” (Varela & Ares, 2012), sensory profiling, as conducted with trained assessor panels, is time-consuming and cost-intensive. Consequently, despite of relevance of traditional profiling, several alternative methods have evolved in recent years, following industrial demand for faster and more cost-effective methods. The resulting rapid sensory methods may – as novel methods for product characterization – not only be regarded as efficient alternatives to traditional methods in sensory science, but expand their range of application to new fields of use (Delarue, Lawlor, and Rogeaux, 2014): Particularly the suitability of these rapid sensory methods for sensory product characterization with consumers (rather than trained assessors) substantiates their noteworthy relevance for the field of marketing, even inducing researchers to refer to these novel methods as the “blurred line between sensory and consumer science” (Varela & Ares, 2012).

Despite the relevance of traditional profiling, several alternative methods have evolved in recent years, following industrial demand for faster and more cost-effective methods. The resulting rapid sensory methods may – as novel methods for product characterization – not only be regarded as efficient alternatives to traditional methods in sensory science, but expand their range of application to new fields of use (Delarue et al., 2014). One of these popular rapid methods is CATA.

CATA (Check-all-that-apply) is known as a rapid descriptive sensory test method in which the respondents (mostly consumers) tick all characteristics of a given product that apply to them, using a given vocabulary list. (Derndorfer & Buchinger, 2020)

CATA is based on this list of attributes from which respondents should select all the words they consider appropriate to describe a product (Adams, Williams, Lancaster, & Foley, 2007). Further sensory methods are required to create such lists in advance. It is necessary to determine sensory terms that are stored in the minds of consumers and are suitable and above all relevant for the description of the specific product category (Steenkamp & van Trijp, 1997).

A vocabulary list for CATA questionnaires can be generated in advance by sensory trained and untrained people using a wide variety of methodologies, or they can be taken from specialist lexica. (Derndorfer & Buchinger, 2020) Literature indicates that the choice of generation method influences the CATA result. (Mahieu et al., 2020)

The extent to which different methods for generating attributes are best for delivering terms that are suitable for a description and differentiation of product samples by the untrained consumers has not yet been proven sufficient.

Traditionally sensory vocabularies are created by experts who generate terms, which are accurately defined and associated with references. (Derndorfer & Buchinger, 2020)

On the other hand, the literature indicates that trained reviewers describe products with attributes that may be irrelevant to consumers. (Fiszman et al., 2015)

Fiszman et al., 2015 compared three methods for generating sensory vocabulary with consumers: repertory grid, comparison of the sample set, and individual qualitative sample description, where the total number of terms generated and the frequency with which consumers generated some terms is focussed.

Our current study aimed to compare three methods of generating sensory vocabulary with a focus on taste. Three CATAs with 10 standardized chocolate bar samples and n = 311 untrained consumers were initiated. In addition to generating sensory terms by semi-trained participants in form of an individual qualitative sample description and generating attributes by napping with untrained consumers, a selection of terms out of an existing vocabulary lexicon of chocolate products was used for the third CATA variant.

Multiple correspondence analysis was performed on the frequency table from each experimental treatment.

Cochran's Q test was carried out on data from each experimental treatment to identify significant differences among samples for each of the sensory terms and to make a statement about the suitability of the collected attributes concerning describability and differentiation of the products.

2 Theoretical background

We decided on three common methods for generating attributes: individual qualitative sample description with semi-trained participants, napping with consumers, and a pre-prepared vocabulary list from the DLG.

2.1 Individual qualitative sample description

In this study, we used the standardized method of simple descriptive tests for the individual qualitative sample description. The aim of this test method set out in DIN 10964 is to describe a given product with individual product terms in case to generate vocabularies for further studies or even to train respondents. (Schneider & Nucke, 2018)

Terms used to describe the given products can be selected freely by the participants but should generally be free from hedonic valuations. According to general sensory analysis practice, these lists of terms subsequently need revising. Details of intensity are not required. This method can be applied by both trained and untrained testers. What is important is that the test persons can describe their sensory perceptions accurately and comprehensively. (Schneider & Nucke, 2018)

2.2 Napping

Napping represents a rapid sensory descriptive method, more precisely, a similarity measurement, in sensory sciences, pursuing the goal of obtaining a sensory comparison of several products in terms of their relative similarity to one another. By providing valuable information about products and their sensory properties, as well as consumers' preferences, napping facilitates comparisons of products with competing products and may provide valuable insights for product development (Schneider-Häder & Derndorfer, 2016).

According to literature, sub-categories of Napping may be distinguished: In general napping, all samples are served at the same time and arranged by the participants on a sheet of

paper relative to each other. If the samples differ, they are placed far away from each other, whereas if they are similar, they are positioned close to each other. Each product can be assigned a position in the coordinate system and be characterized by freely selectable sensory attributes (Derndorfer, 2016).

Sorted Napping extends the positioning of the products by grouping arranged samples with similar sensory properties into product groups. Subsequently, these clusters are described verbally with defined attributes. As a result, in addition to the positioning data of the individual samples, statements about the respective clusters are obtained. (Kermarrec, 2010). Generated terms can be used as a vocabulary for further sensory examinations.

2.3 Professional sensory lexicon

To overcome the challenge of putting the sensory impressions perceived into words to describe the food quality and to avoid misunderstandings in communications between practitioners in day-to-day operations specialist sensory vocabulary has been created in many fields of science. (DLG, 2017)

The publication “Sensory Analysis Vocabulary” of the German agriculture association DLG contains a cross-product basic vocabulary and ten product-group-specific specialist vocabularies, amongst others for chocolate products. The lexicon contains descriptive terms with definitions and reference examples and is structured in accordance with the sensory test characteristics, especially for the fields of quality assurance, product development, and marketing, from academia and education, the food industry, research institutes, and commercial laboratories, as well as from official controls of foodstuffs. (DLG, 2017)

3 Materials and methods

3.1 Samples

As stimuli, 10 different commercially available chocolate bar samples, well known and popular in Austria, were selected. Each of the bars was provided in its own packaging handed out at room temperature. All samples were stored at room temperature until sensory testing. In addition, the samples were coded with four-digit, randomly selected sample numbers.

The decision of this product group is based on the fact that, especially in times of pandemics, a popular mass product should be chosen to enhance the willingness of consumers to participate in the study. At the same time, the samples should be individually packaged, storable, and transportable at room temperature to ensure the safety of the product and consumers.

Samples to be tested were *Duplo, Mars, Twix, Fairetta, Kinder Bueno, Balisto, KitKat, Nutella b-ready, Knoppers* and *Bounty*

3.2 Participants

311 consumers in three groups (102-106 participants) were recruited by an Austrian University via Social Media platforms and regional media calls.

The requirement was willingness to participate, preference for a variety of chocolate bars ability to use computer and the internet as well as an absence of allergies to one of the ingredients.

3.3 Vocabulary generation

Three methods for generating sensory vocabulary were used and compared for the present study: individual qualitative sample description, napping, and an existing DLG vocabulary list for chocolate products.

3.3.1 Individual qualitative sample description

Four to six samples each were randomly distributed to the test persons, who were trained on the method but not on chocolate bars. Twelve semi-trained participants (students and scientific staff) were asked to observe and describe the samples in taste with their own sensory vocabulary and write down the terms. The number of terms in CATA lists is widely considered to be less relevant since long and short lists provide similar results as long as synonym and antonym terms are omitted. (Jaeger et al., 2015) For this reason, only one round was chosen for the attribute reduction, whereby the focus was placed on avoiding the terms mentioned.

Individual sample-description lead to the following 31 terms: *like cocoa, cereal flavored, roasted, like caramel, chocolatey, spicy, buttery, waffle, artificially, milky, like rum, vanilla, like cocos, like nougat, nutty, blazing, astringent, oily, salty, bitter/herb, sweet, salty, grainy, crumbling, melting, tough, tender, creamy, crispy, mousy* and *sticky*.

3.3.2 Napping

For vocabulary generation, a combination of partial and sorted napping was used, pursuing the aim of obtaining statements about the respectively formed sample clusters.

77 voluntary and untrained students of the University participated in the sensory testing whit the aim of vocabulary generating apart from typical napping results. In advance of their participation, respondents were familiarized with the method of Napping.

During sensory testing, each of the 77 subjects was provided with all 10 chocolate bar samples simultaneously. Respondents were instructed to systematically cluster the samples on their table based on perceived similarities and differences in a way that similar samples were arranged close to each other. In the next step, the positions of each sample were transferred to RedJade® program on PC. Moreover, respondents were requested to verbally describe each cluster with sensory attributes, whereby they used their own vocabulary. Overall, three rounds of napping were performed, as participants were asked first to rate samples based on their image, followed by appearance and taste, whereas the focus in this paper is on taste.

The verbal descriptions (sensory terms) were collected for each sample and characteristic. Filtering and reduction of terms were again done in a one-step process of drafting and revising terms by sensory assessors with a focus on avoiding synonym and antonym terms. (Jaeger et al., 2015)

Napping lead to the following 24 terms: *grainy, bitter, like nougat, light, exotic, nutty, like biscuit, like caramel, like coconut, crispy, creamy, chocolaty, tender, crunchy, hard, cereal flavor, oily, sweet, milky, roasted, sticky, artificially, fruity* and *like coconut*.

3.3.3 Existing DLG sensory vocabulary list of chocolate products

Another CATA questionnaire used for this study consisted of 30 sensory terms, which were selected from the available DLG sensory vocabulary list on chocolate products (DLG, 2017) by sensory assessors.

Selecting from the existing DLG sensory vocabulary list lead to the following 23 terms: *melting, creamy, sticky, oily, astringent, sweet, like cocoa, chocolaty, milky, bitter, sour, fruity, peatiness, like caramel, vanilla, crispy, firm to the bite, grainy, roasted, like coconut, cereal flavor, slaty* and *umami*.

3.4 Procedure of CATA study

The sensory testing was carried out by an Austrian University during changing measures regarding the Covid-19 pandemic. This was the reason why the CATA study was carried out in the home-use setting with consumers at their homes. To ensure a smooth and error-free test procedure, the participants were made familiar with the CATA method in advance through a personal approach and a video tutorial.

We conducted a large CATA study with untrained consumers (n=311) in three groups.

Participants were recruited via Social Media platforms and regional media calls to pick up a test packaging from pop-up-chocolate-bar-drive-in of the University.

Ten different chocolate bars for each participant were collected in paper bags and handed over personally to the consumers, supplemented by an instruction leaflet, which again presented the test procedure in writing (apart from the video tutorial, participants received in advance). Subjects had to answer the CATA questionnaire computer-assisted via RedJade® within fourteen days.

3.5 Data collection

Data was collected via RedJade® software. Participants were required to describe the chocolate bar samples by a multi-part CATA questionnaire, subdivided according to the characteristics of image, appearance, and taste. This was followed by a hedonic assessment for each chocolate bar using a 9-point-liking-scale and a description of an individual ideal chocolate bar. Furthermore, they had to choose their favourite bar before answering demographic questions.

Ares & Jaeger, 2013 investigated the optimal degree of randomization for the attributes in CATA studies. They found that it´s useful to randomize the attributes between subjects but to group them according to sensory modalities before. Moreover, terms should be randomized between subjects but not between products. (Meyners & Castura, 2016) The procedure was carried out to that.

3.6 Data analysis

Multiple correspondence analysis was used to examine the relationships between the categorical variables.

Using Cochran's Q and the post hoc test based on critical difference (Sheskin), we identified the significant attributes for comparing the CATA variations. Subsequently, it was analysed which of the lists has the higher percentage of attributes that differ significantly from one another and are therefore suitable for product characterization.

4 Results

Figures 1 to 3 show the percentage of selection of each term of the three different vocabulary lists. Moreover, it is displayed, which terms are suitable to describe and differentiate chocolate bars in their taste perception. Terms selected too often (bars that rise above the upper limit) or too less (bars that are below the lower limit) are therefore not suitable to describe and differentiate between analysed products.

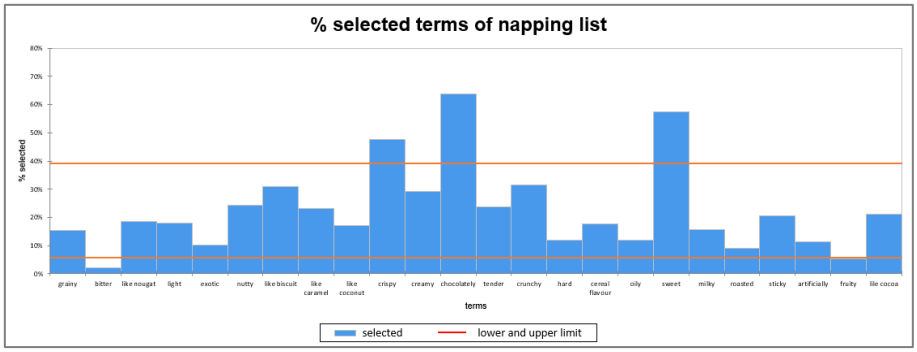

Figure 1: percentage of selected terms of napping list

Figure 1 shows the results for the napping list. Fruity and bitter are terms used too rare to describe chocolate bars in our analyses. Therefore, they are not useful for CATA studies with untrained persons, as well as crispy, chocolatey, and sweet, terms used for too many sample descriptions.

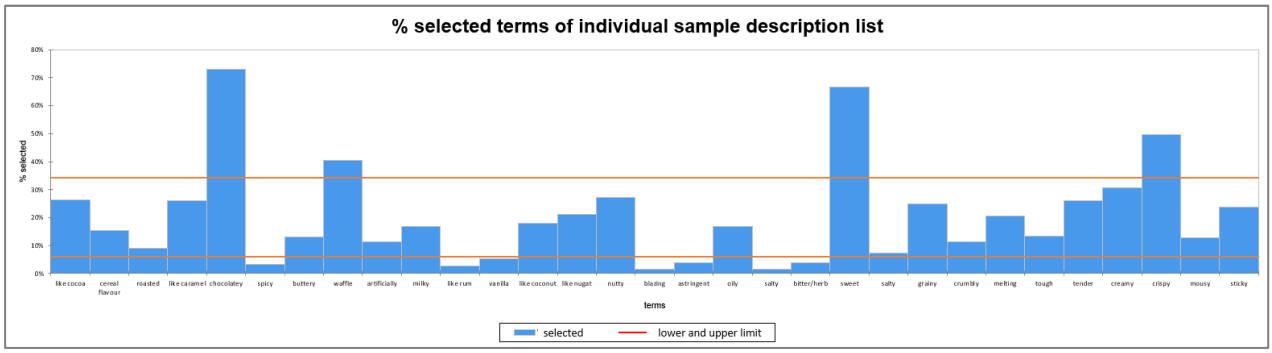

Figure 2:percentage of selected terms of individual sample description list

Figure 2 shows the results for the individual sample description list. It can be seen that significantly more attributes are unsuitable for the description and differentiation of chocolate bars in CATA studies with untrained consumers.

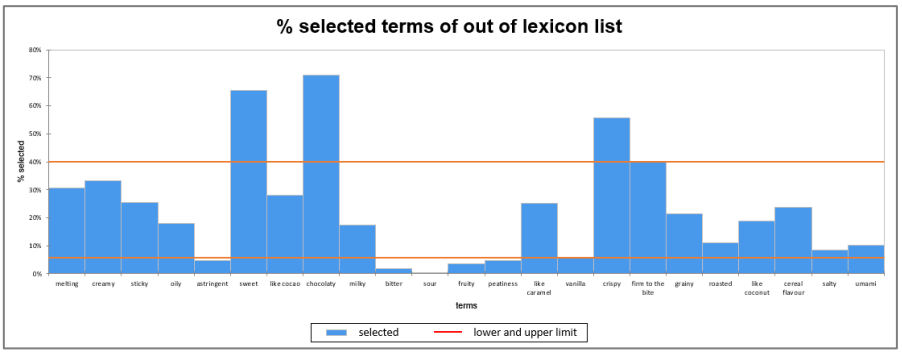

Figure 3: percentage of selected terms out of lexicon list

The list of termes out of the sensory lexicon provides even less useful attributes, as shown in Figure 3.

To complete our results, figure 4 shows that the list of attributes generated by napping (79.2%), compared to the individual qualitative sample description (67.7%) and the selection of existing terms out of a lexicon (56.5%), provides the most terms that are necessary for the description and differentiation of the product samples using CATA are suitable.

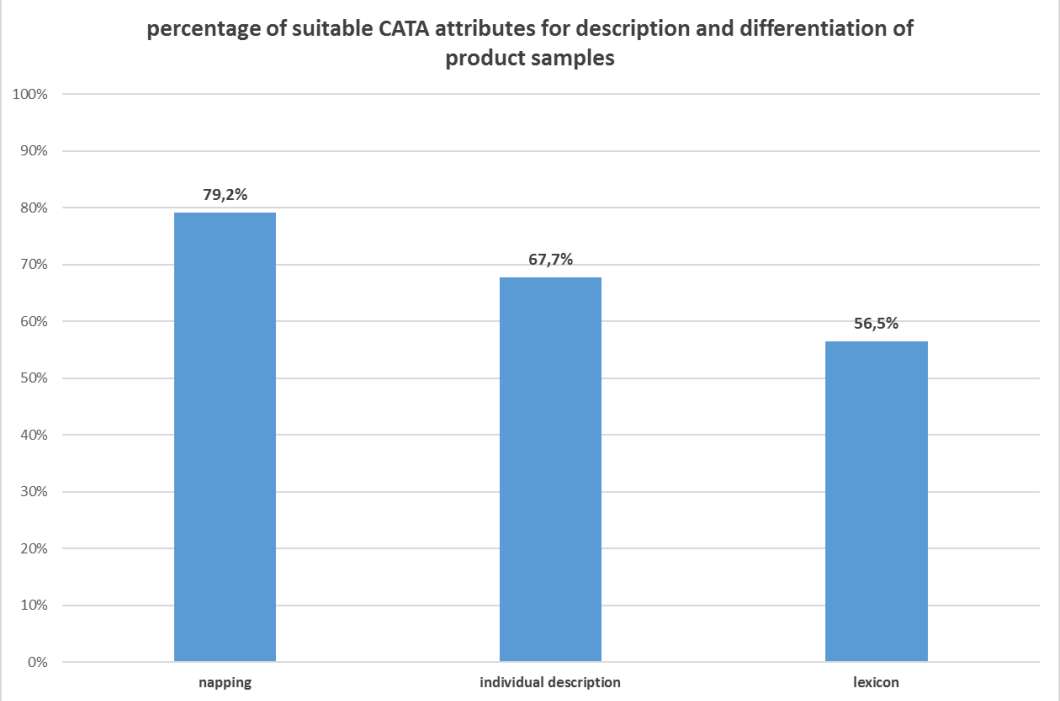

Figure 4: percentage of suitable CATA attributes for description and differentiation of product samples

5 Conclusion

Our results can indicate that the generation of sensory vocabulary by consumers is comparatively best suited to generate attributes for further CATA analyses with consumers.

Based on our analyses, we can conclude that generating terms via Napping with untrained consumers compared to generating attributes through an individual sample description with semi-trained people or extracting pre-defined vocabulary provides significantly more attributes that are useful to describe and differentiate chocolate bars in further CATA studies with consumers.

In conclusion, this gives an essential indication that consumers should be included in the generation product description for the target group of end consumers.

From our point of view, CATA analysis offers several opportunities for further research approaches in the marketing context, as long as a focus is placed on the correct generation of attributes, which should also be done with consumers for further consumer studies. Other areas could be examined, such as the image of products. We see great potential in this method, as it can deliver cost-effective, fast, and above all, customer-oriented results.

6 General discussions, implications, and further research

The current study was carried out using methods for generating attributes, which are common and popular in the German-speaking region.

Our findings can be seen as a first indication that the generation of attributes by consumers is more suitable for further sensory analyses with consumers than those with or by experts.

The extent to which the results could be transferred to other sensory methods for collecting attributes needs to be investigated in further studies and is our further intention.

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