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Can consumer segmentation in projective mapping contribute to a better understanding of consumer perception?

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ABSTRACT

In projective mapping tasks assessors create an overall representation of the similarities and differences among samples by relying on a process of synthesis for analyzing and processing sensory information. Individual differences in consumers' information processing and preference patterns could strongly affect which sensory characteristics they consider more relevant for estimating similarities and differences among samples. Therefore, low-dimensional consensus configurations (obtained via MFA or GPA) may not represent the perception of some consumer segments. This could lead to inaccurate conclusions about consumers' sensory perception of the products or at least to the loss of valuable information about the perception of some consumer groups. In this context, the aims of the present work were to explore consumer segmentation in projective mapping. Datasets from nine studies with 81–102 consumers were analyzed to explore consumers' segmentation. Through applying hierarchical cluster analysis on consumers' coordinates in the first four dimensions of the MFA, between 2 and 4 groups of consumers were identified in each study. Sample configurations and consumers' descriptions strongly differed among the groups, indicating heterogeneity in the relative relevance they gave to the sensory characteristics of the samples for estimating the similarities and differences among samples. In all cases it was observed that the consensus configuration was highly similar to the configuration of one of the groups, which was not necessarily the larger but the one with the highest explained variance by the first dimension of the MFA. These results suggest the need to explore segmentation when analyzing data from projective mapping tasks, and to further study the relationship between consumers' holistic perception of products and preference patterns.

1. Introduction

Interest in consumer-based methodologies for sensory product characterization has steadily grown in the last decade, partly motivated by the need to directly include consumer input in the new product development process (Valentin, Chollet, Lelievre, & Abdi, 2012; Varela & Ares, 2012). Research showing that consumers can provide accurate information about the sensory characteristics of products (Ares, Bruzzone, & Giménez, 2011; Husson, Le Dien, & Pagès, 2001; Moskowitz, 1996; Worch, Lê, & Punter, 2010) has led to the development of new consumer-based methodologies (Ares & Varela, 2014).

Holistic methodologies are among the most popular novel methodologies for sensory characterization which are being increasingly used for uncovering consumers' perception of food products (Varela & Ares, 2012). These methodologies are based on the evaluation of global similarities and differences among samples, and therefore they are useful to identify the main sensory characteristics underlying judgments of perceived similarity (Ares & Varela, 2014). Projective mapping is one of the most popular holistic methods. Assessors are asked to position samples on a bi-dimensional space according to their global similarities and differences (Risvik, McEwan, Colwill, Rogers, & Lyon, 1994), being able to simultaneously consider more than one sensory characteristic. Projective mapping has already been applied for sensory characterization of a wide range of food product categories, including chocolate, cheese, wine, citrus juices, fish nuggets, milk desserts, crackers, and fruits (Albert, Varela, Salvador, Hough, & Fiszman, 2011; Bárcenas, Pérez Elortondo, & Albisu, 2004; Hopfer & Heymann, 2013; Nestrud & Lawless, 2008; Pagès, 2005; Risvik et al., 1994; Vidal, Cadena, Antúnez, et al., 2014).

In a projective mapping task assessors should form an overall representation of the similarities and differences among samples

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by relying on a process of synthesis for analyzing and processing sensory information (Jaeger, Wakeling, & MacFie, 2000). This process of synthesis determines the relative importance of the perceived sensory characteristics for estimating the similarities and differences among samples. For this reason, individual differences in the criteria used by assessors to evaluate samples and complete the task are expected. These individual differences are worth studying, particularly when working with naïve consumers (Nestrud & Lawless, 2008).

Heterogeneity in how consumers perceive food products has been long recognized, i.e. consumers have been reported to differ in how they perceive products (e.g., Prutkin et al., 2000) and/or in the relative importance they attach to the sensory characteristics of products (Carroll, 1972; Harwood, Ziegler, & Hayes, 2012; Love, 1994; Moskowitz & Krieger, 1995). Considering that projective mapping tasks do not involve training in attribute recognition or quantification (Valentin et al., 2012), and also that consumers are not specifically asked about individual attributes but rather to assess them holistically, consumers can generate different sensory spaces which reflects differences in how they perceive samples and how they cognitively assess them. Individual differences in consumers' information processing and cognitive structure and task-related factors can affect synthesis processes and, consequently, the number of sensory characteristics that are simultaneously considered for estimating similarities and differences among samples (Malhotra, Pinson, & Jain, 2010). For these reasons, sample spaces are expected to strongly differ among assessors.

Generalized Procrustes Analysis (GPA) or Multiple Factor Analysis (MFA) are used to handle heterogeneity in individual maps and to obtain a consensus sample configuration in a low-dimensional space (Dehlholm, 2014, chap. 9). However, the low-dimensionality of this sample configuration may not reflect the cognitive representation of all consumers (Summers & McKay, 1976). Therefore, the perception of consumer segments may be underrepresented in consensus configurations from projective mapping, which could lead to inaccurate conclusions about consumers' sensory perception of the products.

In this context, the aims of the present work were to explore the occurrence of consumer segmentation in projective mapping tasks and to estimate its effects when analyzing data from consumer-based sensory characterization studies using this methodology.

2. Materials and methods

Data sets from nine different consumer studies with different product categories (Cadena et al., 2014; Vidal, Cadena, Correa, et al., 2014) were re-analyzed to explore consumers' segmentation. Table 1 shows the description of the data sets.

Table 1
Description of the data sets used to evaluate consumer segmentation on data from projective mapping.

Study ID	Product	Number of samples	Number of consumers
1	Plain crackers	8	91
2	Plain crackers	8	89
3	Vanilla milk desserts	8	101
4	Vanilla milk desserts	8	100
5	Vanilla milk desserts	8	100
6	Vanilla milk desserts	8	100
7	Powdered drinks	6	102
8	Powdered drinks	6	101
9	Yogurt	8	81

2.1. Consumers

Between 81 and 102 consumers participated in the studies (Table 1). In each study consumers were recruited based on their consumption of the target product, as well as their interest and availability to participate in the study. Participants were aged 18–75 years old and the percentage of females ranged from 51% to 73%. Consumer samples were not representative of the general population of the cities in which the studies were performed (Montevideo – Uruguay and Gualeguaychú – Argentina).

2.2. Samples

Four product categories were considered: crackers, milk desserts, orange-flavored powdered drinks, and yogurt. Samples in Studies 1, 2, 7 and 8 corresponded to commercial brands available in the market, which were purchased from local supermarkets. In Studies 3–6 vanilla milk desserts were prepared using water, powdered skimmed milk, inulin, modified maize starch, commercial sugar, polydextrose, sodium tripolyphosphate, carrageenan, vanilla aroma, caramel aroma, egg yellow food coloring and sucralose (Vidal, Cadena, Correa, et al., 2014). In Study 9 yogurts were formulated with skimmed pasteurized milk, commercial sugar, skim milk powder, modified starch, locust bean gum, pectin, and lyophilised cultures of *Streptococcus thermophilus*, *Lactobacillus bulgaricus*, *Lactobacillus acidophilus*, and *Bifidobacteriumlactis* (Cadena et al., 2014).

Six or eight samples were included in the studies, as shown in Table 1. Samples were presented to consumers in plastic containers labeled with three-digit random numbers, and were served all at once in random order for their comparison. Mineral water was available for rinsing between samples but it was not enforced.

2.3. Data collection

The studies took place in standard sensory booths, under white lighting, controlled temperature (22–24 °C) and airflow conditions. Explanation on how to perform the test was provided to participants at the beginning of each study. Consumers were asked to evaluate the samples and to place them on an A3 white sheet (42 cm × 30 cm), according to their similarities and differences, in a way that two samples perceived as similar should be located close together on the sheet, whereas samples perceived as very different had to be placed far from each other. They were asked to complete the task using their own criteria and they were told that there were no right or wrong answers. After completing the projective mapping task, consumers were asked to provide a description of the sensory characteristics of each of the samples.

2.4. Data analysis

The X and Y coordinates of the samples on each consumer's individual map were determined by measuring their position on the A3 sheet, considering the left bottom corner as the origin of the coordinate system. A Multiple Factor Analysis (MFA) was performed on the coordinate data, considering the data from each consumer as a separate group of variables (Pagès, 2005). Sample configurations obtained through this analysis for each study are called "consensus". Confidence ellipses were constructed using parametric bootstrapping (Dehlholm, Brockhoff, & Bredie, 2012).

Consumers' representation in the relationship square of the MFA (i.e. the representation of the groups of variables) provides a measure of the similarity between their individual sample configurations (Pagès & Husson, 2014). In this representation, the coordinates of each consumer (group of variables) on the MFA dimensions correspond to the *Lg* measure between the X and Y