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The application of check-all-that-apply (CATA) consumer profiling to preference mapping of vanilla ice cream and its comparison to classical external preference mapping

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ABSTRACT

This study was conducted to evaluate the use and efficacy of check-all-that-apply (CATA) data for the creation of preference maps, and to compare these maps to classical external maps generated from traditional sensory profiles. Ten commercial vanilla ice cream products were presented to 80 consumers. Consumers answered an overall liking question using the 9-point hedonic scale and a CATA question with 13 attributes which described the sensory characteristics of vanilla ice cream. A trained descriptive panel of 17 individuals developed a profile of 23 attributes for the vanilla ice cream products. Preference maps created by CATA counts were compared to those by descriptive profiles via multiple factor analysis (MFA). The characterization of the products by both sensory methods showed very good agreement between the methods. The MFA of map configurations showed fair agreement between the techniques used to produce the preference maps, indicating that CATA data applied to preference mapping gave similar results to external preference mapping.

1. Introduction

Check-all-that-apply (CATA) questions regarding consumer-perceived product attributes have been used in consumer studies to determine what sensory attributes may be characteristic of a specific product (Lancaster & Foley, 2007). Some researchers already advocate the use of consumer sensory profiling to lead product development as an alternative to classical sensory profiling (Punter, 2008; Worch, Lê, & Punter, 2008). The format of the CATA question allows consumers to choose all potential attributes from the given lists to describe the test products. This is different from scaling in the sense that no intensities are given to the attributes. In addition, the descriptors are not constrained to product sensory attributes, but could also be related to product usage or concept fit. This type of methodology has the advantage of gathering information on perceived product attributes without requiring scaling, allowing for a slightly less contrived description of the main sensory properties of the product tested (depending on how the terms are created).

The actual generation of CATA terms can be performed in many ways: the consumers can choose words to describe the product during the test (modified free choice profiling), terms can be given by a trained panel, or terms can be generated by consumers not testing the product (i.e. a focus group). Free choice profiling allows consumers to use as many or as few words as necessary to describe the product and evaluate the intensities of the chosen attributes, resulting in a less expensive and more accurate view of consumer perception and acceptance (Deliza, Macfie, & Hedderley, 2005; Gonzáles-Tomás & Costell, 2006; González Viñas, Garrido, & Wittig de Penna, 2001; Williams & Langron, 1984). However, if each consumer selects his/her own terms, the analysis becomes cumbersome since each term must be subjectively interpreted and combined with similar terms (Meilgaard, Civille, & Carr, 2007). Seo, Lee, and Hwang (2009) used consumers to describe sensory characteristics of coffee. Verification of the terms was then conducted by other consumers to confirm that the terms were appropriate and understandable. While this is an effective method, the time required is to complete the test is extensive.

Terms generated by a trained panel have the benefit of being more comprehensive and better described, though they may be too complex for the average consumer to understand and could require simplification. Altering the terms in this manner is difficult to do while retaining the correct term description and definition. However, it has been shown that differences in sensory evaluations between trained and untrained (naïve consumers) are minimal (Benedito, Cárcel, & Mulet, 2001; Guerrero, Gou, & Arnau, 1997; Husson & Pagés, 2003; Lelievre, Chollet, Abdi, & Valentin, 2008), so using less obscure terms by a descriptive panel could be a

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beneficial tool for creating a CATA list. Ultimately, it is the researcher's decision as to which method is most appropriate.

The CATA method requires minimal instruction, is relatively easy to perform and is completed quickly (Lancaster & Foley, 2007). Furthermore, it could be a more practical approach than intensity scaling from the standpoint of consumer-led product development. Since CATA responses are directly linked to consumers' perception of product characteristics, these responses could be utilized as supplemental data to maximize acceptance of the targeted products by consumers. CATA provides information on which attributes are detectable according to consumers and how that may relate to their overall liking and acceptance. Understanding sensory characteristics in the process of new product development is of great importance, as failure to obtain correct information about the sensory attributes may lead to fast disappearance of the new products from the marketplace (Stone & Sidel, 2007).

To understand the relationship between consumer and sensory data, preference mapping is a useful method. Preference mapping is a widely used group of multivariate statistical techniques designed to optimize products by understanding the structure between consumer preference and sensory data to identify drivers of liking (Faye et al., 2006; Greenhoff & MacFie, 1999). Among the various product optimization mapping methods, the Euclidian Distance Ideal Point Mapping (EDIPM), an extension of Multidimensional Preference Mapping (MDPREF), is a new approach based on a density analysis of individual consumer ideal product placements in the product configuration space (Meullenet, Xiong, & Findlay, 2007). In this approach, the ideal point of individual consumers is the point which minimizes the correlation between Euclidian distances to the products and hedonic scores.

Another optimization mapping technique, the Response Surface Model (RSM), proposed by Danzart, is based on external preference mapping (Danzart, Sieffermann, & Delarue, 2004). Multidimensional representation of sensory stimuli is first created by sensory (i.e. external) data. The consumer data for individual consumers is then regressed against the product coordinates in the sensory space to determine ideal points for both the individuals and the group (Meullenet, Lovely, Threlfall, Morris, & Striegler, 2008).

To investigate the efficacy of CATA scales within the sensory environment, this study used ice cream as the testing medium. Ice cream is one of the most popular frozen desserts in the United States. The US ice cream market continues to grow and is expected to be valued at over $10 billion by 2012 (Datamonitor, 2007). Vanilla is the most popular ice cream flavor in the US and accounts for almost half of all ice cream sales (Bodyfelt, Tobias, & Trout, 1988). There are many companies producing and commercializing ice cream in the US. In order to compete in this highly competitive market, it is crucial for ice cream manufacturers to understand the strong and weak points of their products, and how consumers' attitudes and preference patterns affect their products.

The objectives of this study were to (1) assess the use of CATA attribute responses for 10 commercial vanilla ice creams as an alternative to consumer attribute intensity ratings, and (2) compare CATA-generated preference maps to classical external maps generated from traditional sensory profiles.

2. Materials and methods

2.1. Samples and sample preparation

Fifteen commercially-available ice creams were initially selected from local supermarkets for testing. Preliminary screening of texture and flavor attributes eliminated five samples due to brand replication and fat content, a popular indicator of ice cream quality, and the use of natural or artificial vanilla flavor. Ice creams were selected so that various combinations of these quality factors were represented in the study. The 10 remaining products, consisting of two high-fat products, six products with moderate fat content and two low-fat products, are detailed in Table 1.

One scoop of each product was placed individually into a lidded white plastic container (45 mm diameter) coded with a three-digit random number. Samples were stored in a commercial-grade freezer (TS-49, True Manufacturing Co., St. Louis, MO, USA) at 18 °C for at least 24 h prior to testing to ensure sample consistency. All samples were tempered for 2 min at room temperature prior to serving for both descriptive analysis and consumer testing. The 2 min increment was determined to be the most appropriate tempering time by observing the condition of the ice cream as a function of time at room temperature. Samples were presented in a sequential monadic order to panelists according to a complete randomized block design, and the serving temperature (−12 + 2 °C) was strictly monitored to maintain consistency (Bower & Baxter, 2003; Li, Marshall, Heymann, & Fernando, 1997).

2.2. Descriptive analysis

The 10 vanilla ice creams were evaluated for taste, aromatic, flavor, and texture attributes by a descriptive panel of 17 individuals trained by the Spectrum® method (Sensory Spectrum Inc., Chatham, NJ, USA). Panelists have over 100 h of training and an average of 1000 h of testing experience. Two orientation sessions were conducted to familiarize the panelists with the samples. Flavor and texture lexicons were developed in four sessions, as described in Tables 2 and 3, respectively. The lexicons consisted of 23 total attributes specific to vanilla ice cream and definitions of each sensory attribute with associated references. Panelists quantified all attributes on a line scale from 0 to 15 (Meilgaard et al., 2007). Unsalted crackers and water were provided for panelists to clean and rinse their palate between samples, and a 10 min break helped prevent fatigue. The flavor attribute testing for all 10 products was

Table 1
A list of 10 commercial vanilla ice cream products.

Brand	Code	Name/description	Fat content (%)	Flavor	Manufacturer
Blue Bell	A	Homemade vanilla	13	Natural and artificial	Blue Bell Creameries
Blue Bunny	B	Premium all natural vanilla	10	Natural and artificial	Wells' Dairy, Inc.
Ben and Jerry's	C	Vanilla	24	Natural	Ben and Jerry's Homemade Holdings, Inc. (Unilever)
Best Choice	D	Vanilla	11	Artificial	Wal-Mart Stores Inc.
Breyers	E	Natural vanilla	12	Natural	Unilever
Edy's "Grand"	F	Rich and creamy vanilla	5	Natural	Nestle
Great Value	G	Vanilla	11	Artificial	Wal-Mart Stores Inc.
Guilt Free	H	Vanilla	4	Natural and artificial	Yarnell Ice Cream Co.
Haagen-Dazs	I	Vanilla	28	Natural	Nestle
Yarnell's	J	Homemade vanilla	15	Natural and artificial	Yarnell Ice Cream Co.