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Check-all-that-apply questions: Influence of attribute order on sensory product characterization

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ABSTRACT

Interest in methodologies for sensory product characterization by consumers is increasing, and check-all-that-apply questions (CATA or checklists) have gained some popularity. This research studied bias pertaining to: (i) the order in which sensory attributes are placed within a CATA question, and (ii) the order of a sensory CATA question within an extended product assessment ballot (including product-elicited emotions, purchase intention and overall liking). In three studies including 335 consumers and using fresh fruit as samples, evidence of attribute order bias was established. In each study, two ballot versions were used in a between-subjects design. Primacy effects linked to attribute salience could explain some of the results. For example, differences in frequency of use of an attribute would be higher on the ballot version where it was placed nearer to the top of the list. However, this type of bias was not sufficient to explain all observed effects. It was found that a random ordering of sensory attributes in a CATA question reduced the total frequency of usage of terms compared with when attributes were grouped with similar terms (e.g. flavour/taste terms grouped together and texture terms grouped together). Some evidence was obtained to suggest that listing sensory attributes in the order that approximate the time when they would be perceived during the course of consuming the sample is necessary unless consumers are given explicit instructions to recall all sensory perceptions and evaluate attributes on the list from that point of reference. It was also found that conclusions regarding differences between samples depended on which ballot version was used. Few order effects were uncovered when the sensory CATA question was prior to or subsequent to other product evaluations (product-elicited emotions and purchase intention). There was no significant effect on hedonic scores of the tested products linked to the attribute order within the sensory CATA question. This research can help to inform best practices in the design of CATA questions for sensory product characterization.

1. Introduction

1.1. Interest in use of CATA questions sensory product characterization is growing

Information about the sensory characteristics of foods and beverages is critical for the successful development and marketing of new products. This type of information has been traditionally obtained using descriptive sensory analysis with trained panels (Stone & Sidel, 2004). It is commonly prescribed that this methodology should be carried out with 8–20 trained assessors, in three steps: (i) descriptor generation, (ii) assessor training, (iii) evaluation of samples (Lawless & Heymann, 2010). Descriptive sensory analysis provides detailed, accurate, reliable and consistent results, being one of the most common methodologies in sensory science (Meilgaard, Civille, & Carr, 1999). However, this methodology is expensive and time-consuming, in part because of the fact that the vocabulary and associated panel training must be adapted to each type of product. Thus, it is difficult for industry, which oftentimes faces resource and time constraints, routinely to apply descriptive sensory analysis in the product development process. Because of these constraints, interest in the development of reliable and quick methods for sensory characterization of food products is increasing (Ares, Varela, Rado, & Giménez, 2011; Moussaoui & Varela, 2010).

In the mainstream paradigm of sensory science, information about the sensory characteristics of food products is gathered from trained panels and consumers are only asked about their liking, not providing information about how they perceive the sensory characteristics of the products. Because trained assessors may describe the product differently from consumers and/or take into account attributes that may be irrelevant for the consumer, consumer-driven sensory characterization of products could be more useful (ten Kleij & Musters, 2003). Thus, another paradigm

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for product optimization is using consumers to describe the sensory characteristics of food products and beverages. In this context, several consumer profiling methodologies have been developed in the last 10–20 years, including sorting (Lawless, Sheng, & Knoops, 1995), flash profiling (Dairou & Sieffermann, 2002), projective mapping or Napping® (Pagès, 2005; Risvik, McEwan, Colwill, Rogers, & Lyon, 1994) – and new methods continue to appear, for example, polarized sensory positioning (Teillet, Schlich, Urbano, Cordelle, & Guichard, 2010).

Check-all-that-apply (CATA) questions, which are among the group of approaches that has been gaining in popularity, is the focus of this research. It is not a new method per se, but a versatile multiple choice question format that is being increasingly applied for a range of different purposes in sensory and consumer science. Briefly, respondents are presented with an object to be evaluated (i.e. a food or beverage product) and a list of terms by which to characterize it. Their task is simply to select all the terms that they consider appropriate, and the relevance of each response option is determined by calculating its frequency of use. Recent examples of the application of CATA questions for sensory characterization of products by consumers include snacks (Adams, Williams, Lancaster, & Foley, 2007), strawberry cultivars (Lado, Vicente, Manzzioni, & Ares, 2010), ice-cream (Dooley, Lee, & Meullenet, 2010), milk desserts (Ares, Barreiro, Deliza, Giménez, & Gámbaro, 2010), orange-flavoured powdered drinks (Ares et al., 2011), cosmetics (Parente, Ares, & Manzoni, 2010; Parente, Manzoni, & Ares, 2011) and citrus-flavoured sodas (Plaehn, 2012). Some studies have compared the sensory maps generated by CATA questions with those provided by descriptive analysis with a trained assessor panel, reporting similar results (Ares et al., 2010; Bruzzone, Ares, & Giménez, 2011; Dooley et al., 2010).

1.2. A need exists for methodological research pertaining to CATA questions

Although the use of CATA questions is already getting established as a way of obtaining reliable sensory product characterizations by consumers at less cost than what would typically be associated with a trained sensory panel, little is known about how decisions made with regard to CATA data collection and analysis influence the results obtained. The present study contributes to a closing of this gap by looking at design aspects of CATA questions, focusing on order effects. There is a tradition in sensory and consumer science for this type of methodological research (e.g. Earthy, MacFie, & Hedderley, 1997; Mela, 1989; Popper, Rosentock, Schraidt, & Kroll, 2004; Vickers, Christensen, Fahrenholtz, & Gengler, 1993), which form the foundation for the development of best practices and guidelines for implementation.

Relevant background knowledge about CATA questions and pros/cons of this format can be gained from the marketing research literature pertaining to multiple-choice questions. CATA questions are a specific type of multiple choice questions in which respondents are not limited to selecting only one answer option, but are free to select all the options they consider appropriate. In marketing research, multiple choice is a popular question format, in part, because it has been shown to reduce response burden (Best & Krueger, 2004; Rasinski, Mingay, & Bradburn, 1994; Smyth, Dillman, Melani Christian, & Stern, 2006). However, some problems have also been identified. One of these is that this question format does not encourage respondents to engage in a deep processing (Sudman & Bradburn, 1992; Krosnick, 1999). Rather than spending the effort required to answer the question optimally, participants prefer to choose the first terms they look at and move to the next question, without giving adequate attention to the remaining response options (Sudman & Bradburn, 1992; Rasinski et al., 1994). For this reason, a pattern of primacy is usually found, where more salient options (e.g. those at the top of the list) are selected more frequently than those less salient (e.g. those appearing at the bottom of the list) (Rasinski et al., 1994; Smyth et al., 2006). This primacy effect has been also reported for the application of CATA questions to sensory characterization of food products. Castura (2009) reported that the position of terms on a list affected their frequency of use when evaluating orange juices. This author reported that first positions within a block of terms increased the number of selections from 2.6% to 5.9%, and that the frequency of selection increased 10–20% when terms were located in the first row and first column, suggesting that fixed choice order CATA ballots could skew results.

Focusing on the application of CATA questions to obtain sensory product characterizations by consumers, the first objective of this research was to confirm that primacy bias is an issue and to gain insight about its magnitude. For example, how many terms and which terms are typically affected? The second objective was to gain knowledge about other consequences of attribute-order effects when CATA questions are used for sensory product characterization. In a typical application, two or more products will be assessed and in addition to obtaining product characterizations for each, the question of whether the products are different from each other is likely to be asked. If attribute-order effects are at play, it is possible that conclusions regarding differences between samples for one or more attributes will vary depending on where in the list the terms are positioned.

Hypothetical scenarios for the effects of the two biases discussed so far are shown in Table 1. Imagine two versions of a CATA ballot (v1 and v2). There are many attributes on the ballot, but v1 and v2 differ only with respect to a single attribute (X), which is positioned either near the top of the list of attributes (v1) or near the bottom (v2). Further, imagine that four products (Product 1 to Product 4) were evaluated with 100 consumers using ballot version 1 and 100 consumers using ballot version 2. In scenario A, the primacy bias is established, as seen by reduced frequency of use for attribute X on ballot version 2. It exists in the absence of significant differences between the four products on attribute X. Its impact pertains to importance of attribute X for the sensory profile of the products, which would be described as less important when data are collected on ballot version 2. Scenario B illustrates the case when the products are different from each other on attribute X only for one of the ballot versions, in the absence of a primacy bias assessed at the aggregate level. In this case, ballot version affects the way in which attribute X is used to describe the four products. Finally, in scenario C, the primacy bias is significant, as is the difference between products, suggesting that ballot version affects both the overall frequency of mention of the term and the way in which it is used to describe products. In the results section of this paper we draw on these scenarios to provide a framework for interpreting the empirical findings.

1.3. Overview of the studies presented in this paper

Results from three consumer studies are presented in this paper. In Studies 1 and 2, two CATA ballot versions were compared. In both instances the order of several sensory attributes were changed to allow examination of the primacy bias. The differences between the ballot versions also pertained to whether the sensory attributes were presented in a more 'structured/logical' way or in a more 'random' way. This is relevant for sensory product characterization where the norm with trained panels is to follow a fixed order starting from odour and finishing with aftertaste (Lawless & Heymann, 2010; Stone & Sidel, 2004). Study 3 investigated presentation order effects in a different way. Here the order of attributes in the sensory CATA question was constant. However, the CATA question was positioned either prior to or subsequent to hedonic and product-elicited emotion assessment. Participants in each of the three studies were