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Temporal dominance of emotions: Measuring dynamics of food-related emotions during consumption

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ABSTRACT

Mapping food-evoked emotions in addition to sensory profiling is topical. In sensory profiling, the Temporal Dominance of Sensation (TDS) method focuses on the assessment of the temporal evolution of dominant sensory attributes over time. We hypothesize that food-evoked emotions also show temporal dynamics that can be related to dynamic sensory perception. This study assessed temporal dynamics of sensory and emotional attributes during chocolate tasting. We used TDS to determine dynamic sensory properties of dark chocolates providing a list of 10 sensory attributes. Comparably, Temporal Dominance of Emotions (TDE) was assessed by replacing the sensory attributes with 10 emotional attributes. Sixty-two participants assessed TDS and TDE of five commercially available dark chocolates (plain and flavoured). Multivariate comparisons (Hotelling test) showed significant differences between products based on the dominance duration of sensory ($p < 0.05$) and emotional attributes ($p < 0.05$). TDS difference curves revealed products to differ based on their dominant sensory attributes, with different attributes peaking at different time moments. TDE difference curves showed that products also differed in the temporal distribution of dominant emotional attributes. Comparing the average dominance rates between plain dark and flavoured dark chocolates revealed that for flavoured dark chocolates mainly flavour attributes and positive/active emotions were perceived as salient whereas for plain dark chocolates textural as well as taste attributes were dominant accompanied by more negative/non-energetic emotions. A joint CVA plot on the duration of dominance for sensory and emotional attributes per product revealed that temporal evolution of sensory – and emotional attributes was related. This suggests a mutual reciprocity between those two entities (sensory and emotional attributes) resulting in more complex, richer product characterization. In conclusion, these findings show TDE to be a promising new venue in characterising food-evoked emotions in relation to sensory profiling.

Introduction

It has become clear there is more to food choice than sensory liking per se, as is illustrated by market failure of newly launched products that previously have stood the test of consumer panels. We need to take a broader perspective on how consumers experience a food product, where we take into account all associations that consumers assign to a product based on experience and learning. Part of these associations has an emotional connotation (e.g. 'product makes me feel happy', 'product excites me') (Cardello et al., 2012; King & Meiselman, 2010; Thomson, Crocker, & Marketo, 2010). Hence, measuring food-evoked emotions can improve the understanding of food choice, consumption, and consumer behaviour.

In the past years a number of new methods have been developed to measure the predominantly positive emotions associated with foods (Desmet & Schifferstein, 2008; King & Meiselman, 2010). To date, these methods involve different formats of questionnaires including "check all that apply" (CATA), rating scales, as used in the EsSense Profile® (Cardello et al., 2012; King & Meiselman, 2010; King, Meiselman, & Carr, 2013; Ng, Chaya, & Hort, 2013), and non-verbal methods such as PrEmo©, a pictorial tool with animated cartoons representing several emotions (unpublished data: personal communication with Gutjar and colleagues). Thomson et al. (2010) advocate a conceptual profiling approach, where product conceptualisations with (abstract) emotional connotations (e.g. 'product is comforting', 'product will calm me') are combined with conceptualisations with functional

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connotations (e.g. 'product is a treat'). This method uses best–worst scaling and has been applied to explore sensory/emotional relationships of dark chocolates (Thomson et al., 2010).

All methods mentioned above are related in that food-evoked emotions are assessed immediately after tasting, resulting in a snapshot of a single event. However, emotions, like many other perceptions, are not single responses but series of dynamic events that unfold over time (e.g. Sander, Grandjean, & Scherer, 2005).

Studies of the temporal aspects of sensory perception during eating started about 50 years ago with the development of the time intensity method (Cliff & Heymann, 1993; Lee & Pangborn, 1986; Neilson, 1957). More recently, the descriptive method of temporal dominance of sensations (TDS) gained interest. In TDS, subjects evaluate a series of usually 10–12 sensory attributes on a computer screen while sampling food products (Goupil de Bouillé, Pineau, Meyners, Martin, & Schlich, 2010; Meyners, 2010). Subjects are asked to indicate which of the attributes is perceived as the dominant sensation, which is often defined as the most striking perception at a given time. In the course of the TDS evaluation, when subjects perceive that the dominant sensation has changed, a new dominant attribute can be chosen until the perception ends (Labbe et al., 2009; Meyners, 2011; Meyners & Pineau, 2010; Pineau et al., 2009, 2012). TDS methodology has also been adapted to investigate temporal aspects of hedonic assessment (Sudre, Pineau, Loret, & Martin, 2012). Compared to static sensory descriptive methods, TDS focuses on temporal evolution of sensory attributes with regard to dominance (not with regard to intensity) during the consumption period and takes into account the multidimensionality of the perceptual space over time by presenting a series of attributes to select from. We hypothesize that food-evoked emotions show similar temporal dynamics and interactions compared to sensory perception of food. Temporal evolution in sensory and emotional attributes could be related to one another, but this has not been investigated yet.

The objectives of this study were twofold. The first was to investigate the temporal aspects of food-evoked emotions during consumption of chocolates using temporal dominance of emotions (TDE). The second objective was to determine relationships between dynamic sensory and emotion perceptions by comparing the temporal dominance profiles of the sensory (TDS) and emotional (TDE) attributes.

Materials and methods

Participant selection

Sixty-two healthy, normal weight participants (25 male, 37 female; mean age 23.4 years (SD 4.4); mean BMI 21.4 kg/m^2 (SD 1.5) were recruited for this study. They had a European (11 male, 14 female) or Asian (14 male, 23 female) background; the majority being students at Wageningen University, The Netherlands. All were consumers of chocolate, had a normal ability to taste and smell (self-reported), and reported no aversions, allergies or intolerance to chocolate products, or chocolate cravings. None of the participants had previous training in sensory evaluation of chocolate. They received monetary reimbursement for their participation. All participants gave written informed consent before the study began.

Product information: chocolates

Dark chocolates were chosen as the stimuli for this study because of its previously reported sensory and emotional attributes (Cardello et al., 2012; Thamke, Dürrschmid, & Rohm, 2009; Thomson et al., 2010). Five commercial dark chocolates from the Lindt Excellence series (70% Cocoa, 85% Cocoa, Blueberry Intense, Intense Orange, and Intense Mint) purchased at a Lindt shop (Utrecht, The Netherlands) were used. Selection of the products aimed for a set of chocolate varieties that had clear distinctions in flavour (e.g. plain dark chocolate vs. fruity and mint flavoured dark chocolate) while keeping other sensory cues constant such as appearance and texture. Samples were presented at room temperature, unbranded, in 10 g pieces on a white plastic tray.

Attribute selection

Selection and definition of the attribute list is a key element in this study since these are the responses that will be collected from the participants. TDS methodology comes with a restriction in the number of attributes that can be evaluated optimally, which varies between 6 and 12 attributes depending on the product and test conditions. In addition, there is the consideration of using sensory attributes representing different sensory modalities such as taste, smell and texture in the same list of TDS sensations. The number of participants and replicates that should be used also needs to be considered. In this study, we followed the recommendations proposed by Pineau et al. (2012) with regard to the extent, choice and definition of the attribute list to ensure data quality. We included 10 sensory attributes to select from in the TDS session and 10 emotional descriptors to select from in the TDE session. We combined sensory attributes describing flavour and texture in the same list for TDS and combined pleasantness-related and arousal-related emotional attributes in the same list for TDE.

Sensory attributes

An initial set of 15 relevant sensory attributes was selected based on sensory characterization of dark chocolates by consumers as reported in literature (Thamke et al., 2009; Thomson et al., 2010) and on a list of attributes regularly used by one of the authors (P.S.) for teaching TDS in practical using the unflavoured chocolates of this study. Three specific flavour attributes (*blueberry*, *orange* and *mint*) that are relevant to the sensory properties of the (flavoured) chocolates were also added to the attribute list. This resulted in a list of 18 sensory attributes. Based on a pre-test in which five volunteers (not participating in the real experiment) tasted and rated the chocolates on these 18 attributes using CATA and answering the question "Please tick the attributes that you are perceiving right now. You are allowed to tick as many as you like". The set of 18 was then limited to the 10 attributes for which consensus (frequency) was highest during the pre-test (data not reported). An overview of the selected 10 sensory attributes (three taste, three flavour, and four texture attributes) with descriptions used in this study is given in Table 1.

Emotional attributes

For the emotional attributes, several papers were screened that reported consumers' emotional characterization of chocolate (Cardello et al., 2012; King & Meiselman, 2010; Macht & Mueller, 2007; Parker, Parker, & Brotchie, 2006). This resulted in approx. 30 terms that deemed relevant for chocolate, including *active*, *adventurous*, *affectionate*, *aggressive*, *bored*, *calm*, *disgusted*, *eager*, *energetic*, *enthusiastic*, *friendly*, *glad*, *good*, *good-natured*, *guilty pleasure*, *happy*, *interested*, *joyful*, *loving*, *merry*, *nostalgic*, *peaceful*, *pleasant*, *satisfied*, *secure*, *warm*, *whole*, and *wild*. To reduce the number of descriptors, we selected one term in case of closely related or synonymous emotion terms, (e.g. *happy*, *joyful*, and *merry* was eventually represented by *happy* only). Selection of representative terms was based on word use frequency in common language (e.g. *happy* has a higher word frequency in English language than *merry*). Finally, similar to the sensory attribute selection, five volunteers tasted and rated the chocolates on the initial