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Alternating temporal dominance of sensations and liking scales during the intake of a full portion of an oral nutritional supplement

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ABSTRACT

Measurement of liking with consumers is often performed on a single sip or mouthful of the product and results in a single liking score that does not necessarily reflect the liking over consumption of a whole product. A dynamic approach could provide this type of information. Thus, obtaining reasons why the liking score is changing over consumption could help to gain insights for product improvement. Recently, Thomas, Visalli, Cordelle, and Schlich (2015) suggested collecting with the same consumers liking scores dynamically and Temporal Dominance of Sensations (TDS) during mono-intakes of flavored cheeses, in two independent sessions. This new type of sensory data has been analysed at individual level to identify "temporal drivers of liking" for each product.

The present paper further develops this method consisting of collecting TDS and dynamic liking data in the same session and during the consumption of the full portion of a product. The products used to experiment this new method were two commercial oral nutritional supplements (ONS) assessed by 65 consumers over two lab sessions separated by one week.

The protocol consisted of a TDS evaluation of 5 flavor, 2 texture and 3 taste sensations during each sip, immediately followed by a liking scale. This protocol was repeated over sips. This method, named "Alternated Temporal Drivers of Liking" (A-TDL), required that consumers record liking changes and do TDS over sips during food consumption. Results showed that one of the two ONS was more liked than the other and consumed in a larger volume resulting in a higher energy intake. In contrast, the other product resulted in a stronger thirst and presented more negative temporal drivers of liking (*dry*, *metallic*, *filming*) over the consecutive sips.

1. Introduction

The sensory cascade of food consumption, composed of various oro-sensory perceptions, is a dynamic process driven by a specific food oral processing (Chen, 2009; Lawless & Heymann, 2010). For food companies, improvement of the characterization of the temporal descriptive profile is a key to better understand the consumers' product experience. The classic sensory analysis methods are generally static and do not take into account temporality of descriptive/hedonic profiles. Further, those tests are often performed with a single intake of the product and therefore do not reflect normal conditions of food consumption which usually is composed of several intakes (bites for a solid food or sips for a beverage).

Temporality in sensory perception is commonly evaluated by the Time-Intensity (TI) method (Lee & Pangborn, 1986). However, TI presents some biases as halo-dumping effects (Clark & Lawless, 1994) or individual signatures in TI-curves (Van Buuren, 1992). Further, the evaluation of different attributes with TI increases the amount of sessions and can quickly become relatively expensive. In order to overcome these limitations several temporal sensory methods have been introduced over the last 20 years: Discontinuous Time-Intensity (Clark & Lawless, 1994), Progressive Profiling (Jack, Piggott, & Paterson, 1994), Dual Attribute Time Intensity (Duizer, Bloom, & Findlay, 1997), Temporal Dominance of Sensations (Pineau et al., 2009), Sequential Profiling (Methven et al., 2010), Temporal Order of Sensations (Pecore, Rathjen-Nowak, & Tamminen, 2011), Multiple Attribute Time Intensity (Kuesten, Bi, & Feng, 2013) and more recently Temporal Check-All-That-Apply (Castura, Antúnez, Giménez, & Ares, 2016).

The hedonic response is often investigated by an overall liking score, but certain authors showed that liking presented a temporal

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aspect during the consumption of piquant crackers (Rozin, Ebert, & Schull, 1982) and liquids (Lee, Barrick, & Welling, 1992; Taylor & Pangborn, 1990). More recently some methods have been developed in order to study the temporal profile of liking discontinuously at different moments of chewing-gum mastication (Delarue & Loescher, 2004) or continuously during consumption of orange lemonades (Veldhuizen, Wuister, & Kroeze, 2006). These two studies showed the feasibility of the task over time. The continuous and discontinuous measurement methods allowed to evaluate the dynamic liking of three different types of cereals over time and the results confirmed time by product interactions of the two approaches (Sudre, Pineau, Loret, & Martin, 2012). These results confirmed that the liking is driven by a specific kinetic and can be evaluated continuously or discontinuously during food consumption.

In recent work, the hedonic and descriptive temporal profiles of fresh flavored cheeses have been studied in order to better understand how sensory characteristics modulate the liking during tasting (Thomas et al., 2015). In this study, sixty-four French consumers participated to a temporal liking and to a TDS sessions, which were separated by one week. Based on descriptive and hedonic temporal data obtained from the same subjects, an innovative concept of "Liking While Dominant" (LWD) has been developed, allowing the consumers to identify sensory attributes able to significantly increase or decrease liking in the product when they are dominant. This method, called "Temporal Drivers of Liking" (TDL), allows individual temporal descriptive and hedonic data recorded from the same consumers to be linked. The results of this study confirmed the added value of a liking kinetic compared to a classic static score. They also suggested that it was possible to describe both perception and liking, from a same consumer in two separate sessions. However, with this concept, the average of the individual temporal liking scores while each attribute was dominant (LWD) in the product is directly compared to the liking mean over the quotations weighted by their durations. This means that the comparison is not based on the same number of panelists. In a workshop at the 2014 Sensometrics meeting, some other authors proposed alternative methods to code and/or analyse this new type of sensory data (Carr & Lesniauskas, 2016; Castura & Li, 2016; Meyners, 2016). The present paper aims at collecting TDS and dynamic liking data simultaneously rather than in two separate sessions in order to relate TDS to liking and proposes an improvement of LWD data analysis.

In addition, to get closer to understanding regular consumption of a product it seems interesting to not base the evaluation on a single bite/sip only, as usually practiced in the classic sensory methods. It was shown before that during usual food consumption the sensory perception can be modulated by successive repeated intakes (Köster, 2003). Recently multi-bite/sip evaluation concept was applied to TDS and TCATA methods, thus highlighting characteristics not discerned by classic static sensory methods (Galmarini, Visalli, & Schlich, 2016; Oliveira et al., 2015; Schlich, Visalli, Urbano, & Pineau, 2013; Vandeputte, Romans, Pineau, & Lenfant, 2011; Zorn, Alcaire, Vidal, Giménez, & Ares, 2014).

In the present study the main objective was to expand the TDL concept by recording TDS and dynamic liking data in the same session and during the consumption of the full portion of a product. Oral nutritional supplements (ONS) were chosen for that purpose, because the full portion must be consumed to deliver expected benefits in the management of disease-related malnutrition (Hubbard, Elia, Holdoway, & Stratton, 2012). However, Methven et al. (2010) showed that a decrease in liking over consecutive sips, due to dynamic changes of taste perception, might lead to the subject not finishing the ONS portion. In their work, a trained panel characterized the ONS by means of a sequential profiling over eight consecutive aliquots (5 mL) and found a buildup effect for specific attributes (mouthdrying, metallic and mouthcoating). These results were used to explain why the liking recorded by another group of naïve subjects decreased over repeated consumption (60 mL in total). However this temporal sensory method focuses on the temporal profile between the successive intakes and does not take into account the changes within sips. Note also that each trained subject consumed 40 mL of each product in one sequential profiling session. However, an average intake of ONS is of 80 mL, considering that the classic bottle size is of 220 mL (Gosney, 2003).

In this context, a new sensory multi-intake method able to identify temporal drivers of liking using a panel of consumers describing perception and appreciation of a full portion of an ONS could contribute to a better understanding of the consumer's preference of this type of product. In addition, the present study proposes a methodology to analyse temporal descriptive and hedonic data obtained with a free multi-intake consumption protocol.

2. Methods

2.1. Products

Two commercial ONS (P1 & P2) were used for this study. P1 and P2 differed in energy density and volume. In order to not identify them, these information cannot be mentioned in the present paper. Each product was presented with its own unbranded white bottle (shape slightly different between products) and coded with a three-digit random number. Samples were served at ambient temperature (20 ± 1 °C). In order to get closer to regular ONS consumption, the consumers drunk straight from the bottle and thus sip sizes were not controlled.

2.2. Participants

The usual consumers of this type of products (ONS) are elderly and/or hospitalized people who have difficulties to consume enough proteins in their daily diets. However, hiring a panel of such types of consumers is very difficult and they may have great difficulties to use computers in their conditions. As our research was mostly methodological and not about the products for themselves, we preferred using 40–60 years old subjects used to consume dairy products. Thus, sixty-five naïve French consumers (31 men, 34 women) of dairy products and aged 40–60 years old participated in this study. Consumers were recruited by means of an on-line questionnaire from a population registered in the Chemosens Platform's PanelSens database. This database has been declared to the relevant authority (Commission Nationale Informatique et Libertés – CNIL – n° d'autorisation 1148039). Each consumer participated in two sessions. The consumers were compensated for their participation. All the participants provided written consent to participate in the experiment, which was approved by the Regional Ethics Committee of Burgundy (France).

2.3. Procedure

2.3.1. General procedure

The sessions took place in isolated sensory booths and lasted about one hour. Products were presented under red light. Each consumer tasted a full ration of P1 in one session and P2 in the other session. Half of the consumer started with P1 and the other half with P2. Data were captured using TimeSens software version 1.0 (INRA, Dijon, France). The consumers came between noon and 1 pm and they were instructed not to eat three hours before sessions. Before tasting, detailed instructions were given to consumers, then they had to rinse their mouth in order to neutralize the palate. Throughout the session, the consumers were not