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Review

Consumers' emotions elicited by food: A systematic review of explicit and implicit methods

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ABSTRACT

Background: The increased interest in consumer and sensory research to focus on total consumer experience when examining the relationship between food and consumer, has led to the development of a number of instruments to capture emotional responses elicited by food, beyond sensory liking.
Scope and approach: This systematic review identified 70 studies that applied both a food preference measurement (e.g. sensory evaluation, acceptance, liking, hedonic or preference measurements) and a measurement of emotion elicited by food. The narrative synthesis provides an overview of the methods, measurements and instruments that are currently applied in consumer and sensory research to measure emotions in relation to food. Based on how emotional responses are assessed, two types of methods are distinguished: explicit and implicit methods. All studies are categorized into these two methods and structured by the applied measurement with their specific instrument.
Key findings and conclusions: The results confirm the dominance of explicit methods to investigate emotional responses in relation to food. Although implicit measurements are only limitedly applied in consumer and sensory research, the increase and evolution of (often interdisciplinary) techniques have created new, promising approaches to capture emotional responses.

1. Introduction

The scientific need to better conceptualize consumers' experience with food has led to an increased interest in integrating emotions into consumer and sensory research (Gutjar et al., 2015b; King, Meiselman, & Carr, 2013; Meiselman, 2015; Mojet et al., 2015; Walsh, Duncan, Bell, O'Keefe, & Gallagher, 2017b). The effect of emotional responses to for example food acceptability, intention to purchase, food choice, attitudes or behavior have been examined in various ways (Walsh et al., 2017b; Wardy, Sae-Eaw, Sriwattana, No, & Prinyawiwatkul, 2015). Whereas the influence of emotions on food choice and food intake has been examined more often (for reviews, see Canetti, Bachar, and Berry (2002); Gibson (2006); Macht (2008)), the opposite direction, i.e. food consumption influencing mood and emotion, has only recently gained attention in consumer and sensory research (Bhumiratana, Adhikari, & Chambers, 2014; Cardello et al., 2012; Dalenberg et al., 2014; Desmet & Schifferstein, 2008; King, Meiselman, & Carr, 2010; Ng, Chaya, & Hort, 2013a). In the last 5 years there is an increased focus on the impact of food on emotions and how this is related to food acceptance (Piqueras-Fiszman & Jaeger, 2014a, 2014b). Evidence shows that consumers' emotional associations with food products can add additional information beyond overall acceptance (Cardello et al., 2012; Gutjar et al., 2015b; King & Meiselman, 2010; Ng et al., 2013a; Schouteten et al., 2015a; Spinelli, Masi, Dinnella, Zoboli, & Monteleone, 2014; Thomson, Crocker, & Marketo, 2010) and even significantly improve food choice prediction (Dalenberg et al., 2014; Gutjar et al., 2015a). Therefore the main reasons to include an emotional measurement in studies were product discrimination (Ng et al., 2013a; Schouteten et al., 2015b) and the need for a better understanding of consumers' food experiences and intake (Leitch, Duncan, O'Keefe, Rudd, & Gallagher, 2015; Piqueras-Fiszman, Kraus, & Spence, 2014).

This rising attention to emotion in consumer and sensory research has led to the introduction of many emotional instruments to capture consumers' emotions elicited by food (Dalenberg et al., 2014). Depending on how emotional associations are assessed, these instruments can generally be divided into explicit and

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implicit methods. Explicit methods are either verbal or visual self-reported measurements that ask participants to report their feeling, emotions upon consumption, smelling or seeing food products. The former uses an emotional lexicon, which is a questionnaire format with a list of emotional terms or a set of emotional descriptors or a list of sentences (such as the Emosemio by Spinelli et al. (2014)) that can be checked (e.g. Check-all-that-apply, CATA) or rated (e.g. RATA or 5 − point rating scale). The CATA scale asks the consumers to check all applicable terms. The RATA scale is a variant of the CATA scale which asks the consumers to rate or indicate the intensity of the applicable term (Ares et al., 2014). The emotional lexicon can also be predefined (e.g. the EsSense Profile® by King and Meiselman (2010)) or consumer-defined (e.g. product-specific lexicons for blackcurrant squashes (Ng et al., 2013a), chocolate (Thomson et al., 2010), hazelnut spreads (Spinelli, Masi, Zoboli, Prescott, & Monteleone, 2015), fruit salads (Manzocco, Rumignani, & Lagazio, 2013) and cheese (Schouteten et al., 2015a)). Ng et al. (2013a) were the first to compare predefined and consumer-defined emotional lexicons. Visual self-reported methods use images to depict different emotions rather than emotional terms. Several instruments have been developed, of which the Product Emotion Measurement Instrument (PrEmo) is one of the most well-known measurements (Desmet, 2003). PrEmo was originally designed for more technical products, such as cars (Desmet, Hekkert, & Jacobs, 2000), but has been recently applied in food products, such as breakfast drinks (Dalenberg et al., 2014), gingerbread and chocolates (den Uijl, Jager, de Graaf, Waddell, & Kremer, 2014) and odors (He, Boesveldt, de Graaf, & de Wijk, 2016). Unlike the verbal self-reported method, the visual self-reported methods are easily used in other languages as translation is not necessary (Koster & Mojet, 2015).

Although explicit measurements are quick and user-friendly they can be cognitively biased (Dalenberg et al., 2014; Danner, Haindl, Joechl, & Duerrschmid, 2014a; de Wijk, He, Mensink, Verhoeven, & de Graaf, 2014; de Wijk, Kooijman, Verhoeven, Holthuysen, & de Graaf, 2012; Lamote, Hermans, Baeyens, & Eelen, 2004; Verhulst, Hermans, Baeyens, Spruyt, & Eelen, 2006). This is why implicit measurement of emotions has been included in studies and has recently gained increased attention. These measures are indirect and non-self-reported and register emotions while participants are consuming, smelling or looking at food, without the need of a cognitive translation after the experience by the consumer (Danner et al., 2014a; De Houwer & Moors, 2007; Mojet et al., 2015). Most implicit measurements are registered continuously while explicit methods obtain data at certain points in time (e.g. filling in a questionnaire during or after consumption).

Interdisciplinary research (psychology, food science and medical science) has created new approaches to measure emotions in an implicit manner (Walsh et al., 2017b) through physiological, expressive and implicit behavioral task measures (Lamote et al., 2004). First, physiological measures are designed to tap into the underlying biological responses that accompany emotions, such as cardiovascular responses (i.e. heart rate, blood pressure), respiratory responses (i.e. respiration rate), electrodermal responses (i.e. skin conductance response, skin conductance level), brain responses (i.e. frontal alpha asymmetry) and pupillary responses (i.e. pupillary reflex) (Kreibig, 2010).

Second, expressive measures target expressive reactions, such as facial expression, that accompany emotion (Desmet, 2003; Ekman & Friesen, 1971; Ekman, 1993). Instruments that measure facial expression capture the facial muscle movements that go along with emotion (for a review, see Wieser and Brosch (2012)), either automatically (FaceReader, nViso, Affidex) or by trained coders. Another instrument that measures facial expressions is facial electromyography (EMG), which records movements of two facial muscles, the corrugator muscle (associated with positive emotion) and zygomatic muscle (associated with negative emotion) (Bailey, 2016).

Third, implicit behavioral task measures, such as the affective priming paradigm (APP), have been frequently used in psychology to register implicit attitudes and emotional responses (Klauer, Musch, Musch, & Klauer, 2003). They are generally based on measuring reaction times. Faster reactions are assumed to imply affective congruent relationships (Verhulst et al., 2006).

Given the aforementioned differences in emotion measurement that are applied in various scientific fields, the aim of this review is to provide a comprehensive overview of methods, measurements and instruments that have been applied in consumer and sensory research to measure emotion implicitly and explicitly in relation to food in the context of food behavior (including consumption and attitudes). This overview serves as a baseline for future reference as it provides an overview of the methods for various studies. To our knowledge, this is the first systematic review on measurements of emotions elicited by food.

2. Study search and selection

2.1. Eligibility criteria

Peer reviewed articles found in ISI Web of Knowledge and PubMed databases that investigated (1) food preferences and (2) emotion were eligible for systematic review. Additional and more specific inclusion and exclusion criteria were used to narrow down to the relevant articles. To be included in the systematic review, a study had to be written in English, had to include a sensory modality (flavor, aroma, appearance, texture, auditory) of a food product and needed to report a measurement of emotion elicited by food. As such, studies that only conducted a measurement of preference (e.g. hedonic testing), i.e. without any measurement of emotion, were excluded (for an overview of such studies, see Booth (2014) and Pool, Sennwald, Delplanque, Brosch, and Sander (2016) for a review on liking). Inclusion and exclusion criteria are shown in Supplementary Table 1.

2.2. Study screening

The search for articles was carried out in June 2016. The syntax is developed in line with common search strategies in consumer and sensory research (Booth, 2014) and in line with studies on emotion in the field of psychology (Mauss & Robinson, 2009). The search included an a priori limit for only human studies and no restrictions were made regarding publication year. The search syntax was developed by use of the PICOS framework: Population, Intervention, Comparison, Outcome, Setting (Supplementary Table 2). The population of interest was limited to consumers, experts, or panels (of consumers/experts). Any intervention that involved evaluation of food, taste (sweet, sour, salt, bitter or umami) or flavor and reported outcomes on sensory evaluation, acceptance, liking, hedonic or preference measurements and outcomes on emotion, mood or arousal were considered valuable. This review focused on research studies that describe preference and emotional responses to food with no limitation in setting. As this review aims to compare different methods of emotion measurements, no exclusions were made based on comparison. Key terms within the PICOS elements were combined using the Boolean operator 'OR' and between elements using the Boolean operator 'AND'. This resulted in the combination of the following keywords: (Consumer* OR Panel*OR Expert*) AND (sensory OR Accepta* OR Lik* OR Hedonic OR Pref*) AND (food OR sweet* OR sour* OR salt* OR bitter* OR umami* OR tast* OR flav*) AND (emotion* OR mood OR arousal). This search