



Sensory expectations based on product-extrinsic food cues: An interdisciplinary review of the empirical evidence and theoretical accounts



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ARTICLE INFO

Article history:

Received 18 June 2014

Received in revised form 2 September 2014

Accepted 30 September 2014

Available online 8 October 2014

Keywords:

Expectations

Extrinsic cues

Perception

Consumption

Food

Predictive coding

ABSTRACT

This article constitutes a state-of-the-art review of the literature on the effects of expectations on the sensory perception of food and drink by humans. In the 'Introduction', we summarize the theoretical models of expectations that have been put forward. In the 'Empirical research utilizing direct methods' section, we describe the influence that expectations created by a variety of product extrinsic cues have on sensory perception, hedonic appraisal, and intake/consumption. We critically evaluate the evidence that has emerged from both laboratory studies and real-world research conducted in the setting of the restaurant, canteen, and bar. This literature review is focused primarily on those studies that have demonstrated an effect on tasting. Crucially, this review goes beyond previous work in the area by highlighting the relevant cognitive neuroscience literature (see the section 'Applied research through the lens of cognitive neuroscience methods') and the postulated psychological mechanisms of expectation in terms of recent accounts of predictive coding and Bayesian decision theory (see the 'Predictive coding and expectations' section).

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Introduction

In our everyday lives, we rarely identify or judge a food or beverage product without having access to various sources of contextual information concerning what it is that we are tasting/consuming

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provided by both higher-level cognition and multiple sensory inputs that are available at the time. Despite the relevance that these cognitive effects have in the sensory and nutritional domain, a comprehensive up-to-date review of the literature encompassing different conceptual frameworks derived from empirical evidence and neuroscience through which to consider expectancy effects does not exist currently. The present work aims to provide such a review. The structure consists of four parts. We start by summarizing the theoretical bases of expectations, describing the explanatory models, a classification of the sources of expectations, and the role that factors such as familiarity have in the process of shaping expectations. We then review the latest direct empirical evidence highlighting the significant effect that product expectations can have on people's perception of a food's sensory attributes when tasting is involved. Although evidence on hedonic evaluations will also be described, it is not our aim to fully examine the extant literature on those studies which focus on product acceptance since comprehensive reviews of this topic already exist (e.g., see Fernqvist & Ekelund, 2014, for a recent review of credence cues and their effect on the consumer liking of food; Cardello, 2007). Furthermore, we will also review the neuroscience literature focusing on expectations that helps to highlight the relevant mechanisms underlying expectations. Finally, we will attempt to provide a novel perspective through which to understand these cognitive effects, namely predictive coding and Bayesian theories.

Expectations and their explanatory models

Whenever we interact with food or drink, or happen to be in a relevant consumption context, our brain initiates a number of psychological, physiological, and/or physical processes (Schiffstein, 1996; Spence, 2011). In particular, our brains interpret and integrate previously experienced (and stored) information with any newly-presented cues about the food that may be available. Consequently, everything from what is known about the product prior to consumption, any visual appearance and orthonasal olfactory cues, and, on occasion, even distal food sounds (just think of the sizzle of the steak on the hotplate) through to the context in which we happen to be eating or drinking, can all set up powerful expectations in our mind about that which we are about to experience (Spence & Piqueras-Fiszman, 2014; Woods, Poliakoff, Lloyd, Dijksterhuis, & Thomas, 2010).

In fact, expectancy effects can also be set up from the first bite of a product and exert an influence over the consumer's experience of the remainder of a food if the difference in taste is not too large. Indeed, Dijksterhuis, Boucon, and Le Berre (2014) recently suggested that the taste expectation that results from the first bite can be seen as a form of perceptual constancy. At one level, one might think that the study of expectations is no different in the world of food and drink than it is for many other products or services. However, there is also at least one potentially salient difference here: The fact that we ingest foods, and that they therefore have the potential to poison us (cf. Koza, Cilmi, Dolese, & Zellner, 2005) might be one reason to think that in the food domain expectations play a more crucial role in how we approach and evaluate a product/beverage.

When the food or drink is subsequently consumed (or when it is evaluated in terms of its flavour, aroma, or taste, as is often the case under laboratory conditions), there may, or may not, be a disparity between the expected experience and the actual experience. When the former occurs, that is, when there is a disparity between the expectation and the subsequent experience, a number of different outcomes have been reported in the literature. Over the years, four main psychological theories have been put forward in an attempt to account for the effects of the disconfirmation (to any degree) of a consumer's product expectations: (1) *assimilation* (or cognitive

dissonance) occurs when the consumer adjusts his/her perception of the product to what was expected, in an attempt to minimize the difference between the two (e.g., as in the case of tasting what we see, which is sometimes referred to as 'visual flavour'; e.g., Hutchings, 1977). Product evaluation ratings tend to shift in the direction of the consumer's prior expectations (e.g., Tuorila, Cardello, & Leshner, 1994), (2) *contrast* occurs when, as a result of the discrepancy, the consumer magnifies this difference (with ratings tending to shift in the opposite direction instead; e.g., Cardello & Sawyer, 1992), (3) *generalised negativity* occurs when a person evaluates a product negatively because the expectations that they had prior to consumption or tasting were not met, regardless of whether or not the product happens to be perceived as better, or worse, than expected; (4) finally, according to the *assimilation/contrast* model, if the discrepancy between what was expected and experienced is relatively small, assimilation will likely occur (see Fig. 1). However, whenever the discrepancy becomes too large, *contrast* may be observed instead (e.g., Anderson, 1973; Cardello, 2007; Deliza & MacFie, 1996). The latter theory has been used by food science researchers in order to account for expectations-based effects on the response of consumers to a variety of food and drink products (e.g., Yeomans, Chambers, Blumenthal, & Blake, 2008).

As will be discussed below, these responses likely also depend on the idiosyncrasies of the consumer and their familiarity with the products concerned. In addition, we would like to argue that they also depend on the degree of discrepancy between the product experience and the consumption situation/context in which a consumer finds his or her self. At this point, it is worth noting that in some contexts, such as modernist/experimental restaurants, diners may be more willing to tolerate, and even come to expect, a certain level of incongruency (e.g., Mielby & Frøst, 2012; Piqueras-Fiszman & Spence, 2012a; Spence & Piqueras-Fiszman, 2014). Nowadays, many people appear to positively relish, and may even come to expect, the opportunity to be surprised, shocked even, by their food.

Assessing the effect of dis/confirmation of expectations on hedonic appraisal

Back in 1963, Carlsmith and Aronson (1963) argued that the disconfirmation of expectations would normally lead to a negative hedonic appraisal of whatever a person happened to be confronted with. This can be thought of as a version of the generalised negativity theory outlined above. Cardello, Maller, Masor, Dubose, and Edelman (1985) supported this idea, arguing that one could increase the acceptance of a novel food product by consumers simply by providing the appropriate information about it. Here it is important to note that there may well have been a significant shift in the mindset of many consumers (at least in western cultures) since these original studies on disconfirmed expectations were published.

On the other hand, the confirmation of expectation, at least when it comes to foods that are more *familiar*, may not affect the consumer's hedonic assessment; instead, it may simply result in 'boredom' (see Piqueras-Fiszman & Spence, 2014; Schiffstein, 2001). However, in the case of familiar foods (e.g., a strawberry ice cream), increasing the degree of disconfirmation even further (by, for example, colouring it green or blue) might be expected to have a negative effect on people's hedonic evaluation (e.g., see Sakai, 2011; Yeomans et al., 2008). This effect is related to the *curiosity hypothesis* (Berlyne, 1960; see also Schiffstein, Kole, & Mojet, 1999). According to this latter hypothesis, a consumer may become familiarised with certain types of stimulation. Hence, when they are presented with a food that happens to match their prior expectations, it is unlikely to affect their overall hedonic appraisal, because it is not particularly interesting. However, if

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