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Research report

Stimulus collative properties and consumers' flavor preferences ☆

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A B S T R A C T

The present work investigated consumers' hedonic response to flavor stimuli in light of Berlyne's collative-motivational model of aesthetic preferences. According to this paradigm, sensory preferences are a function of a stimulus' *arousal potential*, which is determined by its *collative properties*. The relationship between overall arousal potential and hedonic response takes the shape of an inverted "U", reaching an optimum at a certain level of arousal potential. In three independent studies, using different sets of novel beers as stimuli, consumers reported their hedonic response and rated three collative properties: novelty, familiarity and complexity. Relationships between these collative properties and hedonic ratings were explored by polynomial regression. The results revealed patterns in line with Berlyne's predictions (curvilinear relationship) with regard to perceived novelty, whereas mixed results were obtained for familiarity and complexity. Additionally, in two of the studies, the moderating role of relevant consumer characteristics – product knowledge, food neophobia and variety seeking tendency – was investigated. A consumer's degree of product knowledge was found to significantly reduce perceived complexity and novelty, ostensibly reflecting the learning that occurs with previous exposures.

Introduction

Optimal arousal level and consumers' preferences

Consumers often have an ambivalent approach toward new or unfamiliar products. In the food and beverages domain, this has been seen as a reflection of the "omnivore's dilemma" (Fischler, 1990; Rozin, 1976), i.e. the characteristic of humans to be equipped with curiosity toward new and unfamiliar foods (instrumental to a varied diet), but also with an innate fear of them (instrumental to avoid ingesting harmful substances). The net outcome of this apparent paradox may be that consumers prefer products that jointly satisfy both of these contradictory tendencies, i.e. that have an optimal amount of novel elements to generate interest and curiosity, but are familiar enough not to induce fear.

Several "optimum level" theories have been proposed to conceptualize sensory preferences as a function of "arousal" induced by deviations from the familiar (van Trijp & van Kleef, 2008). Although there are some differences between these theories (see Köster & Mojet, 2007, for a review), they are grounded a common tenet of motivation theory: organisms actively look for stimulation, and they try to maintain an optimal level of activation or "arousal" under which they function most effectively.

Among the most prominent theories concerned with optimum arousal level is the collative-motivational model proposed by Berlyne (1967) to account for aesthetic appreciation. According to this theory, all stimuli can induce "arousal" (Berlyne, 1960, 1967, 1970), a state of psychobiological alertness relating not only to both specific and measurable physiological changes (e.g. brain stem activity), but also to behavioral processes such as attention and drive (Berlyne, 1967). A stimulus' arousal potential depends on three classes of properties: *psychophysical properties* (related to the intensity of the stimulus), *ecological properties* (related to biological functions such as thirst, hunger, sex and fear), and, most notably, *collative properties* (Berlyne, 1967). The latter ones are properties that affect the arousal level via the attention process, and are called "collative" because they imply a comparison (a *collation*) of incoming perceptual inputs with previous experiences, as well as an evaluation of similarities and differences between a

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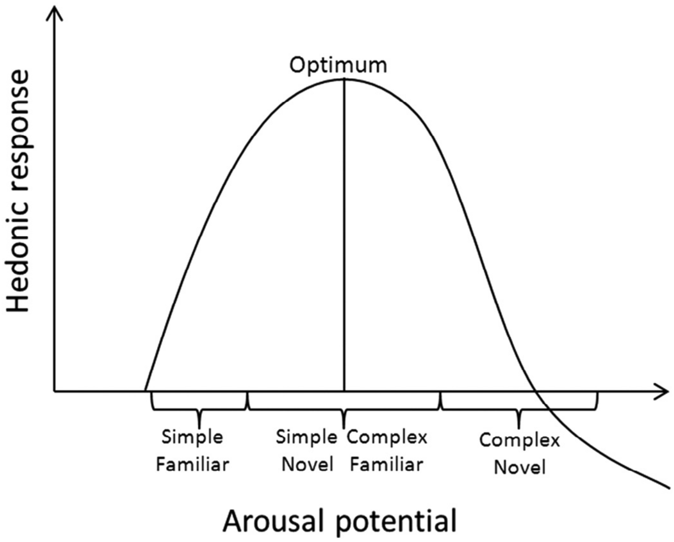

Fig. 1. Relationship between arousal potential and hedonic response (adapted from Berlyne, 1970).

stimulus' different elements (Berlyne, 1967, p. 20). Examples of important collative properties are *novelty* (degree of discrepancy between an experienced stimulus and previously experienced stimuli) and *complexity* (the degree to which different elements in a stimulus tend to co-exist or conflict) (Berlyne, 1967).

According to Berlyne, the relationship between arousal potential and hedonic response takes the shape of an inverted U (Fig. 1) where stimuli with a moderate arousal potential will be preferred.

This model has been widely applied to explain sensory preferences, in most cases using visual stimuli (Blijlevens, Carbon, Mugge, & Schoormans, 2012a; Hekkert, Snelders, & Van Wieringen, 2003; Mielby et al., 2012; Veryzer & Hutchinson, 1998; Whitfield, 1983), and less frequently auditory stimuli (Martindale & Moore, 1989; North & Hargreaves, 1997).

Little is known about whether the theory can be used to explain underlying preference structures in the chemical senses – taste and smell – as well. Acquiring this knowledge would be of both scientific and practical importance, since it could further current understanding of what drive consumers' acceptance of novel foods and thereby provide inputs for successful product innovation. The present research specifically focuses on testing the collative-motivational model on the hedonic appraisal of flavor stimuli. The term "flavor" is here intended as *the complex combination of the olfactory, gustatory and trigeminal sensations perceived during tasting* (ISO 5492:2008 – Sensory Analysis: Vocabulary).

Collative properties primarily examined in the present research are *novelty*, *familiarity* and *complexity*. Novelty is a collative property related to the distance between expectation and perception (Berlyne, 1950, 1966, 1970). As an arousal stimulating property, novelty is related to both positive hedonic response (curiosity and exploratory behavior) and negative ones (fear and withdrawal), inasmuch as its relationship with liking should follow an inverse U-shaped relationship (Berlyne, 1950). In particular, a positive appraisal is given when novelty refers to some unexpected feature in familiar material, by something that is in some degree similar and in some degree dissimilar to what is well known to an individual (Berlyne, 1950).

Perceived familiarity refers to whether the stimulus has been encountered before by an individual. For consumer products, familiarity is often associated to typicality, i.e. the degree to which an object is regarded to be representative of a category (Blijlevens et al., 2012a; Hekkert et al., 2003; Veryzer & Hutchinson, 1998). Hence, familiarity can be thought to measure how well a sensory stimulus from a new product fits previously encountered products in the category. This relies on the sensory memories that each individual has stored in his/her memory. If the fit is close, then the categorization will be very fast and the product will be perceived as familiar. On the one hand, perceived familiarity and hedonic response should stand in a positive relationship which stems from the successful preservation of existing knowledge and the ability of the cognitive apparatus to recognize and categorize a previously encountered stimulus (Mandler, 1982; Veryzer & Hutchinson, 1998). On the other hand, very familiar stimuli will lead to boredom and negative hedonic appraisal; hence an inverse U-shaped relationship is predicted. An important methodological remark is that although both novelty and familiarity have to do with an individual's expectations and past experience with a product, they are not two extremes of a single dimension. A novel stimulus is one that has some surprising elements, not necessarily one that has not been encountered before. Less than perfect correlations between novelty and familiarity have been observed empirically in previous studies (Hekkert et al., 2003), suggesting that they underlie slightly different perceptual dimensions and thus should be measured separately. This view is consistent with recent neuroscientific evidence suggesting that separate neural processes underlie perception of familiarity and novelty (in the posterior parahyppocampal gyrus and the anterior half of the hippocampus respectively), both of whom contribute independently to stimulus recognition and memory performance (Daselaar, Fleck, & Cabeza, 2006).

Complexity is another important arousal-inducing property, related to the number of discernible elements within a stimulus and on the degree to which these elements coexist or conflict (Berlyne, 1960, 1966, 1967). Complexity is thus very close to perceived ambiguity of a stimulus and to the cognitive effort necessary for its interpretation. Like novelty, complexity is an arousal-inducing property that can lead to either positive or negative affect (inverse U-shaped relationship). This ambivalence can be explained by research in affective psychology showing that individuals derive positive affective association from successful interpretation of perceived complexity (Mandler, 1982), implying that both very simple and very complex stimuli will frustrate (though for opposite reasons) the satisfaction derived from decoding a stimulus. Perceived complexity has been the focus of attention in flavor research, where it has similarly been defined as the number of separate sensory attributes that make up the total impression a person has of a stimulus (Jellinek & Köster, 1979, 1983; Moskowitz & Barbe, 1977). Although early work on the topic (Jellinek & Köster, 1979, 1983) suggested that perceived complexity is related to chemical complexity (the number of different compounds actually present in a stimulus), subsequent research has determined that this association is not straightforward. An important corpus of work has since documented that perceptual processing of odors in humans is mostly associative in nature (i.e. we tend to perceive complex object odors as unique stimuli, rather than as a muddle of components). Accordingly, the relationship between the chemical complexity and perceived complexity of a flavor is rapidly lost with increasing number of flavor components (Livermore & Laing, 1998). Previous research has demonstrated that odor and taste complexity is a concept which is meaningful and *directly* measurable with untrained subjects (Jellinek & Köster, 1979, 1983; Lévy, MacRae, & Köster, 2006; Moskowitz & Barbe, 1977; Sulmont-Rossé, Chabanet, Issanchou, & Köster, 2008).

Following Berlyne's model, the working assumption is that perceived complexity, familiarity and novelty can jointly be assumed to determine the arousal potential of a flavor stimulus. Thus, we tested the following theory-based hypothesis: