



## Crossmodal correspondences between taste and shape, and their implications for product packaging: A review <sup>☆</sup>



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### ABSTRACT

A growing body of empirical research now demonstrates that people associate different basic tastes and taste words with specific packaging shapes. While it may be obvious that semantic knowledge concerning products, based on the packaging and/or design elements (e.g., typeface, logo, label, images), can guide the taste expectations that consumers generate in relation to a given product, here we demonstrate that there are also more fundamental correspondences that operate even with unfamiliar stimuli. Specifically, shape features (e.g., straight vs. curvy, or symmetrical vs. asymmetrical) have been shown to influence the taste that people naturally associate with a given shape. The evidence suggests that, at least to a certain extent, people match such shape dimensions with tastes on the basis of their common affective connotation. Here, we critically review the literature on these seemingly arbitrary, yet systematic, crossmodal correspondences between tastes and shape features. We suggest that they can inform the design process when it comes to product packages and labels with the aim of conveying taste information more effectively. This review is relevant to those researchers interested in taste-vision correspondences as well as to food marketers, and those designers interested in the communication and influence of taste information.

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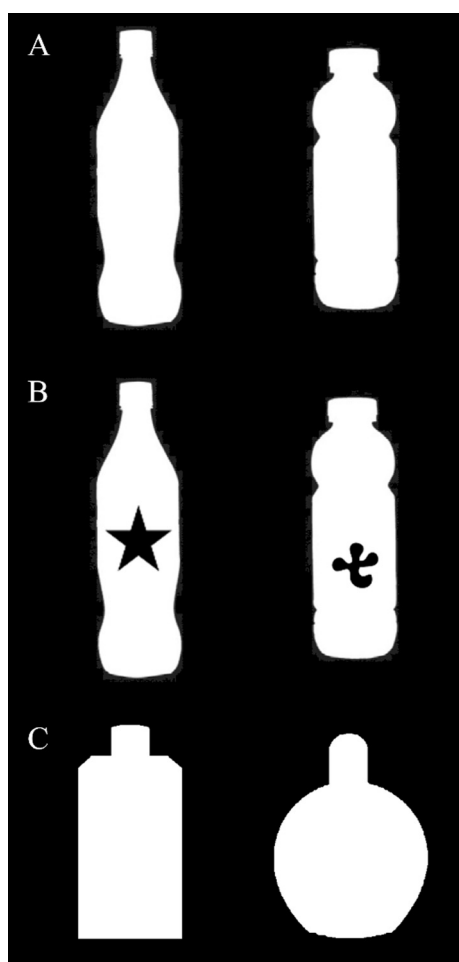
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## 1. Introduction

Most food and drink products come in packages of a particular shape or form, whose attributes prime various concepts in the mind of the consumer (Ampuero & Vila, 2006; Littel & Orth, 2013). Just think of the packages presented in Fig. 1. Could you predict, just from looking at their outline, the likely taste of the products contained within? Here, we argue that this is certainly the case. For example, most consumers may know what taste to expect from Coca Cola's silhouetted signature bottle given their previous interaction with the product (Prince, 1994). Nevertheless, over-and-above the association between prototypical packaging shapes and product taste, there would also seem to be a more fundamental association between tastes and shapes, that of crossmodal correspondences. The term 'crossmodal correspondences' refers to the often surprising associations of features across the senses (see Marks, 1978, 1996; Spence, 2011, for reviews). In this review, we focus on the crossmodal correspondences that have been shown to exist between taste and shape, and evaluate their implications for the design of product packaging and labelling.

At the outset, though, it is going to be important to differentiate crossmodal correspondences from other kinds of crossmodal associations (Spence, 2011). In terms of the latter, for example, people



**Fig. 1.** Sample packaging silhouettes corresponding to prototypical soda and tea (A, left to right). For illustrative purposes, we have superimposed shapes on top of the silhouettes (B). Do your expectations concerning the taste of the products differ between the packages shown in A and B? Panel C presents a pair of novel packaging shapes based on Velasco et al.'s (2014) study. [A and B adapted and reprinted from Food Quality and Preference, 45, Ana M. Arboleda & Carlos Arce-Lopera, 1–10, Copyright (2015), with permission from Elsevier]

may learn from the existing conventions of the marketplace (e.g., Cheskin, 1957, 1981; Moreau, Markman, & Lehmann, 2001; Smets, Overbeeke, & Gaver, 1994; Spence, 2012) that certain tastes (e.g., sweetness) and packaging forms (e.g., “soft drink” as in Fig. 1A) tend to go together with specific products or product categories (see Humphreys & Forde, 2001, for a review on semantic knowledge and object recognition). This high-level conceptual association is based on a common identity or meaning (“soft drink”) in which both visual and gustatory information converge on specific product exemplars (cf. Velasco, Wan, et al., 2015). In terms of crossmodal correspondences, however, the idea is that there may not necessarily be a common object or specific stimulus that embodies both the taste and the shape (Spence, Smith, & Auvray, 2015; Spence, Wan, et al., 2015). Consequently, whilst people may pair the expected sweet taste of a soft drink with its silhouetted shape, the curvilinearity (a low-level feature) of such a shape may also provide some information related to the sweetness of the drink (perhaps because curvilinearity is mapped on to multiple objects or object categories, see Deroy & Spence, 2016; see also Walker, in press).

In this review, it is argued that the expected taste of a product, as well as its actual taste, can be influenced by the different abstract shape features found in a product's packaging (based on the theory of crossmodal taste/shape correspondences). Furthermore, we highlight the importance of considering crossmodal correspondences when thinking about communicating taste information concerning a specific product, and the possible modulation of perception that may follow, based on those expectations. First, though, we examine the evidence concerning those studies that have looked at flavour/shape and taste/shape correspondences. Next, we move on to evaluate those studies that have investigated taste/shape correspondences in the context of product packaging. Finally, we discuss the potential mechanisms that may underlie the aforementioned correspondences. Conclusions and suggestions are drawn and directions for future research highlighted.

## 2. Crossmodal correspondences between tastes and abstract shapes

### 2.1. Crossmodal matching studies involving abstract shapes and flavours with specific taste qualities

Most of our knowledge concerning taste and shape correspondences comes from crossmodal matching studies dealing with flavours that have characteristic taste qualities (for example, a sweet-vs. bitter-tasting chocolate), and shape stimuli (see Spence & Deroy, 2013; Spence & Ngo, 2012, for reviews). At this point, it is essential to differentiate flavours from tastes. Flavour comprise the interaction of olfactory, gustatory, and possibly also trigeminal inputs (Prescott, 2015; Spence, 2015), whereas taste involves specific gustatory sensations that arise from the stimulation of receptors in the tongue (at the very least, bitter, sweet, salty, sour, and umami, though possibly including several more, Rozin, 1982; Spence, Smith, et al., 2015; Stuckey, 2012). In this section, we focus on crossmodal matching studies involving shapes and flavours with specific taste qualities as it can shed light on our understanding of taste/shape correspondences (Spence, Ngo, Percival, & Smith, 2013).

Research on the crossmodal correspondence between flavours and shapes has generally used abstract visual shapes in which a feature or set of features can be manipulated (e.g., Spence & Gallace, 2011). In fact, most studies have tended to focus on shape curvature (see Table 1 for an overview of studies and shape attributes that have been studied to date). These studies have generally

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