



## Visual attention toward food-item images can vary as a function of background saliency and culture: An eye-tracking study



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### ABSTRACT

People often purchase food products on impulse and their visual impression of such products plays an important role in impulse buying. Consumers are also likely to buy food items based on the images as displayed on mobile devices like smartphones. Food-service and dining industries have therefore begun to pay closer attention to improving the visual impression of the foods they offer. This study focused on determining whether participants' visual attention directed toward food-item images can vary depending on the background saliency. Differences in patterns of visual attention with respect to food-item images between North American and Chinese participants were also compared. During the time participants were looking at pictures of food items with varying backgrounds in the absence of a particular task, their eye movements were traced with an eye-tracker. As background contexts such as table setting and decoration became more salient, participants' visual attention toward the food items decreased. Chinese participants also looked at food items significantly later than American counterparts, implying that Chinese participants were relatively more influenced by background contexts. In conclusion, our findings provide empirical evidence that background context and culture can affect participants' visual attention while they are freely looking at pictures of food items.

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### Introduction

The rapid development of information technology (IT) permits people to purchase food items virtually anywhere through mobile devices such as smartphones, tablets, and laptops. In most cases, consumers' decisions to purchase food items are based on visual cues such as photos and video clips provided by websites.

It is also worth noting that many people's food purchases are unplanned; for example, they may be shopping but not actively searching for a particular product (Rebollar, Lidón, Martín, & Puebla, 2015) and may purchase food items on impulse (Bellenger, Roberston, & Hirschman, 1978). In such a situation, visual cues provided with products (e.g., visual elements of packaging design) may play a major role in capturing the attention of prospective consumers at the point of sale (Fenko, Schifferstein, & Hekkert, 2010; Rebollar, Lidón, Serrano, Martín, & Fernández, 2012). Hence, to attract potential customers' attention to particular food items, food-service and hospitality industries have begun to pay greater attention to improving the visual impression of food

items by manipulating features like table decoration, place setting, and lighting color.

There is increasing empirical evidence that perception of a food item and its amount of consumption vary depending on atmospheric visual cues provided by tableware items (García-Segovia, Harrington, & Seo, 2015; Harrar, Piqueras-Fiszman, & Spence, 2011; Hummel, Delwiche, Schmidt, & Hüttenbrink, 2003; Piqueras-Fiszman, Alcaide, Roura, & Spence, 2012; Wansink & Cheney, 2005; Zellner, Lankford, Ambrose, & Locher, 2010) and ambient lighting conditions (Cho et al., 2015; Hasenbeck et al., 2014; Spence, Velasco, & Knoeferle, 2014). For example, sweetened popcorn was rated significantly saltier when it was served in a blue bowl rather than in a white bowl (Harrar et al., 2011). Harrar et al. (2011) reported that the colored-bowl-induced saltiness might be mediated through specific color-flavor associations; for example, the blue color might be reminiscent of the ocean's salty water. García-Segovia et al. (2015) also demonstrated that consumers liked the appearance of roast chicken and were more inclined to eat it when the chicken was served in a gourmet table setting than when it was served in a plastic tray.

Similarly, based on participants' subjective ratings, previous studies have highlighted the impact of cutlery and other ambient contexts on sensory perception and acceptability of foods. In most studies, participants were asked to rate their perceptions,

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expectations, or motivations to purchase/consume food samples with varying visual cues such as cutlery, ambience, or packaging contexts (Ares & Deliza, 2010; Becker, van Rompay, Schifferstein, & Galetzka, 2011; García-Segovia et al., 2015; Hasenbeck et al., 2014; Piqueras-Fiszman & Spence, 2011, 2012; Piqueras-Fiszman et al., 2012; Spence et al., 2014). Many people tended to rely on particular visual elements (e.g., a picture of food product or a nutrition label) in answering questions given during “goal-oriented” (or “top-down”) tasks. For example, if a gluten-sensitive participant is asked to rate his/her willingness to eat a certain food product, he or she may mainly rely on the nutrition label (or the “gluten-free” label) shown on the product package. In fact, recent studies using eye-tracking techniques have provided empirical evidence that particular elements of packaging can capture consumers’ visual attention when they are involved in an activity such as testing their willingness to purchase/consume a product presented to them (Ares, Mawad, Giménez, & Maiche, 2014; Piqueras-Fiszman, Velasco, Salgado-Montejo, & Spence, 2013; van Herpen & van Trijp, 2011). However, since many people purchase unplanned or “impulse” items while they are shopping (Bellenger et al., 1978) or selecting from a food menu (Dodd, 1996; Miao & Mattila, 2013), this study is directed toward determining whether visual cues provided by cutlery and related table-setting contexts could affect visual attention directed toward a food image in the absence of such a testing-oriented focus. In other words, this study investigates “stimulus-driven” (or “bottom-up”) attention with respect to a food-item image by varying the saliency level of the background context. So far, little has been known about such attention in food-related contexts. Recently, Rebollar et al. (2015) demonstrated how the layout of packaging-design elements could affect participants’ visual attention in the absence of a directed task (e.g., in an impulse-buying situation). More specifically, by using eye-tracker techniques, variation in stimulus-driven attention was examined as a function of the layout of four packaging-design elements: (1) a fictitious manufacturing company, (2) the company’s logo, (3) a picture of the food snack, and (4) additional information giving the weight and calorie content of the snack. The surface area of these packaging elements was found to be the most important factor with respect to modulating participants’ visual attention on a packaged chocolate snack during an impulse-buying activity.

Previous cultural and social psychological studies have demonstrated that culture shapes visual perception and cognitive behavior (Chua, Boland, & Nisbett, 2005; Kitayama, Duffy, Kawamura, & Larsen, 2003; Masuda & Nisbett, 2001; Morris & Peng, 1994; Nisbett, Peng, Choi, & Norenzayan, 2001). Generally, Western culture emphasizes independence while East Asian culture highlights interdependence (Chiu, 1972). Furthermore, Western people tend to look at visual stimuli more analytically, focusing on objects and their individual components, while East Asian people pay more attention to contextual information such as background (Masuda & Nisbett, 2001, 2006; Masuda et al., 2008; Miyamoto, Nisbett, & Masuda, 2006; Nisbett, 2003; Nisbett & Masuda, 2003; Nisbett & Miyamoto, 2005; Nisbett et al., 2001; see also Masuda, Wang, Ito, & Senzaki, 2012). For example, in the study conducted by Masuda and Nisbett (2001), both Japanese and American participants were asked to look at underwater animations in which a certain fish was regarded as a focal object. The animation background also included other fish and objects (e.g., plants). After looking twice at the animations, participants were asked to describe them. Japanese participants reported background objects 65% more than did American participants. In another study tracking participants’ eye movement, Chua et al. (2005) demonstrated cross-cultural differences between European Americans and Chinese. American participants looked at the focal object (e.g., a tiger in a jungle) significantly more quickly and for a longer duration than did Chinese participants. Similarly, Goh, Tan, and Park

(2009) demonstrated that Westerners focused for relatively long durations on both objects and backgrounds, while Asians alternated more frequently between objects and backgrounds and exhibited shorter fixation durations.

A number of studies have shown cross-cultural variations between Western and Eastern countries in visual attention, although culture-induced variation in visual attention was not consistently observed in earlier studies (see Evans, Rotello, Li, & Rayner, 2009; Rayner, Li, Williams, Cave, & Well, 2007). However, most studies investigating cultural variation in visual perception have used scenery (Boduroglu, Shah, & Nisbett, 2009; Nisbett & Miyamoto, 2005) and human faces/bodies (Masuda, Wang, Ishii, & Ito, 2012; Masuda et al., 2008) as visual stimuli. Little is known as to whether culture modulates visual attention toward images of foods placed in various atmospheric contexts. Considering previous findings that visual impressions of food items can modulate food choice and acceptance (for a review, see Imram, 1999), it would be valuable to answer the question as to whether cultural background affects consumers’ visual attention to images of food items.

Building on previous findings, the study described here aims to determine whether consumers’ visual attention toward food items varies in relation to background saliency. Again, since consumers frequently buy unplanned items or make unplanned menu selections at points of sale (Bellenger et al., 1978; Dodd, 1996; Miao & Mattila, 2013), participants were asked to freely view images of food-items with varying background saliency without focusing on a particular task or question (e.g., willingness to eat or liking of the food item). It is to be expected that, as the background images (defined as all space/items except for the image of the focal food in the picture) become more salient, participants pay less visual attention to the food-items depicted. For example, when a strawberry cake is presented on a white plate, people may focus more on the cake itself than on the plate. However, when the strawberry cake presentation includes a fashionable cutlery set, people can be vulnerable to distraction by the cutlery set, possibly lessening visual attention given to the strawberry cake.

Another study objective was to determine whether the influence of background contexts on visual attention directed toward food items differs between Western (i.e., North American) and Eastern (i.e., Chinese) cultures. Given previous research that Western people tend to focus more on the focal objects, while East Asians are likely to focus more on the surrounding background, it was hypothesized that North American participants would focus more attention on the food items (i.e., focal objects) themselves than would Chinese participants.

## Materials and methods

### *Ethics statement*

This study was conducted in conformance with the Declaration of Helsinki for studies on human subjects. The protocol has been approved by the Institutional Review Board of the University of Arkansas (Fayetteville, AR).

### *Participants*

Thirty-nine American volunteers (all Caucasians, 14 men and 25 women) born in the United States of America, and 39 Chinese volunteers (14 men and 25 women) took part in this study; the Chinese participants were recruited from the Chinese community at the University of Arkansas (Fayetteville, AR). All Chinese participants were born in China and had completed their undergraduate and/or high school education in that country. They had been in the

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