



The effect of wrapper color on candy flavor expectations and perceptions

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ABSTRACT

The color of a product's metallic paper wrapper influences the expectations concerning the flavor of the product. These color-induced expectations are consistent with flavors associated with those colors (e.g., cherry-red) but vary somewhat with the product to be wrapped (e.g., a candy or beverage). Beverages wrapped in green were expected to have a lemon/lime flavor while candies wrapped in the same color were expected to have a mint flavor. Although flavor expectations were affected by the wrapper color there was no effect of the color of the wrapper on the identification of the flavor of a plain white spun sugar candy wrapped in the paper wrapper. The color of the wrapper also did not affect how much subjects liked the flavor of the candy or the rated intensity of the flavor or sweetness. There was also no difference among the colored wrappers in how appropriate they were judged to be for the candy. All colors were seen as, at best, "somewhat" appropriate. Subjects were more likely to report a candy as having a flavor consistent with the color of the candy than with the color of the paper it was wrapped in. This suggests that people's judgments and evaluations of a food stimulus is most strongly influenced by those aspects of the stimulus they perceive as being an integral part of the food (i.e., the color of the food rather than the color of the packaging).

1. Introduction

The color of a food or beverage leads to certain expectations about what sensory experience we will have when we taste the food or beverage. Some of these color-induced expectations might be caused by correspondences between certain colors and sensory characteristics. There are numerous examples of color-odor correspondences. For example, Kemp and Gilbert (1997) found that dark colors correspond to more intense odors. Correspondences have also been found between specific colors and specific odors (Gilbert, Martin, & Kemp, 1996). In their study, subjects indicated that cinnamic aldehyde (which smells like cinnamon) corresponds to the color red while caramel lactone (which smells like caramel) corresponds to the color brown.

Certain colors have also been found to correspond to certain basic tastes (e.g., red with sweet and green with sour, Koch & Koch, 2003; for a review, Spence et al., 2015). Correspondences have also been found between colors and the sensory experience of refreshment. Zellner and Durlach (2002) reported that subjects listed red, orange, and yellow as the most refreshing colors, and black and brown as the least refreshing. However, Clydesdale, Gover, Philipson, and Fugardi (1992) found brown to be a refreshing color.

The fact that the color brown was found to be both refreshing and

not refreshing suggests that some correspondences between colors and sensory aspects of foods are specific to the product being considered. These associations might be learned through experience with a food and drink of a particular color. Zellner and Durlach (2002) asked subjects about the color of foods or beverages whereas Clydesdale et al. (1992) asked subjects about non-alcoholic beverages. Clydesdale et al. suggested that their subjects found brown to be a refreshing color because they were thinking about cola. Because Zellner and Durlach (2002) asked their subjects to think about both food and drink they might have been thinking about foods such as steaks or hot chocolate in that study, which are not refreshing.

The idea that such correspondences are learned through experience is supported by studies demonstrating differences between people from different cultural groups where the colors that correspond to different foods and flavors might differ. For example, Shankar, Levitan, and Spence (2010) found that when their British subjects (70%) were shown a brown beverage they said that they expected it to have a cola flavor whereas none of their Taiwanese subjects expected cola.

In fact, Stevenson, Boakes, and Wilson (2000) demonstrated learned color-taste associations. Their subjects expected that colored solutions previously paired with citric acid would taste sour and that colored solutions previously paired with sucrose would taste sweet. So it

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appears that prior experience with foods of a particular color having certain sensory qualities can lead to those colors causing certain sensory expectations.

The expectations that colors produce can also impact the sensory perception of a food or beverage of that color once the food or drink is consumed. For example, color can affect the perceived intensity of both tastes and odors. In a series of studies it was found that the addition of a red color to beverages enhanced their perceived sweetness (Johnson & Clydesdale, 1982; Johnson, Dzendolet, Damon, Sawyer, & Clydesdale, 1982; Johnson, Dzendolet, & Clydesdale, 1983; Lavin & Lawless, 1998). Dubose, Cardello and Maller (1980) found that the intensity of an orange beverage was enhanced by an orange color and the intensity of a lemon cake was enhanced when colored yellow.

Although enhancement of orthonasal odor (odor smelled through the nostrils) by color of the stimulus that is the source of the odor has been observed consistently (Christensen, 1983; Engen, 1972; Koza, Cilmi, Dolese & Zellner, 2005; Zellner & Kautz, 1990; Zellner & Whitten, 1999) similar color-induced enhancement of retronasal odor (odor smelled when the food is in the mouth) has not been found. Christensen (1983) and Zampini, Sanabria, Phillips, and Spence (2007) found no effect of color on retronasal odor intensity. Others (Koza et al., 2005; Zellner & Durlach, 2003) have found a suppression of retronasal odor intensity by color.

In addition to affecting the perception of the sensory characteristics of foods and drinks, the color of the food or beverage can also influence how much it is liked (Dubose et al., 1980; Zellner, Bartoli, & Eckard, 1991). Zellner et al. (1991) found that the smell of solutions that are appropriately colored (e.g., a grape solution colored purple) is liked more than the smell of the same solution colored inappropriately (e.g., a grape solution colored yellow). This change in odor pleasantness with appropriateness of color seems to be at least partly due to a decrease in the ability to correctly identify an inappropriately colored odorous solution [although see Piqueras-Fiszman & Spence (2012b) and Velasco et al. (2016) for discussions of incongruity being hedonically positive in certain contexts such as a modernist restaurant].

However, this decrease in liking when a food is inappropriately colored might be the result of conditioned changes in the quantity or quality of the taste and smell of the food caused by a learned association with the color (see Zellner, 2013). Such conditioned odor quality changes have been found in odor-odor conditioning (Case, Stevenson, & Dempsey, 2004; Stevenson, 2001a; Stevenson, 2001b; Stevenson, Case, & Boakes, 2003). When subjects are exposed to a mixture of two odors and then presented with only one of the pair they report smelling the other. If a similar thing happens with color-odor pairings it is possible that the color produces the expectation of a particular taste or odor which then produces a percept of that taste or odor (see Zellner, 2013). That could result in a red drink being perceived as sweeter than a clear drink, and as having a cherry or strawberry odor or flavor.

The fact that color might result in such conditioned percepts is suggested by studies finding that when subjects misidentify odorous solutions they often identify them as odors whose objects have the color of the solution they are asked to identify (Blackwell, 1995; Dubose et al., 1980; Morrot, Brochet, & Dubourdieu, 2001; Zellner et al., 1991 – but see Piqueras-Fiszman & Spence, 2015; Shankar et al., 2010; Zellner, 2013 for limitations). For example, a solution with a lemon odor might be identified as “cherry” or “strawberry” if colored red.

Many of the studies investigating the effect of color on liking and sensory characteristics of food have looked at the effect of the color of the actual food (e.g., yellow cake, red beverages). It seems likely that the production of expectations by the color of the food about the sensory properties of the food plays a role (e.g., Cardello & Sawyer, 1992; Shankar et al., 2010), possibly through previous learned associations. That is, we have learned that red foods often have a “red” flavor such as cherry or raspberry.

However, studies have found that not only the color of the food, but the color of service items on which the food is served can alter liking for

and perception of the flavor of the food [e.g., bowls (Harrar, Piqueras-Fiszman & Spence, 2011, plates (Piqueras-Fiszman, Giboreau & Spence, 2013, cups (Piqueras-Fiszman & Spence, 2012a, cutlery (Harrar & Spence, 2013)]. It is difficult to imagine how the color of the service items would result in different flavor expectations of the food served. More likely, these effects are the result of changes in how the food itself looks when presented on different colored backgrounds, both in terms of color (through simultaneous color contrast) and attractiveness (see Zellner, Loss, Zearfoss, & Remolina, 2014) which changes sensory perception and liking.

While the color of the service items (e.g., plates, cups) probably does not produce its effect directly through expectations caused by the color of those items, the color of the packaging of certain foods might (e.g., red cans with coca-cola, brown wrappers for a chocolate candy, e.g. Hershey bar in the US) because they do seem to cause sensory expectations. For example, Huang and Lu (2015) found that people expected foods in red packaging would taste sweeter than foods in blue or green packaging. However, they did not investigate whether those expectations changed perception of the product.

There has also been some research on the effect of the color of packaging on actual flavor perception, identification and liking (e.g., Ares & Deliza, 2010; Deliza & MacFie, 1996; Piqueras-Fiszman & Spence, 2011; Rebollar, Lidon, Serrano, Martin, & Fernandez, 2012; Tijssen, Zandstra, de Graaf, & Jager, 2017). In one study (Piqueras-Fiszman & Spence, 2011) subjects who were given potato chips (crisps) of a particular flavor from a package having a color they associated with a different flavor often misidentified the flavor as the one corresponding to the color of the package (also see Piqueras-Fiszman, Velasco, & Spence, 2012). This finding suggests that package color might also produce expectations which affected the perceived flavor of the packaged food.

What expectations are produced by the color of the packaging can depend upon the food product. For example, a red can might cause an expectation of a cola flavor but a red yogurt container might cause an expectation of a raspberry flavor because of prior associations of those package colors with those product flavors. Piqueras-Fiszman and Spence's (2011) data supports this idea. People seemed to have learned rather arbitrary color-flavor associations of crisps (potato chips) and which associations they learned depended upon the brand of crisp they ate.

In the case of crisps (potato chips) the package color might be the only color setting up a flavor expectation because chips of most flavors are the same color. However, in some cases we expect the actual product to have a color congruent with the flavor of the product. That is true for many beverages. For example, we expect colas to be brown and other colors such as a clear cola are not acceptable. Soon after a clear version of Pepsi-Cola was introduced in 1993 it was discontinued (Triplett, 1994). The can label indicated that the beverage was Pepsi (Crystal Pepsi) but according to anecdotal reports people did not like the cola if they drank it from a glass (where they could see that it was clear) but did like it straight from the can (where they did not see the color of the beverage).

These studies suggest that both the color of the package of a product and the color of the product itself might both set up expectations concerning the flavor of food or beverage which can influence how they are perceived. Here we investigate the odor quality (what we will call flavor) expectations, if any, produced by colored metallic paper wrappers around a beverage container or a piece of candy. After finding out the flavor expectations the paper produced, we then investigate whether these expectations affect the perception of an unflavored sugar candy wrapped in that paper by asking subjects to taste the candy, identify the flavor of the candy, rate how much they like it, rate the flavor and sweetness intensity, and rate how well they thought the color of the paper went with the flavor of the candy.

If the color of a wrapper produces effects through expectations, much as the color of the actual food does, we expected that people

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