

EAT WITH YOUR EYES: PACKAGE COLOR INFLUENCES THE EXPECTATION OF FOOD TASTE AND HEALTHINESS MODERATED BY EXTERNAL EATING

LEI HUANG, *State University of New York at Fredonia*
JI LU, *Dalhousie University*

In the context of food product marketing, this paper is one of the few academic research studies that examine the effect of package color on consumers' inference on intrinsic product attributes. In a within-subject experimental study, 40 participants rate sweetness and healthiness of 12 food products contained in red, green and blue packages. The results demonstrate that red packaged products are perceived to be sweeter, whereas products packaged in green and blue are associated with the perception of healthiness. In terms of individual differences, external eaters, whose eating behavior is primarily triggered by external hedonic cues, are particularly sensitive to the effect of red package on sweetness taste and healthiness inference. The managerial applications of the consumer's cognitive-behavioral responses to the package color strategy and future research are discussed as well.

INTRODUCTION

A product package often is the first thing that triggers the consumer's instant responses before making purchase decisions in retail environments (Cardello, 1996), and color is one of the most potent features of product package design in the food industry (Deliza, Macfie, & Hedderley, 2003). As package design is an extrinsic cue that can influence consumers' perceptions about the intrinsic attributes of the contained product (Limon, Kahle, & Orth, 2009; Orth & Malkewitz, 2008), marketers tend to use package color to differentiate products. For example, blue or green packaging usually points to healthy foods, whereas red packages often represent tasty and less healthy alternatives. Despite this common industry practice, little academic research has focused on the influence of package color on consumers' perceptions in choosing food products. Instead of using package colors, Vasiljevic, Pechey, and Marteau (2015) examined the impact of color of nutritional labels on the choice of snack foods. In a similar vein, Reutner, Genschow, and Wänke (2015) tested the moderation effect of healthiness perception on the relationship between the color red and food consumption. In Study 1 they investigated incidental consumption of healthy

and unhealthy food from red and white plates while in Study 2 they asked the participants to choose between pieces of bread marked with little green and red flags. As an extension on the current literature, the present study thus aims to examine how an important aspect of packaged food – namely, its package color as an external cue and marketing tool – impacts consumer's perceptions of hedonic value as well as cognitive judgment of the healthiness perceptions.

Shaped by the individual's sociocultural background and everyday life experiences, color carries symbolic meanings that bear both cognitive implications and affective responses thereby strongly influencing the perception of colored objects (Elliot & Maier, 2007). It has been proposed that the effective use of color as a marketing cue, such as in product, logo and package design, is based on the consistency between the individual's perceptions concerning desirable product attributes and the symbolic meanings or affective reactions to different colors (Bottomley & Doyle, 2006; Holmes & Buchanan, 1984; Walsh, Toma, Tuveson, & Sondhi, 1990). Particularly, in food product research, warm colors (e.g., food and beverages in red color) are often tied to hedonic attributes that stimulate the sensory properties, such as the taste of sweetness (Walsh, et al., 1990). On the other hand, cool colors (e.g., blue and green labels) are associated with the healthiness perception resulting from a

cognitive judgement (Schuldt, 2013). Additionally, a recent study has revealed that the package colors of blue and red moderated the healthiness perception of the contained food product (Huang & Lu, 2013). Building upon and going beyond these findings, the current project will examine the hypotheses that red versus blue and green packages are associated with an enhanced perception of hedonic attributes (e.g., sweetness taste) versus healthy food perceptions. Furthermore, the existing literature suggests that consumers often intuitively perceive tasty food as unhealthy (Raghunathan, Naylor, & Hoyer, 2006). It is reasonable to postulate that such intuitions can bridge the red package to the unhealthiness inference mediated by the perception of sweet taste. Finally, external eaters are those individuals whose eating is easily triggered by external sensory cues, such as olfactory and visual stimuli, that carry hedonic value (van Strien, Frijters, Bergers, & Defares, 1986). As a result, external eaters tend to use extrinsic cues to infer the intrinsic hedonic attributes of food (Brignell, Griffiths, Bradley, & Mogg, 2009). As the color red is particularly tied to the perception of hedonic attributes, we expect that external eaters are particularly sensitive to red colored packages in the judgment of food products.

THEORETICAL FRAMEWORK AND HYPOTHESES

According to the three-component theory of color (Hurvich & Jameson, 1957), the human eye senses, or responds to, the three primary colors of light: red, green, and blue, and all other colors in the visible spectrum are mixtures of these three primary colors. In the past few decades, a tremendous amount of research attention has been paid to the influence of these three primary colors' perceptions, specifically hue, on affect, cognition, and behavior (Barsalou, 1999; Connell, 2007; Maier, Barchfeld, Elliot, & Pekrun, 2009). Based on wavelength and arousal, for instance, colors can be grouped into warm and cool. Warm colors (e.g., red) have longer wavelength than cool colors (e.g., blue and green; Mehta & Zhu, 2009). Cognitive thoughts on color are stored in memory with associated mental concepts or experiences that may result from daily knowledge with similar products and

colors; or learned stereotypes and symbolic meanings of colors (Grossman and Wisenblit 1999; Hanss, Böhm, and Pfister 2012). For example, a warm color, such as red, is the color of love and extroversion; whereas a cool color, such as blue is the color of peace and hope (Kaya and Epps 2004).

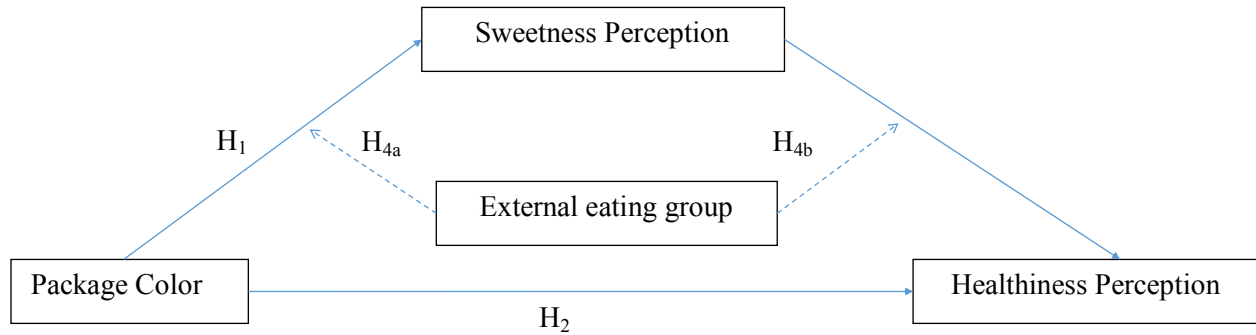
Moreover, depending on the context, a single color or a combination of colors often conveys symbolic meanings that trigger affective responses and are used in marketing practice to identify brands, categorize products, make assumptions, imply quality and guide consumer choices (Aslam, 2006; Bellizzi & Hite, 1992; Grossman & Wisenblit, 1999; Hanss, Böhm, & Pfister, 2012; Loersch & Bartholow, 2011; Singh, 2006). Consumer research suggests that the successful use of color critically depends on the congruency between the symbolic meanings of the color and the type of product or its attributes. For instance, Walsh et al. (1990) found that children preferred red and green colors for candies. Holmes and Buchanan (1984) suggested that people preferred blue for clothes and brown for furniture. For cars, blue and red were preferred as well as silver and black. More recently, a study on brand logos (Bottomley & Doyle, 2006) exhibited that cool colors (e.g., blue or green) were perceived to be appropriate for utilitarian products, such as power tools and car tires, whereas warm colors (e.g., red or orange) were deemed appropriate for products or services that usually brought about hedonic experiences, such as chocolates, nightclubs, and perfume.

In line with the existing literature, we will examine how the three primary colors of packages (i.e., red, green, and blue) influence consumers with different eating behaviors (e.g., high versus low external eaters) on their perceptions of food taste (e.g., sweetness) and healthiness. To illustrate our theoretical framework, Figure 1 summarizes the relationships among the key concepts of this study.

Package Color and Taste Perception

In the domain of food consumption, the symbolic meanings of colors are closely tied to the natural appearance of food (Clydesdale, 1993; DuBose, Cardello, & Maller, 1980;

FIGURE 1:
Theoretical Framework and Hypotheses



Note: Dashed lines indicate the moderating effects.

H₃ is not demonstrated in this figure. H₃ states that the relationship between package color and consumers' perception of healthiness is mediated by the perception of sweetness.

Johnson & Clydesdale, 1982; Lavin & Lawless, 1998). People begin to relate particular colors to different types of foods from birth (Walsh, et al., 1990), and associate these colors with certain tastes or flavors throughout their lifetimes (Christensen, 1985). For instance, one may expect brown pudding to have a chocolate flavor and yellow jellybeans to have a lemon or banana taste. In fact, the food color-taste association can sometimes go beyond the existing expectation and further bias the actual experience and preference. For example, a cherry-flavored drink in orange or green color is thought to taste like an orange or lemon-lime drink (DuBose, et al., 1980).

The color red is often linked to biologically rewarding cues and a high level of emotional arousal (Moller, Elliot, & Maier, 2009; Niesta Kayser, Elliot, & Feltman, 2010). Such links are consistent with the appetitive reaction to tasty foods with high hedonic value (Raghunathan, et al., 2006). Pangborn (1960) and Maga (1974) illustrated a particular correlation between the redness of food and the perception of sweetness. They argue that such a correlation is perceptually rooted in a natural pattern of many ripening fruits turning red. Several further studies have also confirmed this relationship (e.g., see Johnson & Clydesdale, 1982; Spence, Levitan, Shankar, & Zampini, 2010; Strugnell, 1997). For instance, Lavin and Lawless (1998) asked participants to rate the sweetness of four strawberry-flavored drinks with different colors. Their findings suggested

that the participants rated the dark red solutions sweeter than those in other colors. Although a tremendous number of studies have documented the impact of food color on taste or flavor perceptions, the evidence pertaining to the question of whether *package color* influences people's perception of taste or flavor intensity is currently unavailable. Due to the hedonic nature of sweetness and the findings from the existing literature, we also take this specific flavor of taste to study our focal research questions. Mapping the relationship between sweetness and the red package color for foods and beverages, we hypothesize that:

H₁: The package color has a significant impact on the perception of sweetness. Specifically, red packaged foods and beverages are perceived sweeter than those in other package colors.

Package Color and Food Healthiness Perception

Compared to the perception of taste, the food healthiness judgment relies relatively more on cognitive information. Although the nutrition information on food packages, such as health and nutrition content claims, leads consumers to make informed decisions in retail settings, shoppers often do not read or examine this information (Cowburn & Stockley, 2005; van Buul & Brouns, 2013; Wansink & Sobal, 2007). Consequently, the food healthiness perception can be strongly influenced by

peripheral cues such as package design (Vasiljevic et al., 2015) and container size (Wansink & Park, 2001).

As color is viewed as one of the most effective package designing features in food industry, both consumers and manufacturers often associate healthy, nutritious food with green or blue packages. For instance, *Upstate Farms* uses green packaging for its 1% milk and blue for its skim milk. This association between blue or green and healthy food is deeply rooted in the consumers' psychological reactions to these colors and reinforced by the sociocultural environment. Social psychology research on color has revealed that the colors of green and blue are often symbolically associated with naturalness (Clarke & Costall, 2008; Kaya & Epps, 2004); and this is in line with the belief that a food product which is closest to its natural form or is produced and processed in natural ways is healthy (Harper & Makatouni, 2002; Hughner, McDonagh, Prothero, Shultz, & Stanton, 2007). In terms of affective responses, blue and green usually elicit low arousal and positive emotions, such as peacefulness, relaxation and comfort (Kaya & Epps, 2004), and these emotions are also consistent with the affective experience of consuming healthy foods (Conner, Norman, & Bell, 2002; Tam, Bagozzi, & Spanjol, 2010). According to these symbolic meanings and affective responses, organizations in the food industry predominantly use green and blue in their marketing communication materials (e.g., logos) to establish a healthy brand image, such as the U.S. Department of Agriculture organic food labels, Smart Choices Certificate, British traffic-light food labeling system, and President's Choice Blue Menu®. These marketing efforts have consolidated the green/blue equals healthiness association by repeatedly pairing blue and green with healthy food products. Referring to the exhibition in Figure 1, we hypothesize that:

H₂: The package color has a significant impact on the perception of food healthiness. Specifically, blue and green packaged foods and beverages are associated with higher healthiness perception than red packaged products.

Raghunathan, Naylor, and Hoyer (2006) demonstrated an intuitive association between the concepts of "unhealthy" and "tasty" through a set of implicit attitude tests, and such association was salient even for those who explicitly expressed the personal belief that healthy food was tasty. As red often suggests palatability, the "tasty food is unhealthy" intuition may also imply that red packaged food is unhealthy (Reutner et al., 2015). We expect that:

H₃: The perception of sweetness mediates the relationship between the package color and the perception of healthiness of the packaged foods and beverages.

External Eating

Since package colors are important external cues that are used to infer the intrinsic properties of food products, it follows that individual differences in how one reacts to and interprets external cues would moderate the package color effect on the taste and healthiness perception. External eating is an individual propensity with the emphasis on external cues to trigger food consumption and guide food choice (van Strien, et al., 1986), and individuals whose eating behavior is highly sensitive to external cues are referred to as high external eaters. It has been demonstrated that high external eaters' food consumption is more importantly influenced by sensory cues (e.g., smell and sight of food) and less importantly guided by nutritional needs, as compared to low external eaters (Rodin & Slochower, 1976; van Strien, et al., 1986). High external eaters tend to prefer food with high hedonic value and manifest this bias in their attention to, and evaluation of food products (Brignell, et al., 2009; Burton, Smit, & Lightowler, 2007; LeBel, Lu, & Dubé, 2008; Newman, O'Connor, & Conner, 2008; van Strien, et al., 1986).

First, when making food-related decisions and judgments, high external eaters' attention is easily captured by the cues that are tied to the sensory pleasure. For instance, external eaters exhibit focused attention to the pleasure-laden food pictures (Neimeijer, de Jong, & Roefs, 2013; Nijs, Franken, & Muris, 2009). Compared to low external eaters, high external eaters respond to food-related pictures and

words faster, and are more likely to be distracted by food-related hedonic stimuli while performing non-food-related cognitive tasks (Brignell, et al., 2009; Hou et al., 2011). Second, when facing cues such as food pictures that imply hedonic value, external eaters tend to give higher evaluations than others (Brignell, et al., 2009). Since external eaters are sensitive to hedonic cues, we expect that their food-related judgment is also sensitive to food package color, especially red, because red is particularly associated with hedonic experience, as opposed to blue and green. Being exposed to red-colored packages, external eaters' attentions are allocated to process the information related to sensory pleasure and thus they may have a higher expectation on the palatability of food than individuals who are not characterized by external eating. On the other hand, packages with green or blue are associated with healthiness, and palatability is considered less relevant compared with red packages. Therefore, the differences between external eaters and others shall be less salient when confronted with green and blue packaged products. Referring to the exhibitions in Figure 1, we hypothesize that:

- H₄:** The individual propensity of external eating moderates the impact of package color on the perception of sweetness and healthiness perception. Such moderating effects are particularly more salient for red than green and blue package colors. Specifically,
- H_{4a}:** The impact of package color on the perception of sweetness is stronger for high external eaters than for low external eaters.
- H_{4b}:** The effect of package color on healthiness perception manifests stronger for high external eaters than for low external eaters.

METHODOLOGY

Participants

The participants of this study were undergraduate students recruited from a major North American university. They visited a computer lab on campus, where they looked at pictures of hypothetical food product package designs, and then answered questions regarding

their perceptions and expectations of the food contained in the packages. A course credit was offered as compensation for their participation. In a questionnaire, each participant was asked to indicate whether or not he/she has been diagnosed with color blindness or a color-related vision deficiency. According to their self-reported color blindness status, the responses of 40 participants who were not colorblind were included in the data analyses. Among the 40 participants, 22 of them were female, 16 of them were male, and two participants did not disclose their gender. All participants were aged from 19 to 24 (mean=21.32, SD=1.19).

Procedure and Measurements

To examine the package color effects, this study employed a 4 (products: breakfast cereal, ice-cream, iced tea, and yogurt) × 3 (package colors: red, blue, and green) × 2 (external eating: high vs. low) mixed design. The first two factors were within-subject repeated measures. Each of the 40 participants was exposed to 12 package stimuli combinations. Therefore, the total number of observations was 480 in this study (i.e., 12 package stimuli × 40 participants). The last is a between-subject factor. That is, the 40 participants were categorized into two groups by median splitting their external eating scores.

The stimuli in this study were pictures of 12 food/beverage packages (see the examples in the Appendix), which were all designed by a professional graphic designer. There were four products: breakfast cereal, yogurt, ice-cream and iced tea. Each product had three package designs with different dominant colors that covered over 90% of the area of the packages' principle display panels. The dominant package color used for each design was red (Hue: 0°), green (Hue: 120°) or blue (Hue: 240°), and all the colors printed on the packages were solid with 100% saturation and brightness.

The designer was instructed to follow the FDA food-labelling guide for the principle display panel and to use package shapes that were commonly used in the North American marketplace. All the packages carried a hypothetical brand name, "BISSEN" (i.e., "bite" in German), printed in the same font and

size. No participants indicated that they could read German. In the principle display panel, all the packages were also labeled with a product name and product volume/weight (e.g., cereal, 345 grams; yogurt, 100 grams; ice-cream, 1.66 liters; iced tea, 355 ml). The brand name, product names, and volume/weight labels were all printed in white against the dominant package color.

Upon their arrival in the lab, the participants first read the instructions and were asked to rate their feeling of hunger at that moment. Then, the pictures of packages were presented to the participants, one at each trial accompanied with one question. The package pictures were presented in the center of a computer screen against a white background, and all the computer screens used in this study were 17" LCD monitors consistently calibrated for brightness, contrast, and color temperature. To measure the participants' perceptions of the healthiness of the product contained in each package, a question was asked to have the participants indicate their "general impression of the healthiness of the contained food/beverage as compared to typical products in the same category" (anchored as 1–7: not healthy at all – very healthy). Another question asked the participants to rate their sweetness perceptions of the product contained in the package ("What do you think of the sweetness of the product compared with other products in the same category?" anchored as 1–7: not sweet at all – very sweet). Each participant was asked to answer both questions (i.e., the healthiness perception and the sweetness perception) for each of the package stimuli. Therefore, the total number of questions for each participant to answer was 24 (12 package pictures × 2 questions). These 24 questions were asked in a random order.

The external eating was assessed by using a subscale of the Dutch Eating Behavior Questionnaire (van Strien, et al., 1986). The external eating scale is a ten-item measurement (anchored from 1 to 5, Cronbach's Alpha = 0.82) asking the participants to indicate their sensitivities to external food cues, such as the smell and sight of food. There was no gender difference found in the external eating score ($p > 0.4$). The participants were identified as high external or low external eaters on the basis

of a median split on their external eating scores (median: 3.5; low external eating group: $n = 21$; high external eating group: $n = 19$). At the end of the study, the participants were further asked to provide demographic information, including age, gender, language spoken at home, current dieting habits, and color blindness status. In all of the following analyses, effects of age, gender, or cultural background were found not significant, hence were excluded from the models reported in this paper.

RESULTS

In two separate analyses, the 40 participants' perceptions of sweetness and their healthiness perceptions on each of the 12 package stimuli were explained by a mixed model with repeated measures based on 480 observations in total. In this mixed model, the factors (i.e., fixed effects) included package colors (within-subject, 3-level: red, green and blue), and products (within-subject, 4-level: breakfast cereal, iced tea, ice cream, and yogurt), external eating (between-subject, high versus low external eaters), and all their two- and three-way interactions. Hunger feeling was a control variable (i.e., covariate), and its two-way interactions with external eating and color, as well as a three-way interaction of hunger feeling by external eating by color were also included in this model. As per the nature of repeated measures, a random intercept (i.e., variance of subject means) was included in this mixed model to control for the individual differences. Additionally, this model assumed the individual participant would have different preferences to the food products. Hence a random effect (i.e., product) was specified in the model as well. Furthermore, this model employed the "variance components" as its covariance structure with distinct variance components. In other words, the random intercept and the random product effect were estimated with no correlations. All the comparisons between group and marginal means were Bonferroni adjusted.

Sweetness Perception

To predict the participants' sweetness perceptions on the products, the main effect of package color ($F(2,284) = 8.56, p < 0.001$) was significant. In line with H_1 , the post-hoc comparisons revealed that the products

contained in the red packages were perceived as sweeter than those in the blue ($t(284)=7.56, p<0.001$) and green ($t(284)=7.36, p<0.001$) packages, and the latter two package colors were not significantly different in the associated sweetness perceptions. The main effect of the product itself was significant ($F(3,108)=7.92, p<0.001$), but as indicated by a non-significant interaction effect between product and package color ($p>0.3$), the effect of package color was not manifested differently across the four products (See Table 1).

The main effect of the external eating group was not significant in predicting the sweetness perception ($p>0.1$), but the interaction between the external eating group and the package color was significant ($F(2,284)=3.73, p=0.03$), which indicated that the difference between high and low external groups in terms of the sweetness perception was influenced differently by different package colors. The post-hoc group mean comparison supported the proposition of H_{4a} . That is, high external eaters were particularly sensitive to red package color but not to blue and green. As Figure 2 indicates, for red packaged products, high external eaters reported higher sweetness perceptions than low external eaters (estimated difference=0.55, $SD=0.27; p=0.05$). On the other hand, the comparison of sweetness perception between high and low external eaters was not significant for blue (est. diff.=0.01; $p=0.9$) and green colored packaged products (est. diff.=

0.13; $p>0.6$). The three-way interaction between color, product and external eating groups was not significant ($p>0.7$).

Healthiness Perception

In term of the healthiness perception, the main effect of package color was significant ($F(2,284)=10.87, p<0.001$). The multiple comparisons between marginal means were consistent with H_2 . Compared to products packaged in red packages, products in blue ($t(284)=5.22, p<0.001$) and green ($t(284)=4.73, p<0.001$) packages were perceived as healthier; and the difference for blue and green packages was not significant ($p=0.9$). This result indicates that blue and green packages were closely associated with healthy product perception. The main effect of the product itself was significant ($F(3,108)=9.85, p<0.001$), but the interaction between product and package color was not significant ($p>0.9$), which suggested that the effect of package color on healthiness perception was the same across different products (See Table 2).

As for predicting the healthiness perception of products, the main effect of the external eating group was not significant ($p>0.4$). Supporting H_{4b} , a significant interaction effect between the external eating group and package color ($F(2,284)=6.00, p=0.003$) indicates that the difference between high versus low external groups in healthiness perception was

TABLE 1:
The Mean (S.D.) of Sweetness Perceptions of Food Products
Contained in Packages with Different Colors

<i>Products</i>	Package Color		
	<u>Blue</u>	<u>Green</u>	<u>Red</u>
<i>Cereal</i>	3.92 (1.24) ^{ab}	3.71 (1.25) ^a	4.45 (1.33) ^b
<i>Ice-cream</i>	4.37 (1.75) ^a	4.21 (1.73) ^a	5.47 (1.27) ^b
<i>Iced tea</i>	4.11 (1.62) ^a	4.16 (1.52) ^a	5.24 (1.22) ^b
<i>Yogurt</i>	3.21 (1.30) ^a	3.63 (1.20) ^a	4.42 (1.33) ^b

Note: Within each row, the superscript letter of means indicates the result of multiple comparisons between estimated marginal means (Bonferroni); Means with same superscript letter were not significantly different (at $p<0.05$).

FIGURE 2:
The Mean Sweetness Perceptions of Food Products Contained in Packages with Different Colors, Separate for High and Low External Eating Groups

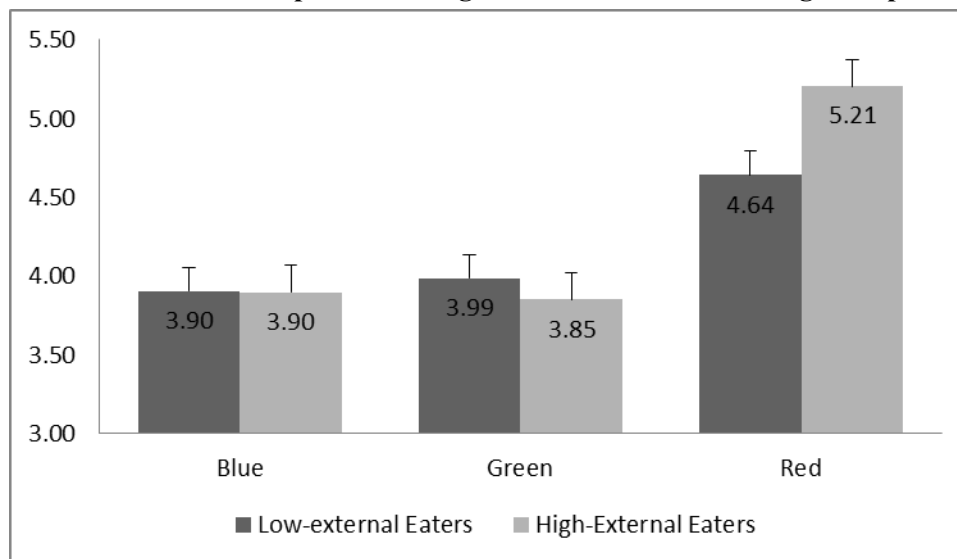


TABLE 2:
The Mean (S.D.) of Healthiness Perception of Food Products Contained in Packages with Different Colors

<i>Products</i>	Package Color		
	<u>Blue</u>	<u>Green</u>	<u>Red</u>
<i>Cereal *</i>	4.50 (1.27) ^a	4.47 (1.41) ^{ab}	3.92 (1.34) ^b
<i>Ice-cream</i>	3.89 (1.47) ^a	3.89 (1.35) ^a	3.26 (1.35) ^b
<i>Iced tea</i>	4.08 (1.12) ^a	4.13 (1.32) ^a	3.47 (0.98) ^b
<i>Yogurt</i>	5.08 (1.42) ^a	4.87 (1.28) ^{ab}	4.37 (1.30) ^b

Note: Within each row, the superscript letter of means indicates the result of multiple comparisons between estimated marginal means (Bonferroni); Means with same superscript letter were not significantly different (at $p < 0.05$).

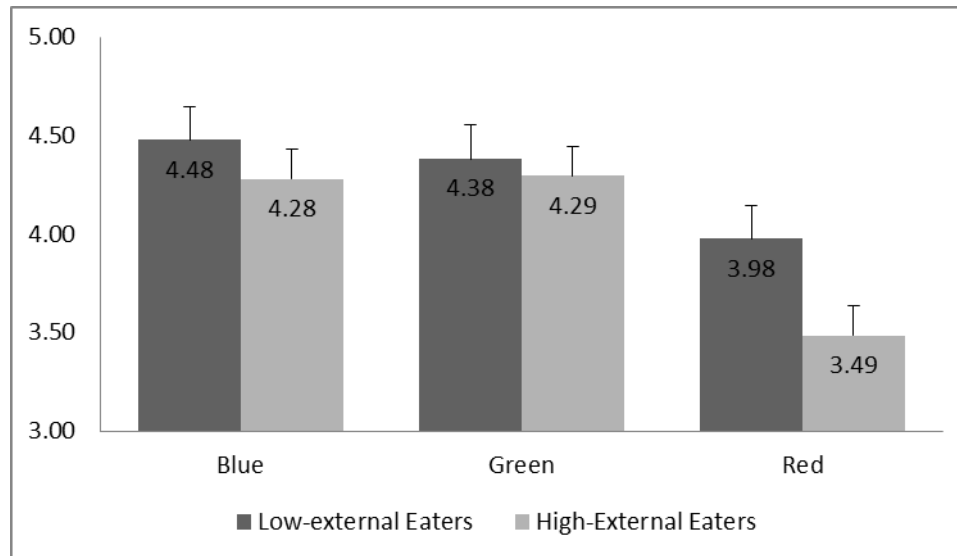
* For cereal products, the group mean comparisons between red and blue packages was marginally significant at $p = 0.06$

particularly salient for red packaged products but not for blue and green packaged foods. Figure 3 illustrates that, among red packaged products, high external eaters reported lower healthiness perception than low external eaters (est. diff. = -0.44; $p = 0.05$), whereas such a difference was not significant for blue (est. diff. = -0.21; $p > 0.3$) or green colored (est. diff. = -0.10; $p > 0.6$) packages. The three-way interactions among color, product and external eating groups were not significant ($p > 0.6$).

Mediating Effect of Sweetness Perception

To explore the mediating effect of the sweetness perception on the relationship between package color and healthiness perception (H_3), we followed the mediating analysis procedures proposed by Baron and Kenny (1986). Specifically, based on the results presented in the previous sections, the analysis of the effect of package color on the sweetness perception indicated that red was associated

FIGURE 3:
The Mean Healthiness Perception of Food Products Contained in Packages with Different Colors, Separate for High and Low External Eating Groups



with a sweeter taste perception (H_1), while blue and green package colors were associated with a healthier product perception (H_2). To further examine the mediating role of sweetness perception, two additional analyses were conducted. Figure 4 and Table 3 summarize the hypotheses testing and results.

In the first analysis, the healthiness perception was predicted by the sweetness perception (covariate), product (4-level within-subject factor) and the interaction in a mixed model for repeated measures. The results reveal a negative relationship between the sweetness perception and the healthiness perception. Products expected to be sweeter were perceived as less healthy ($b=-0.50$, $t(446)=7.06$, $p<0.001$), and no other effect was found significant. This analysis indicates that there was a direct, negative association between the sweetness perception and the healthiness perception.

The second analysis employed a mixed model for repeated measures to explain the healthiness perception. This model included package color, products, and external eating group as fixed factors, as well as their two- and three-way interactions. The sweetness perception was included as a covariate, and hunger feeling was also controlled in the model. The results indicate that the only significant effect was the

sweetness perception ($b=-0.47$, $t(415)=6.01$, $p<0.001$) whereas package color was not significant ($p=0.48$). This result suggests that while package color had significant (indirect) influence on the healthiness perception, such an effect was not significant after the sweetness perception was controlled, which indicated a mediating role of the sweetness perception.

DISCUSSION AND IMPLICATIONS

While research in marketing, psychology and food science has consistently associated food color with food-related perceptions, such as perceived flavor (Christensen, 1985; Garber, Hyatt, & Starr, 2000; Stillman, 1993), taste evaluation (Hoegg & Alba, 2007), and food liking or preference (Christensen, 1985; Compeau, Grewal, & Monroe, 1998), to date the influence of package color on taste and healthiness perception of food, has not been studied in depth. With the examination of how warm versus cool food package colors influence the perceptions of taste, one major contribution of this study is to start closing this gap in the literature by suggesting that the association between package color and food tastes is similar to the association between food color and tastes (e.g., sweetness). Furthermore, the results of the present study provide the empirical evidence showing that the food

TABLE 3:
The Summary Results of Tested Models

Dependent Variables: <i>Independent Variables</i>	<u>Perception of Sweetness</u>	<u>Healthiness Perception</u>	<u>Healthiness Perception</u>	
			Analysis 1	Analysis 2
<i>Product</i>	F(3,108)=7.92*	F(3,108)=9.85*	F(3,416)=0.8	F(3,379)=0.29
<i>Color</i>	F(2,284)=8.56*	F(2,284)=10.87*	-	F(2,301)=0.73
<i>Product * Color</i>	F(6,284)=1.15	F(6,284)=0.13	-	F(6,301)=0.20
<i>External Eating (EE)</i>	F(1,34)=2.83	F(1,34)=0.61	-	F(1,34)=0.11
<i>Color * EE</i>	F(2,284)=3.73*	F(2,284)=6.00*	-	F(2,288)=0.04
<i>Product * EE</i>	F(3,108)=0.40	F(3,108)=0.05	-	F(3,107)=0.35
<i>Product * Colour * EE</i>	F(6,284)=0.67	F(6,284)=0.69	-	F(6,288)=1.50
<i>Hungry</i>	F(1,34)=0.03	F(1,34)=0.59	-	F(1,34)=0.69
<i>EE * Hungry</i>	F(1,34)=4.18**	F(1,34)=1.84	-	F(1,34)=0.02
<i>Perception of Sweetness</i>	-	-	F(1,456)=212.7*	F(1,419)=176.41*
<i>Sweetness * Product</i>	-	-	F(3,449)=0.3	F(3,403)=0.29

* Significant at $p < 0.01$; ** significant at $p < 0.05$

product healthiness judgment is often influenced by factors beyond cognitive information. We argue that food choices and decisions result from a compound set of interwoven internal and external factors. Our results suggest that package color, an external cue that does not reveal any nutritional facts, can influence cognitive judgment of food product healthiness.

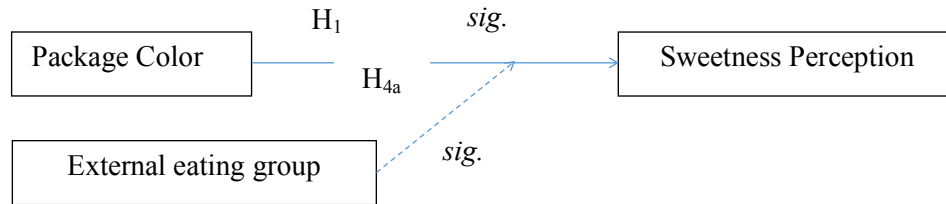
The food color research suggests that color influences people’s perception of taste intensity (Johnson & Clydesdale, 1982) and this study demonstrates that the color-taste association may further influence the perception of food healthiness. For all the products included in this study, red packages were associated with a less healthy perception than green and blue packages, whereas green and blue packages were tied to healthier food perception. Interestingly enough, the mediating analysis in this study provides an explanation that food in

red packages is perceived sweeter than food in other package colors, and sweetness is often intuitively related to the expectation of unhealthy food (Raghunathan, et al., 2006). As a result, red packaged food was perceived as sweeter taste but unhealthy.

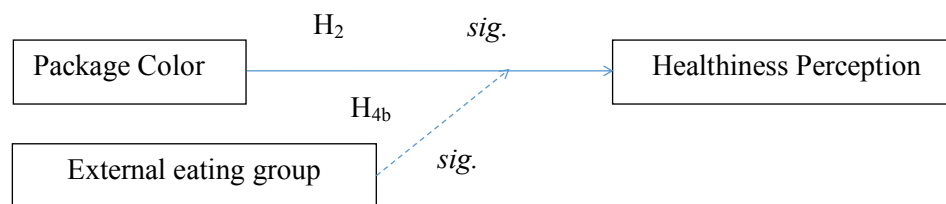
Comparing red with green or blue packaged foods, we find that high external eaters perceived sweeter taste and less healthiness for red packages than did low external eaters. Over the past decade, an increased focus on individual differences has been a noticeable characteristic of behavioral decision research that relates to psychosocial variables such as motivational, cognitive and affective processes. The existing research mainly focuses on demonstrating the attention biases to food related cues among external eaters, and such biases subsequently lead to overeating as compared with non-external eaters (Brignell, et al., 2009; van Strien, Herman, & Verheijden,

FIGURE 4:
Summary of Hypotheses and Test Results

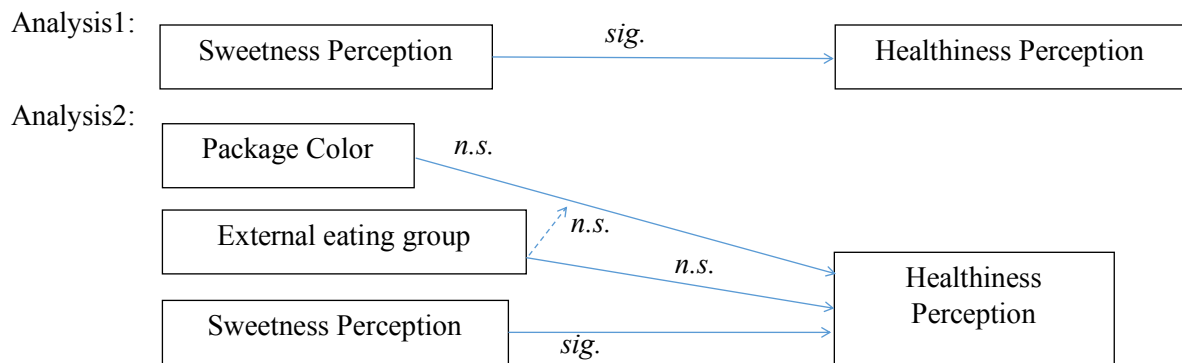
Panel-A: H₁ and H_{4a} - Package color and external eating group predict sweetness perception.



Panel-B: H₂ and H_{4b} - Package color and external eating group predict healthiness perceptions.



Panel-C (H₃): Analysis1 – Sweetness perception predicts healthiness perception; Anlysis2 - Package color, external eating group, and sweetness perception predict healthiness perceptions.



Note: In all these testing models, although “product” was also included as a within-subject factor, the between-product difference was not a focal effect to be tested. As a result, it is not included in this figure. sig.: the relationship was significant (p<0.05); n.s.: the relationship was not significant; dashed lines indicate the moderating effects.

2009). This study reveals that external eaters may interpret the external stimuli, such as package color differently, such that their attentional biases to the sensory cues further “amplify” the effect of external cues (e.g., red) on hedonic value inference (e.g., sweetness taste), which may lead to maladaptive eating patterns. Our study has exhibited a pattern that external eating moderated the effect of package color on hedonic evaluation. That is, confronted with red packaged foods, high external eaters

perceived sweeter taste than did low external eaters.

Another contribution of this research results from highlighting the complex reasons why certain external eaters perceive certain package colors (e.g. red) as less healthy than others. Such differences likely arise from the fact that high external eaters are more sensitive to attentional biases to hedonic value, and this may lead to the opinion or prejudgment of

product healthiness based on the interpretation of the package color. Red is perceived sweeter taste by high rather than low external eaters on account of the different intensity of hedonic value derived from food consumption.

Color affects the human mind and body in various ways. These influences suggest that certain colors appeal to us while others repel us. The use of color in and of itself is not an assurance of success, and an in-depth understanding of psychological reactions to package color is of scientific and empirical interest. From the consumer perspective, the current study has implications for understanding individual differences in cognitive-behavioral responses to an important external food cue, namely, package color. The present findings can be particularly relevant in situations where consumers have different goals in food choices, such as pleasure seeking and/or healthy consumption. Individuals with such different goals present different sensitivities in the perception of sweetness taste and healthiness based on their interpretation of the package color. This mechanism underlies not only the ability to balance cognitive and behavioral responses to motivationally salient stimuli more generally but also, more specifically, cognitive-behavioral responses to food in terms of both sweetness taste and healthiness.

Managerial Implications

First, the current research has significant managerial implications for food manufacturers. Taste and healthiness perceptions are two important attributes that influence consumers' food choice and consumption. Our research findings suggest that the package color is a critical marketing cue about the taste and healthiness perceptions of food products at the point of purchase. Keeping up with the trend of healthiness consumptions, the front-of-package of food products is often cluttered with cognitive information, such as health benefit claims, nutrition content claims, various certificates (e.g., organic, natural, and non-GMO), and other textual descriptions. However, consumers may misinterpret, mistrust, or simply ignore these hard-to-process cluttered messages (Keller et al., 1997; Walters & Long, 2012)

since a particular product category display typically has, on average, less than a 12-second window in front of the consumer in a retailing environment (Dickson & Sawyer, 1990). The results of this study demonstrated that package color, as a visual marketing cue, might work through an affective or peripheral route to communicate the key information with consumers. Specifically, the associations of "red = tasty" and "blue/green = healthy" revealed in our study have provided an evidence-based guidelines for package design aligning messages relating to product attributes with visual appearance.

Second, the findings of our study highlight that using warm/cold colors to suggest taste/healthiness perceptions of food products should be applied with caution in developing marketing competition strategies. Although the mediating effect of taste on the relationship between package color and healthiness perception in our study is consistent with consumers' intuition of "unhealthy = tasty" (Raghunathan, et al., 2006), blue or green packaging may imply that the product is superior to the health-related attributes while they may not be able to compete with red packaging in the perceived taste dimension. In order to build effective and competitive marketing strategies, marketers may need to integrate such tactics as sampling and opinion leaders' endorsement on taste to compensate the negative impact of blue/green packages on the hedonic attributes. It is important to trigger and reinforce as many senses and symbolic meanings as possible since food has the advantage of evoking taste, smell, memories and feelings.

Finally, the empirical results of this research can benefit brand positioning and/or repositioning strategies. Given that many less healthy products in the marketplace are packaged in warm colored packages to stimulate consumption, our results suggest that external eaters may be particularly vulnerable to such stimuli. Going beyond the package, fast food industry has also shown the effective usage of red as an environmental cue. For example, red is intensively used by McDonald's and Burger King in their wrapping papers, food trays, logos, and restaurant decorations to stimulate consumption, as red arouses the taste buds and induces the appetite (Reutner et al., 2015).

Nowadays more and more managers, however, have started to work on improving or changing the unhealthy brand image of this industry. Furthermore, the fast food industry is also undergoing a transition by reducing fat/sugar/sodium contents in their food on the menus, adopting healthier food processing methods, and offering healthier alternatives in their product lines. Along with such industrial trends, another implication of the current research is that the managers who are repositioning the fast food restaurants as less unhealthy may need to strategically reassess the color scheme of the corporate visual identity in terms of logos, architectural elements, product packages, and other environmental cues to be consistent with the new corporate image that they are trying to build.

Limitations and Future Research

Collectively, our findings contribute to the emerging literature on how extrinsic variables can influence food perception emphasizing that this effect is dependent on the specific package color presented, and that results in real life scenarios can be somewhat lessened as compared to laboratory conditions. Undoubtedly, more research is needed to confirm the validity and robustness of such results. Looking ahead, it might be possible to adopt the amount of actual food consumption as one of the dependent measures. This experiment asked the participants to answer two questions regarding each of the 12 package stimuli, which may have caused some of the participants to feel tedious during the study. To avoid having the participants repeatedly answer the same question too many times, future large-scale studies may adopt a between-subject design and assign the participants into different color conditions. Finally, the experimental study reported here utilized relatively small convenience samples of college students from a North American university. The use of such participants may limit the generalizability of these results. Future research may fruitfully explore whether these effects can be replicated among other populations.

American consumers tend to over consume foods perceived as unhealthy because they spontaneously and sometimes unconsciously consider that such foods taste better than

healthy food (Raghunathan, et al., 2006). However, a recent study (Werle, Trendel, & Ardito, 2013) argues that the assumption that unhealthy food tastes better may be true only for consumers in the U.S.A., because the results from their studies demonstrate an opposite intuition that exists in France: unhealthy food is implicitly associated with bad taste while healthy food is linked to tastiness. In addition to the explanation of intercultural differences between American and French consumers, another critical influence on the individual's food healthiness perception may be the cultural meanings of colors. Thus, we suggest future studies extend the analysis to consider different cultural backgrounds and scenarios so as to analyze changes in the perception of one particular package color of the same food category depending on the regions where it is marketed.

Finally, the stimuli used in this research are naturally linked to one dimension of taste, sweetness. Future research can examine the impact of other aspects of taste, such as salty flavor, on the health perception. Although the findings from this research are consistent with the literature that green or blue packages signalize healthy and less sweet taste while red packages represent tasty and less healthy alternatives, marketers have also provided exceptions in the use of blue or green packages, such as Oreos, Apple Jacks, etc. Therefore, future research may employ other categories of food for examination to increase the face validity of the current research.

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APPENDIX:
Package Picture Stimuli Examples Presented in the Study



The colors used for the package design: Red (Hue: 0°), Green (Hue: 120°) and Blue (Hue: 240°). All the colors were with 100% saturation and brightness.