Healthful Food Decision Making in Response to Traffic Light Color-Coded Nutrition Labeling

Joerg Koenigstorfer, Andrea Groeppel-Klein, and Friederike Kamm

This article investigates whether traffic light color-coded nutrition information helps low- (vs. high-) self-control consumers make more healthful food choices within a given product category. Two in-store lab studies assess the effects of traffic light colors. The colors indicate low (green), medium (amber), and high (red) levels of four negative food nutrients (sugar, fat, saturated fat, and salt). The color-coding was implemented on nutrition labeling schemes shown on the front of actual food packages (pasta meals in Study 1; cereal bars in Study 2). Consumers with low self-control to resist food temptations, but not those with high self-control, make more healthful food choices in response to the color-coded labeling. The behavior is congruent with their long-term goals of controlling their food choices and is evident when traffic light colors vary between both nutrients and products (Study 1) and when traffic light colors vary between nutrients but not products (Study 2). The authors derive theoretical implications and draw conclusions from the perspectives of public policy, retailing, and manufacturers.

Keywords: nutrition labeling, traffic light colors, in-store decision making, self-control, food packaging

Consumers often struggle to resist unhealthful food temptations. The ability to resist (food) temptations that provide immediate rewards is referred to as consumer self-control. Low-self-control consumers are more likely to be overweight or obese and less likely to lose weight successfully (Crescioni et al. 2011). Being overweight and obese, in turn, are significant determinants of negative health outcomes (World Health Organization [WHO] 2000). Public policy makers are therefore in search of strategies that halt the increasing prevalence of overweight conditions and obesity, and nutrition labeling is one such strategy.

However, previous attempts to inform consumers about the nutrient content of packaged food items, such as nutrition signposts or back-of-pack labeling, have been sobering (Achabal et al. 1987; Balasubramanian and Cole 2002). Consumers in general—and low-self-control consumers in particular—do not make more healthful food choices in response to these strategies (Hassan, Shiu, and Michaelidou 2010). This finding may be explained by two factors: (1) the low salience of nutrition information on the back of the package when consumers make food decisions (Grunert and Wills 2007) and (2) the lack of guidance regarding how to interpret nutrition information (Hodgkins et al. 2012).

This study examines traffic light color-coded front-of-pack labels and their potential to alter in-store consumer behavior. The colors attract consumer attention (Jones and Richardson 2007) and have been learned in traffic contexts (Bargh 1992); the color red (green), which signals unfavorable (favorable) nutrient levels, may therefore help consumers select more healthful food options. The mechanism may be of particular help to consumers with low self-control because the coloring makes self-control conflicts salient when they make food choices.

The goal of this article is to determine whether low- (vs. high-) self-control consumers make more healthful in-store food decisions if traffic light colors are implemented on front-of-pack nutrition labels. This research contributes to self-control theory in the domain of eating by showing that traffic light–colored nutrition labeling counteracts the tendency of low-self-control consumers to choose unhealthful food within a certain product category (Vohs 2006; Vohs and Heatherton 2000). The color primes can be easily implemented on the packaging. Public policy makers can recommend the use of traffic light–colored front-of-pack

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ISSN: 0743-9156 (print), 1547-7207 (electronic)

nutrition labels to help low-self-control consumers make more healthful in-store food choices.

Front-of-Pack Nutrition Labeling

Political, legal, and physical regulations are put in place to enable consumers to make more healthful food decisions, thereby counteracting the increasing prevalence of overweight conditions and obesity (Popkin, Duffey, and Gordon-Larsen 2005; WHO 2004). Nutrition labeling is considered an instrument useful for attaining this goal. One advantage of front-of-pack nutrition labels (vs. the Nutrition Facts Panel, which is typically provided on the back of packages) is that they receive more attention when consumers choose food items that are displayed on shelves, as is the case in supermarkets (Visschers, Hess, and Siegrist 2010). However, there is still uncertainty about the effectiveness of this strategy (Hersey et al. 2013). Although a large percentage of consumers report the use of nutrition information at the point of purchase (61% worldwide according to ACNielsen [2008]; 70% of U.S. consumers according to Nayga, Lipinski, and Savur [1998]), its actual use and impact on behavioral decisions—when socially desirable responses are minimized—may be overstated (Cowburn and Stockley 2005; Grunert and Wills 2007). For example, Grunert, Wills, and Fernández-Celemín (2010) report that only approximately 27% of consumers used nutrition information when making real product choices in supermarket environments.

A variety of front-of-pack nutrition labels can be found on food packages: nutrient tables, health symbols, health claims, nutrient claims, Guideline Daily Amount (GDA) systems, retailer- and brand-specific systems, and combinations of these systems (Storcksdieck genannt Bonsmann et al. 2010). In the United States, more front-of-pack nutrition labels have appeared, health symbols being the most prevalent system (Andrews, Burton, and Kees 2011). Among member countries of the European Union, front-of-pack nutrition labeling can be found on an estimated country-based average of 49% of processed food products (Storcksdieck genannt Bonsmann et al. 2010). The subject of current debate is which form of nutrition labeling is most effective (Aschemann-Witzel et al. 2013; Bialkova and Van Trijp 2010; Feunekes et al. 2008; Food Standards Agency [FSA] 2009a; Grunert and Wills 2007; Kelly et al. 2009; Van Herpen and Van Trijp 2011).

This study examines traffic light color-coded nutrition labels because colors, in particular the color red, are environmental primes that affect actual consumer behavior in the food domain (Genschow, Reutner, and Wänke 2012). Traffic light–colored nutrition labels use the colors green, amber, and red on the package to signal that a food contains low, medium, or high amounts of particular negative nutrients and may therefore be consumed regularly (green), most of the time (amber), or only occasionally (red). In the United Kingdom, the FSA developed the multiple–traffic light system using cutoff values established by the Commission of the European Communities (2006). Colors typically refer to the four negative nutrients that are of greatest health significance (WHO 2004): sugars, fat, saturated fat, and salt. In some cases, information is also provided about energy content.

In the current research, we develop a theoretical framework of how consumers react to traffic light–colored nutrition labeling. The framework focuses on actual consumer decision making and postulates that consumer self-control moderates the effect of traffic light color codes. The colors may prime "stop" (in the case of red) and "go" (in the case of green) meanings and thus interfere with low- (vs. high-) self-control consumers' motives (Mehta and Zhu 2009)—a situation from which low-self-control consumers may profit when encountering unhealthful food within a given product category at the supermarket.

Literature Review and Theoretical Framework

In-Store Food Decision Making in Response to Traffic Light–Colored Nutrition Labeling

Due to the difficulties of getting access to real-life supermarkets, previous studies have examined the influence of traffic light colors on nutrition labels on antecedents of choice behavior. The results of these studies indicate that traffic light colors may increase visual attention to nutrition labeling, preference for and liking of the labels, explicit understanding of nutrition information, intentions to purchase more healthful options, and product attitudes (Andrews, Burton, and Kees 2011; Borgmeier and Westenhoefer 2009; Feunekes et al. 2008; FSA 2009a; Gorton et al. 2008; Jones and Richardson 2007; Kelly et al. 2009; Maubach and Hoek 2008; McLean, Hoek, and Hedderley 2012; Roberto et al. 2012; Van Herpen and Van Trijp 2011).

However, consumer studies often find attitude–behavior and intention–behavior discrepancies, particularly when health topics become accessible in memory during the studies (Chandon, Morwitz, and Reinartz 2005). Therefore, the generalizability of the results to actual decision making at the point of purchase (i.e., in supermarkets) may be questioned. Recent reviews have supported this view and state that there is uncertainty about the effects of front-of-pack nutrition labeling on the healthfulness of actual in-store food choices (with respect to both food purchases within and between food categories). In addition, they note that more research is needed to determine the effects of front-of-pack nutrition labeling on actual consumer decision making at the point of purchase (Grunert and Wills 2007; Hersey et al. 2013). Grunert et al. (2010, p. 276) conclude that "the final question of whether [front-of-pack] nutrition labelling does increase the proportion of healthy choices in the store still remains unanswered."

Two field studies observing actual sales figures—a study in a U.K. grocery store (Sacks, Rayner, and Swinburn 2009) and a study with an online grocery store in Australia (Sacks et al. 2011)—have found that the multiple–traffic light system, when it was newly introduced, had no effect on the healthfulness of consumers' product choices. However, these studies did not control for changes in the design of the packaging and the nutrient composition of the foods (i.e., takeout sandwiches and ready-to-go meals in the United Kingdom; milk, bread, cereals, cookies, and frozen meals in Australia) and did not label all products within a category. Moreover, the studies did not take into account psychographics, which may explain consumers' reactions to the multiple–traffic light system.

We postulate that consumer self-control may determine how consumers respond to traffic light color-coded front-of-pack nutrition labels in terms of actual food decision making. The point of purchase represents an environment in which consumers make choices from real products; research has shown the actionability of this mode of presentation (vs. picture presentation, as used in most of the aforementioned studies) to trigger self-control strategies in response to food temptations (Geyskens et al. 2008). Therefore, our theoretical framework positions self-control as a moderating variable influencing consumers' actual food decision making.

Theoretical Framework

Our framework proposes that self-control, representing a top-down factor that describes consumers' ability to resist unhealthful foods that provide immediate rewards to them (Baumeister 2002), affects the influence of traffic light–colored front-of-pack nutrition information on the healthfulness of in-store decisions. In this subsection, we first provide theoretical arguments about the effects of traffic light colors in general and in food contexts in particular and then argue why the presence of traffic light colors may interact with consumer self-control.

Consumers have learned the meaning of colors throughout their lives. They repeatedly encounter situations in which red—an arousing and easy-to-detect color—is accompanied by particular experiences. In many contexts, red (vs. green and other control colors) carries a negative meaning of danger, prohibition, and need for vigilance (Elliot et al. 2009; Moller, Elliot, and Maier 2009). In traffic, for example, people learn to stop in front of a red traffic light or a red-colored stop sign (Bargh 1992). In food contexts, biologists have shown that animals consider red a warning, which reduces consumption (Gamberale-Stille and Tullberg 2001). In this case, color associations are evoked through biological predispositions and enforced by learning processes. Consumer studies have replicated the priming effect of red. Genschow, Reutner, and Wänke (2012) find that red decreases people's consumption of soft drinks and snacks when presented on red-colored (vs. blue-colored) cups or plates.

The color green is less arousing than red (and yellow; Wilson 1966) and is the opposite color to red in well-established color models (Fehrman and Fehrman 2004). It represents safety (Caivano 1998) and is generally considered quieting and agreeable, leading to a withdrawal from the external world and a focus on the self (Goldstein 1942). On a general level, it is connected to growth in nature (Moller, Elliot, and Maier 2009). The meaning of the color has not yet been examined in food contexts. However, in traffic, green is associated with the meaning of "go" (Bargh 1992). Thus, we can assume that the color is associated with this meaning when presented in a traffic light color context (as part of the nutrition labeling).

With repeated exposure, the pairing of colors and experiences produces strong associations such that the mere perception of a color in a particular situation can activate the paired association. More importantly, when a color carries a specific meaning, it is presumed to function as a subtle prime (Elliot et al. 2009). Although the salience of the colors (particularly red on unhealthful foods) may not differ between consumers because of the colors' early-level processing within the perceptual system (Gegenfurtner and Kiper 2003), there are reasons to believe that the primes function differently in their effects on behavioral decision making in low- (vs. high-) self-control consumers.

Self-control efforts aim to help consumers overcome temptations in favor of long-term goals (i.e., healthful eating). However, failure of consumer self-control and resulting myopic behaviors are a common occurrence (Vohs and Heatherton 2000). Low-self-control consumers may be guided by traffic light colors because the colors prime associations that help them control their eating behavior. If they do not want to (repeatedly) indulge, they must put effort into regulating their personal states and reactions—that is, they engage in self-regulatory processes with regard to thoughts, emotions, impulsive behaviors, and performances (Baumeister 2002). Therefore, low- (vs. high-) self-control consumers should be more likely to view the coloring as an external aid and choose healthful foods within a certain category. The color red (highlighting high content of negative nutrients) primes "stop," and the color green (highlighting low content of negative nutrients) primes "go," as learned in traffic contexts, and the associations are congruent with the goal of controlling eating behavior (Fishbach and Shah 2006). Thus, low-self-control consumers should make more healthful food choices in response to the traffic light–colored nutrition labeling.

In contrast, high-self-control consumers do not have to cope with self-control dilemmas (Vohs and Heatherton 2000). They already employ decision strategies that support healthful food decision making and are not implicitly attracted to unhealthful foods (Fishbach, Friedman, and Kruglanski 2003). Therefore, a color-coding prime should not affect their in-store decision making within a given food category. On the basis of these arguments, we hypothesize that consumers with low self-control make more healthful choices when traffic light–colored nutrition labels are implemented on the front of food packages. For consumers with high self-control, we expect no differences.

Study 1

Study 1 tests our moderation hypothesis that consumers with low self-control make more healthful in-store food decisions when traffic light–colored nutrition labels are implemented on the front of real food packages, whereas high-self-control consumers do not show these tendencies. We conducted the study in a retailer's laboratory store (32,000 square feet in size and stocking 4,500 different products), which is located in the basement of a supermarket (91,000 square feet in size and stocking 80,000 different products; 5,000–6,000 shoppers per day).

Method

Participants

A total of 184 consumers who were mainly responsible for grocery shopping in their households (146 women; median age of 29 years, ranging from 16 to 70 years old) took part in the study. The median household size was three people (ranging between one and eight). The participants received

US$7 for their participation, and none had any color-vision deficiencies, which were assessed after the study ended.

Design

We applied a one-way factorial (type of nutrition labeling system: with traffic light colors [n = 91] vs. without traffic light colors [n = 93]) between-participants design. We measured the moderator consumer self-control on a continuous scale.

Materials

We chose six products of the category pasta meals as stimuli. The products were displayed at eye level in a single row and in random order on a supermarket shelf without any price tags. To keep the size of the front surface of the packages (3.7 × 8.7 inches), the picture–text position and ratio, and most of the coloring on the packaging constant, we chose six Mirácoli food products. The products were similar in appearance except for the flavor (see Appendix A, Panel A). We chose pasta meals because they are foods that are often served in combination with sauces that are considered more or less healthful depending on certain ingredients (e.g., tomatoes [perceived as dietary permitted], cream or ground beef [perceived as dietary forbidden]; Knight and Boland 1989). The nutrient profiles of the products indicated different degrees of healthfulness. The calorie content ranged between 310 kcal and 580 kcal per portion (between 95 kcal and 210 kcal per quarter pound).

In accordance with the experimental condition, nutrition labels (1.8 × .9 inches) were implemented on the real packaging at a consistent position (bottom right) through computer artwork. The GDA system, which provides the amount of nutrients and percent daily values (referring to daily reference values based on a caloric intake of 2,000 kcal), was used as the basis for the nutrition label in both experimental conditions because it is the most prevalent nutrition labeling scheme in Germany (i.e., the country where the research was conducted; Storcksdieck genannt Bonsmann et al. 2010). In the condition without color-coding, the nutrition label showed the numeric GDA nutrition information with respect to calorie content, sugar, fat, saturated fat, and salt only (see Appendix A, Panel B). In the traffic light–colored nutrition labeling condition, the four negative nutrients displayed on the label were depicted with a background coloring. To determine the nutrient-specific color-coding, we used the cutoff values suggested by the FSA (2009b). Referring to each of the product's nutrient profiles, the least (most) healthful food product showed three macronutrients labeled red (green) with a counterbalanced decrease in the red (green) coloring of the nutrient levels from less healthful to more healthful products (and vice versa; see Appendix A, Panel A).

Procedure

Consumers were recruited immediately after entering the supermarket (21% success rate). The recruitment took place on weekdays from 9 A.M. to 6 P.M. Consumers were informed that the study was about their orientation behavior in a supermarket environment. None of the consumers were aware of the real purpose of the study to avoid priming and socially desirable responses. Before consumers entered the laboratory store, we obtained informed consent (about their participation) from them. Next, participants received a shopping list with four products on it to simulate a buying episode, from which the first three products were included to bring participants into the mode of shopping. Participants were told that we were interested in how they orient when searching for these products (one cereal, one packet of cookies, one ready meal, and one Mirácoli pasta meal). They were asked to buy one product of their choice each in the respective order. The first three filler products were displayed on separate shelves in the store and none of the labeling systems under consideration appeared on them, while the Mirácoli products appeared on a shelf at the very end of the store. The participants were given a shopping basket and were told that they should behave as they normally would. After the shopping trip, a personal interview was conducted, and the participants were fully debriefed.

Measures

Expert ratings assessed the healthfulness of the product choice. We asked professional dieticians who worked as applied nutritional counselors to fill out a survey about their perceptions of the healthfulness of various foods, including the products of interest. One hundred sixty-two dieticians agreed to participate. A 20-point rating scale was applied (1 = "very healthful," and 20 = "very unhealthful"). The six products were rated according to the following question: "In your personal opinion, how healthful is this product when compared with other foods available in the pasta meal category?" To analyze whether the traffic light colors influenced their ratings, the dieticians were randomly assigned to either a condition with a picture of the front of the packages and an enlarged traffic light color-coded GDA system next to the picture or a condition with the packages and an enlarged GDA system without traffic light background colors. The colors had no effects on the evaluations of each of the products (*p*s > .42, not significant [n.s.]). Thus, the nutrition experts were not affected in their evaluations by the coloring of the labeling system, and the sample was aggregated for the following analyses. A repeated-measure analysis of variance revealed that the products differed in healthfulness perceptions ($F(5, 805) = 173.02$, $p < .001$, $\eta^2 = .518$). Pairwise Bonferroni comparisons indicated that all products (except for one pairing) differed significantly (*p*s < .01) from each other in the following order (from most healthful to least healthful, in accordance to what was expected from the color-coding): Tomato Sauce (M = 9.38, SD = 4.17), Arrabbiata (M = 10.02, SD = 4.07), Tomato Mozzarella (M = 11.91, SD = 3.70), Bolognese (M = 13.62, SD = 3.70), Cheese & Herbs (M = 14.12, SD = 3.53), and Carbonara (M = 14.40, SD = 3.51; $p = .34$, n.s., compared with the previous product). We used the reported means as the dependent variable in the following analyses.

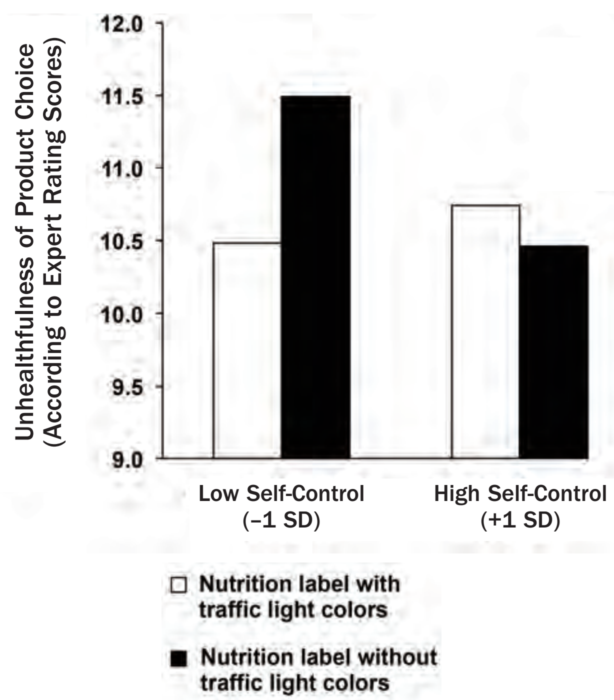
We measured self-control with the following four items adopted from Giner-Sorolla (2001) and fit to the context of the study: "I display a lot of self-control when it comes to healthful eating," "I am able to easily ignore the short-term rewards of tasty food," "I tend to indulge more than I should," and "I often wish I could get myself to avoid food indulgences more often." The latter two items were reversecoded (α = .72) on a seven-point rating scale where 1 = "strongly disagree" (low self-control) and 7 = "strongly agree" (high self-control). Confounding variables include the familiarity with the presented nutrition labeling system (one-item, five-point rating scale; 1 = "very unfamiliar," and 5 = "very familiar") and the unhealthfulness of the product choices from the three filler products in the shopping task (according to their SSAg/1 scores, a measure for interbrand and intercategory comparisons based on nutrient profiles; Rayner, Scarborough, and Stockley 2004). Both variables have been related to healthful food decision making (Bialkova and Van Trijp 2010; Dhar and Simonson 1999). Familiarity with the labeling did not differ between the experimental groups ($M_{\text{Color-coded label}}$ = 3.70, SD = 1.10; $M_{\text{Noncoded label}}$ = 3.90, SD = 1.00; t(182) = –1.29, p = .20, n.s.); the same was true for the unhealthfulness of the filler product choices ($M_{\text{Color-coded label}}$ = 19.11, SD = 1.99; $M_{\text{Noncoded label}}$ = 18.75, SD = 2.01; t(182) = 1.22, p = .23, n.s.). We used video camera recordings to measure the time consumers spent in front of the shelves.

Results

To test our hypothesis, we ran a moderated regression analysis including a variable for the nutrition labeling condition (label without traffic light colors = –1, label with traffic light colors = 1), perceived self-control (mean-centered), and the interaction between the two as independent variables, and familiarity with the nutrition labeling system and the unhealthfulness of the previous choices (both mean-centered and standardized) as covariates. We used unhealthfulness ratings of the product choice (i.e., the higher the score, the less healthful the chosen product) as the dependent variable. The effects of nutrition labeling (b = –.18, SE = .14, p = .21) and self-control (b = –.23, SE = .18, p = .20) were nonsignificant. Neither familiarity with the nutrition labeling system (b = –.11, SE = .15, p = .43, n.s.) nor unhealthfulness of previous choices (b = –.06, SE = .15, p = .71, n.s.) influenced the unhealthfulness of the chosen pasta meal. However, the expected significant two-way interaction between the nutrition labeling scheme and self-control emerged (b = .38, SE = .17, $p < .05$, model R^2 = .05). A follow-up analysis one standard deviation below or above the mean of self-control showed that, among consumers with low self-control (–1 SD), the traffic light colors on the labels led to more healthful choices (b = –.51, SE = .20, $p < .05$; see Figure 1). The unhealthfulness of the product choice was not affected for participants with high self-control (+1 SD; b = .14, SE = .20, p = .49, n.s.). As we expected, the slope of self-control when the nutrition labeling did not show traffic light colors was negative and significant (b = –.61, SE = .24, p = .01). That is, participants made unhealthful choices with decreasing self-control. In contrast, self-control was unrelated to the unhealthfulness of the food choices when traffic light colors were presented on the nutrition labeling (b = .16, SE = .25, p = .53). The results support our hypothesis.

The average time spent in front of the pasta meal shelf was 25.3 seconds (SD = 14.1) in the condition with traffic light–colored nutrition labeling and 23.2 seconds (SD = 13.7) in the nutrition labeling condition without traffic light colors. The time difference did not reach statistical significance (b = –5.07, SE = 7.03, p = .47, n.s.) and was affected neither by consumer self-control nor by the interaction between self-control and the manipulation (ps > .60; neither covariate influenced the time measure, ps > .13).

Figure 1. The Influence of Front-of-Pack Traffic Light–Colored Nutrition Labels in Study 1 (Six Pasta Meals of One Brand)



Discussion

Study 1 shows that the traffic light colors on nutrition labels helped consumers with low self-control make more healthful food decisions in the pasta meal category. The traffic light colors succeeded in disrupting the attraction toward unhealthful foods that has been observed in consumers who try to restrict themselves (Fishbach, Friedman, and Kruglanski 2003; Vohs and Heatherton 2000). The colors primed low-self-control consumers to select more healthful foods. For consumers who reported few problems in coping with these conflicts due to their relatively high self-control, the colors on the labels were of no relevance.

Study 1 has several limitations with regard to the generalizability of the findings. First, consumers often consider more than one brand when making in-store product choices in real life (Chandon et al. 2009). Therefore, Study 2 considers a larger choice set of food products (i.e., products from two brands), keeping important product features constant. Second, whereas Study 1 used pasta meals, which are typically regarded as a main meal, Study 2 uses a different product category (i.e., on-the-go food bars). Third, the food products that belong to one category are often less discriminant in terms of their healthfulness than the pasta meals considered in Study 1 (in which different sauces made the pasta meal more or less rich in calories and negative nutrients). In many categories, food products can be identified less easily as healthful or unhealthful than in Study 1 (Moorman et al. 2004). Therefore, Study 2 considers foods with a nutrient composition where the traffic light colors do not clearly indicate which products are healthful and which are not. The color-coding simply highlights whether a given nutrient has low (green), medium (amber), or high (red) content.

We designed Study 2 to test whether low-self-control consumers still make healthful food decisions when the labels' traffic light colors vary between nutrients but not products (as in Study 1) and therefore provide less obvious guidance to consumers. The study uses a larger choice set and a different product category than Study 1. In line with our arguments that the traffic light color-coding makes self-regulatory conflicts more salient in consumers with low self-control by priming the meaning of stop (vs. go) in food contexts (e.g., "stop and think" or "stop the bad eating" in the case of red), we can assume that the presence of the traffic light colors per se (rather than the variance in the colors between products) is sufficient in helping low self-control consumers make more healthful food decisions.

Study 2

Study 2 tests our moderation hypothesis. It considers a situation in which consumers make a food decision from a larger choice set of food bars (i.e., two brands with four products each) in the presence (vs. absence) of traffic light color-coding. Although the specific content of each of the foods' nutrients differed between the products, there were no differences in color-coding across the products. To simulate real-life food decision making, we conducted Study 2 in the same in-store setting as Study 1.

Method

Participants

One hundred fifty-two consumers who were primarily responsible for grocery shopping in their household (123 women; median age of 30 years, ranging from 16 to 71 years old; median household size of 3 people, ranging between 1 and 11 people) completed the study for a reward of US$7. The participants had no color-vision deficiencies.

Design

The study manipulated the type of nutrition labeling (system: with traffic light colors vs. without traffic light colors) between participants. We manipulated the positioning of the brands to control for (unwanted) effects it might produce (left vs. right; see Appendix B, Panel A). We included this variable because a random presentation of the products (as used in Study 1) is uncommon and because foods are most often displayed by brand in real life (Chandon et al. 2009). The positioning did not affect any of the results; nevertheless, for the purpose of completeness, we report the results including this independent variable in our analyses.

Participants were randomly assigned to one of the four experimental conditions, with sample sizes of 38 participants each. As in Study 1, we measured the moderator (self-control) and the dependent variable (the unhealthfulness of food choice) on a continuous scale.

Materials

We selected eight cereal bar packages (four Corny brand packages and four Sirius brand packages) as stimuli. The products were displayed at eye level on two shelves, with four products on each shelf (two of each brand, standing either on the left or on the right; see Appendix B, Panel A). The shelves showed no price tags. The packages of the two brands were identical in terms of package size (6.0 × 5.7 inches), flavors (chocolate, banana, fruit mix, and apple for each brand), and picture-to-text ratio. Although not completely identical, the coloring of the packages was similar between the brands for the four flavors (see Appendix B, Panel B). Cereal bars are perceived as neither dietary permitted nor dietary forbidden (Knight and Boland 1989) and were deemed appropriate to serve the purpose of the study because the ingredients (e.g., chocolate, fruit sugars) make the food more or less healthful.

We manipulated the packages as in Study 1 and showed GDA nutrition information with or without traffic light colors. In the former condition, the cutoff values provided by the FSA (2009b) were used to determine the coloring. According to the nutrient profile of the products, sugar content was presented on a red-colored background, fat content on amber, saturated fat on red, and salt on green (see Appendix B, Panel B). Thus, the nutrition labels showed all three traffic light colors.

Procedure

The procedure was similar to that of Study 1. The study had a recruitment success rate of 24%. The same in-store environment, cover story, and shopping task were used except that cereal bars (rather than pasta meals) appeared on the last shelf in the store. Participants were told to buy three filler products and one package of cereal bars of their choice. Again, a shopping basket was given to the participants, and they were told that they should behave as they normally would. After the shopping trip, a personal interview was conducted and the participants were fully debriefed.

Measures

To obtain an objective measure of the unhealthfulness of the products, we calculated SSAg/1 scores for each of the products. The SSAg/1 scores consider specific cutoff values for a product's nutrient values—some of which (calories, saturated fat, nonmilk extrinsic sugar, and salt) appear on the labels under consideration—and add up to an overall rating (0 being the most healthful; higher numbers indicate more unhealthful products). The SSAg/1 scores of the products under examination ranged from 8 to 13. We used the same covariates and measures of consumer self-control ($\alpha = .72$) as in Study 1.

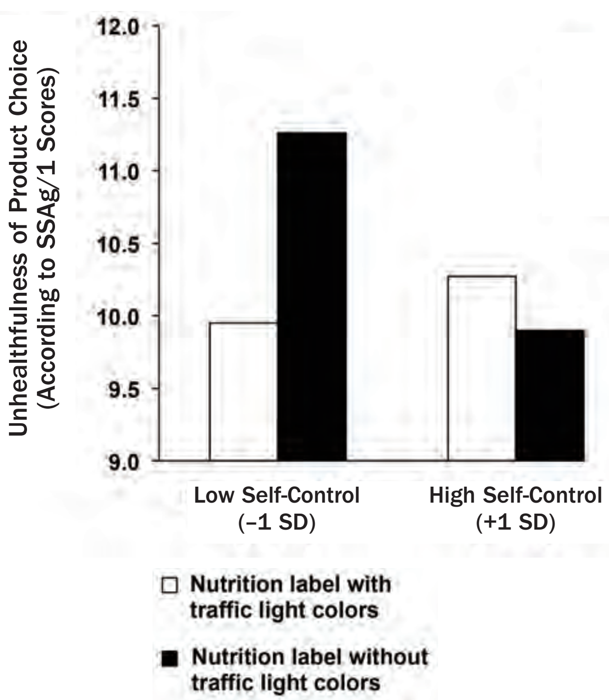
The familiarity ratings with the nutrition labeling system did not differ between the two groups ($M_{\text{Color-coded label}} = 3.82$, SD = 1.10; $M_{\text{Noncoded label}} = 4.01$, SD = 0.99; $t(150) = -1.16$, $p = .25$, n.s.). In addition, there was no difference with regard to the SSAg/1 scores of the filler products ($M_{\text{Color-coded label}} = 19.22$, SD = 2.18; $M_{\text{Noncoded label}} = 18.72$, SD = 1.86; $t(150) = 1.51$, $p = .13$, n.s.).

Results and Discussion

To test our hypothesis, we conducted a moderated regression analysis including a variable for the nutrition labeling condition (label without traffic light colors = –1, label with traffic light colors = 1), the placement of the brands (Sirius left = –1, Corny left = 1), self-control (mean-centered), and all the interactions between these variables as independent variables. We treated consumer familiarity with the nutrition labeling system and the unhealthfulness of the previous choices (both mean-centered and standardized) as covariates. We used the SSAg/1 score, a measure of unhealthfulness of the product choice (i.e., the higher the score, the more unhealthful the chosen product), as the dependent variable. Both covariates were nonsignificant (ps > .55). The effects of brand placement (b = –.24, SE = .13, p = .06) and nutrition labeling (b = –.23, SE = .13, p = .07) did not reach statistical significance, whereas consumer self-control negatively influenced the SSAg/1 score of the chosen product (b = –.23, SE = .12, p < .05). More importantly, there was a significant interaction between self-control and nutrition labeling (b = .38, SE = .12, p < .01, model R^2 = .17; none of the other interactions reached significance).

As we expected, the traffic light colors on the labels helped low-self-control consumers make more healthful choices (–1 SD; b = –.65, SE = .18, p < .001), whereas there was no significant effect on high-self-control consumers (+1 SD; b = .19, SE = .18, p = .28, n.s.; see Figure 2). The slope of self-control when the nutrition labeling did not show traffic light colors was negative and significant (b = –.61, SE = .17, p < .001). That is, participants made less healthful choices with decreasing self-control. In contrast, self-control was unrelated to the unhealthfulness of the food choices when traffic light colors were presented on the nutrition labeling (b = .15, SE = .15, p = .35). These results support our hypothesis.

Figure 2. The Influence of Front-of-Pack Traffic Light–Colored Nutrition Labels in Study 2 (Eight Cereal Bar Packages of Two Brands)



Participants faced the cereal bar shelf for an average of 18.2 seconds (SD = 16.7). However, time was affected by the nutrition labeling manipulation. Consumers spent more time in front of the products that were labeled with traffic light color-coded nutrition information (M = 20.8 seconds, SD = 20.6) compared with products that were labeled with nutrition information without such coloring (M = 15.5 seconds, SD = 11.3; b = 2.63, SE = 1.40, p = .05). The interaction between the nutrition labeling condition and self-control was not significant (b = –1.47, SE = 1.29, p = .26); the same was true for all other conditional and interaction effects (ps > .48, n.s.).

Study 2 provides evidence that the traffic light colors on nutrition labels helped low-self-control consumers make healthful food decisions in situations in which they selected a product from two brands and the coloring only provided guidance within one product (i.e., comparing the low vs. medium vs. high content of the nutrients) but no guidance regarding differences in nutrient content between products. It used an objective measure of the unhealthfulness of food products that was calculated for each of the eight products.

Conclusion

Substantive Contribution of the Findings

Studies 1 and 2 provide evidence that actual food purchase behavior within a given category is affected by front-of-pack traffic light color-coding on nutrition labels. However, this effect is contingent on consumer self-control. Consumers with low self-control, but not consumers with high self-control, make more healthful food decisions in response to the color-coding on GDA labels (vs. GDA labels without color-coding). The color primes help low-self-control consumers control their food purchasing behavior. We found this effect for low-self-control consumers shopping for a pasta meal (six products, one brand) with traffic light colors discriminating between both nutrients and products as well as for low-self-control consumers shopping for a package of cereal bars (eight products total, two brands with four products each) and traffic light colors discriminating between negative nutrients only. One can assume that the external validity of our studies is fairly high compared with previous experimental studies because the research was conducted in an in-store environment and used a real consumer sample that was not informed about the goals of the research. For example, no explanation of the nutrition labeling was given before the study to avoid hypothesis guessing and unwanted salience of health motives (Van Herpen and Van Trijp 2011). Instead, we observed actual behavioral reactions that might be generalizable to the decisions made in real-life supermarket environments (Dijksterhuis et al. 2005).

The findings help explain previous nonsignificant effects of traffic light color-coded nutrition labels on food product sales. In agreement with Sacks, Rayner, and Swinburn (2009) and Sacks et al. (2011), we did not find a main effect of the nutrition labeling condition on the unhealthfulness of the food decisions. However, the color-induced mechanism of the traffic light colors affects in-store decisions of consumers who possess low self-control (from a consumer welfare perspective, a desirable target group) because myopic behaviors (i.e., indulging) may lead to unhealthful outcomes (i.e., obesity and related diseases).

Previous work has linked healthful decision making (as a response to provided nutrition information) to consumers' interest in healthful eating, their primed or unprimed motivation to process nutrition information, and their ability to use nutrition information (Andrews, Burton, and Kees 2011; Grunert, Wills, and Fernández-Celemín 2010; Moorman 1990, 1996; Van Herpen and Van Trijp 2011). However, these factors do not take into account the goal conflicts that may arise from both internal cues (e.g., hunger, starving sensation) and external cues (e.g., product packaging; Herman and Polivy 2004). This is particularly relevant for in-store decisions, for which the physical distance to fulfill short-term goals is small and unhealthful food is truly tempting (Geyskens et al. 2008).

Self-control captures this struggle in day-to-day food decision making (Baumeister 2002). Whereas previous research on consumer self-control has highlighted situations in which self-control attempts fail (Vohs and Heatherton 2000) and in which consumers employ counteractive self-control strategies (Trope and Fishbach 2000), we show that traffic light–color labeling is an environmental prime that enforces avoidance tendencies toward unhealthful food within a given product category in low-self-control consumers without consumers having to consciously increase their willpower to resist temptations. The findings therefore contribute to an increased understanding of self-regulatory behaviors when goal conflicts are present during decision-making processes.

Public Policy and Practical Implications

Our studies' findings have important implications for public policy makers, food manufacturers, and grocery retailers. From our results, public policy makers may favor a traffic light color-coded (vs. monochrome) system for front-of-pack labeling because it potentially leads to more healthful food choices, particularly for consumers who struggle to resist unhealthful food. The traffic light colors are environmental primes that may provide automatic guidance in supermarkets (Dijksterhuis et al. 2005) because the colors themselves, as part of nutrition labels, do not require explicit instructions to consumers (e.g., Hofmann et al.'s [2010] suggestion of stimulating cognitive transformations and implementation intentions) or extensive information processing (Trudel and Murray 2013). Furthermore, the labels can be easily implemented on the product packaging and do not depend on separate media to remind consumers of their goal to control their eating behavior (e.g., the recommendation to put up posters; Papies and Hamstra 2010). Thus, front-of-pack nutrition labeling using traffic lights may be considered a potential tool to prevent self-control failure in low-self-control consumers and combat the increasing prevalence of obesity (Food and Drug Administration 2009). To reduce consumer confusion, public policy makers may recommend both keeping the format of nutrition labels constant (e.g., information content, design, size) and placing the label in the same position (e.g., bottom right) on the packaging (Bialkova and Van Trijp 2010; i.e., factors that our studies kept constant). To increase ease of comparison, policy makers may also recommend placing nutrition labels on all food products rather than on only a selection of products.

Food manufacturers largely support nutrient tables and percent daily values without traffic light color-coding on the front of the packaging. They agree that the use of traffic light colors improves the visibility of the label and is thus relevant for attention; however, they argue that traffic light color-coded schemes distract consumers from processing the exact figures necessary for making healthful choices. Furthermore, they point out that the system stigmatizes foods, leads to misinterpretation, and patronizes consumers (Bussell 2005). Food manufacturers may also be concerned that sales would decrease if their products were labeled with the traffic light system and one or more of their products' nutrients were highlighted in red. This would be true for food that typically contains high amounts of negative nutrients (Drewnowski and Levine 2003). To date, there is no clear evidence about how consumers react to such labeling in real-life situations over time. However, food manufacturers may use the traffic light system to position their brands as healthful when the nutrients are mainly labeled green. In this case, turnover may even increase if consumers perceive the products to be beneficial for their health and this increases their willingness to pay (with respect to willingness to pay for a hypothetical traffic light color-labeled basket of products, see Balcombe, Fraser, and Di Falco 2010).

From the grocery retailer's perspective, a goal relevant to nutrition information would be to prevent additional search costs and confusion for consumers at the point of purchase. The faster and more conveniently consumers are able to make purchase decisions, the more time they have to explore the store and buy other products (Hui, Bradlow, and Fader 2009). Here, traffic light colors may have a different effect depending on the degree to which the colors help consumers discriminate between products. The traffic light colors neither increased nor decreased consumers' time spent in front of the shelf in Study 1, when the colors provided clear guidance as to which product was superior in terms of frequency of the appearance of green versus amber versus red background coloring for each nutrient. However, the traffic light colors increased the time spent in front of the shelf in Study 2, when the colors only provided guidance on an intraproduct (not interproduct) basis (i.e., between nutrients). In the latter condition, consumers spent more time on the decision-making process in response to the colors.

Limitations and Further Research

This research has several limitations. We designed the studies to assess the behavioral effects of traffic light–colored nutrition labels in in-store environments. However, both the laboratory setting and the preselection of stimuli question the generalizability of the results. Although a real consumer sample participated in the study, we cannot rule out the possibility that these participants acted differently compared with their real-life shopping behavior.

Regarding the stimuli, we limited the study to six (Study 1) and eight (Study 2) products, respectively, offering flavors that the manufacturers offered at the time the study was conducted. We presented GDA information either with or without traffic light colors. Our studies did not consider nutrient compositions of foods in which all nutrients had the same background coloring or a simplified traffic light system signaling the overall healthfulness of a product through one color symbol only (e.g., red or green, providing a dichotomous distinction). Such labeling is expected to make automatic processing of nutrition information more likely and may thus reduce the time devoted to the products when making food choices (Van Herpen and Van Trijp 2011). We used the traffic light color-coded GDA system referring to calories and four negative nutrients, with variance in coloring between the nutrients, because more simplistic labels have been criticized to stigmatize foods or mislead consumers (Andrews, Burton, and Kees 2011; Bussell 2005; FSA 2009b). Future studies may assess the differences in processing of background traffic light color-codes depending on how much, and in what format, nutrition information is provided (Viswanathan 1994; Viswanathan, Hastak, and Gau 2009).

A worthwhile avenue for further research is the point of consumption (as opposed to the point of purchase), where different effects may occur. At the point of consumption, the volume of the food eaten affects consumers' health benefits gained from nutrition (Genschow, Reutner, and Wänke 2012). On the one hand, buying a predominantly green-labeled food may serve as a precommitment device to a healthful lifestyle and induce overconsumption. Previous research has shown that this is true for low-fat nutrient claims (Wansink and Chandon 2006). On the other hand, consumers may overreact to the color red on nutrition labels and interpret it as a strict warning that certain foods are forbidden or should never be eaten rather than that unhealthful food should be consumed only occasionally (Grunert, Wills, and Fernández-Celemín 2010). This may be particularly harmful to consumers with nutrition deficiencies (e.g., eating disorders such as anorexia nervosa).

Further research may also be devoted to the exact mechanism that leads consumers with low self-control to make more healthful decisions in response to traffic light–colored nutrition labeling within a product category. The effect may be due to prime-activated thoughts that make goal conflicts more salient and remind low-self-control consumers of their long-term goals. Color-induced automatic approach and avoidance tendencies may provide an alternative explanation (Fishbach and Shah 2006). However, Study 2 provides some suggestive evidence that consumers may process nutrition information more deliberately (rather than automatically) because they spent more time in front of the shelf. Further research may assess the relevance of the two processes in more detail.

Concluding Remarks

Before a final statement regarding the effectiveness of traffic light colors on front-of-pack nutrition information can be made, future studies should examine a wider sample of consumers (e.g., consumers with specific needs, such as diabetes or high blood pressure). Moreover, larger product assortments and traffic light color codes in association with different nutrition labeling systems should be taken into account. From the results of our studies, we can conclude that the implicit meaning of the traffic light colors transfers to the food context and helps low-self-control consumers make healthful food decisions. The colors affect low-self-control consumers' behavior in situations in which the biases of social desirability are reduced. Whether traffic light color-coded nutrition labeling improves low-self-control consumers' diets remains to be shown.

Appendix A. Study 1 Product Packages and Labels

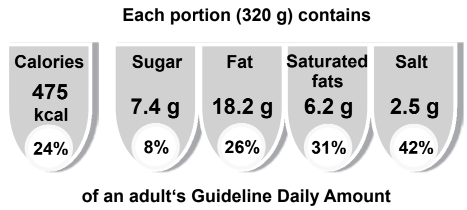
A: Product Packages

Tomato Sauce	**Arrabbiata**	**Tomato Mozzarella**	**Bolognese**	**Cheese & Herbs**	**Carbonara**
(310 kcal 16%, 10.0g sugar 11% G, 8.1g fat 12% G, 4.4g sat. fats 22% G, 2.0g salt 33% A per portion)	(375 kcal 19%, 10.5g sugar 12% G, 8.2g fat 12% G, 4.9g sat. fats 25% A, 2.0g salt 33% A per portion)	(405 kcal 20%, 12.5g sugar 14% G, 8.8g fat 13% G, 4.9g sat. fats 25% A, 2.5g salt 42% R per portion)	(475 kcal 24%, 7.4g sugar 8% G, 18.2g fat 26% A, 6.2g sat. fats 31% R, 2.5g salt 42% R per portion)	(525 kcal 26%, 13.4g sugar 15% A, 19.6g fat 28% A, 8.4g sat. fats 42% R, 2.6g salt 43% R per portion)	(580 kcal 29%, 12.8g sugar 14% A, 22.1g fat 32% R, 8.7g sat. fats 44% R, 2.6g salt 43% R per portion)

Appendix A. Continued

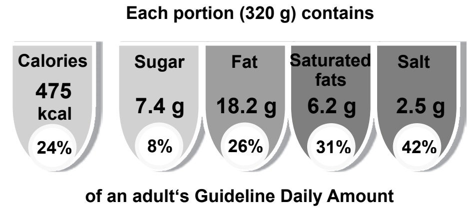
B: Nutrition Labels (Example: Mirácoli Bolognese) and Color Characteristics

Label without traffic light colors



Nutrient	Cal.	Sugar	Fat	Sats.	Salt
Color	Blue	Blue	Blue	Blue	Blue
Hue	200	200	200	200	200
Chroma	20	20	20	20	20
Value	100	100	100	100	100

Traffic light color-coded label



Nutrient	Cal.	Sugar	Fat	Sats.	Salt
Color	Blue	Green	Amber	Red	Red
Hue	200	120	60	0	0
Chroma	20	100	100	100	100
Value	100	100	100	100	100

Notes: The percentages on the nutrition label indicate the percent daily value per serving of the food; g = grams, and kcal = calories.

Appendix B. Study 2 Shelf Arrangement and Product Package Examples

A: Shelf Arrangement

Corny left; Sirius right

Corny Flavor 1	Corny Flavor 2	Sirius Flavor 1	Sirius Flavor 2
Corny Flavor 3	Corny Flavor 4	Sirius Flavor 3	Sirius Flavor 4

Sirius left; Corny right

Sirius Flavor 1	Sirius Flavor 2	Corny Flavor 1	Corny Flavor 2
Sirius Flavor 3	Sirius Flavor 4	Corny Flavor 3	Corny Flavor 4

B: Cereal Bar Package Examples

Corny chocolate

Sirius chocolate

Notes: Each product package contained four cereal bars. Both the traffic light color-coded and the noncoded nutrition labels were designed in the same format as in Study 1 (see Appendix A, Panel B).

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