THE EFFECTS OF LOW-FAT LABELING AND CALORIC INFORMATION ON

FOOD INTAKE

A DISSERTATION SUBMITTED TO THE UNIVERSITY OF HAWAI‘I AT MĀNOA
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE
DEGREE OF

DOCTOR OF PHILOSOPHY

IN

PSYCHOLOGY

DECEMBER 2013

By
Daria S. Ebneter

Doctoral Committee:

Janet Latner, Chairperson
Brad Nakamura
Claudio Nigg
Kelly Vitousek
Yiyuan Xu
ACKNOWLEDGEMENTS

I would like to thank all the students who participated in this project by eating unlimited amounts of M&M’s. Thank you also to the research assistants who collected and entered data for this study.

I wish to thank the members of my committee for their insights and contributions, all of which have made this study better. Thanks especially to my advisor, Dr. Janet Latner, who has supported me throughout my graduate career and who has helped me become a better writer and researcher over the last four years.

Thank you to my graduate school family - Anna Ciao, Erin Cozens, Laura Durso, Shana Golembo Smith, and Danielle Young, who accompanied me every step of the way. Thank you to my husband, Brandon Pearson, whose table and figure making skills are unparalleled and who has supported me in every way possible. Thank you also to my family and friends in Germany who were there for me from afar. And above all, as always, none of this would have been possible without my biggest supporter, my father Wolfgang Ebneter.
Abstract

**Objective:** The present study examined whether low-fat labeling and caloric information affects food intake. The associations between low-fat and calorie labeling and calorie estimates, taste preferences, and health attributions were assessed, as well as the relationships of low-fat labeling and caloric information to feelings of guilt, embarrassment, regret, and loss of control. **Method:** Participants were 224 female undergraduate students who were randomly assigned to one of four experimental conditions. Participants were asked to taste and rate either low-fat or regular labeled chocolate candy. In addition, in two of the four conditions, participants had caloric information available. Main outcome variables included participants’ intake, calorie estimates as well as health-related attitudes. Feelings of guilt, embarrassment, regret, and loss of control were also assessed. Further, participants responded to questionnaires measuring eating disorder attitudes and behaviors, impulsivity, and depressive symptoms. **Results:** The differences in food consumption dependent on fat content labeling and caloric information did not reach statistical significance. However, participants significantly underestimated the calorie content of low-fat labeled chocolate candy and also rated low-fat labeled candy as better tasting when they had caloric information available. Participants endorsed more positive health attributions for low-fat labeled candy than for regular labeled chocolate independent of caloric information. No association between feelings of guilt, embarrassment, regret or loss of control and fat content labeling and caloric information was found. Finally, the inclusion of eating disordered attitudes and behaviors, impulsivity, and symptoms of depression as covariates did not alter the results. **Discussion:** While the effects of fat content labeling
and caloric information on food consumption did not reach statistical significance, this study demonstrated that young women underestimate the calorie content of low-fat foods. This finding may be related to participants’ “health halo” related to low-fat foods. Limitations of the present study are discussed, including methodological issues such as sample characteristics and the laboratory environment under which the study was conducted. Future research might be performed in more natural environments to examine the interaction between fat content and calorie labeling, particularly in populations who may be at higher risk for displaying a “health halo”.
Table of Contents

ACKNOWLEDGEMENTS ............................................................................................................ i
ABSTRACT .................................................................................................................................. ii
LIST OF TABLES .......................................................................................................................... vi
LIST OF FIGURES ....................................................................................................................... vi
CHAPTER I: INTRODUCTION .................................................................................................... 1
  Implications of obesity ............................................................................................................. 1
  The obesogenic environment ................................................................................................. 2
  Predictors of food choices ...................................................................................................... 3
  Food labeling and its effects on food consumption ............................................................... 4
  Caloric information and its effect on food consumption ....................................................... 5
  The present study .................................................................................................................... 7
CHAPTER II: METHODS ............................................................................................................. 8
  Participants and Procedure .................................................................................................... 8
    Study participants ............................................................................................................... 8
    Procedure ............................................................................................................................ 9
  Measures .................................................................................................................................. 10
    Demographic variables .................................................................................................... 10
    Food consumption .......................................................................................................... 11
    Calorie estimates ............................................................................................................. 11
    Taste-rating form .............................................................................................................. 11
    Health attributions .......................................................................................................... 11
    Associated emotions ....................................................................................................... 11
    Eating Attitudes Test ....................................................................................................... 12
    Dutch Eating Behavior Questionnaire .............................................................................. 12
    Barratt Impulsiveness Scale-11 ....................................................................................... 12
    Center for Epidemiologic Studies Depression Scale ..................................................... 13
  Statistical analyses .............................................................................................................. 13
    A-priori power analyses ................................................................................................. 13
    Descriptive analyses ....................................................................................................... 13
    Inferential analyses ......................................................................................................... 14
LIST OF TABLES

Table 1. Pearson product-moment correlations between dependent variables .................................. 17
Table 2. Descriptive characteristics for each of the four experimental conditions ......................... 18
Table 3. ANOVA table with feelings of guilt, embarrassment, regret, and perceived loss of control as dependent variables ................................................................................................................. 26
Table 4. ANCOVA table with food consumption as independent variable ..................................... 27

LIST OF FIGURES

Figure 1. Schematic display of the experimental procedures ............................................................ 10
Figure 2. Mean consumption of M&M’s in grams in the four different conditions ....................... 20
Figure 3. Mean calorie estimation across conditions ..................................................................... 21
Figure 4. Interaction effect of fat content labeling and caloric information on calorie estimates ........................................................................................................................................................................... 22
Figure 5. Mean ratings on taste preference ...................................................................................... 22
Figure 6. Interaction effect of fat content labeling and caloric information on taste preference ........................................................................................................................................................................... 23
Figure 7. Mean ratings on health attributions ............................................................................... 25
The effects of low-fat labeling and caloric information on food intake

Increasing prevalence rates over the last three decades have led to obesity becoming one of the most critical public health concerns in the United States. In a recent survey, almost 70% of American adults were identified as overweight with a body mass index (BMI; kg/m$^2$) at or above 25, including 33.9% of adults who were categorized as obese with a BMI at or above 30 (Flegal, Carroll, Ogden, & Curtin, 2010). Childhood obesity rates are also on the rise, with 16.9% of children and adolescents being categorized with a BMI at or above the 95th percentile. When children and adolescents at or above the 85th percentile are included, these numbers approach nearly 32% (Ogden, Carroll, Curtin, Lamb, & Flegal, 2010). While the obesity rates for adults in the US have stabilized over the last 10 years (Flegal et al., 2010), obesity prevention continues to be one of the most publicized public health initiatives. This public interest in obesity, its causes, and prevention may be explained by the significant implications that obesity has on an individual and societal level.

Implications of obesity

Obesity is thought to have significant implications in areas of public health and economics (Finkelstein et al., 2008) and is associated with psychosocial factors such as stigma and discrimination (Puhl & Heuer, 2009). Obesity has been linked to a wide range of health risks including but not limited to type 2 diabetes (Kahn, Hull, & Utzschneider, 2006), hypertension (Witteman et al., 1989), and coronary heart disease (Rimm et al., 1995; Willett et al., 1995). Further, it has been demonstrated in a sample of over one million white, non-smoking adults that overweight and obesity are associated with increased mortality (Berrington de Gonzalez et al., 2011). Along with its physical health risks, obesity is associated with significant medical costs. A 2008 survey indicated that the medical costs related to overweight and obesity amounted to $147 billion (Finkelstein, Trogdon, Cohen, & Dietz, 2009). Obese individuals have 30% increased healthcare costs compared to normal-weight individuals (Withrow & Alter, 2011) and their lifetime medical costs are positively related to an increase in BMI (Finkelstein et al., 2008).

In addition to the associated medical complications and economic implications, a wide array of psychosocial factors is linked to obesity. Obesity stigma is widespread.
(Puhl & Heuer, 2009) and increasing over time (Andreyeva, Puhl, & Brownell, 2008; Latner & Stunkard, 2003). Stigma toward and discrimination against obese individuals has been documented across educational, medical, employment, and interpersonal settings (O’Brien, Latner, Ebneter & Hunter, in press; O’Brien, Hunter, & Banks, 2007; O’Brien et al., 2008; Puhl & Heuer, 2009) and has been associated with obese individuals’ body dissatisfaction, depressive symptoms, suicidal ideation, low self-esteem, and academic, employment, and relationship problems (Puhl & Latner, 2007).

In view of the high prevalence rates, medical risks, economic burden, and psychosocial implications, it is critical to understand which factors contribute to obesity. The Externality Theory of weight gain prominently features environmental cues as an etiological factor leading to weight gain, and in individuals especially susceptible to these cues, weight gain may lead to obesity (Lowe & Levine, 2005; Wansink, 2004). Recent research revisiting the externality hypothesis has demonstrated that many environmental cues are important determinants of both overeating and the cessation of eating. The current obesity epidemic is likely caused by a combination of changes in physical activity and, of concern here, by adjustments in eating patterns due to changes in environmental cues. Therefore, in order to modify maladaptive eating patterns, it is necessary to elucidate what factors play into people’s food-related decisions.

**The obesogenic environment**

In the past, studies on the causes of obesity focused on an individual level ranging from genetic factors to an individual’s lack of self-control (Caballero, 2007; Ebneter, Latner, & O’Brien, 2011); however, most researchers agree that the causes for obesity are complex. A more recent consensus is that environmental factors, including increasing urbanization that encourages driving instead of walking and a rising number of fast-food restaurants, are contributing to the obesity epidemic (Caballero, 2007). This is consistent with research showing that developing countries such as China and Thailand now have obesity rates progressing at a faster rate than the United States (Popkin & Gordon-Larsen, 2004). Different definitions of what constitutes an obesogenic environment have been proposed, but at the most basic level this term applies to an environment in which maintaining a healthy weight is more challenging due to its surroundings (Kirk, Penney, & McHugh, 2010). Such an environment includes not only a growing number of fast-
food restaurants and limited opportunities for physical activity, but also more subtle factors such as differences in the way food is marketed to consumers which may ultimately lead to changes in food choices and consumption (Chandon & Wansink, 2011).

**Predictors of food choices**

The rise of obesity rates in westernized societies has led to growing awareness of the healthiness of foods consumed. Consequently, consumers’ concerns about foods’ implications for weight gain and health have increased (Borra & Bouchoux, 2009). However, instead of making choices about food consumption based on nutritional information and personal nutritional needs, people tend to categorize food according to heuristic principles (such as healthy vs. unhealthy; e.g. Oakes & Slotterback, 2001a) and place them in categories such as good or bad foods. Such categories appear to provide simplifying strategies for making food choices. It has been shown that one of the primary factors influencing food choices is perceived healthiness (Paquette, 2005). Indeed, 48% of participants in a national sample agreed with the statement that most foods are either good or bad for one’s health (Rozin, Ashmore, & Markwith, 1996). A food’s reputation as good or bad seems to carry over and generalize independent of the quantity in which it is consumed. For example, participants in a survey study believed that a small chocolate candy bar (containing 47 calories and 2.25 grams of fat) would lead to greater weight gain than a significantly larger portion of a snack that is commonly considered as “good” for one’s health, even though it contained 569 calories and six grams of fat (a cup of 1% fat cottage cheese, three carrots, and three pears; Oakes, 2005). Indeed, it has been shown that people underestimate the calorie content of low-fat and seemingly healthy food and overestimate the number of calories in food perceived as unhealthy (Carels, Harper, & Konrad, 2006; Carels, Konrad, & Harper, 2007). Rozin and colleagues (1996) found that almost half of their study participants believed that high-calorie foods in small amounts (e.g. 1 oz of chocolate) contain more calories than low-calorie foods in much larger amounts (e.g. 1 pint of cottage cheese).

People tend to base their judgments about the healthiness of food on factors such as the food’s perceived fat content (Carels et al., 2006) and its capacity to affect weight (Carels et al., 2007). Studies suggest that foods with low-fat claims are perceived as
healthy by adolescents (Croll, Neumark-Sztainer, & Story, 2001) and adults (Oakes & Slotterback, 2001a, 2002). Simply reframing a food product as 75% fat-free versus claiming it contains 25% fat led consumers to believe that the food, in this case ground beef, was leaner and of higher quality (Levin & Gaeth, 1988). Further, if people link the fat content of food to its healthiness, then this may in turn affect their eating behaviors. Roefs and Jansen (2004) demonstrated in an experimental study that people predicted that they would consume less of a milkshake when it was labeled as high-fat than when the same milkshake was labeled as low-fat.

While fat content is, in fact, associated with caloric value and fat contains more calories per gram than carbohydrates and protein, in low-fat foods fat is often replaced with sugar, flour, or starch thickeners to enhance flavor and texture (National Institutes of Health, 2004). Consequently, many low-fat or fat-free foods contain as many calories (or even more) than the full-fat version of the same product (National Institutes of Health, 2004). Consumers commonly believe that low-fat corresponds to low calories; however, they are not aware that when the US Food and Drug Administration endorses a product as low-fat, this decision is based on amount of fat and not on caloric value (Wansink & Chandon, 2006).

**Food labeling and its effects on food consumption**

Food companies and fast food chains have reacted to consumers’ heightened awareness regarding the nutritional and calorie content of foods by advertising their products as fat-free or low-fat. Such marketing may be misleading and potentially harmful, especially when people view low-fat as synonymous with healthy, and in turn allow this to affect food consumption. Wansink and Chandon (2006) demonstrated in an experiment that food labeling may indeed increase actual food intake. Participants were offered a bowl filled with M&M’s, which either displayed a low-fat or a regular label. Labeling affected food intake to the extent that participants chose 28% more M&M’s when they were labeled as low-fat than when they were labeled regularly. Recently, an experimental study with a sample of undergraduate students confirmed these findings (Provencher, Polivy, & Herman, 2009). Participants consumed an additional 35% when a snack consisting of oatmeal cookies was described as low in fat compared to a control condition where the same snack was described as having been prepared with more
fattening ingredients. An experimental study by Shide and Rolls (1995) revealed possible overcompensation following consumption of food labeled as low-fat; women who received a yogurt labeled as low-fat consumed more calories during a subsequent lunch than they did after receiving yogurt with identical energy content, but labeled as high-fat. Furthermore, it has been demonstrated that food labeled as low in fat may lead to increased consumption by reducing guilt associated with eating (Wansink & Chandon, 2006) and by tempting consumers to add high-caloric side dishes (Chandon & Wansink, 2007).

The results of these experimental studies indicate that actual food intake may be influenced by people’s perception of its healthiness and fat content. Specifically, food products advertised as low in fat are commonly perceived as healthy and are either overconsumed or contribute to the consumption of a greater amount of calories at subsequent meals. Low-fat labeling may thus be an important environmental determinant of excess food intake.

**Caloric information and its effect on food consumption**

Chandon and Wansink (2007) introduced the “health halo” effect based on studies showing that people tend to underestimate the calorie content of foods in restaurants where food choices are claimed to be “healthy” (e.g. Subway), compared to restaurants that do not advertise a healthy image (e.g. McDonald’s). Furthermore, they demonstrated in an earlier experiment that people who eat candy labeled as low-fat underestimate its caloric value to a greater extent than people who consume candy with regular labeling (Wansink & Chandon, 2006). In a separate study, Wansink and Chandon (2006) revealed that not only did low-fat labels decrease calorie estimates by an average of 260 calories, the extent of underestimation was similar across foods considered unhealthy (M&M’s) and foods generally viewed as healthy (granola).

As the average daily energy intake for US Americans has increased by almost 200 calories over the last 30 years (Nielsen, Siega-Riz, & Popkin, 2002), one of the public health efforts that has been undertaken to improve people’s food choices and increase their awareness of caloric consumption is the introduction of calorie labeling on food menus (Ludwig & Brownell, 2009). Proponents of menu-labeling legislation, which requires restaurants to include caloric information on their menus, claim that adding
calorie content will have an effect on consumers’ food choices and intake (Roberto, Schwartz, & Brownell, 2009). Studies on the effects of menu-labeling have reported mixed results. Harnack and French (2008) reviewed six studies on the effects of calorie labeling on menu choices, including five studies that supported the hypothesis that having caloric information available will enable customers to make more low-calorie choices, while one study reported a non-significant effect of calorie labeling. However, not only do these studies show a small effect, they also resulted in some inconsistent findings which have been attributed to methodological problems (Harnack & French, 2008).

Further, a laboratory experiment asking participants to choose items from a McDonald’s menu failed to show a difference in calorie choices when caloric information was available (Harnack et al., 2008). On the contrary, a real-world study observing consumers’ purchasing behaviors in fast-food chains reported that people who had caloric information available at a Subway restaurant chose menu options that were significantly lower in calories than consumers who did not have access to this information (Bassett et al., 2008). Similarly, it has been demonstrated that participants ordered food that contained significantly fewer calories when they were informed of the calorie content in comparison to participants who were unaware of the energy value of the menu options (Roberto, Larsen, Agnew, Baik, & Brownell, 2010). A recent study compared data from New York Starbucks’s coffee stores before and after the new menu-labeling policies had been implemented and found that the added caloric information caused customers to purchase foods that had 6% fewer calories while the revenue remained the same (Bollinger, Leslie, & Sorensen, 2011). However, it is important to note that this change translated to only a 15 calorie decrease (Bollinger et al., 2011).

In sum, it has been established that external factors may play an important role in the way that people make food-related purchasing and consumption decisions (Chandon & Wansink, 2011). Research suggests that among other factors such as serving size and food packaging, low-fat claims and calorie labeling have a direct effect on food intake (Chandon & Wansink, 2011). This effect may be caused through the mediating effects of guilt reduction and more positive health attributions that are often associated with low-fat labeled foods (Chandon & Wansink, 2007).
In the current obesogenic environment, which promotes increased food intake and the consumption of high-caloric foods, a major cue for overeating may be the virtually unlimited availability of palatable foods (Hill & Peters, 1998). The current study hypothesized that when palatable food is available an important cue for overeating is labeling that presents those foods as healthy. Regardless of the accuracy of such advertising, “healthy” labeling may serve as a key environmental trigger that provides individuals with perceived permission to overeat. This permission may cause people to abandon any prior efforts at restraint and reduce the guilt they may feel about overeating.

Similar to research on the “health halo” effect (Chandon & Wansink, 2007), it has been shown that when individuals judge a person or object to be good or bad in one category, they are likely to make a similar evaluation across other categories (Asch, 1946). Accordingly, when individuals judge a food to be low in fat and therefore healthy, they are likely to make a similar evaluation across other categories such as the food being low in calories. It was predicted that after learning about a single supposedly healthy attribute of a food product (e.g., low-fat), participants in the proposed study would apply a “health halo” to other attributes of the food as well (e.g., calories), which may in turn lead to increased consumption. Of interest for the current study, however, was also whether knowledge of the actual calorie content may impact and possibly reduce the “health halo” effect that may be caused by low-fat claims.

The present study

The current study aimed to experimentally investigate the effects of low-fat labeling and caloric information as well as the interaction between fat content labeling and caloric information on food intake, health attributions, and associated emotions such as feelings of guilt, embarrassment, regret, and loss of control. The objective was to replicate studies showing that labeling foods as low in fat leads to a higher consumption of these foods in comparison to the intake of foods with regular labels (Wansink & Chandon, 2006). In addition, the influence of caloric information on food consumption and its interaction with low-fat labeling were examined. Health attributions and feelings of guilt were assessed based on studies suggesting that these factors may be associated with an underestimation of calorie content which may ultimately lead to an increase in food consumption. Results may help identify whether and to what extent menu-labeling
(low-fat and calories) of foods that are considered unhealthy (chocolate) plays a role in food intake and how low-fat labeling interacts with calorie labeling.

The current study contributes to the obesity research base by addressing two important questions: (1) Do relative nutrition claims (e.g. low-fat) influence the amount of food individuals consume during a single eating occasion, and (2) does calorie labeling eliminate the effects that low-fat labeling has been shown to have on food intake? Based on evidence from previous studies demonstrating that low-fat nutrition claims increase consumption, because they may increase perceptions of healthiness and reduce anticipated consumption guilt, this study presents two formal research hypotheses:

Central Hypothesis 1: Candy described and labeled as low-fat will be consumed in greater quantities relative to candy described and labeled as having a regular fat content.

Central Hypothesis 2: Participants will decrease their intake in both the low-fat labeling and regular labeling conditions when they have caloric information available relative to conditions in which caloric information is unavailable.

In an effort to identify factors that may be associated with an increased intake in the low-fat labeling conditions, it was also predicted that:

a) Participants will give lower calorie estimates for low-fat labeled candy than for regular labeled candy when they are unaware of the calorie content.

b) Candy described and labeled as low-fat will receive more positive health attributions relative to candy described and labeled as having a regular fat content.

c) Participants will feel less guilty, embarrassed or have lower feelings of regret and loss of control after consuming candy described and labeled as low-fat relative to candy described and labeled as having a regular fat content.

Methods

Participants and Procedure

Study participants. Participants for this study were recruited from undergraduate classes at the University of Hawaii and received course credit for their participation. Participants (N = 224, 100% women) self-identified as Asian (36.6%), mixed ethnic heritage (35.3%), Caucasian (23.7%), Pacific-Islander (2.7%), and Hispanic (1.8%). The current study included only female participants due to pilot testing with both male and
female participants (described below) that led to the decision to include only women. Participants’ mean ($SD$) age was 20.74 (4.08) years and mean BMI was 22.62 (4.18) kg/m$^2$. The study was approved by the University of Hawaii Institutional Review Board, and informed consent was obtained from all participants. Participants were randomly assigned to one of four experimental conditions.

**Procedure.** The experimental procedure of the current study was modeled after research by Provencher et al. (2009) and Wansink and Chandon (2006) examining the effects of food labeling on food consumption and consumption estimates. The study was conducted in a laboratory setting at the University of Hawaii and was advertised as a market research study involving a taste-rating task for a new type of M&M’s. Participants were asked to arrive in a pre-meal state (at least two hours without food prior to the experiment) and were randomly assigned to one of four experimental conditions (“low-fat labeling with caloric information”, “low-fat labeling without caloric information”, “regular labeling with caloric information”, and “regular labeling without caloric information”). A pre-weighed glass pitcher of approximately 2530 g of unusual colored M&M’s (teal, silver, and gold) was presented to participants next to a smaller white ceramic bowl, with a taste-rating form and a bottle of water (for participants to drink and cleanse their palates). Leaning on the glass pitcher filled with M&M’s, a large place card (6.5 x 4.5 inches) was displayed. In the [low-fat/regular] labeling condition the place card read “New Colors of [Low-Fat/Regular] M&M’s”. In the two conditions in which participants were informed of the calorie content the place card in the [low-fat/regular] labeling condition read “New Colors of [Low-Fat/Regular] M&M’s – 240 cal per serving; 1.69 oz, ~55 M&M’s”. Furthermore, a short instruction was read aloud to the participants. The instruction differed according to the condition to which the participants were randomly assigned. In the [low-fat/regular] labeling condition, participants were instructed as follows: “The snack food that you are asked to taste today are new colors of [low-fat/regular] M&M’s. You have 15 minutes to taste the M&M’s and rate them. During the 15 minutes of the taste-rating, you can eat as many M&M’s as you would like.” In the two caloric information conditions the following sentence was added: “One serving size (1.69 oz or 47.9 g, which equals about 55 M&M’s) has 240 calories.” The experimenter asked participants to taste and rate the snack food on a taste-rating form and
left the room. After 15 minutes the experimenter re-entered the room, left the questionnaire package with the participants and removed the bowl of M&M’s to measure grams of candy eaten by each participant. Participants completed the questionnaire information and were measured for height and weight following the taste rating task, in order to prevent these assessments from having any potential impact on eating behaviors. The questionnaires from the package were presented in counterbalanced order. Following the experiment and administration of the questionnaires, participants were fully informed about the deception, the exact nature of the deception, and the reason for the deception. Furthermore, participants were presented with a second consent form that explained the deception and its purpose and provided participants with the opportunity to have their data withdrawn from the study. The experimental procedure is displayed in Figure 1.

![Figure 1. Schematic display of the experimental procedures.](image)

**Measures**

**Demographic variables.** Information on age, ethnicity, and dieting status was collected. BMI (measured in kg/m²) was computed from measured height using a stadiometer and measured weight using a digital scale. Furthermore, participants were
asked to indicate when they last ate or drank prior to the experiment and to rate how hungry they were prior to the taste-rating task. A manipulation check was added by including two multiple choice questions: “Were you given caloric information for the M&M’s that you have tried?” (1 = Yes, 2 = No); “What kind of M&M’s did you try?” (1 = Low-Fat, 2 = Regular, 3 = Don’t know/don’t remember). 78% of the current sample correctly identified or remembered their condition.

**Food consumption.** Food consumption was assessed by weighing the glass jar of M&M’s before and after the taste-rating and subtracting any leftover M&M’s, which resulted in total consumption measured in grams.

**Calorie estimates.** Participants read examples on the calorie content of two food products, saying that “One carrot contains approximately 30 calories, whereas one slice of apple pie contains approximately 300 calories” and were then asked to estimate the calorie content of a serving size of the chocolate candy they had tasted (“How many calories do you think are in one serving size (1.69 oz) of the M&M’s that you tried? One serving size equals 55 M&M’s.”).

**Taste-rating form.** The taste-rating form included six items measuring the perceived palatability of the snack tested (good-tasting, salty, sweet, crunchy, bitter, and sour). Items were rated on a 5-point Likert scale from 1 = Not (i.e. good, sweet) at all to 5 = Very (i.e. good, sweet). Sample item: “How good did this snack taste to you?”

**Health attributions.** To assess participants’ perceptions of the snack food, they answered five health- and weight-related questions. Participants were asked to report their opinions about the new snack food tasted on five-point Likert scales. Specifically, they were asked (1) “How healthy is this snack that you tried for you?” (from 1 = very unhealthy to 5 = very healthy), (2) “If you were eating this snack regularly, how would it affect your weight?” (from 1 = I would lose a lot of weight to 5 = I would gain a lot of weight), (3) “Do you think this snack would belong in a healthy diet?” (from 1 = would belong very well to 5 = would not belong at all), (4) “How good or bad for you are “low-fat” foods?” (from 1 = very bad for me to 5 = very good for me) and (5) “How good or bad for you are “high-fat” foods?” (from 1 = very bad for me to 5 = very good for me).

**Associated emotions.** To assess perceived guilt, embarrassment, and regret about food intake during the experiment as well as self-perceived loss of control, participants
were asked (1) “How guilty do you feel about eating the M&M’s?” (from 1 = *very guilty* to 5 = *not at all guilty*), (2) “How embarrassed are you about eating the M&M’s?” (from 1 = *very embarrassed* to 5 = *not at all embarrassed*), (3) “How much do you wish you had not eaten the M&M’s” (from 1 = *very much* to 5 = *not at all*) and (4) “Did you feel as if you lost control over your eating?” (from 1 = *very much* to 5 = *not at all*).

**Eating Attitudes Test.** To assess for possible baseline differences in eating disturbances between experimental groups and to accurately characterize the sample’s patterns of potential eating psychopathology, the Eating Attitudes Test-26 (EAT-26; Garner, Olmsted, Bohr, & Garfinkel, 1982) was administered. The EAT-26 is a 26-item self-report questionnaire designed to assess problematic eating attitudes and behaviors. Responses are rated on a 6-point scale, from 1 = *never* to 6 = *always* and summed for a total score. Sample item: “I find myself preoccupied with food.” Scores equal to or greater than 20 are indicative of problematic eating attitudes and behaviors. The EAT-26 exhibited an internal reliability (Cronbach’s alpha) of .83 in the current sample and convergent and discriminant validity have also been demonstrated previously (Doninger, Enders, & Burnett, 2005; Mintz & O’Halloran, 2000).

**Dutch Eating Behavior Questionnaire.** To further assess participants’ eating behaviors, the restraint subscale of the Dutch Eating Behavior Questionnaire (DEBQ-R; Van Strien, Frijters, Bergers, & Defares, 1986) was administered. The DEBQ-R consists of 10 items (e.g. “If you have put on weight, do you eat less than you usually do?”) Items are scored on a 5-point Likert scale with high scores indicating a high degree of restrained eating. The DEBQ is reported to have excellent factorial validity, satisfactory to good reliability, and satisfactory concurrent and discriminative validity (Van Strien et al., 1986). Cronbach’s alpha in the present sample was .90.

**Barratt Impulsiveness Scale-11.** To assess whether impulsivity was associated with food intake, a measure of trait impulsiveness was included. The Barratt Impulsiveness Scale Version 11 (BIS-11; Patton, Stanford, & Barratt, 1995) is a 30-item questionnaire assessing different dimensions of impulsiveness such as attentional, motor, and nonplanning impulsiveness. Sample items include: “I don’t “pay attention” for the attentional subscale, “I am restless at the theater or lectures” for the motor impulsiveness subscale, and “I am more interested in the present than the future” for the nonplanning
impulsiveness subscale. Items are scored on a 4-point scale ranging from 1 = rarely/never to 4 = almost always/always. Higher scores indicate a higher degree of impulsiveness. BIS-11 total scores between 52 and 71 are considered to be within normal limits for impulsiveness (Stanford et al., 2009). The BIS-11 is reported to have good convergent validity, concurrent validity as well as internal consistency and test–retest reliability (for a review see Stanford et al., 2009). Cronbach’s alpha in the present sample was .81.

**Center for Epidemiologic Studies Depression Scale.** To capture participants’ level of general psychological functioning and to control for possible baseline differences between experimental groups which may have affected the main outcome variables, the Center for Epidemiologic Studies Depression Scale (CES-D; Radloff, 1977) was administered. The CES-D includes 20 items with six scales reflecting major symptoms of depression. Items are scored on a 4-point scale ranging from 0 = rarely or none of the time to 3 = most or all of the time and are summed for a total score (e.g. “I was bothered by things that usually don’t bother me”). The CES-D is reported to have high internal consistency with Cronbach’s alpha coefficients ranging from .85 to .90 across studies (Radloff, 1977). Cronbach’s alpha in the present sample was .87.

**Statistical analyses**

**A-priori power analyses.** The predicted effect size was calculated based on previous data by Provencher et al. (2009) using differences between means of intake (g) of food described as healthy and food described as unhealthy, and this resulted in an effect size of .46 (mean difference: 14.4 g). It was calculated that for a two-tailed test and 5% p-level, 82% power would require 20 participants per cell to detect a statistically significant difference of food intake between experimental groups. These estimates did not take into account the inclusion of covariates, and therefore may actually have been conservative estimates. An additional power analysis using G-Power 3 (Buchner, Erdfelder, & Erdfelder, 1997) indicated that for a two-tailed test and 5% p-level, an effect size of .3 with 95% power would require 50 participants per cell. The current study sample therefore had an adequate sample size to detect small to medium effects.

**Descriptive analyses.** The software program SPSS/PC+ (v.18, SPSS, Inc., Chicago, U.S.A.) was used to analyze the data from the current study. Descriptive statistics were computed for all demographic variables and study measures. Means for
each outcome measure were calculated for use as dependent variables in the analyses. In addition, correlation coefficients were generated for all dependent variables to determine their degree of covariance. A one-way analysis of variance (ANOVA) was performed to assess whether the four conditions were successfully randomized by age, BMI, ratings of hunger, taste preference, as well as mean scores on the EAT-26, DEBQ-R, BIS-11, and CES-D. Further, chi-square tests were calculated to test for group differences for ethnicity and current dieting status.

**Inferential analyses.** The current study utilized a (2x2) factorial design with fat content labeling (low-fat versus regular) as one factor and caloric information (with versus without) as the second factor. ANOVAs were utilized to determine the effects of information on fat and calorie content on the following dependent variables: intake of the chocolate candy (grams consumed), candy ratings (hedonic, sensory attributes, caloric value, healthiness, ability to affect weight, and appropriateness as part of a healthy diet), and associated emotions after eating (feelings of guilt, embarrassment, regret, and loss of control). The ANOVAs contained three effects, a main effect for labeling, a main effect for calories, and an interaction between labeling and calories. First, the ANOVA main effect for fat content labeling determined whether the low-fat labeling groups had different means on the dependent variables from the regular labeling groups irrespective of caloric information. Second, the ANOVA main effect for calorie content determined whether participants in the groups which had caloric information available had different means on the dependent variables from the groups that did not have access to caloric information. Finally, the ANOVA interaction term determined whether the mean dependent variables differed from the value predicted from the knowledge of the main effects of fat content labeling and caloric information.

In case of significant main effects or significant interaction effects univariate two-way analyses of variance were conducted for each of the dependent variables to clarify the directional relationship. For those dependent variables which showed significant main or interaction effects, Bonferroni post-hoc comparisons were performed to reveal significant differences within each independent variable. Partial eta square effect sizes were calculated for all analyses.
**Pilot results.** Preliminary analyses of both male and female study participants indicated that male participants showed no significant differences between experimental conditions and consumed significantly more M&M’s than female participants, independent of condition. In the low-fat labeling conditions male participants (n = 15) consumed on average 65.23 g of M&M’s (SD = 69.32) compared to 66.77 g in the regular labeling conditions (SD = 40.91; n = 18). While it has been demonstrated that people commonly use the fat content of food as a marker for its healthiness (e.g. Carels et al., 2006), research indicates that compared to men, women appear to depend more on fat content information than on other factors when evaluating a food’s healthiness (Oakes & Slotterback, 2001a; Oakes & Slotterback, 2001b; Oakes & Slotterback, 2001c). It has been shown that women try to avoid fat as a method to reduce caloric intake to a greater extent than men and also attach greater importance to healthy eating overall (Liebman, Cameron, Carson, Brown, & Meyer, 2001; Wardle et al., 2004). The current pilot findings suggesting similar food intake across conditions in men are consistent with studies demonstrating that women are more likely to restrict food (Aruguete, Yates, & Edman, 2006), are more dissatisfied with their bodies (e.g. Rozin, Trachtenberg, & Cohen, 2001), and have higher prevalence rates for eating disorders (Hoek & van Hoeken, 2003). Taking these previous findings and our results from preliminary analyses into account, only female participants were included in the main data collection phase.

**Results**

**Descriptive analyses**

Pearson product-moment correlations were calculated between all the dependent variables that were assessed in the current study. As shown in Table 1, food consumption was significantly correlated with taste preference, ratings of hunger, and feelings of loss of control. The correlations indicate that greater taste preference, greater feelings of hunger, and greater perceived loss of control were associated with an increased intake of M&M’s. None of the remaining dependent variables or BMI was significantly correlated with food intake. Higher calorie estimates were significantly related to beliefs that the snack food was unhealthy, would lead to greater weight gain, and greater feelings of loss of control over eating. Further, higher BMI was associated with greater beliefs that regular intake of the snack food would lead to weight gain. In addition, BMI was
significantly correlated with stronger feelings of embarrassment related to eating M&M’s, and higher restraint scores as measured with the DEBQ-R. Feelings of guilt, embarrassment, regret, and loss of control were all positively and significantly correlated and stronger experience of these emotions was associated with higher scores on the EAT-26 and the DEBQ-R. Finally, higher scores on the CES-D were correlated with stronger feelings of guilt, embarrassment, regret, and loss of control as well as with higher scores on the EAT-26, the DEBQ-R, and the BIS-11.
Table 1  
*Pearson product-moment correlations between dependent variables*

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Consumption</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2) Taste preference</td>
<td>0.28a</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3) Calories</td>
<td>-0.05</td>
<td>0.07</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(4) BMI</td>
<td>0.08</td>
<td>-0.06</td>
<td>-0.03</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(5) Hunger</td>
<td>-0.20b</td>
<td>0.00</td>
<td>-0.06</td>
<td>0</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(6) Perceived health</td>
<td>0.10</td>
<td>-0.12</td>
<td>-0.13c</td>
<td>-0.11</td>
<td>-0.05</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(7) Weight influence</td>
<td>-0.06</td>
<td>0.08</td>
<td>0.20b</td>
<td>0.18b</td>
<td>0.11</td>
<td>-0.42b</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(8) Part of healthy diet</td>
<td>-0.07</td>
<td>0.17c</td>
<td>0.08</td>
<td>-0.04</td>
<td>0.17</td>
<td>-0.54b</td>
<td>0.32a</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(9) Good/bad low-fat</td>
<td>0.10</td>
<td>-0.08</td>
<td>0.11</td>
<td>-0.02</td>
<td>-0.07</td>
<td>-0.02</td>
<td>-0.06</td>
<td>-0.01</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(10) Good/bad regular</td>
<td>-0.03</td>
<td>0.10</td>
<td>-0.10</td>
<td>-0.01</td>
<td>-0.02</td>
<td>0.01</td>
<td>-0.12</td>
<td>-0.12</td>
<td>-0.20b</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(11) Guilt</td>
<td>-0.01</td>
<td>-0.09</td>
<td>-0.10</td>
<td>-0.10</td>
<td>-0.03</td>
<td>0.22b</td>
<td>-0.33a</td>
<td>-0.14c</td>
<td>-0.09</td>
<td>0.30a</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(12) Embarrassment</td>
<td>-0.04</td>
<td>0.08</td>
<td>-0.11</td>
<td>-0.16c</td>
<td>0.01</td>
<td>0.11</td>
<td>-0.32a</td>
<td>-0.09</td>
<td>-0.10</td>
<td>0.20b</td>
<td>0.50a</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(13) Regret</td>
<td>0.03</td>
<td>0.00</td>
<td>-0.11</td>
<td>-0.06</td>
<td>-0.11</td>
<td>0.15c</td>
<td>-0.39a</td>
<td>-0.16c</td>
<td>-0.13c</td>
<td>0.24a</td>
<td>0.72a</td>
<td>0.60a</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(14) LOC</td>
<td>-0.17c</td>
<td>0.09</td>
<td>-0.19b</td>
<td>-0.12</td>
<td>0.05</td>
<td>0.18b</td>
<td>-0.33a</td>
<td>-0.07</td>
<td>-0.07</td>
<td>0.21b</td>
<td>0.50a</td>
<td>0.52a</td>
<td>0.53a</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(15) EAT-26</td>
<td>0.01</td>
<td>0.06</td>
<td>0.00</td>
<td>0.12</td>
<td>0.04</td>
<td>-0.17a</td>
<td>0.29a</td>
<td>0.11</td>
<td>-0.02</td>
<td>-0.25a</td>
<td>-0.53a</td>
<td>-0.41a</td>
<td>-0.43a</td>
<td>-0.36a</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(16) DEBQ-R</td>
<td>0.01</td>
<td>-0.03</td>
<td>0.05</td>
<td>0.25a</td>
<td>0.06</td>
<td>-0.11</td>
<td>0.25a</td>
<td>0.02</td>
<td>0.07</td>
<td>-0.27a</td>
<td>-0.51a</td>
<td>-0.39a</td>
<td>-0.40a</td>
<td>-0.41a</td>
<td>0.58a</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(17) BIS-11</td>
<td>-0.05</td>
<td>0.08</td>
<td>-0.01</td>
<td>0.10</td>
<td>0.00</td>
<td>-0.09</td>
<td>0.03</td>
<td>0.05</td>
<td>-0.05</td>
<td>-0.02</td>
<td>0.01</td>
<td>-0.03</td>
<td>-0.02</td>
<td>0.01</td>
<td>0.01</td>
<td>0.02</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>(18) CES-D</td>
<td>-0.02</td>
<td>0.04</td>
<td>-0.08</td>
<td>0.04</td>
<td>-0.11</td>
<td>-0.05</td>
<td>0.09</td>
<td>0.04</td>
<td>-0.02</td>
<td>-0.06</td>
<td>-0.23b</td>
<td>-0.24a</td>
<td>-0.22b</td>
<td>-0.17c</td>
<td>0.30a</td>
<td>0.19b</td>
<td>0.15c</td>
<td>-</td>
</tr>
</tbody>
</table>

*Note:* Values displayed in bold are statistically significant. Calories = Calorie estimates; BMI = Body Mass Index; LOC = Loss of Control; EAT-26 = Eating Attitudes Test; DEBQ = Dutch Eating Behavior Questionnaire; BIS-11 = Barratt Impulsiveness Scale; CES-D = Center for Epidemiologic Studies Depression Scale; a = p < 0.001; b = p < 0.01; c = p < 0.05
Table 2 presents descriptive characteristics of the sample in each experimental condition. No significant differences were observed between experimental groups for age, BMI, ratings of hunger, eating disorder symptomatology, restrained eating, impulsivity, and depressive symptoms.

Table 2

Descriptive characteristics for each of the four experimental conditions

<table>
<thead>
<tr>
<th></th>
<th>Low-fat</th>
<th></th>
<th>Regular-fat</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>With caloric information</td>
<td>Without caloric information</td>
<td>With caloric information</td>
</tr>
<tr>
<td>(n = 56)</td>
<td>(n = 56)</td>
<td>(n = 56)</td>
<td>(n = 56)</td>
</tr>
<tr>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td>Age (yrs)</td>
<td>21.14 (3.99)</td>
<td>20.82 (3.46)</td>
<td>21.12 (5.59)</td>
</tr>
<tr>
<td>BMI (kg/m^2)</td>
<td>22.55 (5.20)</td>
<td>23.65 (4.49)</td>
<td>22.58 (2.99)</td>
</tr>
<tr>
<td>Hunger</td>
<td>2.98 (1.29)</td>
<td>2.93 (1.20)</td>
<td>2.84 (1.25)</td>
</tr>
<tr>
<td>EAT-26</td>
<td>9.11 (8.43)</td>
<td>10.57 (7.96)</td>
<td>9.52 (9.50)</td>
</tr>
<tr>
<td>DEBQ-R</td>
<td>2.70 (.93)</td>
<td>2.82 (.74)</td>
<td>2.57 (.78)</td>
</tr>
<tr>
<td>BIS-11</td>
<td>2.13 (.27)</td>
<td>2.12 (.32)</td>
<td>2.11 (.35)</td>
</tr>
<tr>
<td>CES-D</td>
<td>14.02 (7.43)</td>
<td>15.00 (8.58)</td>
<td>13.68 (9.41)</td>
</tr>
</tbody>
</table>

Note: BMI = Body Mass Index; EAT-26 = Eating Attitudes Test; DEBQ-R = Dutch Eating Behavior Questionnaire Restraint subscale; BIS-11 = Barratt Impulsiveness Scale; CES-D = Center for Epidemiologic Studies Depression Scale.

Effects of low-fat labeling and caloric information on food intake

Results of the manipulation check revealed that 175 out of 224 participants accurately identified whether they were presented with low-fat versus regular labeled M&M’s and whether they had caloric information available or not. To ensure that correct identification of the condition did not alter the results of the main outcome measures, two conditions were created. The “intention to treat” condition consisted of all 224 participants, whereas the “actual treatment” condition only included the 175 participants.
who correctly identified their experimental conditions. This analysis resulted in the same findings for both the “intention to treat” and the “actual treatment” condition; therefore, only the results for the full sample including all 224 participants will be reported below.

Participants in the low-fat labeling conditions consumed an average of 38.22 g ($SD = 27.65$) when they were unaware of the calorie content and an average of 34.41 g ($SD = 24.77$) when they had access to caloric information. In the regular labeling conditions, participants ate an average of 34.36 g ($SD = 27.14$) when they were unaware of the calorie content and an average of 31.75 g ($SD = 21.29$) when they had access to caloric information. Mean consumption of M&M’s in grams for each of the four conditions is displayed in Figure 2. A 2x2 ANOVA with M&M consumption in grams as dependent variable and fat content labeling and caloric information as independent variables revealed no significant main effects for labeling ($F(1,223) = 0.93, p = .34, \eta^2 = .004$) or caloric information ($F(1,223) = 0.90, p = .34, \eta^2 = .004$). The interaction effect was also not significant ($F(1,223) = 0.31, p = .86, \eta^2 = .000$).

Even though the differences in food intake across conditions did not reach statistical significance, participants in the low-fat labeling conditions consumed on average 8.98% more than participants in the regular labeling conditions (equal to 16.34 more calories). In the low-fat conditions participants consumed on average 9.97% fewer M&M’s (equal to 19.08 fewer calories) when they were aware of the actual calorie content of the candy, while participants in the regular labeled conditions consumed 7.60% fewer M&M’s (equal to 13.10 fewer calories) when they were informed about the M&M’s energy density. The largest difference was found between the low-fat labeling condition without access to caloric information and the regular labeling condition with added caloric information. Participants in the low-fat condition who were unaware of the calorie content consumed 16.91% more M&M’s (equal to 32.47 calories) compared to participants in the regular labeling condition who had caloric information available.
Effects of low-fat labeling and caloric information on calorie estimates

Participants who were unaware of the calorie content of the M&M’s estimated that low-fat labeled M&M’s would contain an average of 166.96 calories per serving size (SD = 95.76), whereas regular-labeled M&M’s were estimated to contain an average of 261.29 calories per serving size (SD = 192.47). In the two conditions in which participants were informed of the energy density of the M&M’s, calorie estimates were more accurate. Low-fat labeled M&M’s were estimated to contain an average of 225.39 calories per servings size (SD = 76.30), similar to estimates for regular labeled M&M’s (M = 229.95; SD = 92.98). Participants’ mean calorie estimations for one serving size of the M&M’s they tasted are displayed in Figure 3.

Figure 2. Mean consumption of M&M’s in grams in the four different conditions. Error bars indicate standard errors of the mean.
A 2x2 ANOVA with estimated calorie content as the dependent variable and fat content labeling and caloric information as independent variables indicated a significant main effect for fat content labeling \((F(1, 223) = 5.71; p < .01; \eta^2 = .04)\) and a significant interaction effect between fat content labeling and caloric information \((F(1, 223) = 7.44; p < .01; \eta^2 = .41)\). The main effect for caloric information was not significant \((F(1, 223) = 0.68; p = .41; \eta^2 = .003)\). The interaction effect indicates that for participants who did not have access to caloric information, low-fat labeled M&M’s led to lower calorie estimates than regular labeled M&M’s. For participants who were aware of the calorie content, labeling had no effect on calorie estimates. The interaction effect is displayed in Figure 4.

*Figure 3.* Mean calorie estimation across conditions. Error bars indicate standard errors of the mean.
Effects of low-fat labeling and caloric information on taste preference

Mean ratings for taste preference ("How good did the snack that you tried taste to you?") are depicted in Figure 5.

A 2x2 ANOVA with taste preference as dependent variable indicated a significant main effect for fat content labeling ($F(1,223) = 14.51; p < .01; \eta^2 = .06$) and caloric information ($F(1,223) = 6.53; p < .05; \eta^2 = .03$) as well as a significant interaction effect for fat content labeling and caloric information ($F(1,223) = 6.10; p < .05; \eta^2 = .03$). This
indicates that for participants who did not have access to caloric information, fat content labeling did not have an effect on taste preference. For participants who were aware of the calorie content, fat content labeling had an effect on taste preference. This interaction is displayed in Figure 6. No significant differences were found between conditions for ratings of saltiness, sweetness, crunchiness, bitterness or sourness.

\[ F(1, 223) = 28.43; p < .01; \eta^2 = .11 \]

\[ F(1, 223) = 2.07; p = .15; \eta^2 = .01 \]

\[ F(1, 223) = 1.21; p = .27; \eta^2 = .00 \]

Similarly, there was a main effect for fat content labeling when question two (“If you were eating this snack regularly, how would it affect your weight?”) was entered as a dependent variable.
(F(1,223) = 4.63; p < .05; ηp² = .02), suggesting that participants thought they would gain more weight if they were eating the regular labeled M&M’s compared to the low-fat labeled M&M’s. The main effect for caloric information (F(1,223) = 0.60; p = .44; ηp² = .00) and the interaction effect were not significant (F(1,223) = 0.60; p = .44; ηp² = .00). Further, when examining question three (“Do you think this snack would belong in a healthy diet?”) as a dependent variable, a significant main effect for fat content labeling was found (F(1,223) = 9.48; p < .01; ηp² = .04), with participants in the low-fat labeling conditions expressing stronger beliefs that the snack would belong in a healthy diet. The main effect for caloric information (F(1,223) = 2.98; p = .09; ηp² = .01) and the interaction effect were not significant (F(1,223) = 0.05; p = .82; ηp² = .00). Entering question four (“How good or bad for you are “low-fat” foods?”) as a dependent variable resulted in a significant main effect for fat content labeling (F(1,223) = 12.15; p < .01; ηp² = .05), indicating that participants in the regular labeling conditions rated low-fat foods as better for them than participants in the low-fat labeling conditions. The main effect for caloric information (F(1,223) = 1.12; p = .29; ηp² = .00) and the interaction effect were not significant (F(1,223) = 0.21; p = .65; ηp² = .00). Finally, examining question five (“How good or bad for you are “high-fat” foods?”) resulted again in a main effect for fat content labeling (F(1,223) = 4.84; p < .05; ηp² = .02), suggesting that participants in the regular labeling conditions rated high-fat foods as better for them than participants in the low-fat labeling conditions. The main effect for caloric information (F(1,223) = 0.01; p = .93; ηp² = .00) and the interaction effect were not significant (F(1,223) = 1.74; p = .19; ηp² = .01).
Effects of low-fat labeling and caloric information on associated emotions

Separate 2x2 ANOVAs revealed no significant main effects for fat content labeling and caloric information when items assessing feelings of guilt, embarrassment, regret, and loss of control over eating were entered as dependent variables. F-values, significance levels, and effect sizes are displayed in Table 3.
Table 3

ANOVA table with feelings of guilt, embarrassment, regret, and perceived loss of control as dependent variables

<table>
<thead>
<tr>
<th>Dependent variables</th>
<th>Main effects</th>
<th>Interaction effects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Labeling</td>
<td>Calories</td>
</tr>
<tr>
<td></td>
<td>F(df1,df2)</td>
<td>p-value (ηp²)</td>
</tr>
<tr>
<td>Guilt</td>
<td>0.12 (1,223)</td>
<td>0.73 (0.00)</td>
</tr>
<tr>
<td>EMBR</td>
<td>1.97 (1,223)</td>
<td>0.16 (0.01)</td>
</tr>
<tr>
<td>Regret</td>
<td>0.11 (1,223)</td>
<td>0.74 (0.00)</td>
</tr>
<tr>
<td>LOC</td>
<td>0.35 (1,223)</td>
<td>0.55 (0.00)</td>
</tr>
</tbody>
</table>

Note: EMBR = Embarrassment; LOC = Loss of Control

Analyses of covariates

All dependent variables as well as BMI and age were entered as covariates in separate 2x2 ANCOVAs with food intake as independent variable and fat content labeling and caloric information as fixed factors. As displayed in Table 4, neither the main effects for fat content labeling and caloric information nor the interaction effect were significant for any of the ANCOVAs.
Table 4

**ANCOVA table with food consumption as independent variable**

<table>
<thead>
<tr>
<th>Covariates</th>
<th>Main effects</th>
<th>Interaction effects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Labeling</td>
<td>Calories</td>
</tr>
<tr>
<td></td>
<td>F(df1,df2)</td>
<td>p-value (ηp²)</td>
</tr>
<tr>
<td>BMI</td>
<td>0.69 (4,223)</td>
<td>0.41 (0.00)</td>
</tr>
<tr>
<td>Hunger</td>
<td>1.33 (4,223)</td>
<td>0.25 (0.01)</td>
</tr>
<tr>
<td>Taste</td>
<td>0.01 (4,223)</td>
<td>0.92 (0.00)</td>
</tr>
<tr>
<td>Guilt</td>
<td>0.93 (4,223)</td>
<td>0.34 (0.00)</td>
</tr>
<tr>
<td>EMBR</td>
<td>0.82 (4,223)</td>
<td>0.37 (0.00)</td>
</tr>
<tr>
<td>Regret</td>
<td>0.95 (4,223)</td>
<td>0.33 (0.00)</td>
</tr>
<tr>
<td>LOC</td>
<td>0.76 (4,223)</td>
<td>0.38 (0.00)</td>
</tr>
<tr>
<td>EAT-26</td>
<td>2.35 (4,222)</td>
<td>0.25 (0.01)</td>
</tr>
<tr>
<td>DEBQ-R</td>
<td>0.97 (4,223)</td>
<td>0.32 (0.00)</td>
</tr>
<tr>
<td>BIS-11</td>
<td>1.46 (4,217)</td>
<td>0.23 (0.01)</td>
</tr>
<tr>
<td>CES-D</td>
<td>1.72 (4,217)</td>
<td>0.19 (0.01)</td>
</tr>
</tbody>
</table>

*Note:* BMI = Body Mass Index; Taste = Taste preference; EMBR = Embarrassment; LOC = Loss of Control; EAT-26 = Eating Attitudes Test; DEBQ-R = Dutch Eating Behavior Questionnaire Restraint Subscale; BIS-11 = Barratt Impulsiveness Scale; CES-D = Center for Epidemiologic Studies Depression Scale.
Discussion

Effects of low-fat labeling on food intake

The results of the present study did not support the prediction that low-fat labeling of chocolate candy leads to higher food intake relative to regular labeled chocolate, which is inconsistent with previous research (Wansink & Chandon, 2006). While participants in the current study consumed on average 16 more calories when they assumed they were eating low-fat chocolate candy as opposed to regular chocolate candy, this difference did not reach statistical significance. Participants in Wansink and Chandon’s (2006) study consumed 54 more calories when they believed themselves to be eating low-fat M&M’s versus regular M&M’s. However, an interaction with weight status revealed that the difference in consumption only reached significance among overweight participants and that normal-weight participants only consumed 30 more calories in the low-fat labeling condition than in the regular labeling condition (Wansink & Chandon, 2006).

While Wansink and Chandon’s (2006) overall findings are of great interest, they should be interpreted with caution. According to their study procedures, participants served themselves M&M’s that were located in gallon-size bowls either labeled as “New ‘Low-Fat’ M&M’s” or as “New Colors of Regular M&M’s” (Wansink & Chandon, 2006). The self-served amount of M&M’s was then weighed and used as a measure of “consumed” M&M’s. However, even though Wansink and Chandon (2006) emphasize that almost all participants finished their M&M’s following the debriefing; at the time that food intake was measured, participants had not actually consumed any M&M’s. In contrast, the current study assessed actual food intake that took place before participants were aware of the experimental conditions. In addition, in the present study participants were alone when they served themselves M&M’s, which may have influenced participants’ intake in that they felt more comfortable serving themselves larger amounts of regular M&M’s because they were not being observed. In contrast, in Wansink and Chandon’s (2006) study participants were accompanied by a research assistant when they served themselves the chocolate candy. Further, and perhaps more importantly, the sample characteristics in the present study differed significantly from Wansink and Chandon’s (2006) sample. Participants in the current study included female undergraduate students with a mean age of 20.7 years while Wansink and Chandon
(2006) included a more heterogeneous sample with a mean age of 31 years. Young adults may be less concerned about the implications of a food product on weight gain. According to the Health Belief Model (HBM), people are more likely to change their potentially unhealthy behaviors such as eating high caloric foods, when they believe that a certain condition (e.g. obesity) is serious as well as relevant to them (Baranowski, Cullen, Nicklas, Thompson, & Baranowski, 2003). It has been suggested that adolescents may not feel susceptible to obesity (Baranowski et al., 2003), which may make the HBM less applicable to the current sample of young adults. Participants in Wansink and Chandon’s (2006) study may have shown changes in their behavior following exposure to a low-fat label, because they may consider obesity as a more serious threat to them and also may feel more susceptible to gaining weight, while young adults in their early twenties may not perceive obesity as an imminent threat. Nevertheless, young female adults are considered at risk for the development of an eating disorder (Hoek & van Hoeken, 2003); a factor which may also influence intake of low-fat versus regular labeled products and is discussed below.

**Effects of caloric information on food intake**

Providing caloric information and adding this information to menus has been suggested to improve people’s nutritional awareness and to reduce their energy intake. The present study aimed to examine if the display of calorie content would result in participants consuming less chocolate candy than in conditions when they were unaware of energy density. Further, the current study investigated whether the provision of calorie content reduces the “health halo” effect that has been observed in previous studies (Chandon & Wansink, 2007). The results of the present study suggest that participants did not consume significantly fewer M&M’s when they were aware of the candy’s calorie content. In addition, no interaction between low-fat labeling and caloric information was observed. Studies on caloric information have resulted in mixed findings (Chandon & Wansink, 2011; Larson & Story, 2009). While some studies reported that calorie labeling led customers to order food with lower calories (Roberto et al., 2010), others did not find a difference in the caloric amount of food choices between consumers who had access to caloric information compared to a control group who was unaware of the food’s energy density (Harnack et al., 2008). A recent study compared calorie content
of lunch time purchases across 11 restaurant chains in 168 locations in 2007, shortly before the implementation of New York’s calorie labeling policy, and in 2009, following the new calorie labeling regulations (Dumanovsky et al., 2011). No significant difference was found in the calorie content of food choices; however, the authors point out that those customers who actively considered energy density as a factor in their decision making process ordered lower calorie options (Dumanovsky et al., 2011). This suggests that availability of calorie content alone may not impact consumers’ choices, but that this information needs to be actively processed to change behaviors. In the present study, the majority of participants who were informed about the calorie content of the M&M’s, accurately repeated this information later in the experiment when they were asked to estimate the energy density of the snack food they had tried. This indicates that participants had acknowledged and retained the caloric information; however, it was not assessed whether they actively used this knowledge to regulate their food intake. Future studies should explore to what extent consumers make use of caloric information and what distinguishes individuals who utilize this information from others who do not. Such factors may include weight status or weight and shape concerns.

In addition, participants in the current study may have not been affected by the calorie content of a food product that is commonly expected to be high in calories. To further examine the interaction between low-fat and calorie labeling, the inclusion of an additional condition in which participants are presented with chocolate candy that is labeled as low-fat and also actually has lower calories than the regular version, may be beneficial. However, one of the aims of the current study was to investigate if knowledge of calorie content would reduce the “health-halo” effect that is commonly induced by low-fat labels. Candy that is high in sugar (e.g. candy licorice) is often advertised as “low-fat”, even though no regular- or high-fat versions of this product exist. This may lead consumers not only to believe that they are choosing a healthier version, but also that the candy is lower in calories than it would be if they were to choose the regular version. Evidence for this can be found in the findings of the present study.

**Effects of low-fat labeling and caloric information on calorie estimates**

When participants in the current study were unaware of the calorie content of the M&M’s they underestimated the energy content of supposedly low-fat M&M’s by an
average of 73 calories, whereas they overestimated the caloric value of regular M&M’s by an average of 21 calories. Wansink and Chandon (2006) examined whether low-fat labeling may lead to an increase in consumption to an extent that would cancel out the potentially lower calorie content of actual low-fat foods. In their market survey, they identified 17 different types of chocolate products (e.g. candy, bars) that were offered in a low-fat as well as a regular version (Wansink & Chandon, 2006). While the low-fat options did indeed have 59% less fat per serving, the caloric difference from the regular versions was a mere 15%. Based on these findings, actual low-fat M&M’s would contain 204 calories per serving size as opposed to 240 calories in the regular version. If actual low-fat M&M’s would have been utilized in the current study, participants in the low-fat conditions would have consumed an average of 154.62 calories (4.26 calories per gram) while participants in the regular labeled conditions would have consumed an average of 165.58 calories (5.01 calories per gram). This indicates that participants in the low-fat conditions would have consumed only 6.61% fewer calories than participants in the regularly labeled conditions if they would have eaten actual low-fat M&M’s. As Wansink and Chandon (2006) pointed out, these numbers may be an underestimation, based on studies showing that fat is often replaced with sugar which may result in the low-fat version having a similar calorie content as the regular version of a product (e.g. low-fat Oreos; Nestle, 2002).

The present study clearly supports the hypothesis that people tend to underestimate the calorie content of low-fat foods. While our findings do not support the conclusion that this underestimation is linked to a change in behavior by increasing consumption of low-fat foods, this may be due to other factors such as the laboratory setting of the study. Again, based on the market average, actual low-fat M&M’s would contain 36 fewer calories per serving size than regular M&M’s. Participants in the present study, however, underestimated the caloric value of low-fat M&M’s by 73 calories, overestimating the effect that low-fat content would have on caloric value by almost 50%.

**Effects of low-fat labeling and caloric information on taste preference**

Interestingly, the results of the present study suggest that people perceive chocolate candy that is labeled as low in fat as better tasting than regular labeled candy
when they were aware how many calories the snack contained. Given that the product utilized in this study was exactly the same, only labeled differently, this finding is of even more interest. A previous study demonstrated that people expected potato chips which claimed to contain 25% fat to taste better than chips labeled as 75% lean (Wertenbroch, 1998), showing that labeling and fat perceptions may alter taste preferences. This may seem surprising given that research suggests that people prefer actual high-fat foods (Drewnowski, 1997), but indicates that cognitive factors such as expected consequences of consumption may play an important role in taste preferences. The interaction between hedonic qualities and cognitive factors was examined in a study by Bowen and colleagues (2003). Female participants in this study received either a low-fat or a high-fat milkshake and were either accurately or inaccurately told that they were going to consume a high-fat or low-fat milkshake (Bowen et al., 2003). Participants consumed more of the high-fat milkshakes and also rated those milkshakes more positively than women who had consumed low-fat milkshakes. However, when participants were told that they were drinking a low-fat milkshake that was actually high-fat, they rated those supposedly low-fat milkshakes as better tasting than women who were told accurately that they were consuming a high-fat milkshake (Bowen et al., 2003). These findings may indicate that while there is a taste preference for high-fat foods, this hedonic preference may be overridden by cognitive factors.

The results of the present study are partially consistent with this hypothesis. While participants did not rate chocolate candy labeled as low-fat as better tasting than regular labeled candy when they were unaware of the calorie content of the regular M&M’s, they did so when they knew how many calories the regular labeled M&M’s contained. This indicates that cognitive factors such as knowledge of energy density may have altered participants’ hedonic perceptions. Possible reasons for this change may be associations between calorie content and health attributions.

Effects of low-fat labeling and caloric information on health attributions

Consistent with previous research (Carels et al., 2006; Oakes & Slotterback, 2001a, 2002; Provencher et al., 2009), participants in the present study rated M&M’s that were labeled as low-fat as healthier, believed they would affect their weight less, and thought they would be more appropriate as part of a healthy diet in comparison to regular
labeled M&M’s. According to the “health halo” effect, people generalize health claims made by restaurants and food manufacturers and apply them to other categories such as energy density (Chandon & Wansink, 2007), which may then lead to an increase in consumption. While the current findings support the hypothesis of a “health halo” for low-fat foods, they do not provide evidence for a link to actual consumption as health attributions were not associated with food intake in the current study. Interestingly, knowledge of the actual calorie content did not interact with health attributions, suggesting that fat content may be a more powerful determinant of health attributions than calorie content. If there is an actual causal link between health attributions and food intake, then this finding may have significant implications for the recent debate on calorie labeling policies. According to the findings of the present study, people base their judgment of a food’s healthiness on the fat content and are less impacted by calorie labeling. This indicates that efforts at increasing the public’s nutritional awareness may be better directed at brand labeling and health claims such as “low-fat”, “reduced fat”, or “organic”, instead of primarily focusing on calorie labeling.

**Effects of low-fat labeling and caloric information on associated emotions**

The present study also examined the associations between feelings of guilt, embarrassment, regret, loss of control and food intake. Wansink and Chandon (2006) introduced the concept of anticipated guilt in an effort to provide a model that may explain the mechanisms through which low-fat claims increase food consumption. It is assumed that feelings of guilt mediate the relationship between low-fat labels and food intake and that this association will be stronger for foods that are considered hedonic (e.g. high-fat products such as chocolate) relative to foods that are described as utilitarian (e.g. healthy foods such as granola; Wansink & Chandon, 2006). Indeed, it has been demonstrated that people predicted they would feel less guilty about consuming low-fat labeled M&M’s as opposed to regular labeled M&M’s (Wansink & Chandon, 2006). This effect was not replicated in the current study and may be due to an important distinction in methodological approaches. In previous studies guilt was assessed before the actual consumption (Wansink & Chandon, 2006), whereas the current study measured these emotions following the consumption of chocolate candy. It is possible that participants reported feeling low levels of guilt, embarrassment, and regret in an effort to rationalize
their consumption, which may explain why the current results differ from studies in which guilt was assessed as anticipated consumption guilt. Not surprisingly, feelings of loss of control were related to higher consumption in the present study; however, no effect of fat content labeling or caloric information on loss of control was found. Similarly, the present study suggests that participants felt more embarrassed about eating the chocolate candy when they had a higher BMI; again, this relationship was not affected by fat content or calorie labeling.

**Relationship between eating disordered attitudes and behaviors and food intake**

The current study examined whether eating disordered attitudes and behaviors were associated with food intake and it was hypothesized that individuals with these concerns may be more impacted by low-fat labeling. The current study failed to show a relationship between eating disordered attitudes and behaviors and food intake. This may be explained by the relatively low expression of eating disordered concerns in the current sample. Participants scored low on the EAT-26 ($M = 9.28, SD = 8.18$), with means comparable to a previously assessed sample of non-eating-concerned individuals ($M = 9.9, SD = 9.2$), but significantly lower than women who were diagnosed with an eating disorder ($M = 36.1, SD = 17.0$; Garner et al., 1982). Future studies should explore the relationship of fat content and calorie labeling and intake in a sample of high-risk individuals, who express high weight and shape concerns since they may be more affected by fat content labeling and caloric information.

**Implications for Obesity Prevention**

The present study adds to the literature examining the impact that our current obesogenic environment has on food intake. Specifically, the interaction between environmental cues such as low-fat labeling and caloric information on food intake was examined. While it is clear that the increasing prevalence of overweight and obese people is partially related to a decrease in physical activity (Caballero, 2007), environmental factors such as increasing portion sizes and availability of palatable, high calorie foods are also contributing factors to the recent obesity epidemic. The current study supports the hypothesis that low-fat labeling is associated with a significant underestimation of calorie content. Participants in the current study underestimated the effect that actual low-fat content would have on energy density by almost 50%. If people constantly
underestimate the calorie content of food products that contain health claims such as “low-fat”, then this may lead to gradual changes in their eating behaviors and may ultimately affect their weight. Katan and Ludwig (2010) describe how slight daily changes such as the addition of one ounce of a sugar-sweetened drink (which could potentially be advertised as low-fat) and decreasing exercise by walking one minute less can lead to weight gain of 35 pounds over a span of 28 years. It can be assumed that those are conservative estimates and that changes in eating behaviors due to health claims may have even more significant implications on weight gain. While the present study failed to show a link between calorie underestimation and actual changes in eating behaviors, previous research with more heterogeneous samples has provided evidence in this respect (Wansink & Chandon, 2006). Public health initiatives concerning the prevention and treatment of obesity may be more successful if they address the caloric biases that people display when they are presented with health claims. Specifically, the difference between energy and fat content and their distinct impact on weight gain should be emphasized. The public may also benefit from education surrounding health claims such as “organic” or “low-carbohydrate”. Such health claims are increasingly marketed and largely displayed on food products and may also lead people to believe that these foods are low in calories or healthier, as has been demonstrated for low-fat labels in the present study.

**Strengths and Limitations**

The present study has several strengths, including its experimental design, which allowed the examination of multiple variables such as low-fat labeling and caloric information in a controlled laboratory environment. Further, the current study measured actual food consumption as opposed to anticipated consumption or served amount. In addition, the present findings add to the growing literature on environmental factors that may impact eating behaviors by examining the interaction between health claims such as “low-fat” and calorie labeling. The current study also included an ethnically diverse sample, a factor that may distinguish it from previous research and which may have also impacted the results in different ways. However, due to the relatively small sample size within each ethnicity, the present study is unable to answer how ethnicity may be associated with concerns for low-fat labels and calorie content.
While the experimental design of the present study may be viewed as one of its strengths, it also adds to its limitations. The external validity and generalizability of findings obtained in a laboratory setting have been questioned, particularly when measuring food intake (Meiselman, 1992). Laboratory studies such as the present one may also alter eating behaviors because of social desirability and demand characteristics. It has been suggested that social desirability may affect food intake in that women decrease their consumption to appear more feminine; however this effect may only be apparent in the presence of a person of the opposite sex (Stroebele & De Castro, 2004). While participants were alone during the actual taste-rating, they may have been concerned that the research assistants, who were close in age to them, would take note of their food consumption following the experiment, which may also explain the link between social desirability and food intake. It has been demonstrated that people who were asked to track their intake consumed less or underreported foods that were perceived as high in fat and that this may be related to social desirability (Scagliusi, Polacow, Artioli, Benatti, & Lancha, 2003). Other variables such as the physical environment of the experiment including room color and lighting may also influence food consumption in laboratory settings (Stroebele & De Castro, 2004). Further, it should be noted that the questionnaires assessing health attributions and associated emotions, while being based on previous research (Provencher et al., 2009; Wansink & Chandon, 2006), were developed by the author of the current study, consequently limiting their reliability and validity.

Adding to its limitations, the current study examined the effects of fat content and calorie labeling on only one type of food (chocolate candy). For one, familiarity with a food product may influence intake (Stubbs, Johnstone, O’Reilly, & Poppitt, 1998) and was not assessed in the present study. It has also been shown that habit strength impacts eating behaviors (Neal, Wood, Wu, & Kurlander, 2011). Accordingly, participants who were used to regularly consume M&M’s may have been less attuned to the low-fat label and may have just automatically repeated their past consumption behaviors. In addition, it has been noted that laboratory studies do not tend to offer a range of foods and participants may feel compelled to consume foods they typically would not chose (Meiselman, 1992). Based on concepts such as psychological reactance (Brehm, 1966), it
has also been suggested that reducing participants’ food options in a laboratory setting may decrease palatability (Tanofsky-Kraff, Haynos, Kotler, Yanovski, & Yanovski, 2007). Field studies in which the fat content and availability of calorie content for a variety of different foods are manipulated may be more sensitive in detecting actual changes in eating behaviors.

Finally, the current study focused on a sample of female undergraduate students. However, future research may benefit from the inclusion of other, potentially high-risk groups that may be more concerned about health claims (e.g. athletes, dieters, overweight individuals).

**Future Research Directions**

Future studies examining the interaction between low-fat and calorie labeling may benefit from including foods that are more commonly advertised as low-fat such as ice-cream or candy licorice. Participants in the present study may have not been convinced by the experimental manipulation, because chocolate based products are less commonly advertised as low-fat than other types of candy. This may explain why a previous study using oatmeal cookies that were described as low versus high in fat found a 35% consumption increase in the low-fat condition (Provencher et al., 2009). Manipulating the fat content in cookies may have been more believable than presenting candy that does not exist in a low-fat version.

The present study suggests that health claims such as “low-fat” influence health attributions and lead to an underestimation of calories. Future studies should include foods that include other health claims such as “low-carbohydrate” or “low-sodium” and examine their impact on food intake. Further, the current findings suggest that knowledge of calorie content may not be as salient to people as has been previously assumed. It would be of great benefit if future research would not only focus on the impact that calorie labeling may have on food intake, but would also include and compare the effects of nutritional health claims on consumption since they may override considerations for energy density. Such research may be better able to guide public health initiatives and may suggest that the public should be educated more on brand labeling and health claims such as “low-fat”, “reduced fat”, or “organic”, instead of primarily focusing on calorie labeling. Alternatives to calorie labeling such as front-of-pack ‘traffic-light’ nutrition
labeling that have been implemented in the United Kingdom (Sacks, Rayner, & Swinburn, 2009) should also be further investigated to elucidate if they provide consumers with more salient information than fat content or calorie labeling.

Several solutions have been suggested to address the common misconceptions of consumers about caloric value. For one, it has been proposed that serving sizes could be adjusted to reflect nutritional claims such as “low-fat” and to compensate for possible overconsumption of such products (Wansink & Chandon, 2006). Second, future studies should explore if consumers are able to make more balanced decisions if they are provided with more information on low-fat claims (e.g. on the percentage that the low-fat version is reduced in comparison to the regular one). Another important area for future research would be to examine consumers’ nutritional knowledge and to investigate whether people who are more knowledgeable about nutritional needs are less susceptible to relative nutritional claims. If research confirms that nutritional knowledge acts as a protective buffer from displaying a “health halo” and overgeneralizing health claims, then this may have significant implications for future public health campaigns. Therefore, future studies should add conditions in which people are educated about basic nutritional principles and average caloric needs and study the interaction between such an intervention and low-fat or calorie labeling on food intake.

It has also been suggested that objective serving-size information may provide a more salient and reliable tool for customers than low-fat labels when they are trying to determine appropriate serving sizes (Wansink & Chandon, 2006). Indeed, it has been shown that presenting people with objective serving size information reduced the effect that low-fat labeling had on the consumption of granola (Wanskin & Chandon, 2006). Future studies should focus on the interaction between serving-size information and health claims such as low-fat and examine how they affect food intake.

Finally, future studies would benefit from assessing how low-fat labeling and caloric information affect subsequent meals. Choosing foods that are low in fat or lower in calories than other options may lead people to feel more justified in making higher caloric choices in subsequent meals and may eliminate the effects of earlier low caloric intake. The present study was only able to examine individuals’ food intake during a single, laboratory-based eating occasion. However, future research would benefit from
investigating long term effects that low-fat and calorie labeling may have on subsequent food decisions as this may have significant implications for obesity prevention and treatment.

**Conclusions**

The present study provides some tentative empirical evidence on the role of low-fat claims and calorie information on food consumption. While the effects of fat content labeling and caloric information on food consumption did not reach statistical significance, the findings of the current study lend clinical significance to several areas. First, the present study demonstrates that people significantly underestimate the calorie content of low-fat foods, which may be related to health attributions such as greater attributed healthiness of low-fat foods or lower perceived ability to affect one’s weight. Second, to our knowledge, the present study is the only published attempt to examine the interaction between fat content and calorie labeling. The powerful effects of low-fat labeling on food intake have been established in several previous studies, while the impact of calorie labeling on food intake is still unclear. The present study adds to the research base by comparing these two factors and provides preliminary evidence that while fat content labeling and caloric information did not affect food intake in female college undergraduate students, low-fat labeling may be a more powerful determinant in the way people make health attributions than caloric information. Future research should expand on this finding by examining the interaction of fat content and calorie labeling on food intake in more real-life, non-laboratory settings.
References


