

**"Healthy," "Diet," or "Hedonic": How nutrition claims affect food-related perceptions and intake?**

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## **Abstract**

The main purpose of this study was to investigate the impact of nutrition claims on food perceptions and intake among adult men and women, during *ad libitum* snacks. In a 3 (healthy vs. diet vs. hedonic) by 2 (normal-weight vs. overweight/obese) by 2 (unrestrained vs. restrained eaters) factorial design, 164 men and 188 women were invited to taste and rate oatmeal-raisin cookies. Despite the fact that the cookies were the same in all conditions, they were perceived as being healthier in the “healthy” condition than in the “diet” and “hedonic” conditions. The caloric content was estimated as higher by participants in the “hedonic” than in the “healthy” condition, by women than by men, and by restrained than by unrestrained eaters. Although measured *ad libitum* cookie intake did not differ as a function of experimental condition, overweight restrained men ate more than did women from each BMI and restraint category. Conversely, overweight restrained women ate less than did men from each BMI and restraint category. In conclusion, our manipulations of healthiness and “fatteningness” of food were effective in changing perceptions, but were not in changing behavior.

## **Keywords**

Nutrition claims, food perceptions, caloric estimation, food intake, eating behavior.

## Introduction

Epidemiological evidence indicates associations between diet and health outcomes (Willett, 1994); eating in a healthy manner plays a role in promoting health and reducing the risk for many chronic diseases. The available literature on diet and health supports the development of current dietary guidelines, nutritional policies, and educational tools to promote healthy eating (Bush & Kirkpatrick, 2003; Bush, Martineau, Pronk, & Brule, 2007). Various nutrition-education campaigns have been implemented by public health organizations to increase knowledge about healthy food choices in hopes of facilitating the adoption of better eating practices. One of these strategies includes the current regulations for the labelling of food products, which consist of, in North America (Santé Canada, 2010; U.S. Food and Drug Administration, 2011), approved nutrient-content claims (e.g., *low in fat, good source of fibre*). But whether consumers clearly understand nutrition information provided on food labels, so that they can choose healthier foods, remains to be clearly established.

Even if different labelling strategies are used to identify healthier foods, consumers seem confused about what healthy eating should be. In fact, they have difficulty clearly understanding more technical and numerical information, such as the terms “cholesterol” and “fatty acids,” but are somewhat better at judging the overall healthiness of a food (Cowburn & Stockley, 2005). Furthermore, even if the claims that appear on food labels must by law be true and not misleading (Canadian Food Inspection Agency. Government of Canada, 2003), they do not necessarily prevent consumers from drawing misleading inferences. As an example of possible misinterpretation, 41% of Canadians believe that

non-hydrogenated or soft margarine contains less fat than butter does, and this percentage did not vary as a function of nutrition knowledge (Canadian Council of Food and Nutrition, 2008).

Aside from nutritional information, previous studies have shown that foods can be, and often are, categorized as healthy or unhealthy by consumers (Carels, Harper, & Konrad, 2006; Carels, Konrad, & Harper, 2007; Oakes & Slotterback, 2001b). Various factors may influence food categorization, such as perceived fat content (Carels, Harper, & Konrad, 2006) and stereotypical beliefs (Oakes, 2006). Furthermore, it has been demonstrated that perceptions about the healthiness of foods or their capacity to influence weight may bias estimations of caloric content of foods (Carels, Harper, & Konrad, 2006; Carels, Konrad, & Harper, 2007). When compared to the actual measured caloric content of the foods, “healthy” food choices are perceived as having a lower caloric content (underestimation), whereas “unhealthy” food choices are perceived as having a higher caloric content (overestimation) (Carels, Harper, & Konrad, 2006; Carels, Konrad, & Harper, 2007). As a consequence, fast-food restaurants claiming to serve “healthy” food may lead consumers to underestimate the caloric content of main dishes and to choose higher-calorie side dishes, drinks, or desserts than when no such claims are made (Chandon & Wansink, 2007).

Individual characteristics, such as sex, weight, and restraint status may influence people’s perceptions of foods’ healthiness or their capacity to influence body weight. For example, compared to men, women report eating healthier foods and consider themselves to be more knowledgeable about what foods are good (Oakes & Slotterback, 2001a). On

the other hand, no sex differences were observed when men and women were rating foods' perceived capacity for weight gain (Oakes, 2005). Overweight/obese individuals and restrained eaters who are trying to better manage their weight might be more sensitive to nutrition information related to healthy eating and weight loss, because it could give help to adhere to their dieting rules. Previous results have shown that dieters are more accurate at estimating the caloric content of healthy foods (Carels, Konrad, & Harper, 2007). It could be postulated that people who are trying to better manage their weight are more attentive to the caloric and fat contents of foods and thus better at estimating the energy content of foods.

Some evidence suggests that describing foods as healthy might have unintended side-effects on food intake. For example, low-fat nutrition claims could contribute to overeating by reducing the guilt associated with eating, particularly among overweight individuals (Wansink & Chandon, 2006). In addition, evidence showed that perceiving oatmeal-raisin cookies as healthy increased intake by 35% (i.e., 56 kcal) in undergraduate female students (Provencher, Polivy, & Herman, 2009). These results also showed that restrained eaters, who may think that they are successfully restricting their food intake, also ate more of the "healthy" snack. A higher "healthy" rating of the snack was associated with a lower "weight gain" rating, suggesting that food perceived as healthy is also considered to be less fattening. These data emphasize the need to further investigate how and why the perceived healthiness of food and its perceived capacity to influence body weight can influence food intake.

The main purpose of this study was to investigate the impact of nutrition claims on food perceptions and intake among adult men and women. More specifically, the objectives of the study were threefold: 1) to assess the effect of “healthy,” “diet,” or “hedonic” claims on perceptions and estimation of caloric content of a food inherently considered as less healthy (i.e., cookies); 2) to verify if food perceptions can influence both measured and reported caloric intake during a single meal; and 3) to verify if these outcomes (food perceptions, caloric estimation and caloric intake) differ according to sex, body mass index (BMI) and level of restrained eating. We hypothesized that the “healthy” and the “diet” claims will significantly influence perceptions of the food, in the sense that cookies will be perceived as healthier or less fattening to the participants. Considering that the caloric content of healthy foods can be underestimated (Carels, Harper, & Konrad, 2006; Carels, Konrad, & Harper, 2007), the reported caloric content of the cookies will also vary according to the nutrition claims. In addition, measured and reported caloric intake will be greater when cookies are described using “healthy” or “diet” claims than when they are described using “hedonic” claim. Women, overweight/obese individuals and restrained eaters could be more sensitive to nutrition information related to healthy eating and weight loss, as they may view foods differently (Havermans, Giesen, Houben, & Jansen, 2011; Papies, Stroebe & Aarts, 2008). Therefore, we predict that women, overweight/obese individuals and restrained eaters will perceived the “hedonic” cookies as less healthy and more fattening, higher in calories, and they will reduce their food intake, and thus even more than men, normal-weight individuals and unrestrained eaters.

## **Methods**

### *Participants and study design*

A laboratory study was conducted on 164 men and 188 women aged 18 to 65, normal-weight ( $18.5 \text{ kg/m}^2 \leq \text{BMI} < 25 \text{ kg/m}^2$ ) and overweight/obese ( $\text{BMI} \geq 25 \text{ kg/m}^2$ ), unrestrained and restrained eaters. Participants were recruited through a mailing list and posters at *Université Laval* in Québec city. They were considered for participation if their weight was stable ( $\pm 2.5 \text{ kg}$ ) during the 2 months prior to study enrollment. Criteria for exclusion were personal history of diseases (eating disorders, types 1 or 2 diabetes, uncontrolled hypo- or hyperthyroidism) that could affect food intake, use of medication that might interfere with appetite or food taste (e.g., antidepressants, antipsychotics or corticosteroids), and food allergies. Women were tested in the follicular phase of their menstrual cycle (Dye & Blundell, 1997; Farage, Osborn, & MacLean, 2008), and they were not pregnant or lactating. Height, weight, and restraint status were reported initially during the screening phone interview. Then, participants were randomly assigned to one of the experimental conditions in a 3 (healthy vs. diet vs. hedonic) by 2 (normal-weight vs. overweight/obese) by 2 (unrestrained vs. restrained eaters) factorial design. Initial randomization was performed according to self-reported BMI and restraint score at the phone screening, but the randomization was adjusted according to measured data, if needed. Note that during screening, 263 participants indicated correct restraint and 317 indicated correct BMI, respectively 74.7% and 88.3%. Each participant was tested during a single experimental session (between 9h and 20h). The study was approved by the institutional review board of *Université Laval* (#2009-117/26-05-2009) and was registered

in the ClinicalTrials.gov registry (NCT01141140). Each participant provided informed consent and received CA\$35 for his/her participation.

### *Measurements and procedure*

#### Taste-rating task

Participants were asked to arrive at the laboratory in a pre-meal state (i.e., at least 2 h without food prior to the experiment). Hunger visual analogue scales administered before the taste test indicated no difference between groups. Participants were blinded to the true purpose of the study. Instead, they were informed that this market-research study involved a taste-rating task in which they would taste and rate a new snack food. More specifically, a pre-weighed plate containing between 500 and 600 g of freshly baked bite-sized oatmeal-raisin cookies was presented to the participant, with a taste-rating form and a glass of water. On average, one bite-size cookie is about 11 g, which represents approximately 43 kcal. Each plate thus had between 45-55 bite-size cookies. The manipulation of “healthiness” and “fatteningness” perceptions of the oatmeal-raisin cookies was implemented by the experimenter, with the description given to participants differing according to the condition to which they were randomly assigned (i.e., “healthy,” “diet,” or “hedonic”). In "healthy" condition instructions emphasized the healthy feature of the cookies (high-fibre oatmeal), in the "diet" condition instructions focused on the satiating effect of fibre who help to maintain a healthy weight. Note that the experimenter never used the word “cookies” in the “healthy” and “diet” conditions to ensure that this inherently unhealthy word did not influence the perceptions of the participants. In the “hedonic” condition, the instructions emphasized on less healthy nutrient content (butter and brown-sugar). The detail of the



instructions is presented in Appendix 1. Participants were instructed to eat as many pieces as needed to achieve accurate ratings and to feel free to help themselves to more after they completed the taste-rating task, as long as they did not change their initial ratings. After 10 minutes, the plate of cookies was removed and weighed to measure how many grams of cookies were eaten by each participant. Measured caloric intake was then calculated (i.e., 3.9 kcal per gram).

### Questionnaires

After the taste-rating task, participants were asked to complete some questionnaires. The Restraint Scale (Herman & Polivy, 1980) was used to assess whether participants exhibited behavioral and attitudinal concerns about dieting and weight control. Participants were categorized as unrestrained eaters (scores below 12 for men and below 15 for women) or restrained eaters (scores of 12 or higher for men and 15 or higher for women), as performed previously (Goldman, Herman, & Polivy, 1991). The validity of the Restraint Scale has been previously reported (Allison, Kalinsky, & Gorman, 1992; Laessle, Tuschl, Kotthaus, & Pirke, 1989; Polivy, Herman, & Howard, 1998; Van Strien, Herman, Engels, Larsen, & van Leeuwe, 2007). Participants were also asked to fill out a sociodemographic questionnaire and to report their opinions about the new snack food tested. More specifically, they were asked; 1) “How healthy is this snack for you?” (an 8-point scale from very unhealthy [1] to very healthy [8]); 2) “If you were eating this snack regularly, how would it affect your weight?” (an 8-point scale from weight loss [1] to weight gain [8]); 3) “With a serving of 6 pieces of this snack, how many calories do you think you would eat?” (estimated caloric content; kcal), and; 4) “How many snack pieces did you eat

during the taste-rating task a few minutes ago?” (reported caloric intake; number of pieces [x 11 g/piece] x 3.9 kcal per g). At the end of the session, the experimenter explained to participants the true purpose of the study and asked them not to discuss any of the details of the study with other people who might participate in the study.

### Weight, height and BMI

Described as normative data collection, weight and height were measured in all participants, and BMI was then calculated ( $\text{kg}/\text{m}^2$ ). Measurements were conducted after the taste-rating task and the completion of the questionnaires.

### *Statistical analysis*

Based on a conservative Cohen’s *d* effect size (ES) estimate of 0.35 (Cohen, 1992), and in accordance with our previous work (Provencher, Polivy, & Herman, 2009), power analyses for the ANOVAs testing main effects and interactions indicated that a sample size of  $n=180$  (for males and females separately) have allowed us to detect significant differences in *ad libitum* food intake with an alpha level of 0.02 and a power (1- $\beta$  error probability) of 0.90. A 3 (healthy vs. diet vs. hedonic) by 2 (normal-weight vs. overweight/obese) by 2 (unrestrained vs. restrained eaters) analysis of variance (ANOVA) was conducted to assess the effects of these three variables on measured and reported caloric intake during the *ad libitum* snack taste test. Opinions about the new snack food (i.e., “healthy” and “weight-gain” ratings and estimated caloric content) were also analyzed using 3-way ANOVAs. Sex, BMI, and restraint status were included as independent

factors in the statistical model to assess possible differences. A paired t-test was conducted to assess differences between the estimated caloric content for a serving of six cookies vs. its real caloric content (i.e., 255 kcal). ANOVAs and t-tests were also conducted to verify if the differences observed (estimated vs. real caloric content) varied according to the experimental conditions, sex, BMI, and restraint status. To assess the magnitude of change for between-group differences observed, effect sizes were also calculated ( $d$  = standardized difference; i.e., difference between means divided by their pooled standard deviation) (Bird, 2002). Strength of effect size was defined as small ( $d = 0.20$  to  $0.49$ ), moderate ( $d = 0.50$  to  $0.79$ ) and large ( $d \geq 0.80$ ) (Cohen, 1992). Pearson and Spearman correlation coefficients were also calculated to assess associations between the estimated caloric content of the cookies and participants' ratings of the snack food's "healthiness" and "capacity to affect weight", as well as association between reported vs. measured intake. A  $p$  value  $< 0.05$  was considered statistically significant and analyses were performed with Statistical Analysis Software (SAS) version 9.2 (SAS Institute, Cary, NC, USA).

## **Results**

Between September 2009 and December 2010, 164 men and 188 women were randomized in the study (118 allocated to the "health" condition, 119 to the "diet" condition, and 115 to the "hedonic" condition), according to their BMI and restraint status. There were thus low and high BMI conditions, with low BMI ( $M = 22.1$ ,  $SD = 1.9$ ) and high BMI ( $M = 28.7$ ,  $SD = 3.6$ ;  $p < 0.0001$ ), and low and high restraint conditions, with low restraint ( $M = 9.6$ ,  $SD = 3.1$ ) and high restraint ( $M = 16.7$ ,  $SD = 3.1$ ;  $p < 0.0001$ ).

Descriptive characteristics (age, BMI and restraint score) of the male ( $n = 164$ ) and the female ( $n=188$ ) in each experimental condition are shown in Tables 1 and 2, respectively. As expected, men reported lower restraint scores than did women. The descriptive characteristics of the whole sample, for men and women separately, are presented in Table 3. The majority of the sample (86.7%) had a collegiate diploma or higher, and near of one-half of the sample had an annual family income higher than \$39,999. Even if participants were randomly assigned to the experimental groups, a 3-way ANOVA revealed differences for the age (data not shown). Age was thus added as a covariate in the models (ANCOVA) presented in the following sections.

#### *Perceived “healthiness” and “fatteningness”*

Main effect of experimental condition,  $F_{(2,326)} = 47.91$ ;  $p < 0.0001$  was observed for the participant’s ratings of the cookies “healthiness” (see Fig. 1). The cookies were perceived as healthier in the “healthy” condition ( $M = 6.4$ ,  $SD = 1.1$ ), than in the “diet” condition ( $M = 5.8$ ,  $SD = 1.2$ ;  $p = 0.0063$ ;  $d = 0.52$ ), or in the “hedonic” condition ( $M = 4.8$ ,  $SD = 1.4$ ;  $p < 0.0001$ ;  $d = 1.27$ ). The cookies were also perceived as healthier in the “diet” condition than in the “hedonic” condition ( $M = 5.8$ ,  $SD = 1.2$  in the “diet” condition vs.  $M = 4.8$ ,  $SD = 1.4$  in the “hedonic” condition;  $p < 0.0001$ ;  $d = 0.77$ ).

A marginal effect of sex,  $F_{(1, 327)} = 3.70$ ;  $p = 0.0553$  was observed for the perceived “fatteningness” of the cookies. In general, women perceived the cookies as more fattening than did men ( $M = 5.3$ ,  $SD = 1.2$  for women vs.  $M = 5.1$ ,  $SD = 1.1$  for men;  $p = 0.0514$ ;  $d =$

0.17). An interaction between the experimental condition and the restrained status was also observed,  $F_{(2, 327)} = 4.28$ ;  $p = 0.0147$  (see Fig. 2). More specifically, the capacity of the cookies to affect weight gain was perceived as higher by restrained eaters in the “hedonic” condition ( $M = 5.9$ ,  $SD = 1.0$ ) than by unrestrained and restrained eaters in the “healthy” condition ( $M = 5.1$ ,  $SD = 1.1$  for unrestrained eaters the “healthy” condition;  $p = 0.0034$ ;  $d = 0.76$ , and  $M = 4.9$ ,  $SD = 1.2$  for restrained eaters in the “healthy” condition;  $p = 0.0001$ ;  $d = 0.91$ , respectively), and by unrestrained eaters in the “diet” condition ( $M = 4.6$ ,  $SD = 1.1$ ;  $p < 0.0001$ ;  $d = 1.24$ ). The capacity of the cookies to affect weight gain was also perceived as lower by unrestrained eaters in the “diet” condition ( $M = 4.6$ ,  $SD = 1.1$ ) than by restrained eaters in the “diet” condition and unrestrained eaters in the “hedonic” condition ( $M = 5.3$ ,  $SD = 1.2$  for restrained eaters in the “diet” condition;  $p = 0.0047$ ;  $d = 0.61$  and  $M = 5.4$ ,  $SD = 1.0$  for unrestrained eaters in the “hedonic” condition;  $p = 0.0008$ ;  $d = 0.76$ , respectively). BMI did not significantly influence perceptions of food ( $p = 0.8751$ ).

#### *Estimation of the caloric content of the cookies*

Main effects of experimental condition  $F_{(2, 323)} = 3.29$ ;  $p = 0.0384$ , sex  $F_{(1, 323)} = 6.22$ ;  $p = 0.0131$ , and restraint status  $F_{(1, 323)} = 5.82$ ;  $p = 0.0164$ , were observed for the participant’s caloric estimation of the cookies. The caloric estimation was higher among participants in the “hedonic” condition than in the “healthy” condition ( $M = 278$ ,  $SD = 175$  in the “hedonic” condition vs.  $M = 214$ ,  $SD = 125$  kcal in the “healthy” condition;  $p = 0.0407$ ;  $d = 0.42$ ), by women than by men ( $M = 264$ ,  $SD = 158$  for women vs.  $M = 235$ ,  $SD = 196$  kcal for men;  $p = 0.0131$ ;  $d = 0.16$ ), and by restrained than by unrestrained participants ( $M = 270$ ,

SD = 202 for restrained eaters vs.  $M = 231$ , SD = 146 kcal for unrestrained eaters;  $p=0.0164$ ;  $d = 0.22$ ). There was a significant difference between the caloric estimation and the real caloric content of cookies (i.e. mean of the caloric estimation for a serving of 6 pieces - 255 kcal) for the “healthy” condition vs. the “diet” and “hedonic” conditions ( $M = -41$ , SD = 125 in the “healthy” condition vs.  $M = +5$ , SD = 215 in the “diet” condition and  $M = +23$ , SD = 175 kcal in the “hedonic” condition;  $F = 4.10$ ,  $p = 0.0173$ ;  $d = 0.26$  and  $0.42$ , respectively), and between unrestrained vs. restrained participants ( $M = -24$ , SD = 146 for unrestrained participants vs.  $M = +15$ , SD = 202 kcal for restrained participants;  $t = -2.06$ ,  $p=0.0401$ ;  $d = 0.22$ ), where negative values represent an underestimation of caloric content and positive values represent an overestimation. In addition, the absolute underestimations observed in the “healthy” condition and among unrestrained participants were significant  $t = -3.57$ ;  $p = 0.0005$  and  $t = -2.16$ ;  $p = 0.0319$ , respectively). No sex ( $p = 0.1324$ ) or BMI ( $p = 0.6118$ ) differences were noted for the caloric estimation vs. the measured caloric content of cookies. A negative correlation was also observed between the estimated caloric content and the “healthy” rating of the snack ( $r = -0.25$ ;  $p < 0.0001$ ), while a positive correlation was noted with the “fatteningness” rating of the snack ( $r = 0.27$ ;  $p < 0.0001$ ).

#### *Measured and reported caloric intake*

Although no difference in measured caloric intake was found as a function of experimental condition, an interaction between sex, BMI and restraint status,  $F_{(1, 327)} = 3.88$ ;  $p = 0.0496$  was observed (see Fig. 3). Overweight restrained men ate more ( $M = 425.3$ , SD

= 252.3) than did women from each BMI and restraint category ( $M = 239.7$ ,  $SD = 133.5$  for normal-weight unrestrained women;  $d = 0.92$ ,  $M = 288.1$ ,  $SD = 162.6$  for normal-weight restrained women;  $d = 0.65$ ,  $M = 230.2$ ,  $SD = 140.0$  for overweight unrestrained women;  $d = 0.96$ , and  $M = 201.3$ ,  $SD = 115.1$  for overweight restrained women;  $d = 1.14$ , respectively). Conversely, overweight restrained women ate less ( $M = 201.3$ ,  $SD = 115.1$ ) than did men from each BMI and restraint category ( $M = 380.6$ ,  $SD = 228.9$ ;  $d = 0.99$ ,  $M = 357.1$ ,  $SD = 160.2$ ;  $d = 1.12$ ,  $M = 322.2$ ,  $SD = 210.4$ ;  $d = 0.71$ , and  $M = 425.3$ ,  $SD = 252.3$ ;  $d = 1.14$ , respectively). In addition, the measured caloric intake of normal-weight restrained men ( $M = 357.1$ ,  $SD = 160.2$ ) and overweight unrestrained men ( $M = 322.2$ ,  $SD = 210.4$ ) was not significantly different than that of normal-weight women (both unrestrained and restrained) ( $M = 239.7$ ,  $SD = 133.5$  for normal-weight unrestrained women;  $d = 0.80$  and  $0.47$  and  $M = 288.1$ ,  $SD = 162.6$  for normal-weight restrained women;  $d = 0.43$  and  $0.18$ ) and overweight unrestrained women ( $M = 230.2$ ,  $SD = 140.0$ ;  $d = 0.84$  and  $0.51$ , respectively).

With regards to the reported caloric intake, a marginal interaction between experimental condition, sex and BMI,  $F_{(2, 326)} = 2.99$ ;  $p = 0.0515$  was observed (see Fig. 4). Normal-weight women in the “healthy” condition ( $M = 243.2$ ,  $SD = 129.5$ ), overweight women in the “diet” condition ( $M = 217.3$ ,  $SD = 132.7$ ), as well as normal-weight and overweight women in the “hedonic” condition ( $M = 244.4$ ,  $SD = 120.6$  and  $M = 218.0$ ,  $SD = 120.4$ ) reported lower caloric intakes than did normal-weight men in the “healthy” condition ( $M = 426.1$ ,  $SD = 245.9$ ;  $d = 0.93$ ,  $1.06$ ,  $0.94$  and  $1.07$ , respectively) and overweight men in the “hedonic” condition ( $M = 387.7$ ,  $SD = 187.7$ ;  $d = 0.90$ ,  $1.05$ ,  $0.91$  and  $1.08$ , respectively).

## **Discussion**

In the present study, the specific objectives were: 1) to assess the effect of “healthy,” “diet,” or “hedonic” claims on perceptions and estimates of caloric content of a food inherently considered as less healthy – namely, cookies; 2) to verify if food perceptions can influence both measured and reported caloric intake during a single eating occasion; and 3) to verify if these outcomes (food perceptions, caloric estimation, and caloric intake) differ according to sex, BMI, and level of restrained eating.

In accordance with our hypothesis, “healthy” and “diet” verbal nutrition claims had a significant impact on the perception of the snacks: cookies were perceived as healthier in these two experimental conditions compared to the “hedonic” condition, with moderate and large ES, respectively. These results suggest that even a food usually considered as less healthy could be perceived as a healthy food choice when the food description highlights healthy ingredients. For example, in a study assessing the effects of using an existing nutrition logo on product evaluation of a chocolate mousse cake, participants perceived a chocolate mousse cake with a logo significantly less unhealthy than the same cake presented without logo (Steenhuis, Kroeze, Vyth, Valk, Verbauwen, & Seidell, 2010). Moreover, a food product labelled with a health claim is often perceived as healthier (Aschemann-Witzel & Hamm, 2010; Kozup, Creyer, & Burton, 2003; van Trijp & van der Lans, 2007). Consumers also tended to overgeneralize the health effect of the claim, thinking the product is globally healthy even though the claim mentioned only one specific aspect (Burton, Andrews, & Netemeyer, 2000; Roe, Levy, & Derby, 1999). It has been



suggested that health claims rather promote sales of food, but their effect on actual health remain unclear (Nestle & Ludwig, 2010).

With regard to their perceived capacity to cause weight gain, the cookies were seen as most fattening by restrained eaters in the “hedonic” condition and as least fattening by unrestrained eaters in the “diet” condition. Although no difference were observed between restrained and unrestrained participants in the “healthy” and “hedonic” conditions, restrained participants in the “diet” condition perceived the cookies as more fattening than did unrestrained participants in the same condition. These results suggest that the “diet” condition may arouse suspicions among restrained eaters, which could be explain by the fact that a claim focusing on weight management is used to describe a snack (i.e., cookies) usually perceived as unhealthy. They could be more preoccupied by a “diet” claim, because such a claim increases the salience of weight concerns. In a previous study, we have indeed shown that a “weight salience” manipulation can influence perceptions about food differently in restrained and unrestrained eaters; restrained eaters rated the snack food more negatively than unrestrained eaters did when they received weight feedback before eating (Provencher, Polivy, & Herman, 2009). However, it could also be postulated that suspicions among restrained eaters could be attenuated in the presence of nutrient claims; no difference was observed between restrained and unrestrained eaters in the “healthy” condition.

As was observed in a previous study (Carels, Konrad, & Harper, 2007), our results showed that sex is associated with people’s perceptions of foods’ capacity to influence

weight (but not the perceived healthiness of food, as only a main effect of the experimental condition was observed). Women perceived the cookies as more fattening than did men. Previous literature suggests that women experience more food-related conflicts than men do, in that they like fattening foods but believe that they should not eat them (Rolls, Fedoroff, & Guthrie, 1991). Women may thus be more suspicious about foods in general with regards to their potential impact on body weight. Moreover, the prevalence of dieting is higher among women, reflecting a greater preoccupation about their body weight when compared to men (Kruger, Galuska, Serdula, & Jones, 2004; Lemon, Rosal, Zapka, Borg, & Andersen, 2009). Nevertheless, not all studies have noted sex differences in food perceptions. No gender differences were observed when men and women were rating food' perceived capacity for weight gain (Oakes, 2005). The absence of sex differences in that study could be explained by the age of participants, who tended to be older (mean age of 48 years). Previous studies have shown that compared to men and older women, young-adult women are more influenced by food stereotypes; for example, women rated low-calorie and low-fat foods as more healthful than did men (Oakes, 2003; Oakes & Slotterback, 2001c). Although the BMI of normal-weight vs. overweight/obese participants was significantly different (22.1 vs. 28.7;  $p < 0.0001$ ), BMI did not significantly influence perceptions of food in the current study.

As has been observed in previous studies (Carels, Harper, & Konrad, 2006; Carels, Konrad, & Harper, 2007), caloric estimation of the cookies varied according to the nutrition claims and individual characteristics. In fact, the estimation of the caloric content was higher among participants in the “hedonic” condition than in the “healthy” condition, in

women than in men, and in restrained eaters than in unrestrained eaters. Although caloric estimation was significantly different in men and women, accuracy in caloric estimation did not differ as a function of sex, as was observed previously (Carels, Konrad, & Harper, 2007). Participants in the “healthy” condition and unrestrained eaters, though, significantly underestimated the caloric content of cookies. In that regard, at least one study has shown an underestimation of the caloric content of foods perceived as “healthy” (e.g. fish, low-fat yogurt) (Carels, Harper, & Konrad 2006). Interestingly, our findings suggest that, following a “healthy” description, caloric content of a food inherently less healthy (i.e. cookies) can also be underestimated. The higher caloric estimation among restrained eaters may be explained by the difference observed in the level of nutritional knowledge and use of food labeling. Indeed, as measured by an adapted version of the 34-item Label Reading Survey (Marietta, Welshimer, & Anderson, 1999), restrained eaters had greater nutritional knowledge (i.e., ability to obtain specific information from food labels, knowledge of the meaning of certain terms or sentences that may appear on the label, and basic nutrition knowledge), and reported reading nutrition labels more often than did unrestrained eaters ( $p = 0.0135$  and  $p = 0.0179$ , respectively). In accordance with previous results (Carels, Konrad, & Harper, 2007), caloric estimation of the snack did not differ according to BMI.

Contrary to our hypothesis, measured caloric intake did not differ as a function of experimental condition, suggesting that the differences obtained for perceptions did not translate into a significant ingestive behavior change under the conditions described in this study. These results differ from the results of earlier studies (Provencher, Polivy, & Herman, 2009; Wansink & Chandon, 2006). The effects of nutrition labeling on food

choice may be moderated by various factors, such as consumers' interest in nutrition (Grunert & Wills, 2007; Levi, Chan, & Pence, 2006) and their ability to understand the nutrition information (Taylor & Wilkening, 2008), which can be influenced by their knowledge in nutrition (Grunert & Wills, 2007). Methodological differences, e.g. the way of describing food and the type of food used, could also be possible explanations to explain the differences observed between studies. It is important to note that our participants were recruited through mailing lists and posters at *Université Laval* in which it was indicated that the study was conducted at the *Institut des nutraceutiques et aliments fonctionnels*. This research center is well-known for its nutrition and health studies. This sampling method may have oversampled participants who are especially interested in nutrition, have higher nutritional knowledge, and who may be more critical about nutritional information and nutrition claims. Moreover, the high level of education of our sample might also be another factor to consider in explaining the absence of an effect on measured food intake. In the Canadian population, about 48% of Canadians aged 25 to 64 had college or trade certification or higher in 2006 (Statistique Canada, 2006), compared to ~87% in the current sample. It is possible that participants with a higher level of education may be more critical (or less naive) about nutritional information and nutrition claims. If so, it confirms the importance of educating the population concerning nutrition and health. However, previous studies showed that when faced with detailed nutrition information, less educated individuals had more difficulty understanding it (Feunekes, Gortemaker, Willems, Lion, & van den Kommer, 2008; Grunert & Wills, 2007). We thus have to ensure that nutrition information given to individuals will not only be beneficial to those who are already doing better.

Overweight and restrained men ate more than did women from each BMI and restraint category, and conversely, overweight and restrained women ate less than did men from each BMI and restraint category, all with moderate or large ES. Previous research suggests that women are socialized to eat differently than are men (Rolls, Fedoroff, & Guthrie, 1991) and that they might view foods differently. One possible hypothesis to explain this result might be that overweight and restrained women could be more inhibited during an experimental context (Roth, Herman, Polivy, & Pliner, 2001) than men with similar characteristics.

Although measured caloric intake did not differ as a function of the experimental conditions, the manipulation of food perceptions seems to have a partial impact on reported caloric intake, as an interaction between experimental condition, sex, and BMI was observed, all with moderate or large ES. Contrary to our hypothesis, in which we predicted that measured and reported caloric intake would follow the same pattern, normal-weight women in the “healthy” condition, overweight women in “diet” condition, and normal-weight and overweight women in the “hedonic” condition all reported lower intakes than did normal-weight men in the “healthy” condition and overweight men in the “hedonic” condition. The impact of the manipulation of food descriptions on reported caloric intake might be explained by the social desirability and social approval biases that appear to vary by gender. Thus, men tend to overestimate fat and energy intakes and women tend to underestimate dietary intakes according to social desirability (Hebert, Ma, Clemow, Ockene, Saperia, & Stanek, 1997). Moreover, self-reports of dietary intake can be biased by the tendency to answer consistent with expected norms (social approval bias) (Miller,

Abdel-Maksoud, Crane, Marcus, & Byers, 2008). According to the expected norms, it is possible that these biases could be more pronounced among overweight women and among those in the “hedonic” condition.

This study has some limitations; for example, the highly educated sample is not necessarily representative of the general population. It is also possible that participants might have eaten more if they had been exposed to an entire meal labelled as healthy, as opposed to only one food item. In our study, participants can easily recall that they have eaten a certain number of cookies, and maybe there was an issue around sensory specific satiety (Rolls, 1986) which could have influenced intake. Sensory specific satiety refers to a decline in pleasantness derived from consuming a food with prior exposure or consumption of that specific food (Rolls, 1986), cookies in our study.

## **Conclusion**

We investigate the impact of nutrition claims on food perceptions and intake. In summary, our manipulations of the “healthiness” and “fatteningness” of food were effective in changing perceptions, e.g., cookies were perceived as being healthier in the “healthy” condition and the caloric content was estimated as higher in the “hedonic” condition. However, these changes in perceptions did not translate into a significant change in the intake of the snack (i.e., measured caloric intake). These findings contribute to a better understanding of how perceptions of food may influence caloric estimation, but not intake. Future studies should take into account the level of education and the level of interest in nutrition of the sample studied, to include participants less educated and less interested by

nutrition, to investigate the impact on food perceptions and intake.

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**Table 1**Descriptive characteristics of the male ( $n = 164$ ) in each experimental condition.

	“Healthy” condition				“Diet” condition				“Hedonic” condition			
	Unrestrained eaters		Restrained eaters		Unrestrained eaters		Restrained eaters		Unrestrained eaters		Restrained eaters	
	Normal-weight ( $n = 13$ )	Overweight ( $n = 14$ )	Normal-weight ( $n = 9$ )	Overweight ( $n = 18$ )	Normal-weight ( $n = 19$ )	Overweight ( $n = 12$ )	Normal-weight ( $n = 11$ )	Overweight ( $n = 16$ )	Normal-weight ( $n = 12$ )	Overweight ( $n = 13$ )	Normal-weight ( $n = 9$ )	Overweight ( $n = 18$ )
Age (yrs)	34.2 ± 17.7	36.5 ± 13.0	35.3 ± 15.8	43.7 ± 12.1	31.4 ± 13.2	43.2 ± 14.1	29.0 ± 12.2	35.7 ± 11.9	32.3 ± 9.8	38.8 ± 18.1	30.9 ± 10.5	39.6 ± 14.2
BMI (kg/m <sup>2</sup> )	22.6 ± 1.7	28.4 ± 5.6	23.5 ± 1.4	29.3 ± 3.0	21.9 ± 2.3	28.4 ± 2.8	22.2 ± 1.4	27.1 ± 2.3	21.8 ± 2.3	28.0 ± 2.7	23.2 ± 1.2	28.7 ± 3.9
Restraint score	7.1 ± 3.3	9.4 ± 1.5	14.7 ± 3.5	15.4 ± 3.6	7.3 ± 3.1	9.8 ± 2.1	14.7 ± 2.3	16.1 ± 3.4	7.5 ± 1.9	8.3 ± 2.3	15.1 ± 3.0	15.2 ± 2.8

Values are mean ± SD.

**Table 2**Descriptive characteristics of the female ( $n = 188$ ) in each experimental condition.

	“Healthy” condition				“Diet” condition				“Hedonic” condition			
	Unrestrained eaters		Restrained eaters		Unrestrained eaters		Restrained eaters		Unrestrained eaters		Restrained eaters	
	Normal-weight ( $n = 17$ )	Overweight ( $n = 11$ )	Normal-weight ( $n = 15$ )	Overweight ( $n = 21$ )	Normal-weight ( $n = 20$ )	Overweight ( $n = 13$ )	Normal-weight ( $n = 13$ )	Overweight ( $n = 15$ )	Normal-weight ( $n = 18$ )	Overweight ( $n = 13$ )	Normal-weight ( $n = 16$ )	Overweight ( $n = 16$ )
Age (yrs)	35.9 ± 15.4	45.4 ± 16.0	32.9 ± 14.8	42.2 ± 15.8	35.1 ± 14.4	51.3 ± 14.0	30.5 ± 13.0	38.5 ± 19.0	40.0 ± 14.2	48.1 ± 14.4	30.9 ± 13.8	40.6 ± 15.0
BMI (kg/m <sup>2</sup> )	21.4 ± 2.0	27.2 ± 2.2	22.1 ± 1.8	29.9 ± 4.9	21.3 ± 1.9	29.2 ± 2.6	22.5 ± 1.9	30.0 ± 3.9	22.1 ± 1.9	27.9 ± 2.8	22.3 ± 1.6	29.0 ± 3.6
Restraint score	9.6 ± 3.8	11.4 ± 2.5	16.9 ± 2.0	17.7 ± 2.4	10.8 ± 2.8	11.3 ± 2.4	18.1 ± 2.7	18.0 ± 2.7	10.9 ± 2.7	11.2 ± 2.7	17.8 ± 2.4	18.4 ± 3.5

Values are mean ± SD.

**Table 3**

Baseline characteristics among men (n=164) and women (n=188).

Baseline characteristics	Men (n = 164)	Women (n = 188)	<i>p</i> values
Age (y)	36.3 ± 14.0	38.9 ± 15.8	0.0964
BMI (kg/m <sup>2</sup> )	25.7 ± 4.2	25.3 ± 4.6	0.3365
Restraint score	11.7 ± 4.6	14.4 ± 4.4	< 0.0001
Occupational status <sup>†</sup>			
Student	41 (25.00)	37 (19.68)	
Worker	78 (47.56)	64 (34.04)	
Unemployed	23 (14.02)	28 (14.89)	
Highest level of education <sup>§</sup>			
Without high school diploma	0	1 (0.53)	
High school diploma	26 (15.85)	15 (7.98)	
College or trade certification	57 (34.76)	60 (31.91)	
University degree	79 (48.17)	109 (57.98)	
Family income before tax for the past year (CA\$) <sup>€</sup>			
0 – 19 999	36 (21.95)	55 (29.26)	
20 000 – 39 999	31 (18.90)	38 (20.21)	
40 000 – 59 999	29 (17.68)	33 (17.55)	
60 000 – 79 999	23 (14.02)	19 (10.11)	
80 000 – 99 999	14 (8.54)	14 (7.45)	
More than 100 000	18 (10.98)	13 (6.91)	

Values are the mean ± SD or number (percentage).

The percentages including missing data do not reach 100 %.

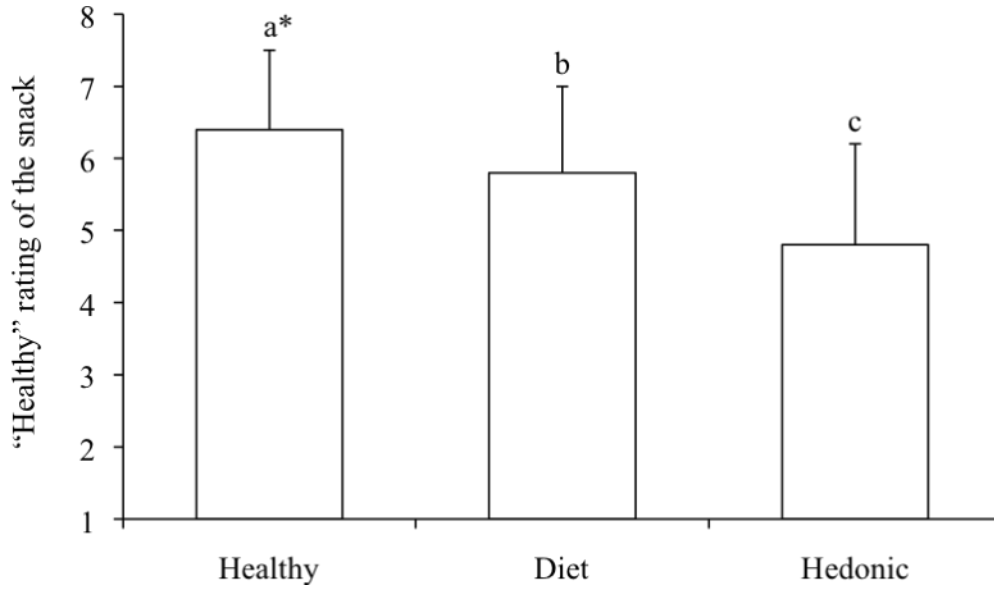
<sup>†</sup> Missing values or prefer not to answer (n=81) (men: n=22 and women: n=59).

<sup>§</sup> Missing values or prefer not to answer (n=5) (men: n=2 and women: n=3).

<sup>€</sup> Missing values or prefer not to answer (n=29) (men: n=13 and women: n=16).

**Figure 1**

Mean of perceived healthiness ( $\pm$  SD) (unitless score) for each experimental condition.

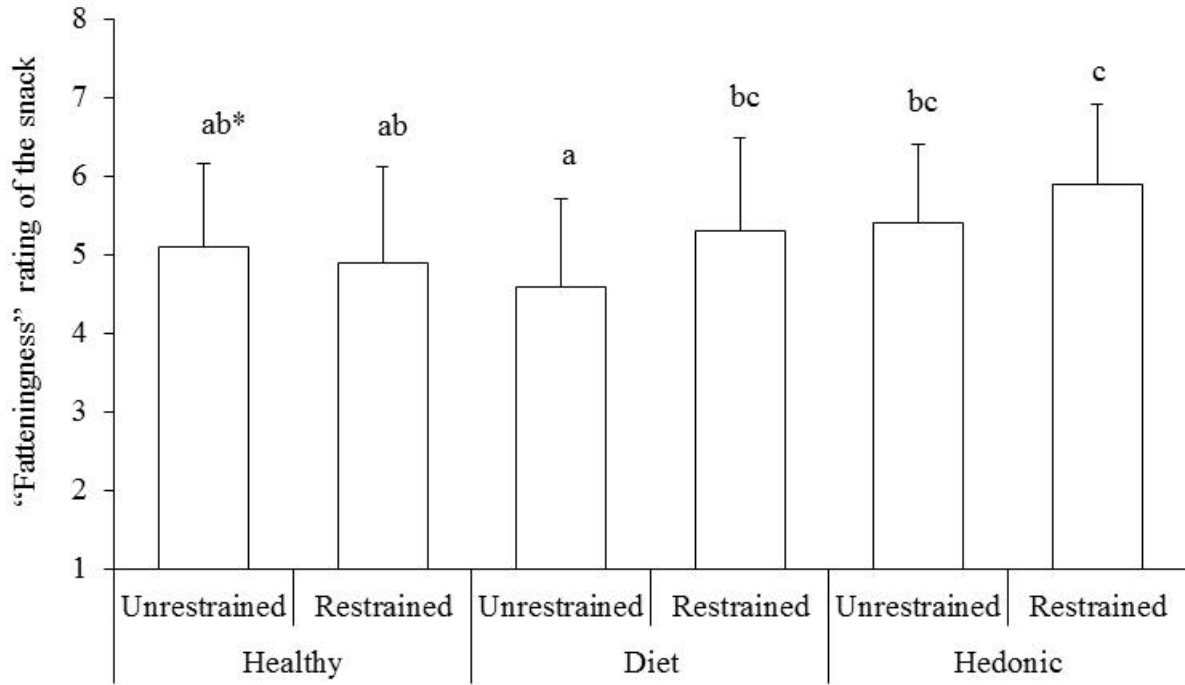


\* Bars with different superscript letter are significantly different ( $p < 0.005$ ).



**Figure 2**

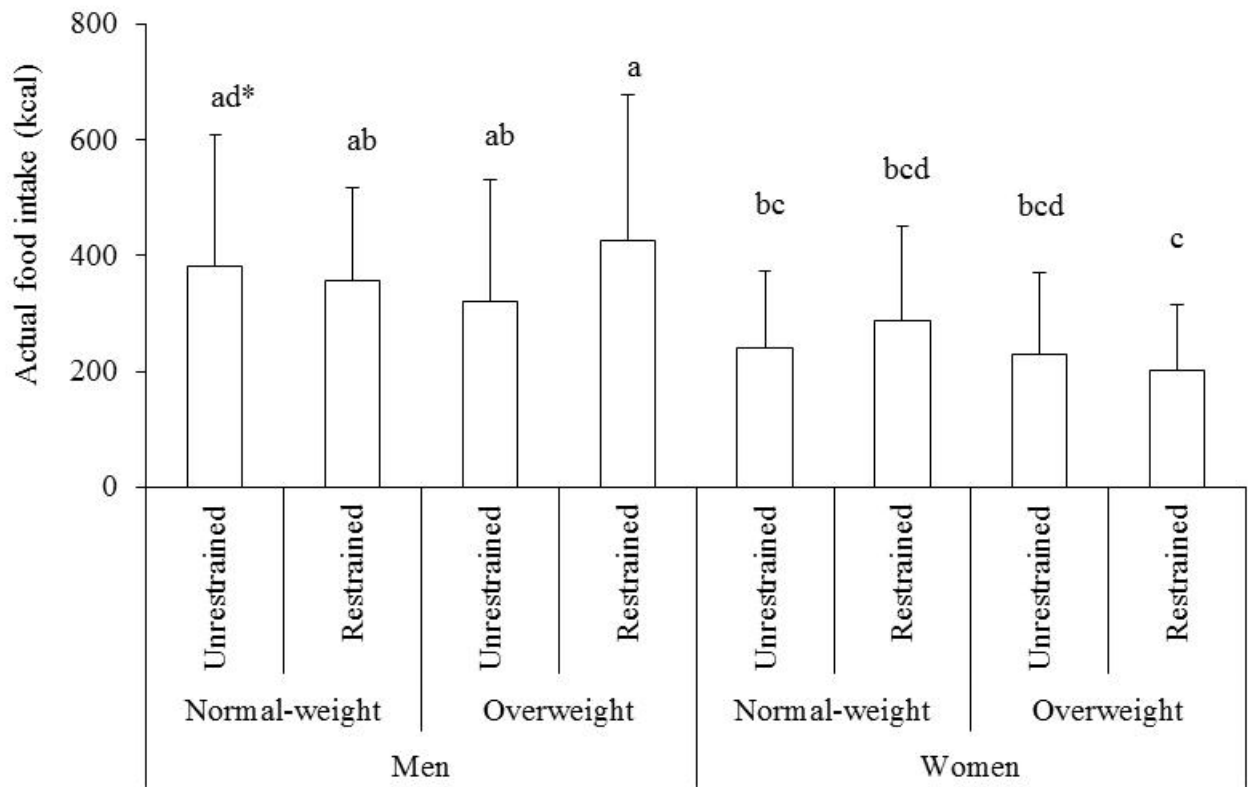
Mean of perceived “fatteningness” ( $\pm$  SD) (unitless score) for the interaction between the experimental condition and the restrained status.



\* Bars with different superscript letter are significantly different ( $p < 0.01$ ).

**Figure 3**

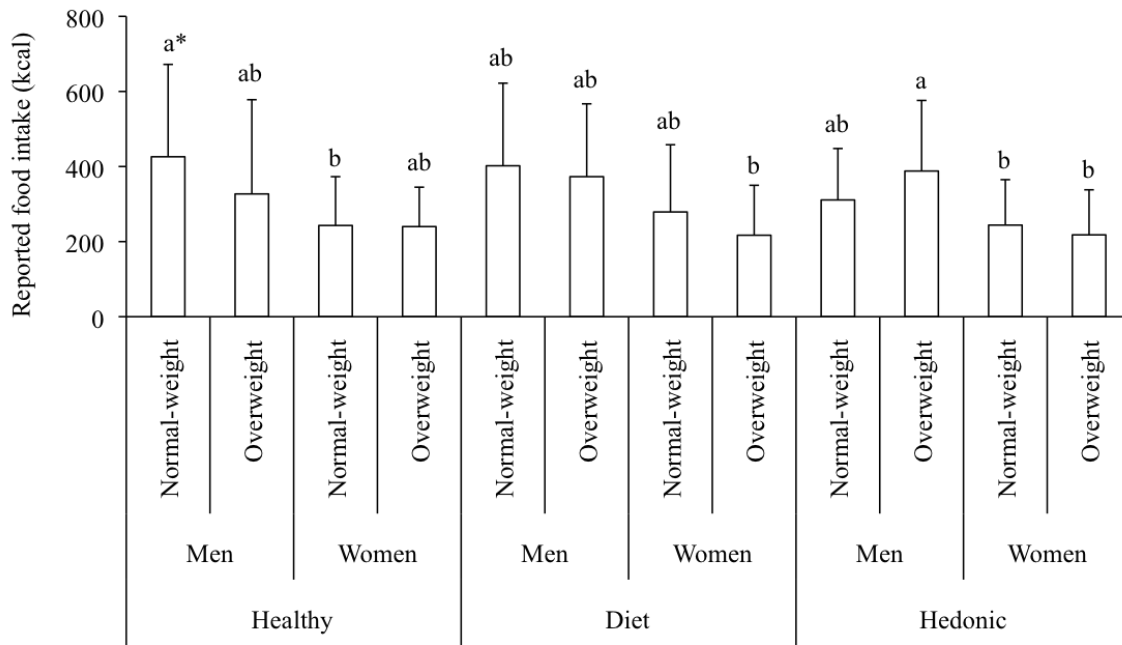
Mean of the actual food intake ( $\pm$  SD) for the interaction between gender, BMI and restraint status.



\* Bars with different superscript letter are significantly different ( $p < 0.05$ ).

**Figure 4**

Mean of the reported food intake ( $\pm$  SD) for the interaction between experimental condition, gender and BMI.



\* Bars with different superscript letter are significantly different ( $p < 0.05$ ).

## **Appendix 1**

The scripts used to describe cookies in the “healthy,” diet,” or “hedonic” conditions respectively, were as follows: “The snack product that you have to taste today is a new high-fiber oatmeal snack made with healthy ingredients. You have certainly heard that whole oatmeal is good for your health because it contains soluble fibers. So, this new oatmeal snack is high in soluble fibers, as well as low in saturated fat and free from trans-fat.”; “The food product that you have to taste today is a new healthy high-fiber snack. You must have probably heard that whole-grain foods, like those that contain oat soluble fibers, are composed of complex carbohydrates which are digested slowly and which can delay the appearance of the hunger. This new healthy snack has been especially designed to satiate, because it is a source of fibers, which make it an interesting choice for any persons concerned to reach and to maintain a healthy weight.”; and “[These are] new gourmet cookies made with fresh butter and old-fashioned brown sugar. So, these new cookies are a great treat with a pleasant, sweet taste.”