The calorie dilemma: Leaner and larger, or tastier yet smaller meals?
Calorie consumption and willingness to trade food quantity for food taste in fast food products

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Previous research has shown that not only do most consumers not change their food choices when exposed to calorie information; while some do reduce their calorie consumption, others actually increase it by shifting to foods with higher calorie content. Overestimation of calorie content of food items is the main explanation for this counterintuitive behavior (choosing higher-calorie items).

This paper aims to provide a differing explanation for this counterintuitive behavior that is based on the idea that there is a correlation between perceptions of a product's attributes and its calorie density. Specifically, higher calorie density is associated with better taste, and there is greater heterogeneity in changes in eating behavior after calorie posting (consumers' willingness to trade their physical appeal for taste) than we expected to observe. Consumers who assign high importance to taste and low importance to their physical attractiveness, or like the full body look have a higher likelihood of shifting to the highest-calorie main course than do consumers who assign high importance to their physical appearance or aim at being slim. The former group might shift their post-information choices to the higher calorie content main course, yet may reduce the number of side orders, resulting in fewer calories overall. Consumers who are more concerned about calorie consumption may choose to consume more dishes, yet each with fewer calories. Our empirical study, which is based on market experimental surveys on perceptions and choices of fast food products, supports this assertion.

Importance of physical attractiveness and fashion; income; and age characterize the two types of consumers – calorie lovers versus calorie avoiders – while gender affects response to calorie information only.

1. Introduction

Previous studies on the effect of calorie information provision on consumer behavior in the restaurant industry have yielded mixed results. Not only have most studies found that calorie posting is ineffective in decreasing actual calorie consumption (Elbel et al. 2009; Finley, 2009; Harnack/French 2008; Mayer et al. 1987), there are studies suggesting that calorie posting regulations may actually cause a boomerang effect wherein some individuals actually increase their calorie intake (Giesen et al. 2011; Loewenstein/Ubel 2010). Yamamoto et al. (2005) found that while most consumers were not affected by calorie information, among those who did change their choices, about 20% increased their calorie consumption post-calorie information. A similar pattern was reported by Bassett et al. (2008), who observed that Subway patrons were more responsive to calorie information than were patrons of other fast food chains; and out of the 32% who reported noticing calorie information, 53% decreased their calorie intake, and 17% increased it. While the difference in the proportion of Subway patrons and patrons of other chains who notice calorie information may be explained by self-selection (customers who are more aware of calories tend to dine at Subway, which has built an image as a health-oriented fast food chain),
the finding that in an overfed society there exists a segment of consumers who actually prefer more calories needs further explanation. [1]

Similarly, the results of Bollinger/Leslie/Sorensen (2009), who studied the effect of mandatory calorie labeling on sales and on substitution between menu items at Starbucks outlets, indicate that the demand for some calorie-dense items actually increased after calorie posting (e.g., Old-Fashioned Doughnut at 450 calories, increased 21.6 %, and Cinnamon Swirl Coffee Cake at 300 calories increased 11.9 %). At the same time, sales of a more healthful option decreased (e.g., Multigrain Bagel at 360 calories by 15.9 %). These results are puzzling and need further exploration.

This paper differs from previous literature by providing an alternative explanation to the unexpected as well as the expected changes in food consumption in light of calorie information, based on the perceptual correlations between calories and taste and consumers’ heterogeneity vis-à-vis the importance they assign to pleasure (taste) relative to physical appearance, health, and other goals whose achievement might be adversely affected by overconsumption of calories. In this sense, the shift of some consumers to higher-calorie food items after exposure to calorie information is consistent with utility maximization, i.e., the consumer assigns high importance to pleasure in the main course, and reduces calorie intake by skipping side orders or desserts.

This paper, therefore, aims to identify segments of consumers who may shift their post-information choices toward either higher- or lower-calorie items and, at the same time, obtain profiling of these segments. Toward this end, we compare the effect of calorie information on perception, choice process, and choice differences between these segments (i.e., those who shifted toward higher-calorie items, and those who shifted toward the leaner options).

The remainder of the paper is as follows: In Section 2 we provide a background and develop hypotheses based on current literature related to health, taste, and consumer profiles. The methodology, data collection, and empirical model used in this study are presented in Section 3. Section 4 presents the results of this study, and the paper is concluded in Section 5, wherein summary and conclusions that include implications, limitations, and suggestions for future research are presented.

2. Calorie information background and hypotheses formulation

Although the majority of consumers tend not to change their food choices post-exposure to calorie information (Elbel et al. 2009), among those who do respond to calorie information, females are more likely to decrease their calorie intake, while males are either indifferent to calorie information (Driskell et al. 2008; Gerend 2009; Mor-

Previous literature has taken three alternative routes to explain consumers who shift their choices to a calorie-denser food product post-calorie information. The first is information gap; the second is income effect; and the third is misunderstanding the metrics of calories. The first explanation suggests that if consumers are not fully informed about the calorie content of the food they are considering, and if their calorie perceptions are higher than the actual densities, then calories are overestimated by consumers. Alternatively, if after being exposed to calorie information, the difference between ex post and ex ante perceptions of calorie content is positive, then it is considered calorie underestimation. Updating one’s perceptions of a food item’s calorie content in a state of calorie overestimation should increase consumption of that item (Chandon/Wansink 2007; Wansink/Chandon 2006). While calorie overestimation may explain results in lab experiments or in a one-time observation, it cannot provide adequate explanation for the findings of Bollinger/Leslie/Sorensen (2009) and Bassett et al. (2008), which are based on actual regular calorie labeling, which is assumed to correct the information gap and eliminate overestimation (underestimation) over time.

The second explanation suggests that the pricing schema wherein the cost per calorie is decreasing motivates low-income consumers to purchase calorie-dense products, which are perceived as cheaper, and thereby give the „best value” for their money. A strong counter-argument for this claim is based on findings that the income effect disappears when calorie information is provided (Giesen et al. 2011). We will not elaborate on the third argument suggesting that consumers have difficulties understanding the metrics of calories, in part since there is evidence that consumers are familiar with and understand the notion of calories, although they do have problems calculating calorie intake and show preferences for certain forms of calorie information presentation (van Kleef et al. 2008).

We suggest that the counterintuitive reaction to calorie information may be explained by a strategy adopted for coping with the desire not to gain weight. Specifically, we suggest that there are two possible food choice strategies, in addition to the status quo strategy of not changing one’s eating habits: One is to shift to lower-calorie foods, thereby avoiding the need to drastically reduce the quantities of food consumed; or, to reduce the quantity of food eaten, yet to continue to consume foods with high calorie values, which are associated with better taste (Raghunathan/Walker-Naylor/Hoyer 2006; Roininen/Tourila 1999; Roininen/Lahteenmaki/Tourila 1999; Westcombe/Wardle 1997).

A representative consumer chooses a meal that maximizes his/her utility by selecting a starter(s), a main
course, side dish(es), and dessert in addition to wine, beer, or soft beverages. If the choice of the meal is made according to utility maximization principles, then the consumer needs to take into account the tradeoffs between taste, health, and contribution to weight (loss/gain). Considering these tradeoffs requires allocation of cognitive resources, which is not very likely given the low-involvement task of choosing food products (Heiman/Lowengart 2011). Previous literature suggests that taste is the only salient attribute when food choices are made routinely (Holm/Kildervang 1996; Kalvisto/Sjösten 1997; Moskovich/German/Saguy 2005). If there are differences between consumers in their choices, it is therefore the outcome of heterogeneity in perceptions of tastiness of various foods, energy requirements, or both. Following this discussion, we hypothesize that:

**H1:** Prior to exposure to calorie information, consumers’ choice processes are based on taste only, and do not take into account the tradeoff between taste (goals) and other goals such as health and personal physical attractiveness. Differences in choices are therefore mostly explained by heterogeneity in perceptions of taste.

The notions of lexicographic choice process and heterogeneity of tastes are well established, and therefore **H1** is a replication of previous studies with a differing data set that is used to validate our data and analysis. The perceptions and choices without exposure to calorie information will be used firstly to identify the segments of calorie lovers and calorie avoiders, and secondly as a benchmark that allows comparing perceptions and choices post-calorie information posting.

Our argument is that there are perceptual correlations between variables that determine the demand for calories, and changes in perceptions of calorie content may be causally related to perceptions of health and taste attributes. FMRI (functional magnetic resonance imaging) studies, which measure changes in blood flow related to neural activity in the brain on the effects of attention, hunger, and calorie content on food reward processing suggest that the perceptual correlation of taste to calorie density is not necessarily manifested in a positive monotonic relationship, i.e., the more calories, the better the taste for all segments. For example, Siep et al. (2009) found that satiated healthy females show increased reward processing in response to low-calorie foods, while hunger increased activity following the presentation of high calories more intensively in females’ brains than in males (Frank et al. 2010). Similarly, state of diet affects perceptions of taste: Dieters (in contrast to non-dieters) are not only more aware of calories, but they tend to perceive low-calorie foods as tastier. For example, women who were in the state of diet rated sweet products lower than did women who were not in a diet state (Drewnowski/Rock 1995).

These findings suggest that the direction of the perceptual relationship between calorie content and taste is triggered by hunger, whether or not the consumer is in a state of low calorie diet. In addition, energy requirements (Wardle et al. 2004) and gender affect perceptions of taste above and beyond hunger and diet. For example, females perceive salads and vegetables to be tastier than do males (Heiman/Lowengart 2010), while males rate the taste of meat and food containing fat higher than do females, and much higher than vegetables (Wansink/Cheney/Chan 2003). Since vegetables are lower in calories than meat, the likelihood of females ranking low-calorie food as tastier is higher. In addition, females assign higher importance to their physical attractiveness than do males (Feingold 1990, 1992; Silberstein et al. 1988), and are more likely to prefer the thinner look, while about half of males are interested in enhancing their masculine image through muscle-building, which requires a high-calorie diet/high calorie consumption (Andersen/DiDomenico 1992; Furnham/Badmin/Sneade 2002). Moreover, higher importance weighting assigned by females to their health and to their diet is expected to increase their likelihood of choosing the low-calorie menu both pre- and post-exposure to calorie information relative to males (Driskell/Schake/Detter 2008; Gerend 2009).

As hypothesized earlier, in their day-to-day food choice tasks, consumers base their choices on taste. However, the importance of physical attractiveness and whether they are currently on a low-calorie regimen are reflected in perceptions thereof, and therefore consumers who assign greater importance weighting to the goal of satisfying pleasure (taste) than to their physical appearance are more likely to choose the high-calorie items independent of provision of calorie information. In addition to gender differences in perceptions and goals and importance assigned to physical appearance, age, education, income, race, and occupational status are frequently used to explain unhealthful food choices (Drewnowski 2009). Low education, low income, and lower occupational status have been correlated with unhealthy food choices (Koldinsky et al. 2009; Thompson et al. 1999), which in turn are correlated with overweight and obesity (Baum/Ruhm 2009) [2]. Following the aforementioned discussion, we hypothesize that:

**H2:** Consumers who choose high-calorie meals are predominantly male, more likely to be less educated, to be young, to have low income and to have a higher propensity to assigning low importance weighting to their physical appeal.

Post-exposure to calorie information, consumers may update their perceptions of calorie contents of various menu items. The posted calorie information may increase, decrease, or not affect calorific perceptions of the foods, depending upon prior perceptions and consumer characteristics. Suppose that a consumer has underestimated the calorie content of his/her preferred main course, while other products’ calorie densities were accurately evaluated. Updating calorie perceptions may cause a change in overall perceptions, which in turn are
likely to cause changes in the importance weightings of products’ attributes (Heiman/Lowengart 2008), thereby changing the choice process from a non-systematic (Chaiken 1980) heuristic to a systematic one that considers the tradeoff between attributes.

Let consider a consumer who, prior to viewing calorie information, chooses main course (1), the highest-calorie main course on the menu, plus side orders; and after receiving calorie information and considering the tradeoff between calories, taste, and likelihood of meeting the goal of controlling body weight now finds that main course (2) plus side orders and beverages provides him/her with higher benefit. This individual may switch to main course (2), or may pass on side orders or beverages and continue with ordering main course (1), ending up ordering a main course with higher calorie content, yet giving up a number of other items. [3] Switching to main course (2) and ordering more food items indicates preferences for quantity and more choices, while ordering the calorie-denser product – probably because it is perceived as tastier – reveals preferences for quality over quantity. While dieticians frequently advise their patients to choose a diet based on large numbers of food products, each with lower-than-average calorie density, there is evidence that consumers prefer to stick to their high-calorie main course and give up on sides. Dubbert et al. (1984) found that consumers substituted high- with low-calorie sides that include vegetables and salads after exposure to calorie information, yet did not change their main course selections, and furthermore, the total volume of sales and the number of visits were not affected by this information, thus strengthening our confidence in this conjecture.

Consumers who choose the strategy of shifting to the higher-calorie main course are those who associate high-calorie foods with better taste, and may be less sensitive to physical attractiveness; while those who shift to the lower-calorie choice derive higher benefit from health and/or physical attractiveness. Alternatively, consumers who shift to (or stay with) the high-calorie alternative may prefer pleasure to quantity (more dishes), while those who shift to (or stay with) the lower-calorie item are those who derive utility from the quantity of food consumed (satisfaction). Based on this discussion, we hypothesize that:

H3: Exposure to calorie information will increase the likelihood of calorie-prone consumers to shift their food choices to a high-calorie main course and reducing the number of side orders, compared to the low-calorie-prone consumer segment.

Our previous discussion suggests that consumers who assign high importance to their physical attractiveness (look) and health are more likely to be affected by calorie information; while the likelihood is greater that consumers who assign high importance weights to pleasure (taste) and less to physical attractiveness, will choose the high-calorie main course after exposure to information. Men, in particular, may shift their choices toward higher-calorie food items (Harnack et al. 2008). Furthermore, being a younger male with low income and education increases the likelihood of objecting to the idea of calorie labeling and expressing this reservation in a shift to high-calorie items (Kolodinsky et al. 2009). Following the aforementioned discussion, we hypothesize that:

H4: Consumers who choose high-calorie meals post-exposure to calorie information are more likely to be male, less educated, earn lower income, and assign lower importance weighting to their physical appeal.

In the next section, we present the experimental survey design, describe the respondents, and present the results of our experiments.

3. Methodology

3.1. Subjects

Overall the sample included 200 respondents, recruited from a high school, a department of Israel’s largest university, and a workplace in a metropolis in the center of the country. The sample contained 63 males and 137 females. Respondents’ education ranged from high school (24.5 %), to vocational college (39 %), to college or university degree (36.5 %). 20 % were younger than 20 years old, 20 % were between 20 and 30 years of age; 20 % were between 31 and 40 years of age; and 40 % above 40 years of age. With respect to income, 24.5 % of respondents earned an income that fell below the national average, 39 % at the average, and 36.5 % above average.

3.2. Manipulations

The research design in this study is a between-subject one that enables detecting variations in consumers’ evaluations of products’ characteristics, as well as their choices of menu main courses and complete meals with and without calorie information. Two groups of respondents were used in this study: control group and manipulation group. Each respondent was randomly assigned to one of the two groups. The interviewer received a packet of questionnaires that contained both versions (of main course products) in random order, the first pages of which were identical, with no labelling that could identify for which group the questionnaire was intended.

In the control group, respondents were shown a menu of fast-food items that included a hamburger, a chicken sandwich, and a green salad (choice set); the menu also included the market prices of these items. These three main courses were selected out of the entire menu, since they represent the most commonly ordered items in fast-food outlets, as was discovered in preliminary focus groups and interviews with McDonald’s shift managers. In the manipulation group, we used the same menu as in the control group, and in addition the calorie content of
each item, as well as the amount of physical exercise needed (i.e., time of workout activity) to burn the calories contained in each of the three products (hereinafter: "burn time"). The choice to present calorie plus workout information was based on the findings of Heiman/Lowengart (2010) and Harnack et al. (2008) that this form of presentation is more effective in changing final choices than is calories only.

We utilized a closed-ended questionnaire to obtain consumers’ preferences for and perceptions of these three food items: a hamburger, a chicken sandwich, and a salad. We also verified that respondents were familiar with these products and had purchased them during the past year, thus screening out consumers who did not patronize fast-food outlets, thereby eliminating confounding effects of product familiarity and usage in our results as well as alleviating potential IIA (Independence of Irrelevant Alternative) effects in the choice model.

Respondents were also asked to answer a set of questions pertaining to their perceptions of and preferences among fast-food products.

### 3.3. Data

Respondents were asked to rate the three main courses on several product attributes using an 11-point scale. For instance, a respondent would be asked: "How would you rate the tastiness of the hamburger? Please respond referring to the scale below (which was -5 to +5), where -5 indicates that you dislike the taste, and 5 stands for extremely tasty." Other attributes included were healthfulness, price, and satisfaction, which were used in previous studies (e.g., Heiman/Lowengart 2008; 2010). Respondents were also asked to choose one product (hamburger, chicken sandwich, or green salad) of the three as their preferred main course. This procedure was performed in both groups.

After completing this task, respondents continued to a second task of the survey aimed at identifying whether they belong to the calorie dense (light) segments. Respondents were shown an extended menu that included, in addition to the three products taken from the previous task: double hamburger; regular size French fries; a combo comprised of a hamburger, French fries, and a soft drink; a combo meal comprised of a chicken sandwich, French fries, and a soft drink; a combo meal comprised of regular hamburger and fries; and a combo comprised of a regular order of French fries and a beverage. Each respondent was asked what s/he would order for lunch. Respondents could chose any number of items from the menu and therefore a respondent could chose a combo meal and additional hamburger and fries – though nobody in our sample did so. The calories of the marked items were added later in order to calculate how many calories each respondent ordered, and were used to create high- and low-calorie consumer segments.

### 4. Results

In the first stage of our analysis we test whether there are differences in perception of taste between choosers of the main courses: hamburger, chicken sandwich and salad. We analyze the consumers’ choice without calorie information aiming to support HI. If HI is supported then differences is perceptions of taste would explain differences in selection of the main courses.

#### 4.1. Perceptual differences without calorie information

Tab. 1 present the differences in perceptions of taste between choosers of the three main courses. Each row represents the perceptions of consumers who chose one of the three main course food items (i.e., 24 chose hamburger) and each column represents the perceptions of taste of the chosen main course (i.e., those who chose hamburger, rated, on average, its taste at 9.21) as well as the perceptions of taste of the other two main courses.

The results of Tab. 1 suggest that consumers do not necessarily select the tastiest main course. Chicken is the exception and therefore although consumers may consider only taste when selecting a dish – taste may be perceptually related to other attributes such as high calorie content and lower price.

The second step in this analysis classifies consumers into segments based on the calorie content of their food orders in the second choice task. Both control and manipulation groups were divided into two segments using two criteria: median choice of calories, and a noticeable difference between the low end of the calorie-dense group and the high end of the calorie-light group. The result of this process led to the division of the control group into two (unequal) segments, wherein 35 individuals were classified as the calorie-dense segment, and 65 as the cal-

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*Table 1: Perception of taste between choosers of the three main courses*

<table>
<thead>
<tr>
<th>Chosen food item</th>
<th>Hamburger</th>
<th>Chicken</th>
<th>Salad</th>
<th>F-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hamburger</td>
<td>10.73</td>
<td>10.08</td>
<td>7.83</td>
<td>26.79</td>
<td>0.001</td>
</tr>
<tr>
<td>N=24</td>
<td>(0.60)†</td>
<td>(1.54)‡</td>
<td>(2.76)‡</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chicken</td>
<td>9.81</td>
<td>10.39</td>
<td>9.42</td>
<td>2.87</td>
<td>0.061</td>
</tr>
<tr>
<td>N=36</td>
<td>(1.39)ab</td>
<td>(1.08)‡</td>
<td>(2.43)‡</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salad</td>
<td>9.21</td>
<td>10.17</td>
<td>10.50</td>
<td>5.50</td>
<td>0.006</td>
</tr>
<tr>
<td>N=40</td>
<td>(1.89)b</td>
<td>(1.09)ab</td>
<td>(1.06)‡</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Key:** Means without a common letter differ significantly (p<0.05) by the Tukey method and the numbers in brackets represent standard deviation.
orie-light segment. The average calorie density in the control group was 982, with the calorie-dense segment ordering 1,667 calories, and the calorie-light segment ordering an average meal content of 602 calories. The manipulated group’s average calorie order was 546; 805 in the calorie-dense group, containing 31 individuals, and 339 in the calorie-light group having 69 individuals in it (see more details in Tab. 7). This sub-division and calorie order level appears consistent, as the ratio of the average order of the control group to that of the manipulation group is 1.79, the ratio in the calorie-dense groups is 2.06; and 1.67 in the calorie-light groups.

4.2. Identifying the demographic and lifestyle characteristic for calorie-dense vs. -light preference segments

In this section, we identify which consumers prefer the dense- (light-) calorie meal, and whether this classification holds after providing calorie information. If the segmenting variables remain significant post-calorie information, then the inherent utility (disutility) derived from calorie consumption that characterizes a certain type of consumer is invariant to information; otherwise it is information-dependent.

The demographic variables employed to identify the two segments were broken down into two categories (high and low), wherein the stratifying value is based on the average of the population according to the Israeli census. The average age of the Israeli population at the time of the study was 29.3 (http://www.cbs.gov.il/shnaton61/st02_11x.pdf), and thus we divided the sample into two segments: below 30 and 30 and above. Income of the sample population is classified by average salary before tax and social security deductions (transfer). The mid-range group was split evenly between the high category (above national average monthly income) and the low category (below national average income).

Similarly consumers were classified according to the media value of the lifestyle variables – importance of dressing fashionably, importance of physical attractiveness/look (interval measurement scales). The descriptive statistics of the samples classification into one of the two segments high and low calorie consumers in the control and manipulation groups are presented in Tab. 2.

Each row represents a calorie preference cross-demographic variable. For example, 57 % of respondents with high education level chose a low-calorie meal, while 43 % of the high-education segment chose a high-calorie meal. The results presented in Tab. 2 imply that income and age differentiate between consumers with respect to their choices of calorie-dense (-light) food. Mature (30 and above) consumers with above-average incomes chose lower-calorie meals. These results are invariant to calorie information, i.e., age and income continue to be separating variables across treatments. Specifically, the difference in age distribution among consumers who chose high-calorie food in both the control and manipulation groups is not significant, and the same holds for the low-calorie segment. Similarly, no significant difference was found with respect to differences in income distribution among consumers who chose calorie dense (light) meals in both the control and manipulation groups. Our finding that older and wealthier consumers prefer to consume fewer calories is consistent with that of Verbeke (2005).

We discovered that in the control group, while women do not significantly differ from men in their choice of calo-

<table>
<thead>
<tr>
<th>Control group: no calorie information</th>
<th>Manipulation group: calorie information</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Calorie density (%)</strong></td>
<td><strong>Calorie density (%)</strong></td>
</tr>
<tr>
<td><strong>N</strong></td>
<td><strong>Low (N=65)</strong></td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td><strong>High</strong></td>
</tr>
<tr>
<td><strong>Income</strong></td>
<td><strong>Low</strong></td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td><strong>High</strong></td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td><strong>Low</strong></td>
</tr>
<tr>
<td><strong>Exercise</strong></td>
<td><strong>High</strong></td>
</tr>
<tr>
<td><strong>Style clothing</strong></td>
<td><strong>Low</strong></td>
</tr>
<tr>
<td><strong>Physical appearance</strong></td>
<td><strong>High</strong></td>
</tr>
<tr>
<td><strong>Low</strong></td>
<td>39</td>
</tr>
<tr>
<td><strong>High</strong></td>
<td>57</td>
</tr>
<tr>
<td><strong>Low</strong></td>
<td>43</td>
</tr>
<tr>
<td><strong>Low</strong></td>
<td>62</td>
</tr>
</tbody>
</table>

Table 2: Socio-economic characteristic of the high and low calorie segments
rie content of food, information generates a marginally significant gender difference. This result suggests that women are more likely to respond to calorie information coupled with workout time data. The insignificant gender difference in the control group does not support this part of H1, while the significance of the cross-treatment test, indicating that their calorie demand shifted down while men’s was not affected, partially supports H4 and is consistent with the results of Driskell et al. 2008 and Gerend 2009.

Our results also suggest that consumers who assign high value to dressing fashionably and chose a high-calorie menu prior to exposure to information, or consumers who chose a low-calorie menu before exposure to information and assign high importance to physical attractiveness, are more likely to select low-calorie items post-calorie information. This result supports H2. With respect to calorie information, the difference in choosing high calorie items between consumers who assign high importance to their physical appearance and consumers who assign low importance to this aspect, increase. More than 90 % of the consumer who assign high importance to physical attractiveness chose low calorie menu compared to 65 % in the case of no calorie information. When confronted with calorie information, 61 % of consumers who assign low importance to physical attractiveness chose low calorie menu whereas 57 % chose these items without calorie information.

4.3. Differences in the choice process

4.3.1. Choice model

The main objective of this section is twofold: 1) estimating the probability of a consumer choosing a specific fast-food product from a set of alternatives; and 2) identifying the fast-food attributes most salient in the consumer purchasing decision. Identifying these variables will enable policy-makers to better identify typical choice processes for various consumer groups, as well as better design communication strategies to alter consumers’ eating habits.

We employed a probabilistic multinomial Logit choice model (McFadden 1974) to analyze the data. Let \( U_{ij} \) be the utility of alternative product \( j \) for customer \( i \), and \( m \) the number of alternative fast-food products. The utility function can be separated into a deterministic component \( V_{ij} \) (derived from the products’ attributes), and an unobserved random component, \( \varepsilon_{ij} \), (iid) such that:

\[
U_{ij} = V_{ij} + \varepsilon_{ij} \tag{1}
\]

The distribution of \( \varepsilon_{ij} \) is assumed to be Gumbel type II extreme value, and thus the probability of the alternative product \( j \) being chosen by customer \( i \) from a choice of \( m \) alternatives depends on the deterministic component of the utility function, such that \( P_{ij} = P[U_{ij} = j \geq U_{ij} \neq j \forall i \in C] \), and can be determined by:

\[
P_{ij} = \frac{\exp(V_{ij})}{\sum_{m=1}^{m} \exp(V_{mj})} \tag{2}
\]

4.3.2. Utility specification

The deterministic component of the utility function has the following form:

\[
V_{ij} = \alpha_i \text{Taste}_j + \alpha_i \text{Health}_j + \alpha_i \text{Price}_j + \alpha_i \text{Filling}_j + \alpha_i \text{PS}_1 + \alpha_i \text{PS}_2
\]

where:

\[
\text{Taste}_j - \text{Consumer } i’s \text{ perceptions of main course } j’s \text{ tastiness}
\]

\[
\text{Health}_j - \text{Consumer } i’s \text{ perceptions of main course } j’s \text{ healthfulness}
\]

\[
\text{Price}_j - \text{Consumer } i’s \text{ perceptions of main course } j’s \text{ price}
\]

\[
\text{Filling}_j - \text{Consumer } i’s \text{ perceptions of her satiation level after consuming main course } j
\]

\[
\text{PS}_j - \text{Product alternative } j’s \text{ idiosyncratic effects for } j = 1, 2, 3
\]

\[
\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5, \alpha_6 - \text{Parameters to estimate}
\]

The product-specific variables are aimed at capturing the unique characteristics of each product’s alternatives. As taste, health, price, and satiation are shared by all items, we increase the predictive power of the model by including these product-specific constants (Guadagni/Little 1983). We use only two such variables in the model to avoid singularity comparing the marginal effects of choice of the hamburger and the chicken sandwich to that of the salad.

4.3.3. Estimations of choice model in the two segments with and without information

Tab. 3 presents the results of the MNL analysis for the control group. Taste is the only significant salient attribute in the choice process for both segments (calorie-dense/calorie-light preferences). These results are consistent with previous studies that suggest that taste explains most of our food choices (Moskovich/German/Saguy 2005). Price is marginally significant in the calorie-light segment. Since the price per calorie is declining, the low-calorie group is marginally more willing to trade income for weight control products. While the product-specific constants Ps1 and Ps2, used to capture the unique characteristics of each product alternative, are in the right order, they are not significant. The choice process post-calorie content and burn information is analyzed and presented in Tab. 4.

Exposure to calorie information transformed the choice process from a single attribute into a compensatory (multi-attribute) one with taste, healthfulness, and satiation being salient in the calorie-light segment. The high-calorie segment, however, did not alter its decision process, and appears not to have considered the manipulated information. A careful look at the ratio of importance weightings of taste to health in this condition reveals that these ratios are much lower than in the control condition.
That is, the ratio between taste and health is 3.27 for the calorie light segment, and 2.19 for the calorie dense segment. This result is mainly attributed to a decrease in the value of the taste parameter in the manipulation group relative to the control group, and to a lesser degree, an increase in the value of the health coefficient in the manipulation group relative to the control group. Thus, the relative effect of taste on health is weaker in the manipulation group than in the control group, indicating a weaker effect of taste on the choice process. This result is consistent with previous research (Heiman/Lowengart 2011).

To verify whether this segmentation scheme is meaningful (i.e., whether separating the sample into two segments should result in a better data fit than would an aggregate sample), we conducted log-likelihood tests, $\hat{\lambda}$, where $\hat{\lambda} = (LL_{\text{segments}} - LL_{\text{aggregate}})$ (Gensch 1985) on the various segmentation schemes. The $\hat{\lambda}$ value for this analysis is 1.78, which is not significant in an $x^2$ test. This result indicates that there is no additional gain in understanding the data through fit measurement, and that there are no differences between the segments and the aggregate. Furthermore, observing the model-estimated parameters, it can be seen that taste has a stronger effect than any other variable, besides its significance, and that this relationship holds across segments as well. The ratio of taste to health is 10.09 for the calorie-light segment, and 4.34 for the calorie-dense segment. Thus, again, we find that taste is the strongest determinant of the choice process. These differences in the choice processes between the two consumer segments are reflected in the $\hat{\lambda}$ value (6.28) of the log-likelihood test for this analysis, which is significant at the 0.001 to 0.05 level.

Next we explore whether the difference in choices can be explained by differences in perceptions, choice, or both. We begin by exploring differences in perceptions between the two segments.

### 4.4. Perceptions without and with calorie information

Tab. 5 presents differences in the average perceptions of taste, healthfulness, price, and satiation between the two segments.

The differences in the perceptions of taste in the control group suggest that while the perception of hamburger’s taste did not differ between the two segments, that of the tastiness of the chicken sandwich and that of the salad differ in between significantly (10.51 vs. 9.66 for the chicken sandwich, and 9.52 vs. 8.14 for the salad) in the dense- (light-) calorie segments respectively. That is, consumers who selected a low-calorie meal perceived the weight control supporting food product as tastier than did the high-calorie segment. Whether the stronger perceptions of tastiness of the low-calorie food resulted in an increased likelihood of choosing them or vice versa –
i.e., choice affecting perception – while interesting, is not relevant to our study. We are rather interested in exploring sources of differences between segments that choose differing diets – and herein we are able to show that taste perception is a source of difference. With regard to the other three attributes – health, price, and satisfaction – there is no observed significant perceptual difference between the two segments.

In the manipulation group, calorie information created perceptual differentiation in the health attribute. Regarding all three products, the calorie-light segment perceived these products’ healthfulness as lower than did the calorie-dense group (5.55 vs. 8.65 for hamburger, 7.48 vs. 9.77 for chicken, and 9.06 vs. 10.39 for salad). The perceptual difference in the taste attribute for the hamburger became significant post-exposure to calorie information, while these increased the calorie-dense segment’s perception of the taste thereof. The difference in the perceptions of the salad’s taste became insignificant.

Calorie and workout information caused the calorie-light segment to reduce its perceptions of hamburger’s taste, while these increased the calorie-dense segment’s perception of salad’s taste. These changes generated a situation wherein the higher-calorie food (hamburger) was perceived by the calorie-light segment as less tasty and less healthful than they were perceived by the calorie-dense segment. While these two segments did not perceive a difference in taste in the lower-calorie food item (salad), there is a large difference at the product level (across treatments) between perceptions of products between the two segments, leading to a potential source of differences in choices.

Table 5: Perceptual differences between the light (heavy) calorie segments.

<table>
<thead>
<tr>
<th></th>
<th>Hamburger</th>
<th>Chicken</th>
<th>Salad</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
<td>Low</td>
<td>p-value</td>
</tr>
<tr>
<td>Control group</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Taste</td>
<td>9.80</td>
<td>10.15</td>
<td>0.238</td>
</tr>
<tr>
<td>Health</td>
<td>8.34</td>
<td>8.38</td>
<td>0.945</td>
</tr>
<tr>
<td>Price</td>
<td>8.34</td>
<td>8.80</td>
<td>0.056</td>
</tr>
<tr>
<td>Filling</td>
<td>9.89</td>
<td>10.34</td>
<td>0.070</td>
</tr>
<tr>
<td>Manipulation group</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Taste</td>
<td>10.81</td>
<td>8.71</td>
<td>0.001</td>
</tr>
<tr>
<td>Health</td>
<td>8.65</td>
<td>5.55</td>
<td>0.001</td>
</tr>
<tr>
<td>Price</td>
<td>7.19</td>
<td>6.84</td>
<td>0.133</td>
</tr>
<tr>
<td>Filling</td>
<td>10.65</td>
<td>10.25</td>
<td>0.021</td>
</tr>
</tbody>
</table>

Table 6: Market shares of control and manipulation groups

<table>
<thead>
<tr>
<th>Manipulation</th>
<th>Segment</th>
<th>Hamburger</th>
<th>Chicken</th>
<th>Green salad</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control group</td>
<td>Calorie-dense</td>
<td>48.6</td>
<td>31.4</td>
<td>20.0</td>
</tr>
<tr>
<td></td>
<td>Calorie-light</td>
<td>35.4</td>
<td>38.5</td>
<td>26.2</td>
</tr>
<tr>
<td>Manipulation group</td>
<td>Calorie-dense</td>
<td>64.5</td>
<td>25.8</td>
<td>9.7</td>
</tr>
<tr>
<td></td>
<td>Calorie-light</td>
<td>24.6</td>
<td>42.0</td>
<td>33.3</td>
</tr>
</tbody>
</table>

Table 5 presents the market shares of the control and manipulation groups of the three products.

The most striking result is that the market share of hamburger – the ultimate diet-buster – increased in the calorie-dense segment from 48.6 % (control) to 64.5 % (the x² test for the calorie light group market share was significant at 0.001). Furthermore, the „calorie lover“ segments shifted their choices to hamburger, reducing the demand for the salad from 20 % market share in the control group to 9.7 % in the informed group. That is, providing information on calorie contents of fast food products increased consumers’ odds of choosing the highest-calorie item. A reverse pattern can be observed for the calorie-light segment, wherein a decrease in the hamburger’s market share post-calorie information is observed, with the salad replacing the hamburger.

Finally, we conjectured that the calorie lovers would adapt their consumption in light of calorie information by reducing the number of products, while the calorie-light segment would continue to consume nearly the same items as before and adjust its calorie consumption by shifting to calorie-light food products. Tab. 7 presents
the number of food items in the two segments across treatments.

The results shown in Tab. 7 indicate that without additional calorie information, the calorie-dense segment chose more product items than did the calorie-light segment. Information eliminated this difference, indicating that consumers in the calorie-dense segment preferred to continue to consume the high-calorie product, i.e., the hamburger, and skip the sides. The effect of information on size of the meal is stronger for the calorie-dense segment that reduces calorie consumption – that actually may reduce the number of side orders and desserts and stay with a high-calorie main course, while the consumer segment that is more concerned with calories chooses to consume more dishes, yet each with lower calorie content. Our empirical study, which is based on experimental surveys, supports this assertion. These findings provide an additional different explanation for the phenomenon of counter-response to calorie information provision.

Unlike previous studies, we examine a choice situation wherein consumers can consider alternative products, enabling us to analyze the choice processes of various consumer groups choosing differing levels of calories in their selections of fast food products. Furthermore, we attempt to identify the characteristics of these individuals, and explore possible explanations for these differences in calorie consumption choices.

The most notable difference between the choice process with and without calorie information (Tab. 3 and Tab. 4) is the shift from a non-compensatory process where only one attribute is salient in the choice task in the control group to a multi-attribute process wherein the tradeoff between two or more attributes is considered. Calorie information causes consumers to consider the tradeoff between taste, health, and satiation in the calorie-light segment, whereas the calorie-dense segment adheres to its non-compensatory choice process, which is based on taste only. The results of this analysis indicate that consumers who prefer to consume high-calorie meals do not change their choice process post calorie information. Although they may reduce their total calorie consumption, their odds of shifting to the calorie-dense product increase after calorie information is provided. The implication of these results is that for young, low-income, males, the desired shift away from their unhealthy eating habits would not be achieved via calorie information provision, and therefore another strategy is needed.

In terms of „who are these individuals?” who consume more calories when informed of calorie contents and burn times, we find that regardless of information, older consumers and higher-income consumers dominate the calorie-light segment. This composition did not change in the manipulation condition. While females, to a certain degree, are more affected by nutrition information than are males, and are more conspicuous in the calorie-light segment, gender’s effect is weaker than are income and age. Being classified into one of these segments, however, is not dependent on education, in our experiment.

### Table 7: The composition of meals – number of food items and calories in the two segments across treatments

<table>
<thead>
<tr>
<th>Kalorienliebhaber</th>
<th>Kalorienvermeidende</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reagierend ohne</td>
<td>Reagierend auf kalorienbezogene Information</td>
</tr>
<tr>
<td>Kalorien des Hauptgerichts</td>
<td>1666 (514)</td>
</tr>
<tr>
<td>Anzahl der Gerichte</td>
<td>2.741 (1.163)</td>
</tr>
</tbody>
</table>

Key: Zahlen in Klammern repräsentieren die Standardabweichung.
Our study considers one type of calorie manipulation. Other types of manipulations can be used to influence consumers’ behavior in changing their food choices. These might include, for example, presenting calorie content information of food items compared to the recommended daily consumption (causing respondents to use relative evaluation) or compared to the recommended calorie consumption of a certain meal (breakfast, lunch, dinner). The effects of these and other types of calorie presentation can be explored in future research. This study considered ready-made food items of pre-determined quantities (e.g., the size of the hamburger) and limited variation in calories (e.g., hamburger, fries, chicken, etc.). Future research can focus on presenting the option of choosing the number of calories freely by allowing respondents to either choose the size of the food item or choose several items out of a large set of options to come up with a desired meal.

Another avenue for future research that can advance the results of this study can focus on adding more personal variables that can be used to identify the composition of the calorie-dense and calorie-light consumer segments. While our choice of fast food products is convenient, as their calorie contents are pretty much determined by the producer, fast food is problematic, as consumers who choose to patronize fast-food restaurants declared that they are not on a weight loss diet (at least on this occasion). Future research may benefit from replicating this study in a home-prepared food environment.

From policy-makers’ standpoints, the implications of this study are that regarding ordinary daily food choices, our results, as in previous research, indicate that consumers use taste as a base for product evaluation, and that taste is in turn affected by gender and goals such as weight control (reduction). In order to change consumer behavior in the direction of more healthful items, a segmented strategy should be adopted: Females and older and more educated consumers are more prone to purchase lower-calorie items, and therefore advertising that aims to elucidate calories consumed, may prove effective. The more problematic group of consumers in terms of their food choices is the young, less educated male segment that appears resistant to calorie posting. This segment is making a rational choice given that health is not considered and that the higher the percentage of fat, the higher the duration of satiety, thus the problem is not with the choice of hamburger versus salad, but rather with the choice of sides. Severing the calorie and price-negative relationship by subsidizing salads and sides and taxing sugar-based drinks may generate the desired change in behavior.

Notes
[2] Low occupational status, low income and education may describe blue-collar employees who need to consume more calories but on the other hand these characteristics may characterize unemployed individuals who need fewer calories on average. We thank an anonymous referee for pointing out this argument.

References
Heiman/Lowengart, The calorie dilemma: Leaner and larger, or tastier yet smaller meals?


Keywords
calorie, choice process, fast food, gender, information, lifestyle, overweight