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The Calorie Dilemma: Leaner and Larger, or Tastier yet Smaller Meals? Calorie Consumption and Willingness to Trade Food Quantity for Food Taste

by

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The calorie dilemma: Leaner and larger, or tastier yet smaller meals?

Calorie consumption and willingness to trade food quantity for food taste

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Abstract

This paper aims to provide an explanation for the counterintuitive response of some consumers to calorie information, which is described in the literature. While most consumers do not change their food choices post calorie information, some do reduce their calorie *consumption*, while others increase their calorie consumption by shifting to foods with higher calorie content. Overestimation of calorie content of calorie-dense food has been widely employed to explain the counterintuitive choice of the higher-calorie dish.

This paper suggests that since calories are associated with better taste, and there is a distribution of willingness to trade physical appeal for taste, then the odds of a consumer who assigns high importance to taste will shift to the highest calorie entrée are greater than those of a consumer who assigns high importance to her or his looks. Consumers who shift their choices of entrée to that with higher calorie content may reduce the number of side orders, and thus consume fewer calories than previously; while the segment more concerned with calorie consumption may choose to consume more dishes, yet each with lower calorie content. Our empirical study, which is based on market experiments, supports this assertion.

The importance of looks and fashion, income, and age characterize the two types of consumers — calorie lovers versus calorie avoiders — while gender affects response to calorie information only.

Keywords: calorie; choice process; fast food; gender; information; lifestyle; overweight

1.0 Introduction

Previous studies on the effect of provision of calorie information have yielded mixed results. Neither Mayer et al. (1987), Harnack / French (2008), nor Elbel et al. (2009) found significant effect of calorie labeling on food choices and calorie consumption; and Yamamoto et al. (2005) showed that most consumers are not affected by calorie information, and there were even consumers who increased their calorie consumption post-calorie information.

Bollinger / Leslie / Sorensen (2009) studied the effect of mandatory calorie labeling on sales, and substitution between menu items in Starbucks stores, and found that while provision of calorie information hardly changed the calorie consumption of beverages, it decreased calorie intake of foods (baked goods); and sales of some calorie-dense items even increased after calorie posting (e.g., Old-Fashioned Doughnut 21.6%, 450 calories; and Cinnamon Swirl Coffee Cake 11.92%, 300 calories); while sales of a healthier option (e.g., Multigrain Bagel 15.89%, 360 calories) decreased.

The finding that there are consumers who shift their choices to a calorie-denser food product post-calorie information has been explained by overestimation of the item's calorie density (Chandon / Wansink 2007; Wansink / Chandon 2006; Barbara / Livingstone / Black 2003). While calorie overestimation may explain results in lab experiments or in a one-time observation, it cannot provide adequate explanation for the finding of Bollinger / Leslie / Sorensen (2009), which is based on permanent calorie labeling.

This paper differs from previous literature in that it offers an alternative explanation that is based on the perceptual correlations between calories and taste, and the heterogeneity of consumers vis-à-vis the importance they assign to pleasure (taste) relative to physical appearance, health, and other goals that might be adversely affected by overconsumption of calories. In this sense, the shift of some consumers to a higher-calorie food after exposure to calorie information is consistent with the utility maximization notion, i.e., the consumer assigns high importance to pleasure in the main entrée, and reduces calorie intake by skipping side orders or desserts. This paper aims to identify the segment that shifted their choice to a higher-calorie food post provision of calorie information; and then to compare the effect of calorie information on perception, choice process, and choice between this segment and the segment that shifted its choice toward the leaner options.

2. Literature review and model formulation

The majority of consumers tend not to change their choices of food post exposure to calorie information. The literature suggests that females are more responsive to calorie

information than are males, who are either indifferent to calorie information (Gerend 2009; Morse / Driskell 2009; Driskell et al. 2008), or respond by actually choosing a higher-calorie meal (Yamamoto et al. 2005). Harnack et al. (2008) explained this finding thusly: "…this result could reflect a desire among males for an energy-dense meal." Another explanation is that consumers who shifted their choices to higher-calorie foods overestimated the calorie content of that food, while consumers who shifted to the leaner foods underestimated their calorie contents (Chandon / Wansink 2007; Wansink / Chandon 2006; Barbara / Livingstone / Black 2003).

Previous literature claimed that females are making healthier food purchase decisions than are males, as they are better informed on health and nutrition issues. This gender information gap is attributed to gender differences in reading interest and media consumption. That is, differing interests between genders (e.g., sports for men, lifestyle for women) result in differing information selection and targeting by editors and publishers (Nisbet / Huge 2000).

The stronger interest of females in nutrition is attributed to their traditional role as being responsible for food preparation, a role that women have continued to assume despite feminism movement (Gillon 1993). Females, therefore, are exposed more frequently and in greater depth than are males to nutritional information.

Besides being baselessly sexist, this assumption suffers from failed internal logic: Since calorie information causes females to adjust their consumption toward a leaner menu, while males either do not respond thereto or increase their calorie consumption, it appears that being informed results in calorie underestimation, while being uninformed leads to calorie overestimation. In other words, it appears that that males striving to ingest more calories coupled with being less informed leads to consistently overestimating calorie content of calorie dense foods.

The gender-based dichotomy of responses to calories is likely too general, since it is absurd to assume that males in general want to gain weight — unless they are body-builders — and that females aspire to a Twiggy-thin shape. While males may consume more calories in general, since their metabolisms differ from those of females, they are not less responsive to calorie information *provided the right format of information is used* (Heiman / Lowengart 2010b).

This paper suggests 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 reduce drastically the quantities of food consumed; or, to reduce the quantity of food eaten, yet to continue to consume foods with high calorie values.

Our proposed explanation for counterintuitive response to calorie information is based on

$$k \in \{K\}$$

(1)

$$w_T T\left(T_{j=1}, \sum_{k=1}^{K} T_k\right) + w_H H_{j=1}\left(Z_H, W\left(\alpha\left(C_{j=1} + \sum_{k=1}^{K} C_k - C^*\right)\right)\right) + w_L\left(L_0 + \alpha\left(C_{j=1} + \sum_{k=1}^{K} C_k - C^*\right), Z_L\right) >$$

$$w_T T\left(T_{j=1}, \sum_{k=1}^{K} T_k\right) + w_H H_{j=2}\left(Z_H, W\left(\alpha\left(C_{j=2} + \sum_{k=1}^{K} C_k - C^*\right)\right)\right) + w_L\left(L_0 + \alpha\left(C_{j=2} + \sum_{k=1}^{K} C_k - C^*\right), Z_L\right)$$

where

w_T, w_H, and w_L are the importance weights of taste, health, and look respectively.

$T\left(T_{j=1}, \sum_{j=1}^{k} T_j\right)$ denotes the production function of taste.

$H_{j=1}\left(Z_H, W\left(\alpha\left(C_{j=1} + \sum_{k=1}^{K} C_k - C^*\right)\right)\right)$ denotes the production function of health.

$L\left(L_0 + \alpha\left(C_{j=1} + \sum_{k=1}^{K} C_k - C^*\right), Z_L\right)$ denotes the production function of looks.

$C_{j=1} + \sum_{k=1}^{K} C_k - C^*$ denotes the effect of calories consumed on the caloric balance in the case wherein entrée j = 1 is selected. The calorie density of a meal is the sum of the calorie density of entrée j = 1 plus the sum of calories of all side dishes and all non-entrée foods and beverages. The optimal allocation of calories per the specific meal C^* (say, calorie consumption requirement divided by 3) is subtracted from the meal's calorie content.

L_0, Z_H, Z_L are the base look and other idiosyncratic characteristics such as genetics that affect the production of health and looks respectively.

Post exposure to calorie information, consumers update their perceptions of calorie contents of the various menu items. The new caloric information may increase, decrease, or not affect caloric perceptions of the foods, depending on prior perception and consumer

characteristics. If consumers increased their perceptions of the calorie density of product j, then $C_j^{t+1} > C_j^t$. We present the case wherein entrée j = 1 has been underestimated, while other products' calorie densities where accurately evaluated. A consumer who chose product j = 1 (Inequality (1) held) prior to information exposure, then discovered that the calorie content of Product (1) was underestimated, updated his / her perceptions, and may need to update his / her choice. If Inequality (1) is reversed, then a consumer can decide either to continue with Product (1) without eating side orders, or alternatively shift to Entrée 1 without giving up entrees. A consumer will continue to eat Entrée (1) if:

(2)

$$w_T T\left(T_{j=1}, \sum_{k=1}^{K} T_k\right) + w_H H_{j=1}\left(Z_H, W\alpha\left(C_{j=1}^{t+1} - C^*\right)\right) + w_L\left(L_0 + \alpha\left(C_{j=1}^{t+1} - C^*\right), Z_L\right) >$$

$$w_T T\left(T_{j=1}, \sum_{k=1}^{K} T_k\right) + w_H H_{j=2}\left(Z_H, W\left(\alpha\left(C_{j=2}^{t+1} + \sum_{k=1}^{K|j=2} C_k - C^*\right)\right)\right) + w_L\left(L_0 + \alpha\left(C_{j=2}^{t+1} + \sum_{k=1}^{K|j=2} C_k - C^*\right), Z_L\right) >$$

$$w_T T\left(T_{j=1}, \sum_{k=1}^{K} T_k\right) + w_H H_{j=1}\left(Z_H, W\left(\alpha\left(C_{j=1}^{t+1} + \sum_{k=1}^{K|j=1} C_k - C^*\right)\right)\right) + w_L\left(L_0 + \alpha\left(C_{j=1}^{t+1} + \sum_{k=1}^{K|j=1} C_k - C^*\right), Z_L\right)$$

Now suppose that in addition to the update on Entrée 1's calorie density ($C_{j=1}^{t+1} > C_{j=1}^t$), consumers also increase their perceptions of the calorie contents of side orders and beverages. In this case, a consumer who pre calorie information chose the lower-calorie entrée j = 2 may find that:

(3)

$$w_T T\left(T_{j=1}, \sum_{j=1}^{K=\{\varnothing\}} T_j\right) + w_H H_{j=1}\left(Z_H, W\alpha\left(C_{j=1}^{t+1} - C^*\right)\right) + w_L\left(L_0 + \alpha\left(C_{j=1}^{t+1} - C^*\right), Z_L\right) >$$

$$w_T T\left(T_{j=2}, \sum_{j=1}^{K=\{\varnothing\}} T_j\right) + w_H H_{j=2}\left(Z_H, W\alpha\left(C_{j=2}^{t+1} - C^*\right)\right) + w_L\left(L_0 + \alpha\left(C_{j=2}^{t+1} - C^*\right), Z_L\right) >$$

$$w_T T\left(T_{j=2}, \sum_{k=1}^{K} T_j\right) + w_H H_{j=2}\left(Z_H, W\left(\alpha\left(C_{j=2}^{t+1} + \sum_{k=1}^{K|j=2} C_k - C^*\right)\right)\right) + w_L\left(L_0 + \alpha\left(C_{j=2}^{t+1} + \sum_{k=1}^{K|j=2} C_k - C^*\right), Z_L\right) >$$

$$w_T T\left(T_{j=1}, \sum_{k=1}^{K} T_j\right) + w_H H_{j=1}\left(Z_H, W\left(\alpha\left(C_{j=2}^{t+1} + \sum_{k=1}^{K|j=2} C_k - C^*\right)\right)\right) + w_L\left(L_0 + \alpha\left(C_{j=2}^{t+1} + \sum_{k=1}^{K|j=2} C_k - C^*\right), Z_L\right)$$

whereas a consumer for whom Inequality (3) holds will replace his / her previous choice of lower-calorie entrée (j = 2) with a higher-calorie entrée, and skip the side dishes.

The aforementioned analysis indicates that new calorie information may cause consumers to shift to higher-calorie entrees and reduce the number of side dishes, desserts, and beverages consumed in a given meal. Other consumers may stick to their prior selections, while yet others may shift to lower-calorie entrees. Consumers who choose the strategy of shifting to the higher-

calorie entrée are those who associate high-calorie foods with better taste, and may be less sensitive to looks; while those who shift to the lower-calorie choice derive higher benefit from health or looks. Alternatively, consumers who shift to (or stay with) the high-calorie alternative may prefer pleasure to quantity (more dishes), as implied by Inequality (3); while those who shift to (or stay with) the lower-calorie item are those who derive utility from the quantity of food consumed (satiation).

Our paper aims to identify those consumers who chose the higher-calorie entrée, and compare them to consumers who chose the lower-calorie foods. Previous literature suggests that females are more concerned about their health and looks than are males; however, males' metabolisms require larger quantities of food and calories. Thus classification by gender is expected to be inaccurate. Our theoretical model 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 odds that consumers who assign high importance to pleasure (taste) and less to looks, will choose the high-calorie entrée are higher, and their resistance to changing their selection will be commensurately higher. The following three hypotheses summarize our findings and the aforementioned discussion.

H1: Consumers who assign greater weight to pleasure than to looks are more likely to choose the high-calorie items both before and after provision of calorie information.

H2: Post calorie information, consumers who assign a greater weight to pleasure than to looks are more likely to shift to the high-calorie item, and reduce the number of dishes ordered.

H3: The importance of physical attractiveness and style will serve as better predictors than will gender in segmentation of calorie lovers (avoiders).

In the next (empirical) section, we present the research, data, and results of our experiments.

3.0 Empirical section

3.1 Methodology

The methodology used in this study is based on a between-subject experimental design that aims to detect the perceptual differences between consumers regarding product attributes and choice processes across products and across experimental conditions.

3.2 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 that are most salient in the consumer purchasing decision. Identifying these variables will allow policy-makers to better identify typical choice processes for various consumer groups, and at the same time, to better design communication strategies to change 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, ε_{ij} , (iid) such that:

$$U_{ij} = V_{ij} + \varepsilon_{ij} \tag{4}$$

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

$$P_{ij} = \frac{\exp^{(V_{ij})}}{\sum_{j=1}^{j=m} \exp^{(V_{ij})}} \tag{5}$$

3.2.1 Utility specification

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

$$V_{ij} = \alpha_1 Taste_{ij} + \alpha_2 Health_{ij} + \alpha_3 \Pr ice_{iJ} + \alpha_4 Filling_{ij} + \alpha_5 PS_A + \alpha_6 PS_B \tag{6}$$

where

$Taste_{ij}$ - Consumer i's perceptions of the tastiness of Entrée j

$Health_{ij}$ - Consumer i's perceptions of the healthfulness of Entrée j

$\Pr ice_{ij}$ - Consumer i's perceptions of the price of Entrée j

$Filling_{ij}$ - Consumer i's perceptions of the satiation level after consuming Entrée j

PS_j - Product alternative j's idiosyncratic effects for j = 1,2,3

$\alpha_1, \alpha_2 \alpha_3, \alpha_4, \alpha_5, \alpha_6$ - 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 *j*-1 variables in the model to avoid singularity.

3.3 Data

We used a between-subject research design that allows the detection of differences in consumers' perceptions of the fast-food product characteristics, as well as their choice processes under differing information scenarios. Two groups of respondents were used in this study: control, and manipulation.

In the control group, respondents were shown a menu of fast-food items that included a hamburger, a chicken sandwich, a green salad, French fries, and a soft drink; the menu also included the market price of these items. The control group was also asked to answer a set of questions pertaining to their perceptions and preferences of fast-food products (as listed below). In the manipulation group, we used the same menu as in the control group, and in addition the menu included 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 five products (hereinafter: "burn time").

We used a fieldwork survey-based approach to collect data from potential respondents utilizing a closed-ended questionnaire to obtain consumers' preferences and perceptions of three food items: hamburger, chicken sandwich, and salad. We chose these three out of the entire menu, since they represent the most commonly ordered items in fast-food outlets, as was discovered in preliminary focus groups. We also verified at the time of data collection 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.

Respondents were then asked to rate the three food items on several product attributes using an 11-item Likert-type scale. For instance, a respondent would be asked: "On the scale below (which was -5 to +5), how would you rate the tastiness of this hamburger?" Other items included were healthfulness, price, and satiation. These attributes were used in previous studies (e.g., Heiman / Lowengart 2008; 2010a). Respondents were also asked to choose one product (hamburger, chicken sandwich, or green salad) of the three as their preferred main dish (entrée). Lastly, respondents were shown a menu that included the following items: hamburger; double

hamburger; chicken sandwich; green salad; regular size French fries; regular size soft drink; a combo meal that includes a hamburger, French fries, and a soft drink; a combo meal that includes a chicken sandwich, French fries, and a soft drink; a combo meal that includes hamburger and fries; and a meal that includes a regular order of French fries and a beverage. The control group was shown these items *with the market price beside each item*, while the manipulated group was shown *a menu that also stated the calorie content of each item.* This measure allows us to learn the differences in calorie preferences among consumers, and create differing consumer segments with respect to calories.

Overall the sample included 200 respondents drawn using a stratified sampling type procedure that allowed us to capture heterogeneity in respondents' demographic and lifestyle characteristics. Each respondent was randomly assigned to one of the two groups (control, manipulation). The sample contained 63 males and 137 females. Respondents' educations ranged from high school (24.5%), vocational training college (39%), to college degree (36.5%). 20% of respondents were younger than 20 years old; 20% between 20 and 30 years of age; 20% between 31 and 40 years; and 40% above 40 years of age. With respect to income, 24.5% of respondents had an income that fell below the national average; 39% at the average, and 36.5% above average.

4.0 Results

The first step in this analysis classifies consumers into segments based on the caloric contents of their food orders. The sample (both control and manipulation groups) was broken into two segments using two stratifying 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 calorie-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. The manipulated group's average calorie order was 546: 805 in the calorie-dense group, and 359 in the calorie-light group. This sub-division and calorie order level appears consistent, as the ratio between the average order of the control group and that of the manipulation group is 1:79, and the ratio between the calorie-dense groups is 2:06; and 1:67 in the calorie-light groups.

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

In this section, we aim at identifying which consumers prefer the low- (high-) calorie meal, and whether this classification holds after provision of 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), where the stratifying value is based on the average of the population according to the 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 stratified the sample into two groups: below 30, and 30 and above. Income of the sample population is classified by average salary before taxes 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).

The median value of the lifestyle variables — importance of dressing fashionably, importance of physical attractiveness-look (interval measurement scales), and intensity of workout effort (measured as the number of weekly physical workout activities) (ratio scales) — was selected as the separating measure. The descriptive statistics of the samples classification in the control group is presented in *Tab. 1*.

Table 1: Control group proportion of respondents

		Control		**Calorie information**	
	Calorie density	**Low**	**High**	**Low**	**High**
	High	0.57	0.43	0.62	0.38
Education	Low	0.52	0.49	0.45	0.55
	High	0.62	0.38	0.67	0.33
Income	Low	0.31	0.69	0.42	0.58
	High	0.74	0.26	0.67	0.33
Age	Low	0.34	0.66	0.45	0.55
	Females	0.74	0.26	0.7	0.3
Gender	Males	0.71	0.29	0.52	0.48
	High	0.61	0.39	0.58	0.42
Exercise	Low	0.60	0.40	0.45	0.55
Style	High	0.54	0.46	0.46	0.54
clothing	Low	0.63	0.37	0.32	0.68

		Control		Calorie information	
	Calorie density	**Low**	**High**	**Low**	**High**
Look	High	0.65	0.35	0.91	0.09
	Low	0.57	0.43	0.61	0.39

Each row represents the proportion of the sample of cross-demographic variable and calorie preferences, i.e., calorie-dense (-light) meal. 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. 1* imply that income (p-value = 0.004) and age (p-value = 0.001) 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 differences age distribution among consumers who chose high-calorie food in both the control and manipulation groups is insignificant (p-value of 0.367), as is the distribution of age among the low-calorie segment (p-value of 0.364). Similarly, the differences in income distribution among consumers who chose calorie dense (light) meal is similar in both the control and manipulation groups (p-value of 0.376) and (p-value of 0.536) respectively. Our finding that older and wealthier consumers prefer to consume fewer calories is consistent with that of Verbeka (2005).

In addition to the role of demographic variables, lifestyle variables can also serve as indicators for calorie choices: Consumers who assign high value to dressing fashionably (style), or who assign high importance to physical attractiveness (look) are more likely to select low-calorie items post calorie information (p-value of 0.013) and (p-value of 0.001) respectively (detailed Chi square analysis is presented in Appendix A). In other words, consumers who assign higher importance to their physical appearance are likely to select lower-calorie food items in light of the manipulated information, while consumers who assign low importance to their looks are likely to reverse their choices, i.e., select the high-calorie entree. The intensity of workout activities (burn time) did not make a significant difference either before or after calorie information.

Previous literature has suggested that females are more likely to prefer the thinner look, while about half of males are into building their masculine image through muscle-building, so it is expected that gender will influence calorie content choices (Frunham et al. 2002; Anderson /

DiDomenico 1992). Our empirical analysis indicates that women are more likely to respond to the type of information presented in this study (p-value of 0.084), and similar results were obtained for the cross-treatment test (p-value of 0.098). These results are summarized in *Tab.2*.

Table 2: Significant characteristics changes in the low- and high-calorie consumption segments before and after manipulation (x^2 Tests)

			Across Treatments	
	Control	**Calorie information**	**Calorie-light**	**Calorie-dense**
	p-value	p-value	p-value	p-value
Education	-	-	-	-
Income	+	+	-	-
Age	+	+	-	-
Gender	-	+ / -	-	+ / -
Exercising	-	-	-	-
Clothing	-	-	-	+
Look	-	+	+	-

Key: + - significant at the 0.05 level; + / - - significant at 0.10 level; - - not significant

Income and age predict calorie consumption before and after provision of calorie information; education does not serve as a predictor for calorie consumption; and gender affects choices only post information, indicating that females are responsive to calorie information, while males are less likely to be influenced thereby.

In the next section we analyzed the difference between the low / high-calorie segments in their response to calorie information. Previous literature suggested that information on health hazards affects the food choice process (Heiman / Lowengart 2008; 2010a), so we expect to find that calorie information changes the choice process, with health becoming salient post calorie information. However, here we have a different situation wherein a group of consumers shows a strong preference for high-calorie meals.

4.2 Differences in the choice process

Tab.3 presents the results of the MNL analysis for the control group.

Table 3: Choice process without provision of calorie information

	Calorie-light		Calorie-dense	
Variable	**Coefficient**	**p-value**	**Coefficient**	**p-value**
Taste	1.947	0.001	1.981	0.008
Health	0.193	0.315	0.457	0.119
Price	-0.397	0.072	-0.095	0.729
Satiation	0.407	0.149	0.679	0.205
Ps1	-0.200	0.708	1.181	0.246
Ps2	-0.310	0.491	0.347	0.659
Log likelihood	-49.2588		-21.1426	
R-square	0.310		0.450	
N	65		35	

Tastiness is a 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. While the product-specific constants are in the right order, they are not significant. Next, the choice process post calorie content and burn information is analyzed and presented in *Tab.4*.

Table 4: Choice process post calorie and workout information; MNL Results

	Calorie-light		Calorie-dense	
Variable	**Coefficient**	**p-value**	**Coefficient**	**p-value**
Taste	0.443	0.000	1.496	0.032
Health	0.356	0.014	0.457	0.336
Price	-0.150	0.558	0.295	0.551
Satiation	0.492	0.045	0.948	0.242
Ps1	-0.180	0.777	-0.619	0.759
Ps2	-0.165	0.732	-1.863	0.278
Log likelihood	-58.38		-16.88	
R-square	0.230		0.504	
N	69		31	

The most noticeable difference between the results in *Tab. 4* and those in *Tab. 3* is the shift from non-compensatory processes (i.e., only one attribute is significant) 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 sticks to its non-compensatory choice process, which is based on taste. 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 to shift to the calorie dense product increases after calorie information is provided. The implication of these results is that for young, low-income, male consumers, the desired shift away from their unhealthy eating habits would not be achieved via calorie information provision, i.e., another strategy is needed.

Finally, given the small perceptual differences between the two segments, regarding the difference in the disposition toward calorie consumption and the effect of information on the choice process, it is expected that the calorie-light segment's final choices will shift to low-calorie food items, i.e., from the hamburger to either the chicken sandwich or the salad; while the calorie-dense segment's choices will remain quite stable, reflecting their preferences toward high-calorie food (i.e., hamburger). The final choices are captured in market shares; Table 5 presents the initial (control) and calorie information-adjusted actual market shares.

Table 5: Market shares before and after calorie posting

	Hamburger	**Chicken**	**Green salad**
Control			
Calorie-dense	48.6%	31.4%	20.0%
Calorie-light	35.4%	38.5%	26.2%
Manipulation			
Calorie-dense	64.5%	25.8%	9.7%
Calorie-light	24.6%	42.0%	33.3%

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 x^2 test for the exercise 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 the odds of consumers 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.

5.0 Summary and conclusions

In the EU, more than 50% of the adult population is overweight or obese (BBC News 2007). Germany leads the EU in overweight, and the UK and Greece lead in the proportion of obese individuals in the population (Speigel International 2007). Overweight individuals are at a higher risk of suffering from health-related ailments such as diabetes, heart attack, and stroke, which in turn increases healthcare expenses. In the EU in 2006, direct obesity-related health care costs were estimated at € 59 billion (Rettman 2006).

Various measures are taken by policy-makers aimed at slowing (or ideally reversing) the pace of weight gain. These include mandatory labeling of the calorie contents of restaurant menu items, in particular fast foods, which are blamed as significant contributors to the obesity epidemic (Rosenheck 2008; Schroder et al. 2007). Previous studies suggest that calorie posting has an insignificant effect on calorie consumption (Harnack / French 2008), as most consumers resist changes in eating their behavior (Adamson et al. 2000). While information affects some consumers, aside from the desired shift (from a public health point of view) toward a lower-calorie diet, there is evidence that there is a segment — nearly as large as the segment that reduced calorie consumption — that actually increases its consumption of high-calorie food post calorie information (Bollinger / Leslie / Sorensen 2009).

This paper aims to identify the segment that prefers to consume high-calorie foods. We argue that the odds of a consumer in this segment shifting to a higher-calorie food post-information are higher than are those from the other segment(s). Such consumers may reduce the number of side orders and desserts, while the segment more concerned with calories prefers to consume more dishes, yet each with lower calorie content. Our empirical study, which is based on market experiments, supports this assertion. These findings provide an additional, differing 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 preferring 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.

Our results indicate that without information, consumers will employ a non-compensatory choice process that relies on taste alone to choose between fast food products. This type of choice process is also identified for the two different consumer segments.

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, $-2 \log \lambda$, where $\lambda = (LL_{segments} - LL_{aggregate})$ (Gensch 1985) on the various segmentation schemes. The λ value for this analysis is 1.778, which is not significant in an x^2 test. This result indicates that there is no additional gain in understanding of the data through fit measurement, and that there are no differences between the segments and the aggregate picture. Furthermore, observing the model-estimated parameters, it can be seen that taste has a stronger effect than any other variable, beside its significance, and that this relationship holds across segments as well. The ratio between taste and health is 7.59 for the control group, 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.

The results of the perceptual analysis at the aggregate and segment levels indicate a somewhat homogeneous pattern, and that there are no substantial differences between the three analyses (aggregate, calorie-dense, and calorie-light). Evaluating differences at the product level (across treatments) revealed more insight into potential differences between the segments. As noted earlier, we found that the taste of chicken and the taste of salad "improve" for the calorie-light group compared to the calorie-dense segment. As there is almost no noticeable difference in the choice process analysis, this perceptual difference potentially contributes to the differences in calorie level selection between the two consumer segments. Namely, consumers who selected low-calorie menu items perceived those items to be tastier than did the respondents in the calorie-dense segment, which led to a higher rate of selection of these items. The causes for such differences can be further examined in future research.

A similar analysis in the manipulation condition revealed a differing pattern of results. Firstly, the choice process is a compensatory one with taste, healthfulness, and satiation being salient at the aggregate level. A similar pattern is found in the calorie-light segment. That is, information on calories and burn time was considered by consumers, and they consequently adopted a more cognitively demanding choice process. 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 taste to health in this condition reveals that this ratio is much lower than in the controlled condition. That is, the ratio between taste and health was 1:15 for the control group, 1:24 for the low-calorie segment, and 2:19 for the high-calorie segment. As these

ratios are similar, this result is mainly attributed to a much lower value of the taste parameter and to a lesser degree, an increase in the health coefficient in the control and calorie-light groups; and a higher value of the health coefficient and even more importantly, a very small decrease in the taste coefficient.

These differences in the choice processes between the two consumer segments are reflected in the λ value (10.8246) of the log-likelihood test for this analysis, which is significant at the 0.001 level. Analyzing the results of the cross-segment perceptual result indicates that the calorie-light segment perceived the higher-calorie food (hamburger) to be less tasty and less healthy than did the calorie-dense segment (no significant differences for these attributes in the control group). These two consumer segments did not perceive a difference in taste in the lower-calorie food item (salad). An increase in perceptions of the calorie-dense segment regarding the tastiness of the hamburger, and a decrease in the perceived tastiness of salad in this segment, coupled with a taste-based choice process, resulted in the hamburger's market share increasing for this group, from 48.6% to 64.5% (*Tab. 5*).

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 has not changed in the manipulation condition. While females, to a certain degree, are more affected by this information than are males, and are more conspicuous in the calorie-light segment, this effect is weaker than are income and age. Being classified into one of these segments, however, is not dependent on education, in our experiment.

Future research can advance the results of this study by adding more personal variables that can be used to identify the composition of the calorie-dense and calorie-light consumer segments. As this study used demographic variables, adding personal traits can enrich its findings.

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Appendix A

x^2-square tests

	Control		Manipulation		Across treatments			
					Low calories		High calories	
	x^2-value	p-value	x^2-value	p-value	x^2-value	p-value	x^2-value	p-value
Education	0.278	0.598	2.569	0.109	0.405	0.525	0.259	0.611
Income	8.253	0.004	5.408	0.020	0.383	0.536	0.784	0.376
Age	14.835	0.000	4.122	0.042	0.824	0.364	0.814	0.367
Gender	0.067	0.795	2.992	0.084	0.302	0.583	2.743	0.098
Exercising	0.023	0.880	1.413	0.235	0.177	0.674	1.453	0.228
Clothing	0.754	0.385	1.750	0.186	0.747	0.387	6.163	0.013
Look	0.539	0.463	13.055	0.000	14.059	0.000	0.117	0.732

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