The Motivation to Eat and its Effects on Obesity

A Review of Literature

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Abstract

Due to the rapid increase in the population of obese people in America, several studies have been conducted in order to pin-point the biological mechanisms behind obesity as well as the motivation to eat. This paper will examine some of those studies and discuss the findings concerning the psychobiology of food preferences, the roles of manipulated food diets and genetics, and the interaction between satiety and the motivation to eat.

Concerning the biological mechanisms behind taste preferences, it is known that rats and humans have a high affinity for sweet tastes. Similarly, the intake of high-fat, high-energy diets is more highly preferred to low-fat diets. The nutritional value of food as well as post-ingestive actions play an important role in taste preference. This food preference could ultimately lead to obesity.

While taste preference plays a major role in food intake post-ingestive actions, satiety and genetics also influence taste preferences and subsequent food intake.

Motivation to eat is regulated by learned and unlearned responses, such as experimence. Manipulated diets are an important part of taste preference as well. A genetic phenotype for food preference and overconsumption has been identified, which contributes to an excess of food intake.

This paper will discuss the underlying taste preference and the factors the influence the motivation to eat. Taking into account taste preference and satiety, a future treatment for obesity is discussed.
INTRODUCTION

Obesity is certainly a rising trend in America’s population. According to Yeomans, obesity is generally regarded as the relationship between energy intake (food consumption) and energy expenditure (exercise or metabolism), specifically, more intake than expenditure (2001). Surprisingly, this rise in obesity is taking place among all ages, races, and gender. This disturbing increase of over-weight individuals has prompted many researchers to try to combat this problem; however, the underlying motivation behind overeating must first be understood. The feeling of satiety is very important in energy intake and overall food consumption essentially because it is an internal trigger providing the signal to either cease eating or to continue food intake. Proposals to explain obesity, ranging from genetic basis to social modeling and influences, have been investigated and tested. Tests concerning the psychobiology behind taste preference and the palatability of certain foods have been determined to contribute a lot to theories in the area of obesity research in relation to taste preference. General food intake is complicated in the sense that it deals with orosensory, gastro-intestinal, and other metabolic signals. Also, the hedonic value, or palatability rating, of the food is a major reason for more or less food consumption. This hedonic value is mostly measured by the presence of high-fat, high-sugar, more palatable foods. These palatability ratings from subjects have generated some useful information such as developing the idea of sensory-specific satiety (Yeomans, 2000). Further testing of the peptide leptin, the product of the identified obese gene (ob), has proved to be a major factor in the studies concerning the signaling, or perhaps lack thereof, of satiety to the brain. This paper will examine what is known about food preferences, specifically related to post-ingestive actions of food,
genetics, and satiety and how these elements can ultimately lead to obesity. Also, theories concerning the motivation to eat and obesity will be considered as well. To fully understand the reasons for overeating, the psychological basis for overeating and an extensive understanding of the biology producing taste preferences should be explained.

**THE ROLE OF POST-INGESTIVE SIGNALS IN FOOD PREFERENCE**

Several factors such as taste, nutritional value and post-ingestive activity influence the choice of food preferences. These factors work in combination with the biological mechanisms of the body such as taste transduction to influence food intake and regulate food choice. For our purposes, we will examine how the taste, the nutritional value and the post-ingestive actions of food influence taste preferences.

Studies in laboratory animals have shown that when offered a choice of foods, rats typically prefer high-fat and/or high-sugar foods over their nutritionally balanced chow diet (Sclafani, 2001). By showing a 20-40% increase in their energy intake, these animals thus develop mild to moderate obesity (Sclafani, 2001). Further studies indicate that food high in fat and sugar tend to be preferred not only because of their flavors but for their post-ingestive nutritive nature (Sclafani, 2001). For example, in studies in which rats have access to a sugar solution in addition to their regular chow and water diet these rats usually consume 60% of their total calories as sugar thus increasing their energy intake by approximately 20% (Sclafani, 2001). Because sugar is more readily digested and absorbed than the starch in lab chow the level to which sugar-induced overeating is due to its sweet taste has been questioned because of its high post-ingestive activity (Sclafani, 2001).
The nutritional value of food is a typical contributor to the palatability of a certain food. Therefore, the more nutritional a food is, the more palatable it becomes. Palatability is determined by several factors, such as caloric as well as nutritional value. Experience and environment contribute to taste preference, too. Similarly, it should be noted that palatability and taste preferences are easily formed by the post-ingestive actions of foods. These actions will be discussed later.

Post-ingestive actions refer to what happens physiologically during and following food-ingestion. These actions could be positive or negative and depend largely on the caloric value of food intake. Satiety, the feeling of being full, is an example of a post-ingestive action that has a large effect on whether or not a food is deemed desirable. For example, if a food causes negative consequences then one would tend to avoid it in the future. If a food is ingested and has no negative effect on the physiology of a person then there would not be an avoidance. Alternatively, if a food in ingested and there is a positive effect, then they would most likely enjoy that particular food and increase consumption.

In earlier studies Sclafani, et al. (1996) used glucose in experimentation to elicit positive post-ingestive feedback. In subsequent studies conducted by Sclafani, et al. (2001) maltodextrin solutions were used as a comparison against the rapidly digested glucose previously examined. Maltodextrin is assumed to be bland in rats as it is in humans much like sucrose and glucose are sweet. In a study by Sclafani, et al. (1996), rats were subjected to an ‘electronic esophagus’ in which freely feeding animals could drink a fluid for 22 hours per day and the same or different fluid could be automatically infused with an implanted intragastric (IG) catheter. This study demonstrated the
postingestive effects of sugar in the experiment by giving one group of rats a highly preferred solution (2% Polycose + 0.2% saccharin) plus the infusion of 30% Polycose A second group was given an unpreferred bitter solution containing maltodextrin (0.03% sucrose octaacetate) paired with the infusion of 32% Polycose. Both groups were exposed to the postingestive effects of the Polycose, but the maltodextrin from the SOA solution was associated with the unfavorable flavors (Sclafani, 1996). During the study, the rats who received the Polycose/saccharin solution consumed more of it and were thus infused with more of the maltodextrin solution. This group also consumed more energy than the sucrose octaacetate (SOA) or control group and they essentially gained more weight. The SOA group didn’t gain more weight than the control group, but their total energy intake was higher than that of the control group. The results show that post-ingestive actions can have a major impact on the preference for and the intake of carbohydrate solutions as the taste was replaced with energy (Sclafani, 1996).

Another study reports that rats drink significantly more saccharin solution when it was paired with an IG carbohydrate infusion instead of a water infusion (Lucas, 1999). Because the flavor of the food is identical during each infusion condition, this finding shows that postingestive nutrient action most likely has an effect on food preference and intake. Furthermore, the post-ingestive influence over preference and intake of sugar and maltodextrin solutions appear to be the result of an inborn, nutritionally conditioned reaction to carbohydrate digestion (Lucas, 1999).

Also attributing to these findings are the results of Azzara and Sclaffani (1998) in which they support their findings of rats being able to distinguish between the postingestive effects of sucrose and maltose solutions. In their experiment, the flavor
paired with IG maltose was preferred significantly to the flavor paired with IG sucrose. Because of the experimental design, this shows that calories cannot solely account for nutrient-conditioned flavor preferences (Azzara, 1998). While sucrose is shown to have a higher taste preference than maltose, rats when given prolonged exposure to the two sugars switched their preference from sucrose to maltose presumably due to the greater postingestive reinforcing action of maltose. This is demonstrative of the role of taste receptors in the mouth in determining initial intake and the subsequent learned preferences mediated by postingestive nutrient detectors (Azzara, 1998).

It is known that rats learn to associate a food’s flavor with its postingestive actions. This is known as flavor-postingestive consequence learning or calorie-based learning (Warwick, 1997). In repeated ingestive experiences with flavors that are distinctively different, rats preferentially ingest one of the solutions when given simultaneously. In two-bottle tests, the preferred flavor is typically the flavor that has been previously paired with more calories and is taken to reflect the rewarding nature of the nutrient’s postingestive effects. A flavor cue, which is predictive of a nutrient’s satiating effect, can suppress intake and is known as conditioned satiety (Warwick, 1997).

According to Warwick, et al. (1997), behavioral demonstrations of conditioned satiety include the following: intake of 30% carbohydrate was less when flavored with an odor previously paired with 50% carbohydrate, relative to intake when flavored with an odor previously paired with 10% carbohydrate (Booth, 1972); a flavor paired with real-feeding sucrose suppressed sham-feeding intake, a paradigm in which the anticipated postingestive consequences do not occur (Weingarten, 1989); a flavor previously paired...
with real-feeding sucrose was consumed in smaller quantity than a flavor previously paired with sham-feeding (Sclafani, 1994; Warwick, 1996); a flavor previously paired with real-feeding a relatively concentrated calorie source (30% sucrose) was consumed in smaller quantity during a two-bottle test than a flavor previously paired with real-feeding a dilute calorie source (5% sucrose) (Warwick, 1996). It should be noted that all of these when taken together suggest that learned ingestive responses to flavors previously paired with calories reflect the behaviorally opposing effects of positive reinforcement (which usually increases intake) and conditioned satiety (which usually decreases intake) (Warwick, 1997). Several experiments have been performed to demonstrate the efficacy of isocaloric concentrations of various nutrients in producing conditioned satiety which is behaviorally defined as a decrease in the intake of the flavor previously paired with more calories in two-bottle testing (Warwick, 1997).

The fat content of food plays a major role in its palatability and postingestive actions as well (Sclafani, 2001). Rats typically prefer and thus eat foods high in fat compared to low-fat diets, thus, gaining more weight on this regimen. Sclafani (2001) concludes that foods high in fat and sugar are particularly attractive to rats and even promote overeating. This effect of a high-fat diet in regard to post-ingestive effects and taste preference was demonstrated when a control group of rats and two other groups which were fed either a high-fat or a high-carbohydrate diet via self-regulated IG infusions (Sclafani, 2001). Results conclude that whenever the rats ingested more saccharin, thus infusing themselves with more diet than the high-carbohydrate rats, the postingestive actions of the high-fat diet were significant enough promote overeating. These postingestive actions are also due to the fact that the caloric density and flavor
differences were eliminated. These results lead researchers to confirm that post-ingestive actions of high-fat diets not only promote overeating but influence food preference via a flavor-nutrient conditioning process, which would occur on the basis of the post-ingestive actions (Sclafani, 2001).

When the flavor of a solution paired with IG carbohydrate infusions is enhanced, carbohydrate selection and total energy intake are increased significantly (Sclafani, 2001). In contrast, when the flavor of a highly preferred carbohydrate solution is taken away, this does not affect the carbohydrate selection and intake, which indicates that there are perhaps limits to the degree to which palatability manipulations can influence food choice and consumption. When a flavor aspect is added, changes in the nutrient composition of the IG infusions are better able to alter the energy intake, particularly, infusions of a high-fat diet tend to stimulate more overeating than do infusions of a high-carbohydrate diet (Sclafani, 2001). The post-ingestive actions of high-fat and high-carbohydrate diets have been examined through manipulations in dietary composition (Sclafani, 2001).

Other aspects of taste preference can be observed by comparing the dietary components of foods. Often studies manipulate test diets in order to examine the role of individual components of specific foods. These diets can be as simple as regulated caloric intake or as complex as exact measures of a particular oil in each food across the test board. Sometimes with manipulated test diets, especially in obesity studies, subjects are told to write down their daily caloric intake and are placed on an exercise regimen.

Several studies have been conducted to assess the ability of a subject to detect hedonic, sensory and nutritional differences between covertly manipulated high-fat (HF)
and low-fat (LF) diets. It has been suggested that the higher levels of energy intake induced by HF diets are due to the energy density and low postingestive satiety value of fat relative to protein and carbohydrate (Blundell, 1997). The studies investigating energy intake and nutrient balance usually include a number of versions of each diet, which are concocted corresponding to the required dietary manipulations (Stubbs, 2001). Using these manipulated diets, it may be possible to determine what part of the high-fat diet or low-fat diet a subject finds more attractive by typically examining sensory influences of fat on energy intake (Stubbs, 2001). Such sensory findings include: texture and taste.

**THE ROLE OF SATIETY IN FOOD PREFERENCE**

Satiety is defined as the feeling of fullness during and after eating. Satiety surely plays a role in taste preference and obesity by allowing one to know which foods fulfill the human nature of eating to satisfy hunger. It is noted that satiety could be tied to taste preference as seen in experimentation with manipulated diets.

Satiating effects play an important role in taste preferences. As stated previously, these satiating effects may be in conjunction with nutritional value or post-ingestive actions. In the study by Azzara and Sclafani (1998), they conducted an experiment comparing the intake of subjects when given a flavored solution, CS, (cherry-, strawberry-, grape-saccharin) plus either HF diet infusion, HC diet infusion, or and IG water infusion (H2O). The rats overconsumed the CS + HF by taking more bouts per day. Further, in two-bottle testing, rats preferred CS + HF and CS + HC to CS + H2O which shows that there is perhaps a nutrient-conditioned flavor preference. The higher preference for the CS + HF flavor shows that the postingestive effect of a HF liquid diet
is more reinforcing to rats than an isocaloric HC liquid diet. The results from this study are contrary to previous studies testing the same measures (Azzara, 1998). Instead, these results conclude that fat is inherently more reinforcing than carbohydrate diets. This shows that fat is perhaps indirectly responsible for the taste preferences as it increases the diet’s reinforcing action by reducing its satiating potency (Azzara, 1998).

Similarly, the experiment conducted by Sclafani and Lucas (1999) tests the preference conditioning effects of carbohydrates and fats. The experiment was designed to compare the effectiveness of isocaloric infusions of corn oil and maltodextrin to condition flavor preferences. Again, rats were given IG feedings of the solutions. Results conclude that carbohydrate (Polycose) and fat (corn oil) infusions are different in their satiating/satiety and reinforcing effects. When the results are taken together, previous IG feeding studies suggest that the reduced postingestive satiating effect of dietary fat may promote overconsumption, as well as increase the preference for high-fat foods (Sclafani, 1999).

An experiment paired different nutrient sources (see Table 1) with two distinct flavors, lemon and almond extracts (Warwick, 1997).

Table 1: Designation of subject groups by nutrient (Warwick, 1997)

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Group design</th>
<th>0.2 kcal/mL</th>
<th>1.6 kcal/mL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glucose</td>
<td>GLU</td>
<td>5%</td>
<td>40%</td>
</tr>
<tr>
<td>Fructose</td>
<td>FRU</td>
<td>5%</td>
<td>40%</td>
</tr>
<tr>
<td>Sucrose</td>
<td>SUC</td>
<td>5%</td>
<td>40%</td>
</tr>
<tr>
<td>Maltodextrin</td>
<td>MALT</td>
<td>5%</td>
<td>40%</td>
</tr>
<tr>
<td>Corn oil</td>
<td>CORN</td>
<td>2.2%</td>
<td>17.8%</td>
</tr>
<tr>
<td>MCT oil</td>
<td>MCT</td>
<td>2.4%</td>
<td>19.3%</td>
</tr>
</tbody>
</table>
In the experiment, lemon and almond extracts were used for a distinctive flavor for each concentration. A two-bottle preference test measured the influence of nutrients on intake (Warwick, 1997).

Conclusions show that the rats actually consumed less of the flavor that had previously been paired with a high number of sucrose calories (F-hi) than of a flavor previously paired with a relatively low concentration (Warwick, 1997). This is demonstrative of conditioned satiety; the pattern of intake of F-hi decreased due to its expected higher caloric yield. However, rats in the CORN group showed the opposite pattern and tended to consume more F-hi than F-lo, but this was not significant (Warwick, 1997). This shows that sucrose is more satiating than corn oil.

One problem with this study, however, is the fact that similar studies comparing learned responses to various sugars have produced incongruent results. The differences may be accounted for by differences in calorie dose, deprivation level and length of test (Warwick, 1997). The nutrient absorption site could perhaps play a role in the conditioned satiety, thus overeating and ultimately obesity. For example, both carbohydrates used in the study and MCT are absorbed via the liver, but corn oil absorption bypasses the liver the behavioral similarity of carbohydrate- and MCT-trained rats provides additional evidence that different post-ingestive signals are produced by different areas of absorption (Warwick, 1997). While the study by Azzara and Sclafani (1998) argue against absorption rate as a critical factor in flavor preference, they do not identify the postingestive mechanisms responsible for the differential reinforcing effects of glucose and fructose and are rather open-ended about their results.
Another fact that must be considered when determining satiety is that because conditioned satiety is taken to mean that “fullness” is based on post-ingestive consequences, increasing the consequences, or calories, would in fact increase satiety. The experiment by Warwick (1997) tests this theory of doubling calories to produce quicker conditioned satiety. In the experiment, groups of 12 rats were given emulsions of corn oil at a 35.6%, 17.8% and 2.2% concentrations to test the theory that doubling calories could produce quicker conditioned satiety. Rats trained with the 35.6% emulsion tended to consume less F-hi than F-lo whereas rats trained with the 17.8% emulsion tended to show the exact opposite intake pattern. However, the latter failed to reach significance in a statistical test. Results show that doubling the number of fat calories associated with F-hi rats produced a tendency to consume less F-hi in two-bottle tests (Warwick, 1997).

In addition to post-ingestive effects, dietary composition can affect satiety. A study by Stubbs, et al. examines the sensory effects of high-fat and low-fat covertly manipulated diets (2001). Eight healthy men and eight healthy women were presented two versions of the same food, one being high-fat and the other presentation being low-fat. Each subject was given a perceived pleasantness questionnaire and were told to rate the pleasantness of each presentation independently. Secondly, the subjects were given a simple difference questionnaire in which they were told to note whether or not they perceived a difference in the two versions of each food they were given. Thirdly, subjects were given a directional difference questionnaire where they were told to identify how they perceived the foods with regard to protein, carbohydrate, sugar, fiber
and salt. Possible responses were: ‘high in’, ‘low in’, ‘neither’ and ‘do not know’ (Stubbs, 2001).

One conclusion from the experiment is that the sensory characteristics of the HF and LF foods were recognizably different to the subjects when the samples were presented simultaneously for direct comparison. The subjects could not detect differences in salt, sugar, energy, fiber, protein or carbohydrate content between the HF and LF versions of food. The experiment concludes that there was not an overall preference of HF or LF manipulations (Stubbs, 2001). While subjects could detect sensory differences in food characteristics, but didn’t appear to relate this to macronutrient composition, data suggests that subjects are inaccurate in identifying HF foods. Another observation from the experiment is that some foods were on average identified as high-fat foods, suggesting that the fat content in certain types of foods are more easily detected (Stubbs, 2001). Thus, satiety levels would differ with the nutrient content as well.

In support of this experiment, Stubbs sites a study by Cooling and Blundell (1998) in which they observe that it is possible to categorize groups of individuals based on the amount of fat eaten including types of food consumed, amounts of other macronutrients, patterns of eating, food preferences and the degree of dietary restraint. Also, it is noted that diets high in fat are associated with weight gain and obesity (Stubbs, 2001). Because foods high in fat are high in energy, there is a chance for overconsumption because of this rapid intake of a large amount of energy. Often this happens without a conscious effort and thus is termed *passive overconsumption* (Cooling, 1998). Perhaps the biological basis for this phenomenon is questioned due to the fact that some people
successfully manage to avoid high fat consumption, while some people fall victim to high fat hyperphagia. Previous studies show that rats and human both show tendencies to choose high-fat diets (Cooling, 1998). Moreover, high-fat intake in children is shown to be correlated with parental body fat (Cooling, 1998). This shows that perhaps biological differences concerning the control of appetite may underlie, at least somewhat, the development of HF and LF phenotypes.

In the experiment by Cooling, sixteen healthy non-obese males participated, first by filling out questionnaires in which they conveyed their eating patterns and various nutritional intake (1998). Because of the length of the study, experimenters had the opportunity to measure different patterns of food intake during each meal over several days and manipulated diets through change in nutrient composition and fat value. Measures were plotted on a scale determined by the subjects’ answers to the questionnaires at the beginning of the study (Cooling, 1998).

The study shows that the two groups of subjects, divided by their consumption of high-fat or low-fat diets show different profiles of hunger in response to fixed energy loads and different behavioral and subjective responses to nutrient challenges (Cooling, 1998). The pattern shown by significant energy load by group interaction suggests different sensitivities in the early post-ingestive physiological signals. These early signals could involve gastric sensory mechanisms, upper intestinal sensory, or hormonal responses such as leptin reactions. Essentially, it was shown that the LF group reported less hunger before the fixed loads, but also reported that the amount of hunger depression was less after the meal. Contrastingly, those in the HF group were more hungry before the meal and that their hunger was remarkably depressed after the meal (Cooling, 1998).
In conclusion, there are perhaps mechanisms in early post-ingestive states that produce feelings of satiety.

Furthermore, in the study by Yeomans, et al. (2001), the eating patterns of 24 male volunteers were observed in relation to the perceived palatability of meal preloads and also the time of meal completion. In some trials, subjects were only allowed to finish half of their dinner due to experimental time constraints and in other trials the subjects were ‘forced’ to clean their plates. These were all factors in how the subjects perceived the pleasantness of the test-meal preloads. Experimenters manipulated different types of food such as soups and pastas (Yeomans, 2001). These foods may lead to more substantial results because these are not normal everyday foods to most people. Novelty could perhaps play a role in the preference of foods and affect feelings of satiety.

Three main findings from the study include the following: a reduction of food intake was discovered at a test-meal of disguised high-energy fat and carbohydrates 30 minutes after the initial test meal, but this reduction was inadequate to compensate for the additional energy in the preload; the amount by which subjects reduced intake at the test meal depended on the palatability of the test meal, but there was little compensation when the meal was more palatable; no differences between the fat and carbohydrate preloads were seen on any intake measure (Yeomans, 2001). The finding that normal-weight subjects ate less lunch 30 minutes after having consumed fat and carbohydrate preloads containing an extra 300 kcal expands the findings replicated in previous studies, thus validating Yeomans, et al. (2001). From the study, overall energy intake was higher when the subjects consumed more energy, but not when they consumed the more palatable lunch (Yeomans, 2001). It can be concluded that in normal-weight men,
disguised energy in the form of fat and carbohydrates generated satiety signals which
reduced subsequent energy intake, but not to a level which fully compensated for the
hidden energy (Yeomans, 2001).

Westerp-Plantenga concludes from his study that the cumulative food intake
curve is relevant and adequate in determining the effects of dietary and clinical
interventions that are hypothesized to affect meal size and satiety (2000). Westerp-
Plantenga concludes this because his experiment observed that subjects ate on average
24% more when told to eat as much as they could and changed their eating style with
respect to meal duration (2000). He also observed that when satiation limits and other
physiological or cognitive parameters were added eating behavior became much more
clear. During a meal, it was observed that subjects mainly monitor their food intake by
weight of the food consumed over time (Westerp-Plantenga, 2000). While monitoring
food intake by weight of the food consumed, palatability and sensory specific satiety
appeared to play a role, in that these factors were related to eating rate.

THE ROLE OF PHENOTYPES IN FOOD PREFERENCE

The peptide, leptin, is a product of the obese (ob) gene and is thought to play a
major role in regulating energy expenditure and food consumption. Cooling, et al. (1998)
identified the behavior phenotype of HF and LF consumers and examined circulating
levels of leptin as an influence on intake. Cooling, et al. (1998) found positive correlation
between high plasma leptin concentrations and high body mass indexes.

This study required subjects to adhere to a fasting procedure after which their
blood plasma and leptin levels were tested and analyzed. After analyzation, the HF
subjects had significantly high plasma leptin concentrations and lower plasma glucose
than the LF subjects (Cooling, 1998). Also, results show that the plasma leptin level correlated with body mass index (BMI), fat mass, and percent body fat (%BF) and there was a positive correlation between plasma leptin and both total and percent dietary intake (Cooling, 1998). Basically, a high BMI should equal high leptin levels. It should be pointed out that while groups did differ in the total energy intake, there was no difference in BMI, body weight, fat mass, or %BF. Thus, the HF subjects who were consistently consuming a high fat and high energy diet did not differ in body composition from the LF subjects. It was concluded that some factor, such as a protective action of high plasma leptin levels, must be providing a level of protection against the weight inducing action of a high-fat or high-energy diet. This assumption was a hypothetical construct and not supported by data (Cooling, 1998).

On the contrary, Finnish researchers Karhunen, et al. (1998) conducted a study on obese women and found the opposite conclusion than those reported by Cooling, et al. (1998). In their study, food preferences for fat and sugar were determined by three consecutively performed hedonic tests: preferences for ten different food items were assessed, preferences for the tastes of typical Finnish milks with three different fat concentrations, and preferences for the tastes of nine cream-sugar mixtures (1998). Since underreporting is a common aspect of obese women, one factor that must be considered in parallel with the previous study is that subjects in this study were all obese women and thus underreporting of taste preferences was common. After statistical analysis, the conclusion was that high serum leptin concentrations could be associated with lower energy and fat intakes in obese women which was specifically measured by their choices of food (Karhunen, 1998). As can be seen in from the conflicting results in two studies
concerning the role of leptin in human eating behaviors, further studies must be conducted in order to understand fully the relevance of leptin plasma levels and the role of leptin in the motivation to eat and food intake (Karhunen, 1998).

Concerning obesity and taste preference, Spiegel (2000) points out several questions to be considered: Are there behavioral differences between lean and obese people that promote overeating in the obese? If so, will changing their eating behavior help obese people to eat less? Are there motivational differences between lean and obese people? What are the treatment implications of similarities and differences in eating behavior and motivation of lean and obese subjects? In the review of eating behaviors, it is noted that obese people take larger bites and eat faster than lean people, so by decreasing bite size and by slowing down eating, obese tendencies should decrease (Spiegel, 2000). Results from the experiment show that increasing bite size significantly increased the average rate of intake in both lean and obese subjects, thus subjects ate faster when they took larger bites. While the results do not agree with the assumption that slowing the ingestion rate by reducing bite size could reduce the amount of food that subjects ate, these results are consistent in a similar experiment conducted with rats (Spiegel, 2000). Overall, the ingestion rate changed, but the meal size remained the same (Spiegel, 2000). On the contrary, when human subjects were given the control of administering a liquid diet either orally through a straw or intragastrically through a nasogastric tube, it was found that meal size actually increased as the delivery rate increased (Spiegel, 2000). Also these subjects tended to slow the burst of the injection thus lessening the amount of the solution which was administered and, more importantly, decreasing the rate of ingestion (Spiegel, 2000). Thus, meal size was not consistent and
perhaps this type of control over food intake could lead to overconsumption and a higher motivation to eat.

The second study addressed the question: Are there motivational differences between lean and obese people? Results show that the different responses of lean and obese subjects to palatability were not significant for total intake since both lean and obese groups ate more in the high than in the low deprivation conditions, both having maximum consumption in the high deprivation high palatability condition (Spiegel, 2000). Obese women were more discriminating in their response to the food when acutely food-deprived, at least at the beginning of the meal when subjects were the most hungry (Spiegel, 2000). These results show that it would stand to reason that to avoid weight gain and quick satiation one should avoid the combination of highly palatable foods and extreme food deprivation. General results from the two studies by Spiegel (2000) indicate that behavior by people towards the physical properties of food may cause someone to overeat and not an underlying disturbance in the control of eating.

**DISCUSSION**

It has been clearly demonstrated that the preference of high-fat diets to low fat diets in rats and humans is influenced by several physiological mechanisms. The actions after ingestion, such as positive effects, have an effect on the choice of foods. Similarly, fulfilling the need for fullness has an impact on food preference. Logically, in these cases when there is a stronger signal from these mechanisms there is better intake. Evidence for genetic implications concerning taste preference and obesity have elicited both support and non-support for various genetic theories. Certainly, behavioral effects have implications on taste preference and obesity. Even the availability of foods high in
sugar, fat, and salt provides an environment that promotes overeating which could result in obesity (Birch, 1999). Though not elaborated on in the paper, there are other non-biological factors that could also influence the motivation to eat and taste preference should be considered. After all, children learn by example and are influenced by their environment. If a parent fosters overconsumption of high-fat foods in their children, they are possibly setting their children up for health risks in the future.

The nutritional aspect of food is becoming more and more unhealthy as fast-food is becoming more popular (French, 2001). French, et al. (2001) conducted a study in adolescents on the nutritional intake of fast-food restaurant use (FFRU). Their findings conclude that adolescents who had a high FFRU rating had a significantly lower intake of fruits, vegetables, grains, and servings of milk while they had a higher intake of soft drinks, cheeseburgers, pizza and french fries (2001). This is especially alarming among adolescents mostly because of the increased risk of obesity associated with the lack of nutritional value at such an early age (French, 2001). In an article by Alexandra Greeley, it is noted that when fruits and vegetables age, most of their natural sugars are turned to a bitter starch. This may be a factor as to why people tend not to consume as many fruits since it is known that humans are more prone to enjoy sweet tastes over bitter (1992).

Television viewing has also been named as a contributing factor in high-fat intake and poor nutrition (French, 2001). For example, mere exposure to advertisements may influence a viewer to buy their products. Further, these influences may be towards high-fat, high-energy goods. Also, simply snacking in front of the television is a major contributor to high-fat intake. Possible concentration on a television program might be distracting enough so that satiety signals are ignored (French, 2001). In conjunction to
this study, Ricketts (1997) concluded that sedentary activity is related to dietary fat intake and body composition. Thus, children who are exposed to foods with a lower fat content may develop a preference to these foods and promote a healthier lifestyle. Also, a positive correlation between fat preference and measures of body fat were found to be significant (Ricketts, 1997).

The most successful treatments for obesity and overconsumption are not the ones directed at changing the microstructure of eating behavior. Rather, targeting food selection and stimulatory effects of preferred foods on intake show more promise in preventing overeating and thus obesity. Most food companies try to do this by offering low-fat and reduced-fat selections of their products, but these alternatives differ in taste preferences as well as nutritional content. It would be easy for one to delete preferred foods from diet since monotony decreases food intake, but this is an unacceptable solution since one may not have access to a variety of palatable foods to maintain the monotonous diet. Another route of treatment would be to gear it towards selecting palatable foods that are low in energy density. However, patterns from the studies indicate that at the beginning of the meal rats choose flavors that have previously been paired with foods of high energy density while at the end they preferred flavors that had been paired with food of low energy density. Consequently, low energy dense foods may become less preferred if dieting people become more hungry as they lose weight and continue to diet. Because opiates are involved in the reward and pleasure of palatable and sweet studies, it has been suggested that opiate antagonists have been shown to decrease appetite and thus reduce the pleasure of some highly preferred foods.
So, why do we eat the things we do and choose the foods we choose? Alan Strathman and colleagues (1999) conducted surveys in which they asked participants to rate how much they agreed with the statement, “I consider how things might be in the future and try to influence those things with my day-to-day behavior.” Results showed that convenience was the most highly rated factor that determined how one chooses to do things, such as eating. Fast-food restaurants are obviously more convenient sometimes than going to the grocery store and finding things to cook when one is in a hurry. In the article, Mary Ann Chapman notes that human desire to take the “path of least resistance” is so strong that sometimes one continues to do what they know is “destructive behavior” (smoking, overeating) simply because we are slaves to instant gratification (1999).

Humans are seen to have a predilection to fat and have large appetites for energy-dense foods, therefore one can assume that it is perhaps an adaptive response to consume these energy-dense foods to obtain energy (Foreyt, 1992). Humans also like to eat fat for the texture, citing the smoothness or crispiness of frying. Because there is an excessive amount of fat in the current American’s diet, there is an increased risk for certain kind of cancer and not to mention obesity (Foreyt, 1992). The reduced palatability in low-fat foods is generally not successful in lowering the intake of high-fat nutrients. Certainly, manipulating the effects of satiety both physically and psychologically offer a means of preventing overconsumption as opposed to the low-fat substitutes. Further, the combination of low-fat substitutes that mimic their high-fat counterparts and provide an increase in satiety show promise as a successful combatant in preventing obesity.


Greeley, Alexandra (1992). Not only sugar is sweet. FDA Consumer, April, 17-21.


