

Is Food Marketing Making Us Fat? A Multi-disciplinary Review

Pierre Chandon

Brian Wansink*

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* Pierre Chandon is Professor of Marketing at INSEAD, Boulevard de Constance, 77305 Fontainebleau, France (Tel: +33 160724987, pierre.chandon@insead.edu) and the director of the INSEAD Social Science Research Center. Brian Wansink is the John S. Dyson Professor of Marketing at Cornell University, 110 Warren Hall, Cornell University, Ithaca, NY 14853-7801. (Tel: (607) 255 5024, wansink@cornell.edu). The authors wish to thank France Bellisle for her detailed and constructive feedback, as well as Jason Riis, Jennifer Harris, and participants in the collective expertise on food behaviors organized by INRA (P. Etiévant, F. Bellisle, J. Dallongeville, F. Etilé, E. Guichard, M. Padilla, and M. Romon-Rousseaux). The authors also thank the editor and the reviewers for their guidance in the review process.

Whereas everyone recognizes that increasing obesity rates worldwide are driven by a complex set of interrelated factors, the marketing actions of the food industry are often singled out as one of the main culprits. But how exactly is food marketing making us fat? To answer this question, we review evidence provided by studies in marketing, nutrition, psychology, economics, food science, and related disciplines that have examined the links between food marketing and energy intake but have remained largely disconnected. Starting with the most obtrusive and most studied marketing actions, we explain the multiple ways in which food prices (including temporary price promotions) and marketing communication (including branding and nutrition and health claims) influence consumption volume. We then study the effects of less conspicuous marketing actions which can have powerful effects on eating behavior without being noticed by consumers. We examine the effects on consumption of changes in the food's quality (including its composition, nutritional and sensory properties) and quantity (including the range, size and shape of the packages and portions in which it is available). Finally, we review the effects of the eating environment, including the availability, salience and convenience of food, the type, size and shape of serving containers, and the atmospherics of the purchase and consumption environment. We conclude with research and policy implications.

Obesity has been on the rise for the past thirty years, and not just in rich countries. At the last count, 68% of US adults were classified as overweight and 34% as obese, more than twice as many as 30 years ago (Flegal et al. 2010), and 17% of US children are now obese, three times as many as 30 years ago (Ogden et al. 2010). Obesity rates are climbing even faster in emerging countries, which have undergone an extremely fast nutrition transition and have seen over-nourishment replace under-nourishment as a leading public health concern earlier than anticipated (Popkin 2002). Although obesity rates are finally starting to stabilize in the United States, they are still at an extremely high level compared to the target obesity rates and contribute significantly to mortality. For example, being overweight (BMI between 25 and 29.9 kg/m²) increases mortality rates by 13%, and being obese (BMI between 30 and 34.9) increases mortality rates by 44% among healthy people who have never smoked (Berrington de Gonzalez et al. 2010). Obesity also has major cost implications. The costs attributable to obesity among full-time employees alone amount to \$73.1 billion (Finkelstein et al. 2010) and rising obesity rates are predicted to add an additional \$200 billion a year in health care costs by 2018 (Thorpe 2009).

Although everyone agrees that the current obesity epidemic has many roots, the marketing actions of the food producers, stores, and restaurants, are often regarded as one of the key reasons why we, as a population, are getting fat (Brownell and Battle Horgen 2003; Dubé et al. 2010; Kessler 2009; Nestle 2002; Pollan 2006; Popkin 2009). This theory is particularly plausible given that food and beverages (hereafter referred to as “food”) are some of the earliest ‘branded’ products in history, perhaps as early as the fourth millennium BC (Wengrow 2008). Food remains one of the most heavily marketed products, especially for children (Batada et al. 2008; Desrochers and Holt 2007; Harris et al. 2010; Powell, Szczypka, and Chaloupka 2007a; Story, Neumark-Sztainer, and French 2002). It is also among the most astutely marketed products, as demonstrated by the fact that numerous marketing innovations

were pioneered by food marketers (Bartels 1951; Wilkie and Moore 2003). Thus it is important to review the evidence of the relationship between food marketing and obesity and, more importantly, to examine how exactly food marketing may have made us fat.

The objective of this paper is to review the literature in marketing, nutrition, psychology, economics and related disciplines which investigates the link between marketing activity, food intake and obesity, with a particular emphasis on the effects of marketing on overeating (increased energy intake). This allows us to bring together streams of research which have so far been largely disconnected. For example, there exists a large body of literature on the effects of television advertising on food preferences and behaviors published in nutrition and health economics journals which is not cited by marketing scholars. Conversely, only a small fraction of the consumer research literature is cited by nutrition researchers, and the existing review of environmental factors (Wansink 2004) is rapidly becoming outdated given how much new research has been published since.

To limit the scope of the review, we focus on the direct effects of marketing activity¹ under the direct control of food marketers, i.e., the 4 P's of product, price, promotion, and

¹ We use the American Marketing Association's new definition of marketing as "the activity, set of institutions, and processes for creating, communicating, delivering, and exchanging offerings that have value for customers, clients, partners, and society at large". We therefore include activities such as food formulation, that are not under the sole responsibility of marketing executives but that rely on inputs from marketing. This still leaves out many influencers of food intake that are not directly controlled by marketers, at least in the short run. These include leisure and workplace physical activity (Church et al. 2011), personal, cultural, and social norms about food, eating, and dieting (Fischler, Masson, and Barlösius 2008; Herman and Polivy 2005; Stroebe et al. 2008), the timing of meals (de Castro et al. 1997), incidental emotions (Winterich and Haws 2011), or body image perceptions and preferences (Campbell and Mohr 2011; Smeesters, Mussweiler, and Mandel 2010). We also exclude the effects of corporate activities that are only tangentially related to marketing such as lobbying (Mello, Studdert, and Brennan 2006), sponsoring of research and advocacy groups (Wymer 2010), and industry self-regulation (Ludwig and Nestle 2008; Sharma, Teret, and Brownell 2010). We do not review the literature on pro-social marketing which examines how marketing can promote more effective public health programs or educate consumers about nutrition (see Goldberg and Gunasti 2007; Seiders and Petty 2004). Another important caveat is that, although we identify ways to curb energy intake, it is important to note that energy intake does not equal weight gain, let alone obesity and that the relationship between

place (distribution), and on consumption volume (*how much* we eat) because of its direct impact on energy intake. We also review studies on food choice (*what* we eat), to the extent that it obviously impacts energy intake (e.g., people choosing to eat chocolate cake or fruit for a snack) but exclude studies of the effects of marketing on energy expenditure (e.g., physical activity).

Figure 1: How Food Marketing Influences Overeating



As shown in Figure 1, food marketers can influence food consumption volume through four basic mechanisms with varying levels of conspicuousness, and through deliberate or automatic processes. First, the short- and long-term price of food and its format (e.g., a straight price cut or quantity discount) can influence how much people consume. This factor is conspicuous and the effect on consumers is likely to be the result of deliberate decisions. Second, food marketing can influence consumer expectations of the sensory and non-sensory benefits of the food through advertising and promotions, as well as by branding the food

food intake and obesity is complex (Bellisle 2005). For example, increasing consumption frequency can help maintain a healthy weight if people compensate the higher frequency of snacking with a lower quantity per consumption.

itself, and by making nutrition and health claims. This second route is the one most closely associated with food marketing and the most closely scrutinized by non-marketing researchers. As Figure 1 shows, marketing communication is almost as conspicuous as price changes but not all of its effects on consumption are deliberate, as consumers are not always aware of them. Food marketers can also influence both the quality (composition, sensory properties, calorie density, etc.) and quantity (package or portion size) of the food itself. Finally, food marketers influence the eating environment: the convenience and salience of the purchase, preparation and consumption, the size and shape of serving containers, and the atmospherics of the purchase and consumption environments. The latter are less frequently studied and their effects are the most likely to be driven by automatic, visceral effects outside the awareness and volitional control of consumers.

Although the factors outlined in Figure 1 will be discussed individually, it is important to note that marketing strategies and tactics often rely on multiple factors simultaneously. For example, changing from à la carte pricing to an all-you-can-eat fixed price can increase energy intake (Wansink and Payne 2008) because of pricing effects (zero marginal cost of consumption), communication effects (loss of information about what is an appropriate serving size), and because of changes to the eating environment (increased access to food and clean plates that prevent the monitoring of consumption).

How Long- and Short-Term Price Reductions Stimulate Consumption

Food products like milk, some meats and fruits and vegetables, are commodities. In this case, short-term prices are determined by supply and demand on world markets and long-term price changes are determined by efficiency gains in the production, transformation, and distribution of food, with limited input from marketers. Still, many food products are differentiated in the eyes of consumers thanks to the effects of marketing, branding, unique formulations, exclusive distribution, or a combination of these elements. In this case,

marketers can choose long-term price levels, as well as temporary price changes (sales promotions) across different customer segments. Advances in marketing segmentation and targeting have enabled companies to direct price cuts only to the most susceptible consumer segments, thereby increasing their effectiveness at the lowest possible cost (Rossi, McCulloch, and Allenby 1996).

Effects of long-term price changes

The relative price of food declined significantly from 1950 to 2000 (Christian and Rashad 2009; Drewnowski 2003; Lakdawalla, Philipson, and Bhattacharya 2005). Transformed foods, particularly those with high concentrations of sugar and fat, experienced the steepest price declines (Brownell and Frieden 2009; Finkelstein, Ruhm, and Kosa 2005). For example, the price of butter and soda rose respectively 15% and 23% less quickly than inflation, whereas the price of fruit and vegetables increased 40% faster than inflation between 1989 and 2009 (Leonardt 2009). The price of food prepared away from home (which includes meals in restaurants, take outs, and delivered prepared food) has also declined significantly over the years (Powell 2009). Studies suggest that prices of food items available from vending machines have declined fastest of all, whereas the price of full-service restaurants has increased (Christian and Rashad 2009).

Do lower prices increase energy intake? Econometric studies suggest that lower food prices have led to an increased energy intake. Even though the average price elasticity of food consumption is low (0.78), it can be quite high for some categories (e.g., 1.15 for sodas). The price of away-from-home food seems to be a particularly powerful predictor of BMI, more so than the price of in-home food (Chou, Grossman, and Saffer 2004; Powell 2009). For example, Chou et al. (2004) found that a 10% increase in the prices of fast food and full-service restaurants was associated with a 0.7% decrease in the obesity rate. These conclusions are reinforced by the results of randomized controlled trials which demonstrate the causal

effects of price changes. Field experiments in cafeterias (French and Stables 2003) found that price reductions significantly influenced the consumption of snacks but also of fruit and vegetables, as long as they were substantial (above 25%). Another field experiment in a restaurant setting found that the effect of a change in price was much stronger than the effect of nutrition labeling, which sometimes backfired because of negative taste inferences (Horgen and Brownell 2002). The only exception to the rule that higher prices reduce consumption comes from a study showing that higher prices at an all-you-can-eat pizza restaurant led to higher consumption of pizza (Just and Wansink 2011). This may be explained by normatively irrational but psychologically well-documented sunk cost effects, as people at all-you-can-eat buffets try to consume the amount that enables them to get their money's worth (Prelec and Loewenstein 1998). However, this pattern remains the exception.

One of the most thorough studies (Epstein et al. 2006) examined the effects of price changes on sales of healthier or unhealthier food substitutes and the interaction with budget constraints. In two field experiments, children were given different budgets to buy food whose price varied over time. The authors found strong and comparable same-price elasticity for healthy (-1 and -1.7 in two studies) and unhealthy (-.9 and -2.1) foods, and significant but smaller cross-price elasticities (four times smaller on average). Substitution only occurred when children had a very low budget. With large budgets, the authors found that children actually responded to an increase in the price of unhealthy food by buying less of the healthy food. This is consistent with studies showing that participation in food stamps programs, by increasing the food budget, tended to increase purchases of unhealthy foods by low-income families (Meyerhoefer and Pylypchuk 2008; Wilde, McNamara, and Ranney 1999).

These results seem to contradict the findings of other studies that indicated that people expected lower prices to signal poorer food quality and taste, and therefore did not increase energy intake (Plassmann et al. 2008). In reality, the evidence linking negative quality and

taste inferences with lower price is limited to categories such as wine, for which consumers have little ability to detect quality variations from the food itself (Plassmann et al. 2008). A lack of negative price-quality inferences for food was also evident in a recent study which showed that both tangible rewards and social praise actually increased intrinsic liking for and consumption of healthy foods among children over a three-month period (Cooke et al. 2011). In general, consumers appear to have learned that lower-priced foods (e.g., from private labels or store brands) are as hedonically satisfying as higher-priced foods. For example, in a recent study, Austrian consumers thought that price was unrelated to quality of food and beverages, which is not surprising given that the correlation between price and objective quality (estimated by experts) for 272 food and beverage brands in this country was only 0.07 and not statistically different from zero (Kirchler, Fischer, and Hölzl 2010).

Effects of temporary price promotions and quantity discounts

Even temporary price reductions, advertised or not in stores, can increase energy intake. Until recently it was believed that these marketing actions simply shifted sales across brands or across time (as pre- and post-promotion dips), but it has become clear that temporary sales promotions can lead to a significant increase in consumption (for a review, see Neslin and Van Heerde 2009). For example, one study estimated that 28% of the incremental sales of tuna caused by a temporary price cut came from consumption increase (Chan, Narasimhan, and Zhang 2008). Price deals can influence consumption even when the food has already been purchased (e.g., by another family member) and is therefore an irreversible sunk cost which should not, normatively, influence consumption. Studies have found that people accelerate the consumption of products perceived to have been purchased at a lower price (Wansink 1996). This is either because past prices are seen as an indication that the product will be discounted again in the future and hence can be re-purchased at a lower price (Assunção and Meyer 1993), or simply because consumers feel that they must get “their

money's worth" out of their purchases and hence tend to save expensive purchases for a special occasion but consume cheaper products right away (Chandon and Wansink 2002).

Marketers can also reduce the relative price of food by offering quantity discounts if consumers buy larger package sizes or multi-unit packs. Although one study found that removing the quantity discount offered when buying larger sizes of fast-food items did not significantly influence caloric intake (Harnack et al. 2008), others found a significant effect among overweight consumers (Vermeer et al. 2010a), and many more have shown that quantity discounts lead to stockpiling, which accelerates consumption (for a review, see Neslin and Van Heerde 2009). Indeed, the better value of supersized packages and portions is the number one reason provided by consumers to justify their purchase (Vermeer, Steenhuis, and Seidell 2010c).

Stockpiling can increase both consumption frequency and the quantity consumed per consumption occasion, although consumers are not aware of these effects. One study found that weeks when multi-unit packages were purchased saw consumption of orange juice increase by 100% and by 92% for cookies, but no change in consumption of non-edible products (Chandon and Wansink 2002). The authors replicated this effect in a field experiment where the quantity of food was randomly manipulated while keeping its price constant, and found that large purchase quantities influenced consumption by making the food salient in the pantry or fridge, and not just by reducing its price (Chandon and Wansink 2002).

Beyond the degree of the incentive, the form of the promotion and the payment mechanism can also influence energy intake. A study by Mishra and Mishra (2011) showed that consumers preferred price discounts to bonus packs for "vice" foods, but preferred

bonus packs to price discounts for “virtue” foods.² The authors showed that this happened because it was difficult for consumers to justify buying more vice foods, whereas a price reduction acted as a guilt-mitigating mechanism. The greater difficulty of justifying purchases of unhealthy foods also explains why they are more likely to be purchased when people pay via credit card than when they pay cash, a more painful form of payment which elicits a higher need for justification (Thomas, Desai, and Seenivasan 2010).

Conclusion

Overall, pricing is clearly one of the strongest – if not *the* strongest – marketing factors predicting energy intake. The pattern of declining food prices in recent decades, of foods in general and particularly for calorie-dense products, is seen by many as the common variable explaining a number of findings previously unconnected (Drewnowski 2007), including the role attributed to soft drinks, sugar, fat, fast food, snacks and higher portion sizes, which are all ways to provide cheap calories, in explaining increasing obesity rates. Pricing effects can also explain why lower income households consume more calorie-dense foods that are high in fat and sugar, why they consume more sodas and snack food, and why they go to fast-food restaurants more often. However, price is not the only determinant of food choices and cannot alone explain rising obesity rates (Chou et al. 2004). As we show in subsequent sections, other factors influence consumers’ food perceptions and preferences. Unlike price, which arguably influences consumption through deliberate processes that people are aware of, these other factors are often beyond volitional control and sometimes outside conscious awareness.

How Marketing Communication Stimulates Consumption

Advertising and promotions are the most visible – and hence the most studied – actions of food marketers. Marketing communication does not just inform people about the attributes of

² Although related to the categorization of food as “good” or “bad” that people spontaneously invoke, researchers usually prefer to the more formal and value-neutral distinction of “vice” and “virtue”. A relative vice (virtue) is a food that is preferred to a relative virtue (vice) when considering only the immediate (delayed) consequences of consumption and holding delayed (immediate) consequences fixed (Werthenbroch 1998).

the food product, such as its price or where it can be purchased, it makes the food and its brand more accessible in memory and impacts the associations made with it. Simply creating brand awareness can have an important effect on food choices because it reduces search by enabling people to look for the brands that they already know on the supermarket shelves (Chandon et al. 2009; Van der Lans, Pieters, and Wedel 2008). For example, one study found that increasing awareness of some brands in a food category led people to sample fewer foods and reduced the likelihood that they would select the food with the highest rating in a blind taste test (Hoyer and Brown 1990). Familiarity effects are particularly strong for children, who like what they know and prefer to eat what they already like (Cooke 2007).

Moving beyond awareness, communication enhances people's expectations of the sensory and non-sensory benefits (e.g., the social and symbolic value) associated with the purchase and consumption of food. In this way, marketing communication can be thought of as a food complement because it enhances the utility derived from the actual consumption of the food, just as milk is a complement to breakfast cereals. Even if it fails at changing the expected benefits of consumption, marketing communication can influence the relative importance of these benefits in driving food decisions. This is important because most people have contradictory goals when making food decisions. When asked which non-price attribute drives their food decisions, at home or out-of-home, consumers overwhelmingly rate flavor first (which they often simply describe as "taste"), followed by nutrition and convenience (Stewart, Blisard, and Jolliffe 2006). This implies that most people try to balance taste and health goals (Dhar and Simonson 1999; Zhang, Huang, and Broniarczyk 2010). While some people try to balance these competing goals every time they make a food decision, most people alternate them across different meal components (e.g., food vs. beverages), meal occasions, and different periods of their life, alternating periods of restriction and periods of disinhibition. One study reported that 47% of men and 75% of women in the US have been

on a diet at least once in their life (Jeffery, Adlis, and Forster 1991). The importance of health generally increases with age, if only because the sense of taste and smell decline as people get older (Schiffman 1997).

Advertising and promotion effects

The food industry is among the top advertisers in the U.S. media market (Story et al. 2002). Children and adolescents, especially those from poorer socio-economic backgrounds, are exposed to a high level of television advertising (Powell et al. 2007a). Food advertising accounts for about one third of the television advertising in children's TV programs (Desrochers and Holt 2007). American children are exposed to approximately 40,000 food advertisements per year, 72% of which are for candy, cereal, and fast food (Mellow et al., 2006). In 2009, the fast-food industry alone spent more than \$4.2 billion on marketing and advertising; preschoolers saw almost three ads for fast food on TV per day, a 21% increase over 2003 (Harris et al. 2010). Most of the television advertising for food is for unhealthy food with a high fat, sodium, or added sugar content (Batada et al. 2008). The message communicated in these ads is that unhealthy eating (e.g., frequent snacking on calorie-dense and nutrient-poor food) is normal, fun, and socially rewarding.

Marketing communication does not just involve television, print, radio or billboard advertising (the so-called 'above-the-line' media); it also operates via new media (the internet, social networks, product placement, point-of-purchase advertising, etc.), and through packaging, direct marketing, public relations, event sponsorship, and sales promotions. In fact, food marketers, like all consumer goods marketers, are diverting budgets from print and television advertising to new media, making the focus on research and regulations on television advertising less and less relevant (Harris, Schwartz, and Brownell 2009a). These actions can be implemented for a specific brand, multiple brands (through co-branding, say movie tie-ins) or for an entire category (e.g., various milk communication campaigns).

Together, these different forms of communication create an enormous number of exposures to food marketing.

On a broad level, one would expect advertising and promotion to have a strong effect on energy intake, if only because they inform consumers about factors, such as price, that are known to drive consumption. Advertising should be particularly effective for new brands and for younger consumers who have not yet developed fully formed preferences (Cooke 2007). Given this, it is remarkable that the link between television advertising and energy intake is still controversial. Some authors, for example, still argue that television advertising only affects brand preferences and not overall energy intake (Young 2003). Part of the explanation for the duration of the controversy is that, unlike other factors such as price or portion size changes, advertising is a complex multi-dimensional intervention with many variations in the target audience, the nature of the message, the creative techniques used, the size of the budget, the media scheduling, etc. This makes it difficult to estimate reliable effects using non-experimental real-world data.³

Television viewing or television advertising? The correlation between television viewing and current (as well as future) levels of obesity is well established. This may be because television viewing increases exposure to food advertising, but also for a variety of other reasons. Television viewing could be associated with obesity because it is a sedentary activity

³ Comparison to the history of tobacco marketing and of the actions of the tobacco industries are often invoked to justify further regulations of food advertising (Brownell and Warner 2009). However, the link between obesity and any single factor is more complicated than the link between smoking and lung cancer. Unlike tobacco, food is necessary for life and no single food is intrinsically unhealthy; it depends on how much of it is consumed. Second, people partially compensate for or habituate to most changes in energy intake, making it difficult to attribute long-term weight changes to any single factor in a natural setting. This makes the standards of evidence required by some probably unrealistic. For example, a recent paper deplored the absence of studies quantifying the effects of advertising on long-term changes in body weight in a realistic setting (Veerman et al. 2009). Although ongoing efforts to examine these issues are clearly useful and warranted, prominent researchers, partly again by analogy with the history of tobacco regulation, have argued that it is not always a good idea to wait until we have achieved this level of scientific certitude to draw implications for public policy or self regulation (Ludwig and Brownell 2009).

that burns few calories; because it is associated with unhealthy snacking; because eating in front of the television reduces the memory of consumption (and hence satiety); or because of advertising for cars, games, toys and other products that promote a sedentary lifestyle. Some progress has been made on this difficult question and randomized controlled experiments have shown that reducing television viewing leads to weight reduction primarily because it reduces energy intake, not because it changes physical activity (Epstein et al. 2008; Robinson 1999). Still, these studies cannot disentangle the effects of television viewing from the effects of television advertising.

One of the major difficulties when estimating the effects of television advertising on energy intake and obesity using real-world data is the lack of natural variation in the exogenous variables, which requires making many statistical assumptions. For example, one study relied on differences in the cost of television advertising over time and location (Chou, Rashad, and Grossman 2008) to estimate that viewing more fast-food commercials on television raised the risk of obesity in children. In this context, probably the most convincing study using real-world data comes from Goldberg (1990), who used as a natural experiment Québec's ban on television advertising aimed at children. He found that the ban reduced the quantity of children's cereals in the homes of French-speaking children in Québec, but not for English-speaking children who continued to be exposed to food advertising through US television stations. Additional analyses showed that the lower cereal consumption was explained by the diminished exposure to television advertising and not by other factors. Other experimental studies conducted with children in closed environments (e.g., schools, summer camps) showed that exposure to television advertising for unhealthy foods increased the likelihood that they would be chosen on a single consumption occasion as well as for longer time periods (Gorn and Goldberg 1982) and that the largest effects occurred among obese children (Halford et al. 2008).

In summary, all reviews of this literature (Harris et al. 2009c; Livingstone 2006; McGinnis, Gootman Appleton, and Kraak 2008) conclude that food advertising and promotion have a causal and real, although small, direct effect on children's food decisions, and also that food advertising interacts with other marketing factors to influence obesity in a proportion which is not well established. While some reviews conclude that food advertising has modest effects compared to parental diet or peer pressure (Livingstone 2005), others (Harris et al. 2009c) point out that advertising probably influences these other factors as well. For example, exposure to television advertising for snacks has been shown to increase snack consumption among children as well as adults even for brands that are not advertised, suggesting that these ads may promote short-term enjoyment goals in general, to the detriment of longer-term healthy living goals (Harris, Bargh, and Brownell 2009b).

Branding and labeling effects

In addition to television advertising, marketers have found other ways to influence people's brand awareness and preferences. Branding is the creation of names, symbols, characters and slogans that help identify a product and create unique positive associations which differentiate it from the competition and create additional value in the consumer's mind. Even in the absence of advertising, people acquire expectations about the taste, healthiness, and social connotation associated with a particular food and its ingredients, though branding, nutrition information, or health claims.

The branding and labeling of food often operates by relying on people's natural tendency to categorize food as good or bad, healthy or unhealthy. For example, in one study (Rozin, Ashmore, and Markwith 1996), 48% of Americans agreed with the statement: "Although there are some exceptions, most foods are either good or bad for health." These categorization effects are largely insensitive to the amount of food under consideration. For example, the same authors found that a diet without any "bad" ingredients, such as salt, was

perceived to be healthier than a diet with only traces of it, although salt is a necessary component of any diet. As we show below, the goal of many of the branding and labeling efforts by food marketers is to portray one aspect of the food as healthy, in the hope that it will be enough for the entire food itself to be categorized as healthy, which has important effects on purchase and consumption.

Food and ingredient branding. The name of the food (brand name or generic category name) has a strong effect over and above the description of its ingredients or nutrition content on consumers' expectations of how tasty, filling or fattening the food is, but these expectations (especially those about weight gain) are poorly correlated with reality (Oakes 2006). For example, Oakes (2005) showed that people expected that a mini Snickers bar (47 calories) eaten once a day when hungry, led to more weight gain than a cup of 1% fat cottage cheese, 3 carrots and 3 pears (569 calories) eaten in the same circumstances. These expectations impact the actual consumption experience and retrospective evaluations of the taste (Robinson et al. 2007). For example, simply adding adjectives like "succulent" or "homemade" can make meals more appealing, tastier, and more filling (Wansink, van Ittersum, and Painter 2005). These branding effects are particularly strong when people have not had a chance to experience the range of all possible tastes (Hoegg and Alba 2007). A recent comprehensive study (Irmak, Vallen, and Robinson 2011) showed that branding the same food as a "salad special" (vs. "pasta special") or as "fruit chews" (vs. "candy chews") increased dieters' perceptions of the healthfulness, tastiness, and actual consumption of the food (but not its perceived "fillingness"). Interestingly, these effects were absent among non dieters and disappeared when dieters were asked to consider the actual ingredients (vs. the name), and when looking only at dieters with a high need for cognition, which suggest that these effects are driven by heuristic processing.

Beyond the name of the food, its nutrient composition and some ingredients (e.g., high fructose corn syrup, additives, soy, preservatives, etc.) strongly influence food expectations (Wansink 2003; Wansink and Park 2002). Fat content has a stronger effect on health perceptions than energy density, fiber, or sugar content (Oakes and Slotterback 2005). This may explain the recent campaign to rebrand high fructose corn syrup simply as corn sugar, or why some food manufacturers make sure that negative ingredients like sugar do not appear first in the ingredient list by using different types of sugar. Further evidence that ingredient branding influences the taste experience instead of modifying retrospective interpretations is provided by a study which found that disclosing that a beer contains vinegar reduced liking for the beer, but only when disclosed before the tasting (Lee, Frederick, and Ariely 2006). Finally, neuro-imaging studies (Plassmann et al. 2008) show that marketing actions influence not just self-reported liking but also its neural representations, suggesting that these effects are not merely caused by socially-desirable responding and that marketing actions modify how much people actually enjoy consuming the food.

Names and logos are the most prominent brand elements, but anything that is uniquely associated with the brand, like the presence of a licensed or brand-owned character (e.g., a Disney character or the Pillsbury Doughboy), or the color, design and texture of the packaging can influence brand awareness and brand image (Harris et al. 2009a). Packaging is particularly important for food because some foods elicit disgust when they are not properly packaged. As shown by a study by Morales and Fitzsimons (2007), direct physical contact (but not simple co-location) with a disgusting product can transfer offensive properties to other products (e.g., rice cakes touching lard on a supermarket shelves are perceived to be more fattening). Conversely, packaging may elicit positive sensations which transfer to the food itself. For example, water is perceived to taste better when it is poured from a firm bottle than from a flimsy bottle (Krishna and Morrin 2008). Overall, these studies show that

marketers can influence consumer expectations, and even their post-experience liking for food and their food consumption, without relying on advertising but simply by modifying the name, logo, characters, ingredient information displayed on the food packaging, as well as the physical characteristics of the package itself.

Nutrition information. There is a large body of literature on the effects of providing nutrition information about calories, nutrient levels, and serving sizes (for a recent review, see Grunert, Bolton, and Raats 2011). Although a large proportion of consumers express interest in obtaining and using nutrition information, only a minority actively searches for and uses this information when making purchase and consumption decisions. For example, only 0.1% of consumers were observed accessing on-premises nutrition information before purchasing food at four fast-food chains (Roberto, Agnew, and Brownell 2009a). As with other marketing actions, labeling effects are context-dependent and have different effects when framed positively or negatively. For example, food is perceived to be leaner and higher quality when labeled “75% fat-free” than “25% fat” (Levin and Gaeth 1988; Wertenbroch 1998). Consumers are also more likely to choose healthier food when energy is labeled in kilojoules rather than in kilocalories, because this makes the energy differences nominally larger (Pandelaere, Briers, and Lembregts 2011).

Overall, we know that nutrition information helps people identify healthier alternatives, and is better if displayed on the front of the package and accompanied by some sort of a traffic-light system which translates nutrient content information into a simple recommendation. More complete labels that include recommended daily intakes are not necessarily better at helping people identify healthy food, although they do provide useful information for some consumer segments with special dietary needs (Grunert et al. 2010; Riis and Ratner 2010). In contrast, providing category benchmarks for each ingredient and nutrient (average or range) helps consumers process the nutrition information (Viswanathan

and Hastak 2002), while summarizing information in a graphic format is particularly helpful for illiterate consumers (Viswanathan, Hastak, and Gau 2009).

Moving from comprehension to actual effects of behavior, the issue of whether nutrition labels actually improve dietary intake is still largely unresolved (Grunert et al. 2011). A number of studies have examined the effects of the Nutrition and Labeling Education Act (NLEA) of 1990, which made nutrition information mandatory for packaged foods but not for food purchased away from home (i.e., in restaurants, vending machines, school or hospital cafeterias, etc.). Overall, field and laboratory studies have not detected a major change in the consumer's search for and retention of nutrition information, except among highly motivated and less knowledgeable consumers (Balasubramanian and Cole 2002). These authors found that the NLEA increased the attention given to negative nutrition attributes more than for positive ones. These findings could explain why, once selection effects are controlled for, the NLEA did not improve the diet (except for the fiber and iron intake) of people who read labels (Variyam 2008). Another study (Variyam and Cawley 2006) found that people who claimed to read labels gained less weight after the NLEA than people who did not read labels, although the effect was only statistically significant among non-Hispanic white women. As we will see later, part of these effects could be because the NLEA did not succeed in making a majority of food marketers improve the nutritional quality of their offering (Moorman 1996; Moorman, Ferraro, and Huber 2011).

A number of studies have examined the effects of providing nutrition information, particularly calorie counts, for food purchased away from home. Recent review papers (Harnack and French 2008; Roberto, Schwartz, and Brownell 2009c) show that despite mixed results reported in some cases (Elbel et al. 2009; Harnack et al. 2008; Yamamoto et al. 2005), most experimental studies find that calorie information does, on average, improve food decisions (Downs, Loewenstein, and Wisdom 2009; Harnack and French 2008; Ludwig and

Brownell 2009). For example, one experiment (Roberto et al. 2009b) found that providing calorie information led to smaller meal sizes and also decreased the total number of calories eaten during the day. Bollinger, Leslie, and Sorensen (2011) compared transaction data from Starbucks store in NYC before and after calorie posting and in adjacent states without mandatory calorie posting. They found that calorie posting reduced average calories per transaction by 6%, that the effects persisted, that they were entirely drive by food purchases, and that revenues were not adversely impacted.

Consumer and product heterogeneity in terms of dietary goals and calorie-based inferences may explain these inconsistent results. For example, Elbel et al. (2009) focused on low-income neighborhoods whereas the participants in Roberto et al.'s (2009b) study were from mixed backgrounds. Similarly, Bollinger, Leslie, and Sorensen (2011) found stronger effects among Starbucks consumers with higher education and income. Gender is another moderator of the effect. Harnack et al. (2008) found that calorie information increased the choice of high-calorie items by men, but not by women. Tandon et al. (2010) found that providing calorie information led to lower-calorie fast food choices when adults ordered for their children, but not when they ordered for themselves. Burton et al. (2006) found that providing nutrition information did not influence purchase intentions unless consumer expectations substantially underestimated nutrition levels (i.e., there's a "nutrition label shock"). Finally, Tangari et al. (2010) found that calorie disclosures had inconsistent effects across menu items and restaurant chains, due to different perceptions and initial expectations about the calorie levels of each type of food or of the type of food served in these chains.

In North America, serving size and the number of servings contained in the package are also part of the mandatory nutrition information for packaged goods (in Europe, nutrition information is indicated per 100 g or 100 ml). Serving sizes are determined by the USDA and are supposed to indicate the amount of food that a person generally eats at a time, although –

as indicated later – USDA serving sizes are often significantly lower than actual serving sizes (Nielsen and Popkin 2003 ; Young and Nestle 2007). One study showed that adding serving size information reduced granola intake for both overweight and normal weight consumers, but did not reduce the effects of labeling the food as “low fat” (Wansink and Chandon 2006a). Other studies found that reducing serving size (from “contains 1 serving” to “contains 2 servings”) did not influence intake or satiety ratings, especially among overweight people (Ueland et al. 2009; Wansink and Chandon 2006a). This could be because many people see serving sizes as an arbitrary unit designed to allow a comparison of nutrition facts across products rather than as a general guide to how much people should consume (Ueland et al. 2009). Indeed, consumers often think that the entire content of the package is the appropriate serving size (Geier, Rozin, and Doros 2006).

Nutrition and health claims. In some categories, marketers make heavy use of nutrition claims (e.g., “low fat,” “rich in Omega 3”), so-called “structure-function” claims (e.g., “proteins are essential for growth”), health claims (e.g., “supports immunity”), vague unregulated claims (e.g., “smart choice,” “better for you”), or use third-party ratings or endorsements (e.g., “Kosher,” “Halal,” “organic,” or the heart check mark of the American Heart Association). Some of these claims can improve brand evaluation and sales (Levy and Stokes 1987), although these effects are not universal and are influenced by comparisons with the nutrition claims of other foods in the same category (Kozup, Creyer, and Burton 2003). For example, a supermarket experiment (Kiesel and Villas-Boas 2011) found that “low calorie” and “no transfat” shelf signs significantly increased popcorn sales, while others (“low fat”) did not, perhaps because of negative flavor expectations.

Beyond asserting whether nutrition and health claims are scientifically true, an important question is to examine how they are understood by consumers. In a recent review, Mariotti et al. (2010) identified many sources of confusion. First, although the relationship between any

nutrient and health is almost always curvilinear, consumers expect it to be monotonic (“more is better”). Second, consumers may not realize that they are already taking too much of a particular nutrient (e.g., protein intake in Western countries). Third, wording can be misleading (e.g., when “provides energy” is understood as “energizing”). Finally, some claims are based on flimsy science or overstate research findings. These issues have led some researchers to call for an outright ban on front-of-package claims (Nestle and Ludwig 2010). Other recommendations are more nuanced but still have important practical implications. For example, Mariotti et al. (2010) recommend that only generic structure-function claims should be allowed (vs. claims for a specific brand), and only when consumption levels are not sufficient in the population. In addition, these authors recommend that the claims be accompanied by disclaimers explaining that the health-related condition is also influenced by many other factors, that more is not necessarily better, and that consumers should follow general dietary guidelines. Of course, this would reduce the effectiveness of health claims, including those that may be truly beneficial for consumers. As a rule, simpler front-of-pack health claims and guidelines (e.g., the “half-plate” rule of thumb) are more effective in terms of both comprehension and behavior change than more complex ones (Riis and Ratner 2010). For example, a field experiment found that simple color coding of cafeteria foods with a green, yellow, or red label (for “healthy,” “less healthy,” and “unhealthy” foods) improved sales of healthy items and reduced sales of unhealthy items (Thorndike et al. 2011).

It is interesting to elaborate on one of the robust findings of studies of the effects of health claims – the “health halo” effect. Many studies have shown that a specific health claim is often enough for the food to be categorized as “good” or “healthy”, which leads people to make misleading generalizations that the food scores highly on all nutrition aspects (Andrews, Netemeyer, and Burton 1998; Carels, Konrad, and Harper 2007; Keller et al. 1997). A study by Wansink and Chandon (2006a) found lower calorie estimations for granola

than for M&Ms, a product with the same calorie density but considered less healthy than granola. The same study also found that labeling both products as “low fat” reduced calorie estimation and increased the amount that people served themselves or consumed, especially for people with a high body mass index. In another study (Chandon and Wansink 2007a), the same authors found evidence for health halos created by the name of a restaurant or the food available on a restaurant menu. For example, they found that Subway meals were perceived to contain 21.3% fewer calories than same-calorie McDonald’s meals. These results were replicated in a scenario where the health positioning of the fast-food restaurant was empirically manipulated rather than measured. These results were replicated with other foods and restaurant brands (Tangari et al. 2010).

In a series of experiments, Chernev et al found that adding a healthy food to an unhealthy food could lead to calorie estimations that were lower than for the unhealthy food alone (for a review, see Chernev and Chandon 2010). For example, one study found that a hamburger alone was perceived to have 761 calories, a broccoli salad alone was perceived to have 67 calories, but a combination of the same hamburger and salad were thought to have only 583 calories (Chernev and Gal 2010). The “negative calorie” illusion created by adding a healthy food to an unhealthy is particularly strong among people who are on a diet or simply “watching what they eat”(Chernev 2011a). Different biases (contrast effects) occur when people estimate calories sequentially instead of simultaneously (Chernev 2011b). In the case of sequential estimations, a food considered unhealthy (e.g., a burger) looked less healthy, and thus was perceived to have more calories, when people were first asked to estimate the number of calories of a healthy food (e.g., a salad) than when they previously estimated the number of calories of another unhealthy food (e.g., a cake).

Overall, the finding that people expect that they can eat more – and do eat more – when marketing actions lead the food to be categorized as healthy is robust and is replicated

independently of people's BMI, gender, or restrained eating (Bowen et al. 2003; Provencher, Polivy, and Herman 2008). This boomerang effect seems to occur because people feel that they can eat more of the healthy food, or can eat more unhealthy (but tasty) food after choosing healthy food without adverse health consequences (Ramanathan and Williams 2007). In fact, simply considering the healthier option without actually consuming it can be enough to allow some consumers to vicariously fulfill their nutrition goals. As shown by Wilcox and colleagues (2009), the mere presence of a healthy food on a menu increases the chance that people will choose the most indulgent food available. Similarly, Finkelstein and Fishbach (2010) showed that the imposed eating of healthy food (rather than freely choosing to eat healthy food) was perceived by consumers as a signal that the health goal was sufficiently met, which made people hungrier. Another reason why people may overeat food positioned as healthy is that they anticipate that they will experience less guilt from overeating this food (Chandon and Wansink 2007a).

To fully understand the effects of health claims however, we must look at their impact on purchase and not just on consumption, and here the effects are more mixed. First, studies have shown that people on average expect "unhealthy" food to taste better, and that these effects persist even after actual intake (Raghunathan, Naylor, and Hoyer 2006), although another study found this only among dieters (Irmak et al. 2011). These results, coupled with the findings reported earlier that taste expectations are the strongest driver of food choices, imply that positioning food as healthy may not necessarily increase total energy consumption if the higher intake per consumption occasion is compensated by fewer consumption occasions or by fewer consumers. The net effect probably depends on brand and individual characteristics, and is stronger for some claims than others. For example, differences in taste expectations about food, specifically when described as "low fat" (as opposed to branded as "healthy" in general), have been found between men and women (Bowen et al. 1992), and

mostly influence unfamiliar brands. It is also unlikely to influence foods strongly categorized as healthy or unhealthy. This could explain the null effect of some of the studies (Roefs and Jansen 2004) and some of the earlier opposite findings (Wardle and Solomons 1994). The negative association between health and taste also seems less pronounced in Europe, where people tend to associate healthy with freshness and higher quality, and thus sometimes healthier can be tastier (Fischler et al. 2008; Werle et al. 2011).

How Marketing Stimulates Consumption by Changing the Food Itself

Although marketing is most readily associated with communication and pricing, marketers are closely involved when making decisions about the product itself. This includes making decisions about the “quality” of the food (its composition, nutritional and sensory properties) and also its “quantity” (the portion or package sizes at which it will be offered). Such changes can be made to a flagship brand but more dramatic changes can be made through line extensions that broaden or create variations of the basic flavor and texture profile (Coke to Diet Coke, to Coke Zero, and 6.5 oz to 64 oz containers), and which in turn affect how the original food is consumed, even if the original variant remains unchanged (Moorman 1996).

Effects of the composition, sensory, and nutritional properties of the food

Before being a source of nourishment, food is a source of pleasure and stimulation – otherwise people would obtain the required carbohydrates and fat by simply eating butter and sugar. It is hence not surprising that one of the primary goals of food marketing is to improve the palatability of the food, i.e., the acceptability of the taste and its ability to stimulate appetite. At a basic level it is hard to imagine how palatability would not increase energy intake because people simply do not eat what they dislike and eat more of what they like (Drewnowski 1997; Sorensen et al. 2003). Although improving palatability and the sensory and nutritional properties of food are largely driven by advances in food science, marketing

plays a role because it helps incorporate the expressed and latent desires of consumers and, above all, the role of perception (Moskowitz and Reisner 2010). For example, preference data can be biased by differences in sensory perceptions and some people may not like a given amount of sweetness simply because they don't experience it as much as others (Moskowitz et al. 1974). Others may like it as much but have a different interpretation of what the scale labels (e.g., "extremely sweet") mean. Current market research tools recognize that preferences and sensations are related and that labels do not have universal meaning and use comparisons to unrelated standards (e.g., "the strongest imaginable sensation of any kind") to make valid comparisons across groups (Bartoshuk et al. 2006; Bartoshuk, Fast, and Snyder 2005). Marketers collaborate with food scientists to create the best sensory experience given the expectations created by the brand, marketing communication, and competition.

Sensory perceptions. Flavor is a seamless combination of taste and smell, although it is mostly determined by smell (Small and Prescott 2005). Studies have found that sensory-specific satiety can occur within a reasonably short time regardless of whether a person tastes a food or simply smells it (Rolls and Rolls 1997). The form of the food (e.g., solid or liquid), its texture, color, sound, temperature and visceral sensations all influence flavor perceptions because of multi-sensory taste integration but also because of consumers' expectations (Krishna and Elder 2009; Rozin 2009; Shankar, Levitan, and Spence 2009). In general, increasing the complexity of the sensory experience by adding different layers of flavors, more sensory cues, and more sensory stimuli improves palatability (Kessler 2009). Sensory complexity can increase taste perceptions even without changes in the food itself, if, for example, the advertising uses multiple sensory cues (Elder and Krishna 2010).

The form of the food has a direct effect on energy intake independently of its impact on flavor. For example, people tend to consume more calories from liquid than from comparable solid foods of the same energy density, if only because of the lower bite effort and shorter

sensory exposure (de Wijk et al. 2008). More generally, slow foods that need time and effort to be eaten are consumed in lower quantities and lead to higher satiation than food that is consumed quickly and effortlessly (de Graaf and Kok 2010).

Because people associate certain colors with certain foods and flavors, food marketers have long used colors to improve taste expectations, while avoiding colors deemed inappropriate for the food (Garber, Hyatt, and Starr 2000). For example, adding caramel odors that have no taste themselves enhances the perceived sweetness of food (Auvray and Spence 2008). Moreover, studies have shown that colors, especially those with strong flavor expectations, play a very important role in helping consumers discriminate between different foods and, in the case of orange juice, is more important than either taste or brand information (Hoegg and Alba 2007; Shankar et al. 2010).

Due to the difficulty of manipulating each sensory aspect of food independently and because of complex interaction issues among sensory modalities, it is difficult to isolate the effects of each sensory property of food. However, advances in measurement techniques, especially in neurological imaging, should help overcome some of the limitations of the subjective ratings of sensory inputs (e.g., the difficulty of distinguishing valence and intensity).

Macro-nutrient composition. Up to a certain level, increasing the amount of sugar, fat and salt in a food improves palatability (Mattes 1993) but does not increase its satiating power in the same proportion (Stubbs et al. 1996). Beyond sugar, salt, and fat, which are the three most important ingredients for palatability, the flavor enhancer glutamate creates a pleasurable Umami taste sensation, which increases the palatability of some food and can be used to maintain the palatability of fat-reduced foods (Bellisle 1999). Interestingly, there is a positive interaction effect between salt, fat, and sugar content on palatability. For example, sugar enhances palatability more when added to whole milk than to skim milk (Drewnowski 1995).

These two results explain why a large proportion of the added supply of calories in recent decades have come from processed food rich in fat and added sugar, and especially from sweetened drinks (Duffey and Popkin 2008; Putnam, Allshouse, and Kantor 2002). Even though it is true that the percentage of calories consumed from fat has declined in the US, the percentage decrease is the result of an increase in total energy intake; fat consumption itself has not decreased (Hill 2009; Kennedy, Bowman, and Powell 1999). Fat consumption has also remained high in countries such as France, where the volume of processed food (excluding desserts) consumed during lunch and dinner has doubled in the last 45 years (Etiévant et al. 2010).

Of course, not everybody responds in the same way to changes in the macro-nutrient composition. People with a high BMI perceive sugar flavor less intensely and prefer foods high in sugar and fat (Bartoshuk et al. 2006). It is possible that people with a high BMI may be more sensitive to the hedonic aspect of the food than to their nutritional and homeostatic needs (Yeomans, Blundell, and Leshem 2004). Finally, positive and negative changes in nutrient and ingredient composition do not necessarily have comparable but opposite effects. For example, adding ingredients (e.g., extra vitamin D, calcium) reduces the perception that the food is natural, which is an important criteria for food choices, whereas subtracting ingredients (e.g., skim milk) does not (Rozin, Fischler, and Shields-Argelès 2009).

Food marketers have changed the composition of foods not just to increase palatability but also to respond to public pressure (e.g., concerns about a particular ingredient or macro nutrient) and regulatory changes (such as mandatory nutritional labeling forced by the Nutrition Labeling and Education Act of 1990). Responses to mandatory nutrition labeling have been mixed. One study suggested that the NLEA led food marketers to improve the level of taste-neutral positive nutrients, such as vitamins, in their core brands and to introduce healthier brand extensions with similar levels of positive nutrients but with lower levels of

negative nutrients (Moorman 1996). These results were confirmed in a recent analysis which found that the NLEA led to an increase in nutritional quality (measured as the amount of fat, cholesterol, sodium, and fiber per serving) among new brands, brands with a weak nutritional profile, snacks, and brands in junk food categories (Moorman et al. 2011). However, this study also found that despite these advances, the average nutritional quality of food products sold in supermarket had actually worsened compared to pre-NLEA levels and compared to similar food products unregulated by the NLEA. This effect is largely driven by established brands which account for a large portion of people's diet (e.g., dinner food) and whose nutritional quality has slightly deteriorated. The authors speculate that this may be because companies are afraid of reducing levels of negative nutrients (e.g., fat or sodium) in their flagship brands for fear that it may decrease flavor or flavor expectations and because companies prefer to compete on taste than on nutrition, which can now be more easily compared.

Calorie density. It is well established that calorie density – the number of calories per unit of food – increases energy intake over the short term. This happens because people, particularly children, prefer calorie-dense food (Gibson and Wardle 2003) and because people are bad at estimating calorie density before (or even after) intake. Primarily though, this happens because people tend to eat the same quantity of food, regardless of its calorie density (Flood, Roe, and Rolls 2006; Rolls, Morris, and Roe 2002; Rolls, Roe, and Meengs 2007b). In fact, the volume of food eaten is a better indicator of how full people feel than the calorie density of the food (Bell, Roe, and Rolls 2003; Rolls et al. 2002).

Understanding the exact reason why people focus on food volume rather than actual calories is beyond the scope of this review and still in debate. However, some researchers have argued that some consumers, especially those with high BMI, have a hard time determining how much they have eaten, or even how full they are, from internal signals only

and rely instead on external signals (Wansink, Payne, and Chandon 2007). Unfortunately, such external cues and rules of thumb can yield biased estimates and unexpected surprises. In one study, unsuspecting diners were served tomato soup in bowls that were refilled from tubing that ran under the table and up into the bottom of the bowls. People with varying BMI levels eating soup from these “bottomless” bowls ate 73% more soup than those eating from normal bowls, but they estimated that they ate only 4.8 calories more (Wansink, Painter, and North 2005).

Because the short-term effects of calorie density are well documented, recent research has looked at its effects not just on the consumption of the target food but also on the consumption of other foods eaten during the same meal or the same day (inter-day compensation is relatively infrequent, see Khare and Inman 2006). The evidence of long-term effects, however, is sparse and it remains unclear whether the strong short-term effects of calorie density on consumption volume extend over time because of compensation and habituation (Bellisle and Perez 1994; Stubbs and Whybrow 2004). As a rule, compensation works well to balance a deficit of calories, but much less well to compensate for an excess of calories, especially among adults and for beverage consumption (Bellisle 2010; Kral et al. 2007). Habituation may also weaken the positive short-term effects of lower calorie density, if, for example, artificial sweeteners disrupts people’s ability to regulate their intake based on their sweetness sensations (Brown, de Banate, and Rother 2010).

Sensory variety. It is well known that increased food variety, both within and across meals, increases consumption volume because it reduces sensory-specific satiety within a meal and monotony across meals (Inman 2001; Khare and Inman 2006; Remick, Polivy, and Pliner 2009). For example, one study found that when consumers were offered an assortment of three different flavors of yogurt, they were likely to consume an average of 23% more yogurt than if offered only one flavor (Rolls et al. 1981). A recent review (Remick et al.

2009) showed that the variety effect held independently of characteristics such as gender, weight and dietary restraints, and was only somewhat reduced with age. Although flavor, texture and appearance-specific satieties have been identified, these effects seem independent of macronutrient content and energy density (Bell et al. 2003; Sorensen et al. 2003).

Food marketers have explored many ways to reduce sensory-specific satiety. One study found that adding different condiments to a fast-food meal reduced sensory-specific satiety and increased consumption by up to 40% (Brondel et al. 2009). Giving people some choice over what they eat (even if illusory) may reduce monotony and hence the variety effect (Remick et al. 2009). Recent studies have shown that simply increasing the perceived variety of an assortment by changing the number of colors of candies or the structure of their organization, can increase consumption (Kahn and Wansink 2004). In fact, changing the organization, duplication and symmetry of an assortment may be enough to influence the perceived variety of an assortment (Hoch, Bradlow, and Wansink 1999). Part of this could be because increasing variety reduces perceived quantity (Redden and Hoch 2009). Finally, increasing distraction reduces sensory-specific satiety (Brunstrom and Mitchell 2006), perhaps because it draws attention away from food (Hetherington et al. 2006).

Liking or wanting? Despite the links between sensory stimulation, palatability, and consumption, the availability of tasty, highly palatable foods is neither a necessary nor a sufficient cause of over-consumption (Drewnowski 1997; Mela 2006). In developed countries with high standards of living, an individual's liking of what they choose to eat is uniformly high and variation in food palatability may therefore explain only a small fraction of variation in energy intake (de Castro and Plunkett 2001). In addition, the impact of palatability on subjective appetite sensations is mixed; people may feel hungrier after a palatable meal or after an unpalatable one (Sorensen et al. 2003). Whereas palatability may prolong satiation (how long it takes to feel full), it does not influence subsequent satiety (how long people do

not feel hungry between meals) (De Graaf, De Jong, and Lambers 1999). In fact, highly palatable food samples actually enhance subsequent consumption of similar foods and may prompt people to seek any rewarding food (Wadhwa, Shiv, and Nowlis 2008). Even then, people eat beyond the level at which their appetite is satisfied, as evidenced by the fact that they eat and drink less when asked to focus on taste satisfaction, and more when focusing on perceptions of fullness, i.e. perceived stomach fullness (Poothullil 2002). Conversely, habituation can occur through mental stimulation alone. A series of studies showed that simply imagining eating 30 pieces of cheese reduces consumption, increases satiation for the imagined food, and reduces subsequent wanting for the food, but not its hedonic liking (Morewedge, Huh, and Vosgerau 2010).

More generally, there is converging evidence that food decisions are influenced by motivational ‘wanting’ – the salience or reinforcement value of eating – and not just by hedonic ‘liking’ – the pleasure derived from sensory stimulation (Berridge 2009). For example, recent research suggests that expected satiation, which is primarily driven by perceived portion sizes, determines consumption volume more than expected liking (Brunstrom and Collingwood 2009; Brunstrom and Rogers 2009). The neural systems underlying the hedonic system and the homeostatic control of eating are separate, involving distinct brain structures and neurochemical reactions (Yeomans et al. 2004). So although there is no doubt that marketing has played a role in developing more complex, palatable, and rewarding foods which people cannot easily resist or stop eating (Kessler 2009), the hedonic effects of sensory properties are just one of many drivers of energy intake, and future research is necessary to understand the full effects of the quality of the food itself.

Altering package and portion sizes

Trends in portion and package sizes. Unlike alcohol, which in most countries must be packaged in standardized sizes, food and beverage manufacturers are free to choose the size

and description (e.g. “medium”, or “value” size) of the packages that they offer on the market. Restaurants can also freely set portion sizes and the way they describe them (e.g., Starbuck’s entry-level “tall” cups).

Product package and portion sizes have grown rapidly over the past decades and are now almost invariably significantly larger than the USDA recommended serving sizes (Condrasky et al. 2007; Nestle 2003; Rolls 2003; Schwartz and Byrd-Bredbenner 2006; Wansink and van Ittersum 2007; Young and Nestle 2002). Over the last twenty years for example, portion sizes have increased by 60% for salty snacks and 52% for soft drinks (Nielsen and Popkin 2003). While this is a trend in much of the developed world, supersizing is particularly common in the United States and has been identified as one of the reasons why obesity has increased faster in the US than in other developed countries (Brownell and Battle Horgen 2003; Hannum et al. 2004; Nestle 2003; Rozin et al. 2003).

Larger package sizes almost always have lower unit prices (by volume or weight), except when there is more competition on the smaller sizes or when smaller sizes are used as image builders by retail stores (Sprott, Manning, and Miyazaki 2003). Marketers can reduce the unit price of larger products and hence increased consumer value because of their lower packaging costs. More importantly, larger portions and packages allow greater absolute margins because the marginal cost of the extra food is often minimal compared to its perceived value for the consumer. For food retailers and restaurants with high fixed costs (e.g., real estate, labor, marketing costs), reducing portion sizes, and hence average consumer expenditure, would require a huge increase in traffic to break even—which is why the few restaurant chains that have tried this tactic (e.g., Ruby Tuesday) have quickly stopped. In fact, it can even be optimal for food marketers to price the incremental quantity below its marginal cost if their products are bought by two distinct consumer segments: one concerned about overeating and willing to pay more for smaller portion sizes that help them control their

intake, and the other unconcerned about overeating and willing to buy larger quantities to obtain the lower unit price (Dobson and Gerstner 2010; Wertenbroch 1998). As a result, larger package sizes are typically more profitable for food marketers as well as benefiting from a higher perceived economic and environmental value, a win-win in all aspects but convenience and consumption control.

Supersizing effects. There is considerable evidence that, with the exception of children under three, whose self-regulation abilities are still intact (Birch et al. 1987; Rolls, Engell, and Birch 2000), larger portion size significantly increase consumption (Chandon and Wansink 2002; Devitt and Mattes 2004; Fisher, Rolls, and Birch 2003; Fisher and Kral 2008; Geier et al. 2006; Rolls et al. 2000; Wansink 1996), as can the size of portion servings in kitchens and in restaurants (Nisbett 1968; Rolls et al. 2002; Sobal and Wansink 2007). In addition, these effects appear to hold for a long time period, up to 11 days in one study (Rolls et al. 2007b). In a recent review paper, the effects of at least 30% higher consumption levels due to portion size were reported frequently, with larger effects for larger portion sizes (Steenhuis and Vermeer 2009). Supersized portions can even increase the consumption of bad-tasting foods, such as 14-day-old popcorn (Wansink and Kim 2005; Wansink and Park 2001). As mentioned earlier, portion size increases energy intake more than the actual calorie count of the food, i.e., regardless of its calorie density (Kral, Roe, and Rolls 2004; Ledikwe, Ello-Martin, and Rolls 2005), suggesting that the effects are not driven by homeostasis. In fact, even “virtual” serving sizes can influence consumption. Studies have shown that simply adding unobtrusive partitions (e.g., colored papers in between the cookies inside the package or a red Pringle chip every seven yellow ones in a tube) can reduce intake (Cheema and Soman 2008; Wansink, Rozin, and Geier 2005). However, partitioning only works when people pay attention to the partition. One study (Vermeer, Bruins, and Steenhuis 2010b) found that 93% of the purchasers of a king-size pack containing two theoretically single-

serving candy bars intended to consume both within one day, often because they had not noticed that smaller sizes of candy bars were available for purchase. This is consistent with earlier results indicating that people take package size as a cue for appropriate serving size (Geier et al. 2006; Ueland et al. 2009).

The effects of package size on consumption are strongly influenced by the range of the other sizes available and by the portion size chosen by other consumers. Sharpe, Staelin, and Huber (2008) found that people avoided the largest or smallest drink sizes. Such aversion to extremes causes consumers to choose larger size drinks when the smallest drink size is dropped or when a larger drink size is added to a set. Modeling studies have shown that larger package and portion sizes can also impact energy intake of others, since people tend to imitate how much other people choose (Engell et al. 1996; Herman and Polivy 2005; Herman, Roth, and Polivy 2003), particularly if the person that they have observed is not obese (McFerran et al. 2010a, b).

There are some exceptions to the rule. Recent studies have found that small units, such as 100-calorie packs, may increase consumption volume on one consumption occasion more than regular size packs for hedonic products and when people's self-regulatory concerns have been activated, or for restrained eaters (Coelho do Vale, Pieters, and Zeelenberg 2008; Scott et al. 2008). These studies show that, unlike larger package sizes, small units "fly under the radar" and encourage lapses in self control because the consumption of these small packages fails to activate healthy eating goals. However, these effects do not seem to hold for long periods; over long periods small sizes do lead to reduced calorie intake (Stroebele, Ogden, and Hill 2009).

There are a number of explanations of why large packages and portions increase consumption (Wansink and van Ittersum 2007). One could be the social norm that people should clean their plate (Birch et al. 1987). However, this norm cannot explain why large

packages also increase the pouring of inedible products such as shampoo, cooking oil, detergent, dog food, and plant food. Nor does it explain why large packages of M&Ms, chips, and spaghetti increase consumption in studies where even the smaller portions were too large to eat in one sitting (Folkes, Martin, and Gupta 1993; Wansink 1996). Another explanation is that larger portion sizes are used as an indication of the “normal” or “appropriate” amount to consume. Even if people do not clean their plate or finish the package, the large size presented to them gives them the liberty to consume past the point where they might otherwise stop with a smaller but still unconstrained supply (Geier et al. 2006). This explanation is consistent with the finding that supersized portions increase energy intake even when people eat in the dark (Scheibehenne, Todd, and Wansink 2010).

A final reason is that people are simply unaware of how large the supersized portions and packages are (Chandon 2009, 2010). Information about food size, volume, or calorie is not always easily available (e.g., in restaurants or at home once the food is no longer in its packaging). Even when it is available (e.g., in supermarkets), most people, and especially low-income consumers, chose not to read it, preferring to rely on visual estimation of the package’s weight or volume to infer the amount of product that it contains (Lennard et al. 2001 1571; Viswanathan, Rosa, and Harris 2005). Building on the psychophysics of volume estimation, a number of studies (Chandon 2009; Chandon and Wansink 2007b; Wansink and Chandon 2006b) have shown that people’s calorie and volume estimations are inelastic (they underestimate the actual magnitude of change). They show that increasing the size of a meal or of a portion by 100% leads to an increase in perceived size of only 50% to 70%. As a result, whereas small portions tend to be accurately estimated, large portions are greatly underestimated. These biases even affect trained dieticians, are the same regardless of the individual’s BMI or interest for nutrition, and have been replicated with a variety of food categories (Chandon and Wansink 2007b; Tangari et al. 2010). In other words, meal size, not

body size, explains portion size errors. The reason why people with a high BMI underestimate calories more than people with a low BMI (Livingstone and Black 2003) is simply that they tend to select larger meals, not that they are intrinsically worse (or biased) portion size estimators (Wansink and Chandon 2006b).

Size labeling. The size labels used for food and beverages (such as “short” or “large” and also “biggie” or “petite”) have acquired meanings among consumers, who are able to rank order them (Aydinoglu, Krishna, and Wansink 2009), although definitions of the size of a “medium” portion vary widely (Young and Nestle 1998). In reality however, these labels mask huge discrepancies as a small size can be larger than a medium size from another brand (Hurley and Liebman 2009). For example, McDonald’s abandoned its supersize 42 oz beverages and 200 g fries, while other fast-food chains retained the portion size but renamed them. At Burger King, a “medium” drink became a “small,” a “large” became a “medium,” and a “king” became a “large” (Harris et al. 2010; Young and Nestle 2007). These labels are important because they influence size perceptions, preferences, and actual consumption. Aydinoglu and Krishna (2011) found that “labeling down” (labeling a large portion “medium”) had a stronger impact on size perception than “labeling up” (labeling a small portion “large”). In addition, these authors found that smaller labels made people eat more but think that they eat less.

A few studies have shown that marketers can influence impressions of size by changing the visual representations on the package. Folkes and Matta (2004) found that containers that attracted more attention were perceived to contain more product. Two recent studies (Deng and Kahn 2009; Kahn and Deng 2009) showed that people expected packages with pictures of the product on the bottom or on the right of the package to be heavier. Finally, simply showing more products on the packaging has been shown to increase size perception and consumption, especially when consumers are paying attention (Madzharov and Block 2010).

Overall, there is strong evidence that the amount of food served or packaged, its shape and description strongly influences energy intake.

How Marketing Changes to the Eating Environment Stimulate Consumption

In the same way that food is more than nourishment, eating is more than food intake. It is a social activity, a cultural act, and a form of entertainment (Kass 1999). Paradoxically, eating is also mostly a mindless habitual behavior which is determined by the environment, often without volitional input (Cohen and Farley 2008; Wansink 2006). In this context, the most subtle and perhaps the most effective way marketing influences consumption is by altering the eating environment and making food accessible, salient, and convenient to consume.

Access, salience, and convenience

Access. One of the biggest goals of food marketers is to facilitate access to food by making it easier to purchase, prepare, and consume. Obviously, food availability is a key factor since food that is not available cannot be consumed. For example, the availability of fruit and vegetables is the number one driver of their consumption by children (Cullen et al. 2003) and the limited availability of healthy foods from local retailers is associated with a poorer quality diet among the local community (Franco et al. 2009). In addition, the sheer availability of a variety of palatable foods can derail the homeostatic system designed to regulate food intake (Kessler 2009). For example, one study found that overweight men who had been following a 3,000 calorie diet who were given access to two free vending machines were unable to stick to the diet and consumed instead an average of 4,500 calories (Larson et al. 1995). This pattern also holds for healthy foods. For example, reducing the cost of obtaining water by placing it on the table instead of 20 ft away, strongly increased its consumption (Engell et al. 1996).

At a more general level, convenient ready-to-eat food is now available at any point in the day and almost everywhere. One can buy food in restaurants, grocery stores, and coffee bars, of course, but also in gas stations, pharmacies, kiosks, places of work, at school and in the hospital, and have food delivered almost immediately at home or elsewhere. Food which used to be bought in small family-owned stores is now bought in small or large outlets belonging to multi-national corporations with strong marketing skills and vast resources. In France, for example, 70% of the food consumed at home is now bought in supermarkets and hypermarkets compared to about 10% in 1970 (Etiévant et al. 2010). As a result, the total supply of calories has increased tremendously, reaching 3,900 kcal per person and per day in the US (Ludwig and Nestle 2008) and between 3,400 and 3,600 kcal in other rich countries (with the notable exception of Japan where it is only 2,700 kcal).

One particularly important driver of energy intake is the increased availability of ready-to-eat food prepared away from home, particularly in quick-service restaurants. Between 1982 and 2007, whereas spending on at-home food remained stable, expenditure on away-from-home food in the US increased by 16%, and now represents 49% of all food expenditures (Shames 2009). Econometric studies have suggested that the increased availability of fast food and full-service restaurants is the number one predictor of local obesity trends, even ahead of reduced food prices (Chou et al. 2004; Rashad 2005). For example, Chou et al. (2004) estimated that a 10% increase in the number of restaurants increased the probability of being obese by 1.4 percentage points. According to another study (Currie et al. 2009), the proximity of a children's school to fast food restaurants (but not to full-service restaurants) predicts local childhood obesity rates. In contrast, proximity to grocery stores (but not to convenience stores) was associated with a lower BMI, possibly because grocery stores offer more healthful foods (Powell et al. 2007b)..

Saliency. In today's cluttered stores and pantries, marketers know that availability, awareness, and even preferences are not enough; food visibility must be maximized at the point of purchase and at the point of consumption. For example, eye-tracking studies (Chandon et al. 2007; Chandon et al. 2009) showed that simply increasing the number of facings on a supermarket shelf or placing familiar foods on top of the shelf (vs. the bottom) increased the chances that these brands would be noticed, considered, and chosen. Seeing, smelling and touching food can stimulate unplanned purchase. For example, one study found that placing signs in a supermarket encouraging shoppers to "feel the freshness" increased unplanned purchases of fruit (Peck and Childers 2006). Another study (Downs et al. 2009) found that making healthy foods easier to order at a fast-food restaurant by displaying them conspicuously on the menu led to a significant increase in sales. Displaying healthier food more conspicuously in cafeteria (by placing them at eye levels shelves and conveniently at various points in the cafeteria line) also increases their consumption (Thorndike et al. 2011).

The saliency (or visibility) of food at home also increases energy intake. When jars of 30 chocolate candies were placed on the desks of secretaries, those in clear jars were consumed 46% more quickly than those in opaque jars (Painter, Wansink, and Hieggelke 2002). Another study (Chandon and Wansink 2002) showed that simply placing a food magnet on the refrigerator reminding people of food that they had bought in large quantities was enough to trigger consumption of ready-to-eat food. Spreading products in the pantry (vs. stacking them) can increase people's awareness that the product is available, and that they are less likely to run out of food stored in a more salient location and more likely to consume it (Chandon and Wansink 2006). The increased intake of visible foods occurs because their saliency serves as a continuously tempting consumption reminder. While part of this may be cognitively based, part is also motivational. Simply seeing or smelling a food can increase reported hunger, stimulate salivation and consumption, even when sated (Cornell, Rodin, and

Weingarten 1989; Rogers and Hill 1989), and can activate the region of the brain involved with drive (Wadhwa et al. 2008; Wang et al. 2004). In addition, salient food cues activate the need to eat by devaluing other goals and the evaluation of objects unrelated to eating (Brendl, Markman, and Messner 2003).

Although seeing or smelling a food can make it salient, salience can also be internally generated (Wansink 1994). Internally generated cues are stronger antecedents of meal termination for people with a low BMI than for those with a high BMI and for French people than for Americans (Wansink et al. 2007). A study manipulated the salience of canned soup by asking people to write a detailed description of the last time they ate soup. Those who increased their consumption salience of soup in this way intended to consume 2.4 times as much canned soup over the next two weeks, as did their counterparts in the control condition (Wansink and Deshpande 1994).

Convenience. For most people, with the exception of specific festive occasions, food preparation is a cost that consumers are increasingly less willing to pay, especially with increases in single-family households and female employment (Blaylock et al. 1999). Food marketers have responded to the preference for improved convenience by reducing preparation time and increasing the share of ready-to-eat food. Supporting the role of convenience, studies have shown that increased consumption is largely driven by increased consumption frequency rather than by increased consumption quantity per meal (Cutler, Glaeser, and Shapiro 2003). The same study showed that between 1978 and 1996 energy intake increased more for snacks (+101%)—which experienced the highest convenience gain—than for breakfast (+16%), lunch (+21%), and dinner (-37%). The same authors also found that convenience gains explained the higher BMI increase of certain groups in the population (e.g., married women) who now spend less time preparing food at home. This may

also explain why maternal employment is associated with childhood obesity (Anderson, Butcher, and Levine 2003).

Convenience also explains the success of “combo” meals at fast food restaurants which combine a sandwich, a side, and a beverage. One study (Sharpe and Staelin 2010) showed that consumers place a higher value on a “bundled” combo meal than purchasing the individual items separately, even after controlling for the effect of price discounts. They showed that this happens in part because combo meals reduce transaction costs and increase the saliency of the “featured” items on the menu board.

Convenience also interacts with other factors such as portion size and salience. In one study (Chandon and Wansink 2002), researchers stockpiled people’s pantries with either large or moderate quantities of eight different foods. They found that stockpiling increased consumption frequency but only for ready-to-eat products, and that this effect leveled off after the eighth day, even though plenty of food remained in stock. Interestingly, they found that stockpiling increased the quantity consumed per consumption occasion of both ready-to-eat and non-ready-to-eat foods throughout the entire two-week period. The same authors also found that the initial increase in consumption incidence of ready-to-eat food was due to the higher visibility of stockpiled food.

Shape and size of serving containers

About 70% of a person’s caloric intake is consumed using serving aids such as bowls, plates, glasses, or utensils (Wansink 2005). The size of bowls and plates obviously influences energy intake for the 54% of Americans who say that they “clean their plates” no matter how much food they find there (Birch et al. 1987; Collins 2006). This can influence energy intake simply because people (and not just those who clean their plates) rely on visual cues to terminate consumption (Wansink 2006). If a person decides to eat half a bowl of cereal, the size of the bowl will act as a perceptual cue that may influence how much is served and

subsequently consumed. Even if these perceptual cues are inaccurate, they offer cognitive shortcuts that allow serving behaviors to be made with minimal cognitive effort.

A number of studies (Piaget 1969; Raghubir and Krishna 1999; Wansink and Van Ittersum 2003) have shown that when people observe a cylindrical object (such as a drinking glass), they tend to focus on its vertical dimension at the expense of its horizontal dimension. Even if the vertical dimension is identical to that of the horizontal dimension, people in western societies still tend to overestimate the height compared to the width of an object (Segall, Campbell, and Herskovits 1963). So, for example, when people examine how much soda they have poured into their glass, they tend to focus on the height of the liquid poured and to downplay its width. To prove this, one study with teenagers at weight-loss camps (as well as a subsequent study with non-dieting adults) showed that this basic visual bias caused teenagers to pour and drink 88% more juice or soda into a short, wide glass than into a tall, narrow one of the same volume (Wansink and Van Ittersum 2003). The teenagers believed that they had poured only half as much as they actually did. Similar support for the finding was found among veteran Philadelphia bartenders. Another study (Krishna 2006) found a reversal of this general principle when only touch (and not vision) was used to judge volume. In this case, short fat containers were perceived to be larger than elongated ones, probably because when people hold a glass between their fingers, they naturally focus on its width rather than their height.

The size-contrast illusion, also known as the Delboeuf illusion, suggests that if we spoon 4 oz of mashed potatoes onto a 12-inch diameter plate, we will estimate its size to be less than if we had spooned it onto an 8-inch plate (Sobal and Wansink 2007; van Ittersum and Wansink 2007). That is, the size contrast between the potatoes and the plate is greater on the 12-inch plate than on the 8-inch plate. A study showed that people who were given 24 oz bowls of ice cream served and consumed 15-38% more ice cream than those given 16 oz

bowls (Wansink, van Ittersum, and Painter 2006). However, other studies (Caine-Bish et al. 2007; Rolls et al. 2007a) found that using a smaller plate did not reduce energy intake during a week. This suggests that the effect of the size and shape of glasses, cups, and bowls are more reliable than the effects of plate size.

Finally, recent studies have started to link these results with work in psychophysics and to look at the interaction effects of size and shape on size perceptions and preferences (Chandon 2009; Krider, Raghubir, and Krishna 2001; Krishna 2006, 2007). An important finding has been that the lack of sensitivity to increasing sizes is even stronger when packages and portions increase in all three dimensions (height, width, and length) compared to when they only increase in one dimension (Chandon and Ordabayeva 2009). This could explain why the effect is stronger for cups, glasses, and bowls (3D objects) than for plates (essentially 2D). The same authors have shown that because people underestimate volume changes that occur in three dimensions, they pour more beverage into conical containers (e.g., cocktail glasses where volume changes in three dimensions) than into cylindrical containers (where volume changes in one dimension). In addition, people's preference for supersizing is higher when products grow in one dimension. Although some studies have shown that part of these effects is mediated by attention (Folkes and Matta 2004; Folkes et al. 1993), others (Krishna 2007) suggest that they are mostly driven by biases in the computation of the changes (e.g., people failing to compound the changes of multiple dimensions).

Atmospherics of the purchase and consumption environments

Atmospherics refer to ambient characteristics, such as temperature, lighting, odor, and noise that influence the immediate eating environment. Some, like temperature, have direct physiological effects. Studies have shown that people consume more energy when the ambient temperature is outside the thermo neutral zone, the range in which energy expenditure is not required for homeothermy (Westerberp-Plantenga et al. 2002). For this

reason it has been argued that obesity could be linked to the reduction in the variability in ambient temperature brought about by air conditioning (Keith et al. 2006). For example, consumption increases more during prolonged cold temperatures than in hot temperatures because of the body's need to regulate its core temperature (Herman 1993).

Other factors, such as lighting, odor, and noise have a more indirect impact on energy intake. They increase consumption volume partly because they make it comfortable or enjoyable to spend more time eating and partly because they interact with sensory perceptions to influence palatability. Some environmental cues can even trigger consumption independently of any sensory or physiological mechanism because of learned associations between the stimuli and consumption. For example, Birch et al. (1989) showed that conditioned visual, auditory, and location cues can initiate consumption even among sated young children.

Dimmed or soft lighting appears to influence consumption by lengthening eating duration and by increasing comfort and disinhibition. It has been widely reported that harsh lighting makes people eat faster and reduces the time they stay in a restaurant (Stroebele and De Castro 2004), whereas soft or warm lighting (including candlelight) generally causes people to linger, and likely enjoy an unplanned dessert or an extra drink (Lyman 1989). The effect of lighting may be particularly strong when dining with others (Wansink 2004).

Ambient odors can influence food consumption through taste enhancement or through suppression (Auvray and Spence 2008; Rozin 2009). For example, Wadhwa et al. (2008) found that that exposure to an appetizing odor increased soft drink consumption during movie-watching and that exposure to an offensive odor decreased consumption without people being aware of these effects. Unpleasant ambient odors are also likely to shorten the duration of a meal and to suppress food consumption, perhaps by speeding satiation.

The presence of background music is associated with higher food intake (Stroebele and de Castro 2006). Soft music generally encourages a slower rate of eating, longer meal duration, and higher consumption of both food and drinks (Caldwell and Hibbert 2002). When preferred music is heard, individuals stay longer, feel more comfortable and disinhibited, and are more likely to order a dessert or another drink (Milliman 1986). This is because when it improves affective responses (environmental affect, mood or arousal), background music reduces perception of time duration (Morrin, Chebat, and Gelinias-Chebat 2009). In contrast, when music or ambient noise is loud, fast, or discomforting, people tend to spend less time in a restaurant (North and Hargreaves 1996). A recent meta analysis found that music also influences shopping in a large range of retail contexts, that slower tempo, lower volume and familiar music increase shopping duration, whereas loud, fast, disliked music increases perceived time duration (Garlin and Owen 2006).

All of these findings highlight the role of distraction in influencing consumption volume (Bellisle and Dalix 2001; Bellisle, Dalix, and Slama 2004). For example, one study found that eating while watching TV or eating with friends (but not with strangers) impaired the ability to self-monitor, decreased the attention given to the food itself, and led to higher energy intake (Hetherington et al. 2006). Other studies found that eating while distracted reduced satiation and impaired memory of past consumption, which reduced the time until the next eating episode (Higgs and Woodward 2009). Indeed amnesiac patients have been found to eat the same meal multiple times in a row if they are told that it is dinner time (Higgs 2008; Rozin et al. 1998). Distractions influence taste perception (e.g., reduces sensory-specific satiety) and increase subsequent consumption volume by emphasizing the affective (vs. cognitive) drivers of taste. One study (Shiv and Nowlis 2004) found that distraction while sampling food increased enjoyment as well as the subsequent choice of the relative vice (chocolate cake) vs. the relative virtue (fruit salad). In addition, people may choose to eat in

distracting environments as part of a habitual consumption script, not because they are necessarily hungry.

Although one of the least studied ways marketers can influence consumption, the effects of the eating environment are strong and multifaceted, despite being often overlooked by consumers. Overall, these studies show that consumption volume is influenced by the eating environment, by facilitating access to the food, increasing its salience and the convenience of its preparation, but also by modifying the shape and size of serving containers as well as temperature, brightness, ambient odors and music.

Conclusion

Food marketers are not focused on making people fat but on making money. In a free market, for-profit food companies that are less profitable than their competitors are likely to end up being acquired by their rivals, or simply go bankrupt. In this context, the mission assigned to food marketers is to understand what different groups of consumers want and to give it to them, at a profit. Primarily, what most people want are tasty, inexpensive, varied, convenient and healthy foods, in roughly that order of benefit importance. The marketer's job is to help identify and create foods that deliver these benefits better than traditional foods, communicate these benefits, package, price, and distribute these foods in the most profitable way, and protect these innovations by branding the food so that it acquires unique and positive associations in the mind of consumers, even when competition catches up. In this respect, food marketers have been extraordinarily successful and have pioneered many marketing innovations that are now used in other industries.

Yet, as this review has shown, the vast ingenuity and resources of food marketers have created a myriad of ways in which food marketing influences consumption volume and hence may promote obesity. Although television advertising has justifiably attracted the attention of researchers, because of its obtrusive nature, it is simply the tip of the iceberg. It is neither the

most innovative nor the most powerful way food marketing works right now, and its importance is declining. It is clearly impossible to say which marketing action is the most powerful because it obviously depends on the magnitude with which it is implemented, how competitors respond, which consumer segment is targeted, and what the consumption context is. Still, if asked to summarize how food marketing has made us fat, we would say that it was through increased access to continuously cheaper, bigger, and tastier calorie-dense food. In addition, we can hypothesize that the effectiveness of persuasive mechanisms that operate through deliberate decision-making processes (e.g., nutrition information, health claims, informational advertising) is probably overestimated, whereas the effectiveness of factors that operate “below the radar” and often through self-regulation failures (brand associations, calorie density and sensory complexity of the food; the size and shape of portions, packages, and serving containers; and the convenience and salience of food stimuli in the eating environment) are probably underestimated.

Future research opportunities. Despite decades of research, what we know about how food marketing influences consumption is still dwarfed by what we don’t know. The flip side of this depressing thought is that there are still many opportunities for impactful research. However, we should have realistic expectations regarding what research can do. This review shows that food marketing can influence consumption in many inter-related ways and that food consumption is governed by a complex set of dynamic interactions. In this context it is unlikely that any amount of research will be able to “prove” general statements such as “nutrition information improves consumption decisions,” because the magnitude and direction of the effects will vary across consumer segments, consumption occasions, and the type of food studied.

One of the most important areas for future research would be to examine how the short-term effects reviewed here, which were found for a single consumption occasion, hold when

looking at longer time horizons. This is particularly important because habituation and compensation can offset short-term effects. Ideally, these studies would combine the best aspects of studies from consumer research (e.g., rich psychological insights, multi-method testing), nutrition, (e.g., longitudinal designs, representative obese and normal weight participants), and health economics (e.g., population-level estimates, policy implications). As such, they would provide the necessary link between individual short-term food choices and long-term weight gain.

Another area worthy of future research would be to examine whether the factors identified in this review as contributing to energy intake could also be used to reduce energy intake, promote consumption of healthier food, and more generally increase the importance people attach to health over taste, price, and convenience when making food decisions. Some of the evidence reviewed here suggests that this is the case. For example, we can cite studies showing that consumers of healthy and unhealthy food respond similarly to price reductions (Epstein et al. 2006), that it is possible to incentivize children to prefer healthy food (Cooke et al. 2011), or that proportional downsizing of food packages can lead people to prefer smaller portion sizes (Chandon and Ordabayeva 2009).

Finally, it would be important to examine the interplay of marketing factors and cultural, social, and individual characteristics. Although obesity is a global problem, almost of the studies reviewed here were conducted among North American consumers and often among undergraduate students. Yet we know that culture, age, income, education and a host of other socio-economic factors influence food decisions. For example, there are important differences between how Americans, European, and Asians approach food and eating (Fischler et al. 2008; Rozin et al. 1999). Beliefs that are taken for granted in a US context, for example that “unhealthy = tasty”, or that external cues influence satiation, may not apply elsewhere (Wansink et al. 2007; Werle et al. 2011).

Policy implications. After reviewing the studies outlined here, one may wonder about the potential effects of some of the policy changes currently being discussed by regulators, in particular mandatory (or voluntary) improved nutrition labeling. In order to predict the effects of mandatory nutrition disclosure (or in fact any policy changes), it is not enough to examine how they would influence consumer response; one must also examine how they would impact companies' actions. This is important because although mandatory nutrition information seems, on average, to improve consumption decisions, it may not necessarily encourage companies to improve the nutritional quality of their products. As a rule, mandatory information disclosure has the intended effect when there is a consensus among consumers about the valence of the information (e.g., when an attribute like trans fats or pesticides are universally seen as negative or when another, like fiber, is seen by all as positive). For example, studies have shown that New Zealand's nutrition logo system led companies to reduce salt content by reformulating their products (Young and Swinburn 2002). As suggested by Moorman, Ferraro, and Huber (2011), however, mandatory disclosure may backfire if the information is about attributes that are not uniformly valued, like calories, which are seen by some as a signal of rich taste. In this case, companies may actually choose to compete on less transparent attributes, such as taste or social benefits (e.g., group affiliation), and to target taste-conscious consumers who think that calorie and taste are inversely correlated by actually increasing the calorie density of their food.

By highlighting the effects of unobtrusive environmental factors on energy intake, the findings in this review support the current "small steps" approach to obesity prevention (Hill 2009). This approach stands in contrast with traditional public health efforts which have focused on providing science-based nutrition information and have exhorted people through didactic and sometimes moralizing appeals to change their dietary habits. Unfortunately, the traditional approach has not achieved the intended results over the long term because it is

difficult to resist the temptations of our obesogenic environment over extended periods. The small steps approach focuses on adopting smaller, more sustainable goals. It recognizes that self control is a limited and often absent resource and focuses less on persuasion and more on benevolent interventions that “nudge” consumers into making slightly better but repeated food choices without thinking about it. This is done mostly by altering the eating environment, for example by substituting calorie-dense drinks like sodas with calorie-light drinks like water or diet soda in cafeterias, surreptitiously improving food composition, encouraging people to prefer smaller package sizes by promoting them on menus (or by eliminating quantity discounts and adding an extra small size to the range), storing tempting food out of reach and healthier alternatives within reach, using smaller cups and bowls, and pre-plating food instead of family-style service. The small steps approach is not designed to achieve major weight loss among the obese but to prevent obesity for the 90% of the population which is gradually becoming fat by consuming an excess of less than 100 calories per day (Hill et al. 2003).

We are at a point of development where much of the incremental improvement in our lifespan—and especially in our quality of life—is likely to come more from behavioral changes in our lifestyle (better nutrition and more exercise) than from new medical treatments or medications. When it comes to contributing most to the lifespan and quality of life in the next couple of generations, smart, well-intentioned marketers may be well-positioned to help lead this movement toward behavior change. Obesity is a good place to start.

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