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# ENVIRONMENTAL FACTORS THAT INCREASE THE FOOD INTAKE AND CONSUMPTION VOLUME OF UNKNOWING CONSUMERS*

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**Key Words** consumption volume, energy intake, energy, obesity, environmental influences, situational cues, weight control

■ **Abstract** Package size, plate shape, lighting, socializing, and variety are only a few of the environmental factors that can influence the consumption volume of food far more than most people realize. Although such environmental factors appear unrelated, they generally influence consumption volume by inhibiting consumption monitoring and by suggesting alternative consumption norms. For researchers, this review suggests that redirecting the focus of investigations to the psychological mechanisms behind consumption will raise the profile and impact of research. For health professionals, this review underscores how small structural changes in personal environments can reduce the unknowing overconsumption of food.

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## INTRODUCTION

Food choice decisions are different from food consumption volume decisions. The former determine *what* we eat (soup or salad); the latter determine *how much* we eat (half of the bowl or all of it). An impressive amount of time, intelligence, and resources have been invested in understanding the physiological mechanisms that influence food choice (111). A much smaller investment has been made in understanding how and why our environment influences food consumption volume (42). Yet environmental factors (such as package size, plate shape, lighting, variety, or the presence of others) can increase food consumption volume far more than people may realize.

This is one of the ironies of food consumption research. Whereas people will acknowledge that environmental factors influence others, they often wrongly believe they are unaffected (138). This suggests there are influences at a basic level of which people are not aware or do not monitor. Understanding these drivers of consumption volume has immediate implications for research, nutrition education, and consumer welfare (64, 111). This review examines the environmental factors that influence consumption intake and why they do so.

Although research on eating should be interdisciplinary, much of it is not. Some of these gaps between fields are caused by language differences that separate the literatures. For instance, while the words "energy" or "calorie intake" are commonly used in the health sciences, words implying more personal volition, such as "consumption volume" or "usage," are often used in the social sciences. In this review, special effort will be made to introduce recent findings in psychology, economics, consumer research, marketing, and family and consumer science in addition to underscoring the contributions in nutrition, dietetics, and epidemiology.

The environment can be organized into the eating environment (124) and the food environment (see Figure 1). The eating environment refers to the ambient factors associated with the eating of food, but that are independent of food, such as atmospherics, the effort of obtaining food, the social interactions that occur, and the distractions that may be taking place. In contrast, the food environment refers to factors that directly relate to the way food is provided or presented, such as its salience, structure, package or portion size, whether it is stockpiled, and how it is served.

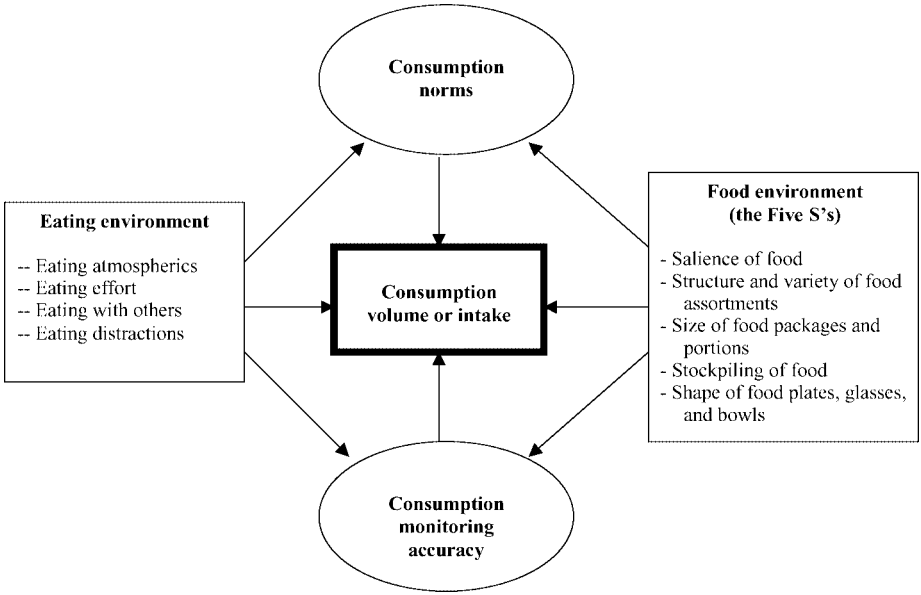


**Figure 1** Antecedents and mediators of food consumption volume.



Both environments contribute directly to consumption volume; they can also contribute indirectly by suggesting consumption norms and inhibiting consumption monitoring. For instance, dining with a friend can have a direct impact on consumption because of the longer duration of the meal. It can also have an indirect impact because of the consumption norms set by the friend—who cleans his plate and orders a dessert—and because the enjoyment of his or her company distracts one away from accurately monitoring consumption.

Although the environmental factors outlined in Figure 1 are discussed individually below, it is important to realize that they operate simultaneously. Consider the end-of-the-year weight gain that many experience over the holidays (105, 150). For most, this weight gain is a combined result of the eating environment and the food environment. The holiday eating environment directly encourages overconsumption because it involves parties (long eating durations), convenient leftovers (low eating effort), friends and relatives (eating with others), and a multitude of distractions. At the same time the food environment—the salience, structure, size, shape, and stockpiles of food—also facilitates overconsumption.

After underscoring the ubiquitous impact of consumption norms and consumption monitoring on behavior, this review describes the systematic influences of the eating environment and the food environment. For researchers, this review suggests that redirecting our focus to the processes behind consumption will raise the profile and impact of research. For health professionals, this review underscores how small structural changes in personal environments can help reduce the unknowing overconsumption of food.

## WHAT MEDIATES CONSUMPTION?

Research has effectively identified many of the environmental factors that influence consumption. It has less effectively, however, explained why they do so. Two promising starting points involve consumption norms and consumption monitoring. An important theme of this review is that consumption norms and consumption monitoring partially mediate or explain why many seemingly unrelated environmental factors consistently influence eating behavior in predictable ways.

### Consumption Norms Offer Suggestible Benchmarks

People can be very impressionable when it comes to how much they will eat. There is a flexible range as to how much food an individual can eat (40), and one can often "make room for more" (7, 26, 31).

A key element of Figure 1 is that of consumption norms. For many individuals, determining how much to eat or drink is a relatively low-involvement behavior that is a nuisance to monitor continually and accurately, so they instead rely on consumption norms to help them determine how much they should consume. Food-related estimation and consumption behavior can also be based on how much one normally buys or consumes (18). Consumption can be further influenced by other norms or cues that are present in the environment. Many seemingly isolated influences of consumption—such as package size, variety, plate size, or the presence of others—may involve or suggest a consumption norm that influences how much individuals will eat or drink.

Such norms suggest a quantity (or a range) that it is acceptable to consume. That is, the number of items in an assortment or the eating behavior of a dinner companion may serve as a normative benchmark that an individual uses to gauge how much should be consumed. Similarly, large plates or packages may implicitly or at least perceptually suggest it is appropriate to eat more food than would be suggested by smaller plates or smaller packages. The use of consumption norms, as with normative benchmarks in other situations, may be relatively automatic and may often occur outside of conscious awareness (117, 118).

### Consumption Monitoring Moderates Consumption Discrepancies

A second key element of Figure 1 is that of consumption monitoring, which helps individuals reduce discrepancies between perceived and actual consumption levels. The influence of environmental factors on consumption is magnified because they can bias or confuse one's estimate of how much he or she has eaten. Even when individuals were shown that larger package sizes caused people to underestimate their consumption by at least 20%, many participants in lab and field studies wrongly maintained that they were unaffected (134). The same is true with other

studies examining low involvement behaviors. Whereas these individuals readily acknowledge the influence of environmental factors on others, they deny that the factors influence them as well (138).

Not surprisingly, a major determinant of how much one eats in a distracting environment is often whether the person deliberately paid attention to (or attempted to monitor) how much he or she ate (1, 87). In lieu of monitoring how much one is eating, people can use cues or rules-of-thumb (such as eating until a bowl is empty) to gauge how much they will eat. Unfortunately, using such cues and rules-of-thumb can yield biased estimates and surprises. In one study, unknowing diners were served tomato soup in bowls that were refilled through concealed tubing that ran through the table and into the bottom of the bowls. People eating from these "bottomless" bowls consumed 76% more soup than those eating from normal bowls, but estimated that they ate only 4.8 calories more (143).

Paradoxically, people who tend to be most focused on food consumption and weight control may be particularly susceptible to the environmental factors that spark overeating and that undermine their attempts at restraint (38, 66). Eating is multidimensional and difficult to monitor. This can cause people to focus more on food choice than on consumption volume, and it can lead to unmonitored, unintended results. For instance, people dining at an Italian restaurant correctly believed that if they ate butter with their bread they would consume fewer fat calories per slice of bread than if they dipped their bread in olive oil. What they did not realize, however, is that they compensated for this reduction in fat calories by eating 23% more bread during the course of the meal (140).



## HOW THE EATING ENVIRONMENT STIMULATES CONSUMPTION

What causes the initiation and the cessation of eating? One study asked dieters to maintain a consumption diary and to indicate what caused them to start and to stop eating (130). Aside from hunger, participants claimed they started eating because of the salience of food ("I saw the food"), the social aspects of eating ("I wanted to be with other people"), or simply because eating provided them with something to do ("I wanted something to do while watching TV or reading"). When asked why they stopped eating, some participants pointed to environmental cues (such as the time or the completion of the meal by others) that served as external signals that the meal should be over (116). Others stopped eating when they ran out of food, and still others stopped because their television program was finished or because they were at a stopping point in their reading.

These findings are consistent with others that suggest people may have continued to eat if they had been given more food, more time to eat, or more time to watch television (109). These responses illustrate four important consumption

drivers in the eating environment: (*a*) eating atmospherics, (*b*) eating effort, (*c*) eating with others, and (*d*) eating distractions. Each driver is investigated in turn below.

## Atmospherics Influence Eating Duration

Atmospherics refer to ambient characteristics—such as temperature, lighting, odor, and noise—that influence the immediate eating environment. Consider the direct physiological influence that ambient temperature has on consumption. People consume more during prolonged cold temperatures than during hot temperatures (13) because of the body's need to regulate its core temperature. In prolonged cold temperatures, more energy is needed to warm and maintain the body's core temperature (148); therefore, more food is eaten. In prolonged hot temperatures, the body's core temperature must be cooled and maintained (72); therefore, more liquids must be consumed.

Other atmospherics—such as lighting, odor, and noise—are similar to each other in that they have a more indirect or mediated impact on consumption. These atmospherics are thought to increase consumption volume partly because they simply make it comfortable or enjoyable for a person to spend more time eating (see Figure 2). Each is discussed individually.

LIGHTING Dimmed or soft lighting appears to influence consumption in two different ways: by increasing eating duration, and by increasing comfort and disinhibition. It has been widely reported that harsh or bright illumination decreases how long people stay in a restaurant (120), whereas soft or warm lighting (including candlelight) generally causes people to linger and enjoy an unplanned dessert or

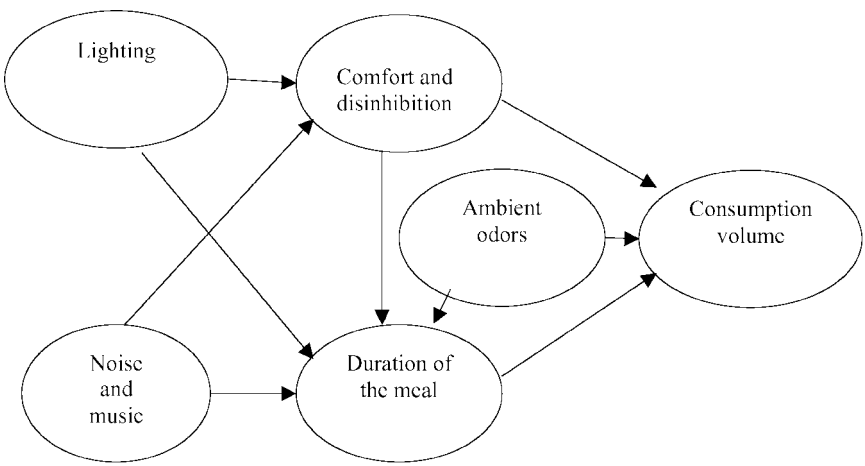


**Figure 2** Atmospherics that influence food consumption volume.

an extra drink (63, 91). Because people are less inhibited and less self-conscious when the lights are low, they are likely to consume more than they otherwise would (57). The effect of lighting may be particularly strong when dining with others.

ODOR Odor can influence food consumption through taste enhancement or through suppression (108, 122). Unpleasant ambient odors are likely to shorten the duration of a meal and to suppress food consumption. Yet the reverse is not necessarily true; it is not known whether favorable odors necessarily increase consumption volume. It has been found, for instance, that regardless of whether a person tastes a food or simply smells it, sensory-specific satiety can occur within a reasonably short time (104). This suggests that although odors can have a depressing impact on consumption, they might not necessarily increase consumption other than by simply initiating it.

NOISE AND THE SOUND OF MUSIC Soft music generally encourages a slower rate of eating, longer meal duration, and higher consumption of both food and drinks (15). When preferred music is heard, individuals stay longer, feel more comfortable and disinhibited, and are more likely to order a dessert or another drink (70). In contrast, when music (or ambient noise) is loud, fast, or discomforting, people sometimes spend less time in a restaurant (76). In some cases, an abbreviated meal can lead individuals to quickly clean their plates and overeat without monitoring the extent to which they are full (61, 92). Although more controlled fieldwork needs to be done in this area, it appears that both extremes (soft, comforting music as well as loud, irritating noise) increase consumption, but they do so in different ways.

## Increased Effort Decreases Consumption

Effort is related to the ease, access, or convenience with which a food can be consumed. It is one of the strongest influences on consumption (58, 135). The effort it takes to obtain food often explains which foods people prefer and how much they will consume (149). Cafeteria studies show that people ate more ice cream when the lid of an ice cream cooler was left open than when it was closed (68), that they drank more milk when the milk dispenser was placed close to the dining area (60), and that they drank more water when a water pitcher was on their table than when it was further away (30).

Scores of studies have investigated effort and animal feeding (such as requiring animals to press bars to obtain food pellets), but surprisingly few have been conducted with humans (58). Notable exceptions include a study that showed obese people were much more likely to eat almonds if they were shelled versus unshelled (114). Another investigation found that obese subjects were more likely to use silverware than chopsticks (which require more of an effort) when compared to normal-weight patrons in Chinese restaurants (115). The same impact of effort was found in a study of nonobese secretaries who were given Hershey's kisses either on their desks or two meters away from their desk. When the candies were

placed on their desks, secretaries ate 5.6 more chocolates a day than when they had to stand up and walk two meters for them (78). These results help corroborate initial findings regarding effort (37), particularly when foods are ready to eat (17).

Although these studies focused on physical effort, psychological effort may also play a role in consumption. Recent plate waste studies among U.S. soldiers indicate that once any component of a field ration is opened, it is generally completely consumed. Although the physical effort to open the small component packages in a field ration is minimal, a psychological barrier may prevent individuals from opening another item if they have already opened and eaten several of them. Follow-up lab studies suggest that people tend to eat less when offered multiple small packages than when offered a large package of the same volume. Part of the reason is that the smaller packages provide discrete stopping points for a person to reconsider whether he or she wants to continue eating (135).



## Socializing Influences Meal Duration and Consumption Norms

It has been well established that the presence of other people influences not only what is eaten, but it can also increase how much is eaten (see Figure 3). Eating with familiar people can lead to an extended meal (4). In other cases, simply observing another's eating behavior—such as a role model (8), parent, friend, or even stranger (24)—can provide a consumption norm that can also influence how much the observer eats. These effects can be dramatic. De Castro has shown that meals eaten with one other person were 33% larger than those eaten alone (22),

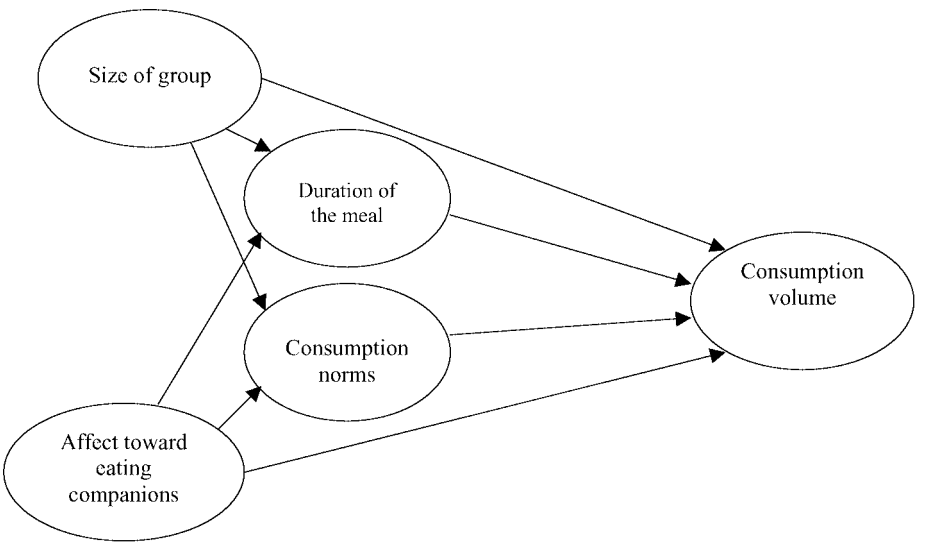


**Figure 3** How social interactions influence food consumption volume.

and consumption increases of 47%, 58%, 69%, 70%, 72%, and 96% have been respectively associated with meals eaten with two, three, four, five, six, and seven or more people (23).

An increased amount is eaten at meals with familiar and friendly people because they can help make a meal relaxing, more enjoyable, and long. These meals can also reduce an individual's ability or motivation to monitor consumption. In contrast, eating with unfamiliar people can suppress food intake in situations where self-monitoring and self-awareness is high, such as during job interviews or first dates (16, 71, 123).

Interestingly, as the number of eating companions increases, the average variability of how much is eaten may actually decrease (19). Pliner et al. (82) found that people eating alone ate less than those in groups of two or four, but that this was driven by the amount of time they spent dining. What is most interesting about this study is that as the number of people in the group increased, the variance in how much they ate appeared to decrease. That is, a person eating alone was likely to eat either much more or much less (on average) than when eating with a larger group. At least some part of this decrease in variance is likely to be a result of the consumption norms of the situation.

Indeed, simply viewing the behavior of others has been shown to have an implicit impact on consumption (39, 88). Studies have shown that students will vary the amount of cookies they eat (107) and the amount of water they drink (30), depending on how much fellow students are eating (88). The impact of these external social cues can be particularly strong on obese individuals (39).

## Distractions Can Initiate, Obscure, and Extend Consumption

Distractions such as reading or watching television can increase consumption by initiating, obscuring, and extending consumption. Distractions can initiate script-related patterns of food consumption that are uncorrelated with hunger; they can obscure one's ability to monitor consumption; and they can extend the duration of a meal.

It was noted above that a diary survey of obese people indicated that some had stopped eating simply because a television program had ended or because they had finished reading a magazine (130). Just as the completion of a television show or a magazine article can lead one to terminate a meal, a longer television show or a longer magazine article may prolong the duration of a meal past the point of satiation.

Whereas part of the overconsumption associated with distractions such as television and magazines can be related to longer meals, another part of it is due to how the distraction can obscure one's ability to accurately monitor how much has been eaten. One controlled study showed that people who ate lunch while listening to a detective story ate 15% more than those who ate their lunch in silence (5). Distractions such as television, reading, movies, and sporting events may simply redirect attention to the point where orosensory signals of satiation are ignored

(89). Consistent with this theory, the key correlate of how much popcorn people ate in a Chicago movie theater was whether they claimed they paid more attention to the movie or to how much they ate (144). The more attention they paid to the movie, the more popcorn they ate.

In addition to the influence these distractions have on meal duration and on monitoring, they can also evoke consumption scripts that initiate consumption because they lead people to associate the distraction with food. In fact, one's consumption during these events—be it a hot dog at a ballgame, popcorn during a movie, or cookies during a favorite television program—might simply be influenced by behaviorally ingrained eating scripts or patterns. That is, eating in these situations might be related more to habit than to hunger. Indeed, participants in a two-week panel study were asked to indicate how hungry they were each time they ate a meal or snack. People who ate meals or snacks while watching television reported being less hungry than those who ate when they were not watching television (123).

All of these findings are consistent with the basic notion that people may elect to snack in these distracting environments because such eating is part of a habitual consumption script and not because they are necessarily hungry. Rozin et al. showed that amnesiac patients who were told it was dinnertime ate a second complete meal only 10 to 30 minutes after having eaten a prior meal (109). Even if they are not physically hungry, simply thinking it is time to have a meal or a snack is enough to cause some people to eat (116, 147). For some people, one time to snack is when they turn on the television. Unfortunately, both children (25, 27) and adults (49, 128, 129) tend to snack more when watching television, and they may do so even if they are not physically hungry. Although it is frequently found that television viewing, food intake, and obesity are related (34, 54), these correlational studies are often confounded with factors such as a general lack of physical inactivity. Nevertheless, the studies do suggest an important relationship between activity and distracted consumption intake (126).

Yet this basic connection between distractibility and food intake may have an even more fundamental connection to obesity. Past research has indicated that obese people have a greater tendency to be distracted than nonobese people (93), and may eat even more than do normal-weight people in identical potentially distracting circumstances, be it watching a television program, reading a newspaper, or enjoying a conversation. In a media-rich, food-rich environment, distraction-prone people will not be able to accurately monitor their consumption and are likely to overeat.



## HOW THE FOOD ENVIRONMENT STIMULATES CONSUMPTION

The allure of ice cream in the freezer is much stronger for most than the allure of broccoli in the refrigerator. Food intake can often be related to the perceived taste or cravings associated with foods (84), and such cravings, especially for comfort

foods, can differ across gender and across age groups (136). It is well supported that liking for a food can increase chewing and swallowing rates (6), and it is generally correlated with greater consumption (10, 65).

Despite this link between palatability and consumption, the availability of tasty, highly palatable foods is neither a necessary nor a sufficient cause for overconsumption (67). People can unknowingly overeat unfavorable foods as much as they do their favorites. This section examines the food-related environmental factors that influence consumption volume but are unrelated to palatability. These factors can be characterized as the Five S's of the food environment: salience, structure, size, whether it is stockpiled, and how it is served.



## Salient Food Promotes Salient Hunger

Simply seeing (or smelling) a food can stimulate unplanned consumption (11, 20). For instance, when 30 Hershey's kisses were placed on the desks of secretaries, the candies placed in clear jars were consumed 46% more quickly than those placed in opaque jars (142). Similarly, some who were given sandwich quarters wrapped in transparent wrap were found to eat more than those who were given sandwiches in nontransparent wrap (50).

It had been believed that such increased intake of visible foods occurred because their salience served as a continuously tempting consumption reminder. While part of this may be cognitively based, part is also physiologically based. Simply seeing or smelling a favorable food can increase reported hunger (12, 47, 53, 121) and can stimulate salivation (41, 94), which can be correlated with greater consumption (73). Recent physiological evidence suggests that the visibility of a tempting food can enhance actual hunger by increasing the release of dopamine, a neurotransmitter associated with pleasure and reward (132). The impact of these cues can be particularly strong with unrestrained eaters (46).

Although seeing or smelling a food can make it salient, salience can also be internally generated (112). One food recall study suggested that eating bouts associated with internally generated salience may involve greater consumption volume than those associated with externally generated salience, such as the sight or smell of a food (133). That is, people who impulsively ate cookies when walking by a cookie dish reported eating fewer than those who more deliberately sought the cookies out. Another 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 than did their counterparts in the control condition (137).

## Structure and Perceived Variety Can Drive Consumption

Rolls and her colleagues have shown that if consumers are offered an assortment with three different flavors of yogurt, they are likely to consume an average of 23% more yogurt than if offered only one flavor (100). This basic notion that

increasing the variety of a food can increase the consumption volume of that food (69, 95) has been found across a wide range of ages (102) and across both genders (97, 99).

Recently, Kahn & Wansink have shown that simply increasing the perceived variety of an assortment can increase consumption (52). In one study they gave people an assortment of 300 M&M candies that were presented in either seven or ten different colors. Although the taste of each color was identical, those who had been given a bowl with ten colors ate 43% more (91 versus 64 candies) over the course of an hour than those who had been given seven colors. Further evidence of how perceived variety (versus actual variety) can influence consumption was shown when people were offered either organized or disorganized assortments of six flavors of 300 jelly beans. Those offered the disorganized assortment rated the assortment as having more variety, and they ate 69% more jelly beans (22 versus 13) than those offered the organized assortment of identical flavors (52).

Even if the actual variety of the assortment is not increased, these studies suggest that simply changing the structure of an assortment (for example, the organization, duplication, or symmetry) can increase how much is consumed. One reason this occurs is that increases in perceived variety make a person believe he or she will enjoy the assortment more (see Figure 4). A second reason this occurs is that increasing the perceived variety can concurrently suggest an appropriate amount to consume (the consumption norm) in a particular situation.

For researchers, it is important to know that perceptions of variety (43, 44, 131)—and not just actual variety—can influence consumption. For consumers, it is more important to know that one can personally adjust, modify, or design the immediate food environment in order to help them control their intake.



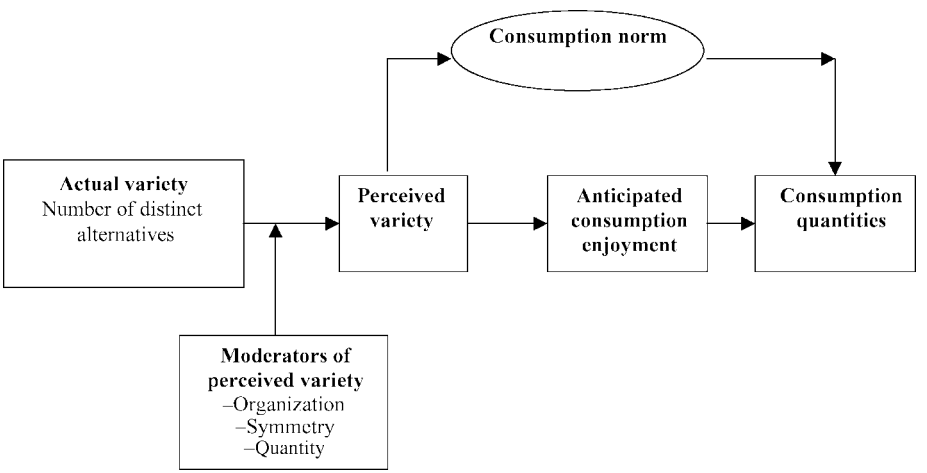


**Figure 4** How structure and assortment variety influence consumption.

## The Size of Packages and Portions Suggest Consumption Norms

There is overwhelming evidence that the size of food packaging and portions has steadily increased over the past 30 years (96, 151). Although this is a trend in much of the developed world, it is particularly common in the United States, and may help contribute to weight gain with some individuals (14, 36, 74). Rozin and his colleagues have shown that the size of packages and portions in restaurants, supermarkets, and even in recipes is much larger in the United States than in France, which is often considered to be a more food-centric country (110).

In relation this to consumption, it is well supported that the size of a package can increase consumption (134), as can the size of portion servings in kitchens (75, 103) and in restaurants (28). What is notable is that package and portion size can even increase the consumption of unfavorable foods. For instance, when moviegoers in a Philadelphia suburb were given either medium-size or large-size buckets of stale, 14-day-old popcorn, they ate 33.6% more popcorn from the larger buckets despite the poor taste of the popcorn (139). It would appear that environmental cues might sometimes be as powerful—within limits—as the taste of food itself.

Package and portion sizes have a considerable impact on consumption. When packages are doubled in size, consumption generally increases by 18% to 25% for many meal-related foods (such as spaghetti), and 30% to 45% for many snack-related foods (134). Such predictable increases in consumption occurred even when Rolls and her colleagues altered the energy density of the food (55). In effect, the volume of food eaten tends to be a better indicator of how full individuals report they feel than does the calorie density of the food (98, 99, 103).

Significant child development research by Birch and Fisher has shown that portion size first begins to influence children between the ages of three and five (9, 32, 101). The tendency of children to let portion size influence their consumption volume has been referred to as the "clean your plate" phenomenon or the completion principle (119). However, neither of these suggested mechanisms explains why large packages also increase the use of less-edible 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 (33, 134). In both general cases, people poured or consumed more even though there was no possibility of cleaning one's plate.

The more general explanation of why large packages and portions increase consumption may be that they suggest larger consumption norms (recall Figure 1). They implicitly suggest what might be construed as a "normal" or "appropriate" amount to consume. This would also help explain why people consume more from half-filled large packages than they do from completely filled medium-sized packages that contain the same volume (134). Even if individuals do not clean their plates or finish the package, the larger size gives them liberty to consume beyond the point where they might have stopped with a smaller, but still unconstrained, supply.

## Stockpiled Food Is Quickly Consumed

Having large stockpiles of food products at home (such as multi-unit packages purchased at wholesale club stores) can make those products more visible and salient than less-plentiful ones. Not only do stockpiled products take up a great deal of pantry space, they are often stored in salient locations until they are depleted to more manageable levels (17). Because visibility and salience can stimulate consumption frequency, it is often asserted that bulk buying or stockpiling contributes to overconsumption and may promote obesity.

To investigate this, Chandon & Wansink (17) stockpiled people's homes with either large or moderate quantities (twelve versus four) of eight different foods, and then monitored each family's consumption of these foods for two weeks. It was found that when convenient ready-to-eat foods were initially stockpiled, they were eaten at slightly twice the rate of nonstockpiled foods (an average of 112% faster). After the eighth day, however, the consumption of these stockpiled foods was similar to that of the less-stockpiled foods, even though plenty of both remained in stock. This eventual decrease was partly due to burnout or taste satiation (45), but was also the result of the inventory level dropping to the point where the foods were much less visually salient (137).

To investigate the link between the visibility of stockpiled food and obesity, Terry & Beck (127) compared food storage habits in homes of obese and nonobese families. Curiously, although their first study showed that stockpiled food tended to be visible in the homes of obese families, their second study showed the opposite. In general, however, recently stockpiled products tend to be visually salient, and this is one reason why they are frequently consumed (17, 137).

## Serving Containers That Are Wide or Large Create Consumption Illusions

More than 71% of a person's caloric intake is consumed using serving aids such as bowls, plates, glasses, or utensils (135). If a person decides to eat half a bowl of cereal, the size of the bowl can act as a perceptual cue that may influence how much he or she serves and subsequently consumes. Even if these perceptual cues are inaccurate, they offer cognitive shortcuts that can allow serving behaviors to be made with minimal cognitive effort.

Consider drinking glasses and the vertical-horizontal illusion. Piaget and others 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 (56, 79, 90). Even if the vertical dimension is identical to that of the horizontal dimension, people still tend to overestimate the height by 20%. This general principle explains why people marvel at the height of the St. Louis Arch but not at its equal-size width.

In the context of drinking glasses, when people estimate how much soda they have poured into a glass, there is a fundamental tendency to focus on the height of the liquid that has been poured and to downplay its width. To prove this, Wansink

& Van Ittersum conducted a study with teenagers at weight-loss camps (as well as a subsequent study with nondieting adults) and demonstrated that this basic visual bias caused teenagers to pour and drink 88% more juice or soda into short, wide glasses than into tall, narrow glasses that held the same volume (145). These teenagers believed, however, they poured half as much as they actually did. Similar results were found with veteran Philadelphia bartenders. When asked to pour 1.5 ounces (one shot) of gin, whiskey, rum, and vodka into short, wide (tumbler) glasses, the bartenders poured 26% more than when they poured into tall, narrow (highball) glasses (145).

What about the size of plates and bowls? The size-contrast illusion suggests that if we spoon four ounces of mashed potatoes on a 12-inch plate, we will underestimate its size compared to the same amount spooned onto an 8-inch plate (146). That is, the size contrast between the potatoes and the plate is greater when the plate is 12 inches in diameter than when it is 8 inches. A study at an ice cream social demonstrated consistent results. People who were randomly given 24- or 16-ounce bowls dished out and consumed an average of 31% more ice cream when given the larger bowls (141). The size-contrast illusion also has an apparent effect on the use of spoons to measure medicine doses. When cough medicine was given to health center patients, the patients using larger spoons increased the dosage they poured by 22% over the recommended dosage level (146). There is a basic tendency to use the size of plates, bowls, and spoons as an indication of how much should be served and consumed.



## CONSUMPTION: THE NEXT GENERATION

Food consumption volume decisions are not the same as food choice decisions. The mechanisms behind each of these are very different. Although impressive resources have been invested in understanding food choice (85, 135), it is now becoming increasingly important to better understand what drives food consumption volume (86). Yet trying to address the overconsumption problem without a research strategy and without an eye on consumer welfare implications may invite scattered, idiosyncratic studies that simply end up proving the obvious.

Given the concern of obesity (21, 59), research progress in this area will advance when researchers systematically address theoretical issues that are broader than single studies. Given the impact that environmental factors have on unknowing consumers, consumer welfare will advance if these discoveries help them to personally and effectively alter their environment without having to continually monitor how much they eat.

### Research Advances Through Theory

Since the mid-1960s, researchers have been identifying many important factors correlated with food consumption. The next step needs to be in the direction of understanding the reasons behind food intake volume. The focus needs to explain

why we eat the amount we eat, not simply show it. This entails more of a focus on developing and testing process models and theories of consumption. Doing so will allow more productive integration across studies and will help identify the more fundamental low-involvement drivers of consumption.

Early advances in better understanding these processes involved trying to determine whether obese individuals responded to environmental cues differently than nonobese individuals (75, 80, 81, 83, 113). Studies from the 1960s and 1970s indicated that obese people might be more responsive to many external cues, such as salience (106) and effort (50, 51). In returning to the impact of this earlier work, important process-related questions need to be addressed and low-involvement, nonmotivational issues need to be reconsidered (51, 77).

In redirecting our research efforts, two promising areas for study involve consumption norms and consumption monitoring. As illustrated in Figure 1, both at least partially mediate the impact of seemingly disparate drivers of consumption (such as package size, variety, and social influences). Keeping a focus on the mechanisms or processes behind consumption will help the interdisciplinary area of food consumption research progress in ways that can raise its profile and its impact on academia, on health practitioners, and ultimately on consumer welfare (86).

Part of this progress will entail better conceptualizing the consumption period being analyzed. Consumption is typically studied within a single-period feeding, such as during lunch, during snacks, or during a 30-minute lab experiment. It is important to realize, however, that multiperiod consumption involves both consumption quantity and consumption frequency and needs to be measured appropriately (125). Eating one chocolate each hour while at work influences daily intake as much as eating eight chocolates in one hour. Total consumption intake within a given time period (for instance, 24 hours) is comprised of how many occasions a food is eaten (frequency) and how much is eaten during each occasion (volume).

This distinction is important because consumption norms and consumption monitoring impact frequency and consumption volume differently. How frequently a food is eaten can be influenced by the salience of the food and by the effort required to obtain and consume it. The volume of food that is consumed in a sitting is influenced by a wide range of other factors and is partly mediated through consumption norms and through the amount one believes he or she has consumed. Understanding how environmental factors and situational cues bias estimates of consumption is a promising area for future research.

## Consumer Welfare Requires Changing Personal Environments

A wide range of individuals and institutions would like to better control a person's consumption of food for a wide range of reasons. Those in the hospitality industry want to decrease food costs (via serving size) without decreasing satisfaction. Those in public policy want to decrease waste. Those in health and nutrition want to decrease overconsumption. Those in strenuous field situations want to eliminate the fatigue associated with underconsumption. Those on restricted diets want to decrease calorie, fat, or sugar intake.

**TABLE 1** Altering one's personal environment to help reduce consumption

| How environmental factors influence consumption | How one's personal environment can be altered to help reduce consumption |
|---|---|
| **The eating environment** | |
| Eating atmospherics: Atmospherics influence eating duration | • Before completing a meal, have the breadbasket removed or have an entrée portion wrapped up "to go." The atmosphere of a long and relaxing dinner can then be enjoyed without the temptation to overeat.<br>• Although soft music and candlelight can improve one's enjoyment of a meal, they have calorie intake consequences. Instead of lingering and eating a dessert, enjoy a cup of coffee in the pleasant atmosphere. |
| Eating effort: Increased effort decreases consumption | • Store tempting foods in less-convenient locations (such as in a basement or in a top cupboard).<br>• Do not leave serving bowls and platters on the dinner table. Keep second servings a safe distance away. |
| Eating with others: Socializing influences meal duration and consumption norms | • Decide how much to eat prior to the meal instead of during it. Order smaller quantities (e.g., half-size portions) to avoid "keeping pace" during the meal.<br>• Model the behavior of a person who appears to be eating the least or the slowest. |
| Eating distractions: Distractions can initiate, obscure, and extend consumption | • Discourage "grazing" by focusing only on food. Try to eat only when sitting down, and do this at a distraction-free table.<br>• Before eating a distracting meal or snack (such as eating while watching television or reading the newspaper), pre-serve the portions and allow no "refills." |
| **The food environment (the Five S's)** | |
| Salience of food: Salient food promotes salient hunger | • Eliminate the cookie jar, or replace it with a fruit bowl.<br>• Wrap tempting foods in foil to make them less visible and more forgettable.<br>• Place healthier, low-density foods in the front of the refrigerator and the less healthy foods in the back. |
| Structure and variety of food assortments: Structure and perceived variety drives consumption | • Avoid multiple bowls of the same food (such as at parties or receptions) because they increase perceptions of variety and stimulate consumption.<br>• At buffets and receptions avoid having more than two different foods on the plate at the same time.<br>• To discourage others from over-consuming in a high-variety environment (such as at a reception or dinner party), arrange foods into organized patterns. Conversely, arrange foods in less-organized patterns to help stimulate consumption in the cafeterias of retirement homes and hospitals. |

(*Continued*)

**TABLE 1** (*Continued*)

| How environmental factors influence consumption | How one's personal environment can be altered to help reduce consumption |
|---|---|
| Size of food packages and portions: The size of packages and portions consumption norms | • Repackage foods into smaller containers to suggest smaller consumption norms.<br>• Plate smaller dinner portions in advance.<br>• Never eat from a package. Always transfer food to a plate or bowl in order to make portion estimation easier. |
| Stockpiling of food: Stockpiled food is quickly consumed | • Out of sight is out of mind. Reduce the visibility of stockpiled foods by moving them to the basement or to a cupboard immediately after they are purchased.<br>• Reduce the convenience of stockpiled foods by boxing them up or freezing them.<br>• Stockpile healthy, low-energy-density foods to stimulate their consumption and to leave less room for their high-density counterparts. |
| Serving containers: Serving containers that are wide or large create consumption illusions | • Replace short wide glasses with tall narrow ones.<br>• Reduce serving sizes and consumption by using smaller bowls and plates.<br>• Use smaller spoons rather than larger ones when serving oneself or when eating from a bowl. |



Consumption is a context where understanding fundamental behavior has immediate implications for consumer welfare (21). People are often surprised at how much they consume (145), and this indicates their consumption may be influenced at a basic level of which they are not aware or do not monitor. This is why simply knowing these environmental traps exist does not typically help in avoiding them (2, 48). Relying only on cognitive control (11) and on willpower (3) often yields disappointing results. Furthermore, consistently reminding individuals to vigilantly monitor their actions around food is not realistic (62). At best, continued cognitive oversight is difficult for people who are focused, disciplined, and concentrated; it is impossible for those who are not.

What can be done? The studies reviewed here illustrate how an individual can alter his or her personal environment so it does not have unintended effects on how much is eaten. For some, this might involve repackaging bulk food into single-serving containers, storing tempting foods in less-convenient locations, and plating more modest amounts of food prior to beginning a meal (and allowing no refills). For others, simply using narrow glasses and smaller plates might be all that is required to make their environment less conducive to overeating. Table 1 outlines ideas that can serve as initial steps in these directions.

The environment can work for people or against people. On one hand, it can contribute to the overconsumption of food by unknowing individuals. On the other hand, a personally altered environment can help individuals more effortlessly

control their consumption and lose weight in a way that does not necessitate the discipline of dieting or the unintended consequences of external intervention.

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