

Are We Aware of the External Factors That Influence Our Food Intake?

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Objectives: This research examines the extent to which people accurately report some of the external influences on their food intake. **Design:** In two studies, specific factors (the presence and behavior of others) were manipulated in order to influence the amount of food that individuals consumed. **Main Outcome Measures:** The main outcomes of interest were participants' spontaneously generated explanations for their food intake (Study 1; $n = 122$), and their ratings of the importance of several potential determinants of food intake (Study 2; $n = 75$). **Results:** In Study 1, there was high concordance between the amounts eaten by members of a dyad, but very few participants indicated that they were influenced by their partner's behavior; they instead identified hunger and taste as the primary determinants of intake. Study 2 showed that participants' intake was strongly influenced by the behavior of others, but people rated taste and hunger as much more important influences on their intake. **Conclusions:** If external environmental factors influence people's food intake without their awareness or acknowledgment, then maintaining a healthy diet can be a challenge, with long-term consequences for health and well-being.

Keywords: food intake, overeating, external influences, social influences

From fad diets and chronic food restriction to food intake that is often excessive, people's eating habits have frequently been cause for concern, particularly with respect to health outcomes. Until the 1960s, it was widely assumed that physiological signals were the primary regulators of food intake; people eat when they are hungry and stop eating when they are full. More recently, researchers have identified a number of nonphysiological factors that influence individuals' food intake. These include cultural factors (e.g., Rozin, 1996), social influences (e.g., Herman, Roth, & Polivy, 2003), environmental cues (e.g., Wansink, 2004), and the influences of the food industry and the "toxic" food environment (e.g., Brownell & Horgen, 2004). These research findings notwithstanding, most people are likely to have their own assumptions about what determines how much they eat in specific situations. For example, some might focus on internal cues such as hunger, whereas others might focus on external cues such as portion size, and still others might point to some general notion of personal control or "free will." The types of explanations that people offer for their food intake can have important implications. We know that individuals who overeat and/or who are overweight or obese are seen as lacking

willpower and self-control, and are blamed for their "affliction" (e.g., Crandall, 1994; Puhl & Brownell, 2001). In addition, if individuals attribute their own food intake to seemingly appropriate causes (e.g., hunger), but ignore other important but less "acceptable" influences (e.g., social influences), avoiding eating to excess may be a challenge. Thus, examining people's awareness or acknowledgment of what actually influences their food intake has important implications for research, nutrition education, and individuals' health and well-being.

The present research examines the extent to which people acknowledge some of the external influences on their food intake. In a pair of laboratory studies, we manipulated external factors (the presence of others and the amount eaten by others) in order to influence the amount of food that people ate. We then asked participants in those studies to report why they ate as much as they did. By comparing verbal reports to the experimentally manipulated external conditions, we can directly assess the extent to which people are aware of and acknowledge how such influences affect their intake.

External Influences on Food Intake

There is a substantial body of research demonstrating that external environmental factors can influence people's food intake. For example, a robust influence on people's eating behavior is the presence and behavior of others (Herman, Roth, et al., 2003). People model the intake level of their eating partners, eating as much as, or as little as, their eating partner (Herman, Koenig-Nobert, Peterson, & Polivy, 2005). Modeling of food intake occurs even under conditions of extreme hunger (Goldman, Herman, & Polivy, 1991) or fullness (Herman, Polivy, Kauffman, & Roth, 2003). Other research has consistently shown that the amount of

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food that individuals eat increases as a function of the number of eating partners present, both in daily diary studies (e.g., de Castro, 1994; de Castro & Brewer, 1992) and in experimental studies (e.g., Clendenen, Herman, & Polivy, 1994).

In addition to these social influences, there is clear evidence that portion size influences the amount of food that individuals consume, even though they do not acknowledge this influence (Rolls, Morris, & Roe, 2002; Wansink & Kim, 2005). For example, in a study by Wansink, Painter, and North (2005), diners were served tomato soup in bowls that were imperceptibly refilled through concealed tubing that ran through the table and into the bottoms of the bowls. People eating from these “bottomless” bowls consumed 73% more soup (113 more calories) than did those eating from normal bowls, but estimated that they ate only 4.8 calories more. (For a review of the factors that can influence eating outside of conscious awareness, see Wansink, 2004, 2006.)

Failure to Report External Influences on Behavior

The notion that people do not or cannot report the factors that influence their behavior was first demonstrated by Nisbett and Wilson (1977). Both through a review of the existing literature and in a series of their own experiments, they showed that people often fail to accurately report on the various stimuli that influence their behavior. Although people did not identify the factors that actually influenced their behavior, they were nonetheless more than willing to generate several (often elaborate) “explanations” for their behavior. These explanations were usually based on implicit, a priori, causal theories. For example, in one study, Nisbett and Schachter (1966) gave participants a pill (actually a placebo) that would supposedly produce heart palpitations and hand tremors, among other symptoms. Participants then received a series of shocks of increasing intensity. The hypothesis was that those participants who could attribute the symptoms of shock to the placebo pill would be willing to tolerate more intense shocks, as was indeed the case. Of particular importance, when informed that they took more intense shocks than most participants, participants did not attribute their high shock tolerance to the alleged effects of the pill, but offered such explanations as, “. . . I used to build radios and stuff when I was 13 or 14, and maybe I got used to electric shocks” (p. 237). Nisbett and Wilson (1977) concluded that individuals “are sometimes (a) unaware of the existence of a stimulus that importantly influenced a response, (b) unaware of the existence of the response, and (c) unaware that the stimulus has affected the response” (p. 231). Similarly, Wilson and Brekke (1994) described the process of mental contamination, which refers to “cases whereby a judgment, emotion, or behavior is biased by unconscious or uncontrollable mental processes” (p. 118). They suggested that mental contamination is difficult to avoid because people have trouble detecting mental contamination, they underestimate their own susceptibility to such contamination, and they overestimate their own mental control.

More recent social-cognition research has consistently shown that people are often unaware of the stimuli that influence their behavior. For example, Bargh, Chen, and Burrows (1996, Experiment 2) had participants complete a scrambled-sentence task that contained words that were relevant to the *elderly* stereotype (e.g., old, lonely, gray) or that contained a set of control words. The researchers then unobtrusively recorded how long it took partici-

pants to walk down the corridor after the experiment. Participants who were primed with the stereotype of the elderly walked more slowly down the hall than did participants in the control condition. What is particularly important is that Bargh et al.’s (1996) participants reported no awareness of the elderly stereotype primes contained in the scrambled-sentence task, or of any connection between that task and their subsequent behavior. These research findings provide clear evidence that people fail to acknowledge external environmental stimuli that influence a variety of their behaviors. In light of the increasing concerns with overeating, obesity, and their effects on health outcomes, we should be particularly concerned with unacknowledged factors that influence individuals’ food intake.

People’s Explanations for Their Food Intake

A small number of studies have asked respondents to report on their reasons for initiating or terminating a meal (Hetherington, 1996; Mook & Votaw, 1992; Tuomisto, Tuomisto, Hetherington, & Lappalainen, 1998; Zylan, 1996). Mook and Votaw (1992) had participants indicate the most important factor for ending a meal from a list of four or five potential factors, and found that the mostly frequently cited reason was satiety (“I feel full”). A subsequent study by Zylan (1996) found a similar pattern of results, but also found that the next most important factor for men was the mere availability of food (“food was all gone”); for women, it was the taste of the food (“food stops tasting good”). Tuomisto et al. (1998) had a group of obese patients indicate reasons for initiating and terminating an eating episode in their everyday lives by selecting from a much longer list of potential reasons. In contrast to the previous studies, hunger and satiety were not the most commonly cited reasons. Rather, habit (“It’s mealtime”) was the most commonly cited reason for initiating an eating episode and cognitive factors (“I had eaten enough”) were cited for terminating a meal.

These studies provide some initial data regarding what individuals report as the determinants of their food intake. However, because these self-report data could not be corroborated in actual eating situations, these findings cannot attest to the validity of participants’ responses. One study (Hetherington, 1996) did ask participants about the reasons for terminating a meal in the context of that meal and found that “got tired of the food” and “felt full” were among the principal reasons cited. However, that study did not manipulate any conditions, nor did the author directly compare ratings of hunger, desire to eat, or pleasantness of the foods consumed, to the reasons that participants provided for terminating the meal. Thus, the validity of participants’ reports could not be assessed.

We sought to expand on this previous research on reported reasons for food intake in a number of ways. First, participants in these earlier studies were asked to report on their recent food intake or their intake in general, but the researchers did not have access to information about (or control over) the circumstances surrounding those eating episodes. In the spirit of Nisbett and Wilson (1977), we examined verbal reports of reasons for amount of food eaten in the context of laboratory studies in which certain variables were manipulated in order to influence participants’ food intake. Second, previous studies typically provided respondents with a list of options and asked them to indicate the explanation(s)

that applied. We used a broader range of assessment techniques, including: (a) spontaneously generated reasons for why participants ate the amount that they did in a particular situation, and (b) ratings of the importance of a number of factors (provided by the researchers). We predicted that people would be unable or unwilling to identify the specific manipulated factors as having influenced their food intake, but would nonetheless be willing to provide a number of plausible explanations to account for their intake.

Study 1

In this first study, we examined the explanations that individuals spontaneously generated to account for the amount of food that they ate in the context of a laboratory experiment.

Method

Materials and procedure. Data were collected from 122 female undergraduate students (mean age = 21.2 years) who participated in a laboratory experiment in which pairs of participants had incidental access to food (mini pizza pieces) while they were watching TV together; results of that study showed that there was a high degree of correspondence between the amount consumed by each member of the dyad ($r = .64$; Herman et al., 2005).¹ Participants also reported the number of hours since they last ate (which can be taken as an index of their hunger level). At the end of the experimental session, participants were asked to indicate in an open-ended format "which factor or factors led you to eat as much as you did, and not more or less."

Factor coding. The categories of responses (hereafter referred to as "factors") were derived from initial perusal of the narratives that participants provided to explain why they had eaten as much or as little as they did. Initially, more than 30 categories were derived from the open-ended responses to this and other pilot studies (a complete list of factors is available upon request from the authors). Participants' open-ended responses were subsequently coded for the presence or absence of each factor (coded as 1 or 0) by two independent coders. Each participant's response could contain multiple factors, but any given factor was coded only once (as either present or absent). Agreement between the two coders across all categories was 97%, and disagreements were resolved by the primary investigator (L. R. V.).

Results

Most frequently cited factors. Because some of the factors were cited so infrequently, our analysis focuses on the factors that were cited by at least 10% of participants. As is shown in left half of Table 1, the most commonly cited factors relate to internal signals (e.g., hunger and satiety), time-related factors (e.g., availability of time, proximity to other meals), and factors related to aspect of the food itself (e.g., taste). In addition, participants also noted noneating activities (the study involved watching TV) and free will as reasons for their intake.

Identification of external factors. Of particular interest was the question of whether or not respondents were able to spontaneously identify the specific external environmental factor that influenced their consumption (in the case, their eating partner). As shown in

Table 1, only 3 of the 122 participants (2.5%) reported being influenced by how much the other person ate.

Accuracy of self-reports. There was only a modest correlation between the number of hours since participants last ate and the number of pizza pieces that they consumed ($r = .19$), and that correlation was significantly smaller than was the correlation between the amount eaten by each member of a dyad ($r = .64$), $Z = 4.40$, $p < .001$. Yet when it came to reporting the reasons why they ate as much as they did, hunger and proximity to other meals were among the most frequently cited factors, whereas the presence of the other person was close to the bottom of the list of cited factors, $\chi^2 = 74.77$, $p < .001$ and $\chi^2 = 19.53$, $p < .001$, respectively.

Discussion

The results of Study 1 support our prediction that people would fail to report some of the strong influences on their food intake, but that they would nonetheless be willing to provide a number of plausible explanations for their intake. Consistent with previous research, among the most commonly cited reasons for the amount of food consumed were hunger, satiety, and taste. Most important is the fact that the vast majority of participants did not report any reason that was even remotely related to the presence of the coeater.

Study 2

In Study 1, we relied on participants' ability to spontaneously identify various factors that they believed influenced their food intake. In Study 2, we examined whether or not participants would acknowledge the influence of these factors if they were presented in survey format.

Method

Materials and procedure. Twenty of the factors that were generated from the open-ended responses in Study 1 were incorporated into a questionnaire, and respondents were asked to indicate the extent to which each factor influenced them to eat as much as they did, and not more or less. Each factor was rated on a 7-point scale (1 = *Not at all an influence*; 7 = *Very much an influence*). Data were collected from 75 undergraduate students (43 women, 32 men; mean age = 19.3 years) who participated in a laboratory experiment that used a remote-confederate manipulation (Leone, Pliner, & Herman, 2007, Experiment 1). Before they ate, participants in that experiment inadvertently learned about the amount of food eaten by several supposed previous participants. The intake of those previous participants was widely distributed (from 4 to 14 cookies). The results of that experiment showed that,

¹ Although the correspondence between participants' intake in this case is purely correlation, a number of experimental studies over the past few decades have clearly demonstrated causal effects of modeling of food intake (e.g., see Herman, Roth, et al., 2003 for a review). Typically, participants in those studies eat either alone or in the present of a co-eater (a confederate) who eats very little (e.g., 1 cracker) or a lot (e.g., 20 crackers). Participants who eat with a minimally eating confederate eat less than do participants eating alone, and participants who eat with a confederate who eats a lot eat much more than do those who eat alone.

Table 1
Reported Determinants of Food Intake in Studies 1 and 2

Most frequently cited factors (Study 1; $n = 122$)		Highest-rated factors (Study 2; $n = 75$)	
Factor	N (%)	Factor	Mean (SD)
Hunger	63 (51.6)	Taste	5.92 (1.23) ^a
Non-eating activities	32 (26.2)	Stable preferences	5.67 (1.18) ^a
Availability of time	26 (21.3)	Hunger	4.57 (1.84) ^a
Proximity to meals	25 (20.5)	Proximity to meals	4.51 (1.85) ^a
Taste	23 (18.9)	"In the mood for. . ."	4.37 (1.66)
Satiety	14 (11.5)	Satiety	4.36 (1.89)
Free will	14 (11.5)	Appearance/smell	4.31 (1.91)
Behavior of co-eater	3 (2.5)	How much others ate	1.84 (1.30) ^b

Note. For Study 2, the rating scale ranged from 1 (*Not at all an influence*) to 7 (*Very much an influence*).
^aMeans are significantly above the midpoint (4) of the scale at $p < .05$; ^bmeans are significantly below the midpoint of the scale at $p < .001$.

in the absence of a clear consumption norm regarding the appropriate amount to eat (i.e., when there was no obvious group tendency to eat a particular amount), participants dramatically increased their consumption. This pattern of findings was replicated in Leone et al.'s (2007) second experiment. That second experiment further showed that providing clear norms (i.e., clearly high or clearly low intake) eliminated the overeating observed in the ambiguous-norm condition. In Leone et al.'s first experiment (which we include here), participants also rated their hunger level (1 = *Not at all hungry*; 5 = *Extremely hungry*), indicated the number of hours since they last ate, and indicated how much they liked the taste of the cookies that they consumed (by placing a mark on a 14.6-cm line).

Results

Highest-rated factors. Those factors that were rated above the midpoint of the rating scale (i.e., above a rating of 4) are listed in the right half of Table 1. We used single-sample t tests to determine which factors were rated as being significantly above the midpoint of the rating scale. As in Study 1, the factors rated as being important determinants of food intake fell into the categories of internal signals (hunger and satiety), factors related to aspects of the food itself (taste, stable food preferences, appearance/smell of the food, being "in the mood for" the food), and time-related factors (proximity to other meals).

Ratings of external factors. The mean rating for the factor "How much others ate" was 1.84 ($SD = 1.30$). This rating is significantly below the midpoint of the scale, $t = -14.45$, $p < .001$, and was the second-lowest-rated factor overall, just above "medical conditions."

Accuracy of self-reports. To examine the accuracy of participants' self-reported reasons for their intake, we first examined the correlations between the standardized score for amount of food eaten (Z_{intake}) and the standardized score for each of (1) participants' hunger ratings (Z_{hunger}), (2) the time since they last ate (Z_{time}), and (3) their ratings of how much they liked the taste of the cookies (Z_{liking}). Neither Z_{hunger} ($r = .13$, $p = .28$) nor Z_{time} ($r = -.05$, $p = .67$) were significantly correlated with Z_{intake} , but Z_{liking} ($r = .26$, $p = .02$) was positively correlated with Z_{intake} . Next, we calculated difference

scores between Z_{intake} and each of Z_{hunger} , Z_{time} , and Z_{liking} . These difference scores provide an index for each participant of how strongly intake is related to each of the three factors; smaller difference scores indicate that intake and a given factor are closely related, whereas larger difference scores indicate that intake and a given factor are not closely related. Each absolute difference score was then correlated with participants' self-reports of how much the amount that they ate was influenced by (1) hunger, (2) proximity to other meals, and (3) taste. A negative correlation would suggest that participants accurately reported on the influence of a given factor (e.g., participants reported that hunger influenced their food intake, and hunger was indeed closely related to intake, as indicated by a small difference score). In contrast, a zero correlation would indicate low accuracy, and a positive correlation would suggest a denial of the influence of that factor (e.g., hunger was closely related intake, as indicated by a small difference score, but participants reported that hunger did not influence their intake). There were no significant correlations between the difference scores and participants' ratings of how much they were influenced by hunger ($r = -.09$, $p = .44$), taste ($r = -.07$, $p = .53$), or proximity to other meals ($r = .07$, $p = .54$). Overall, then, there is little evidence to suggest that participants' self-reports of the determinants of their intake are accurate.

Discussion

Study 2 builds on Study 1 by showing that similar effects emerge regardless of whether participants rate the importance of a list of possible reasons for their food intake or spontaneously generate the reasons for their food intake. As in Study 1, and consistent with previous research, taste and hunger/satiety were among the highest-rated determinants of intake. In addition, it again appears that participants were unable (or unwilling) to acknowledge the influence of the manipulated variable (the alleged intake of previous participants). Overall, the findings of Studies 1 and 2 are consistent with the work of Nisbett and Wilson (1977) showing that people do not acknowledge many of the influences on their behavior, but that people are also quite willing to provide explanations that are consistent with their implicit causal theories.

General Discussion

The purpose of the present research was to investigate the extent to which people can and do accurately report on the external environmental factors that influence their food intake. Building on the work of Nisbett and Wilson (1977), we expected that people would fail to acknowledge the reasons why they ate as much as they did (unless those reasons happened to correspond to a priori causal theories about why people eat as much as they do). Indeed, in our laboratory studies, we found that people did not accurately identify specific influences on their intake (e.g., the presence of others). Despite failing to identify certain specific external influences, participants were willing to generate several alternative explanations for their behavior. Most of these explanations were rooted in common-sense theories about what causes someone to start and stop eating, such as internal states (hunger and satiety) and factors related to aspects of the food itself (taste and stable food preferences). Our findings are consistent with previous research on stated reasons for meal initiation and cessation, in that factors such as hunger, satiety, and taste were presented as among the most important determinants of food intake (Mook & Votaw, 1992; Zylan, 1996).

Although the reasons that individuals provided for why they ate as much as they did (e.g., hunger, taste) may be genuine and important influences on food intake, our findings underscore that there are unnoticed or unacknowledged factors that can also have a major impact on individuals' intake. For example, one study had participants eat with a partner while watching a video. The results of that particular study showed that the correlation between the amounts eaten by dyadic partners was $r = .64$ (Herman et al., 2005), yet only 3 out of 122 participants (2.5%) mentioned that (their awareness of) the amount eaten by their partner influenced how much they ate. The fact that people tend not to acknowledge their own susceptibility to a number of environmental influences on their food intake is consistent with research showing that, although people generally acknowledge that external elements (e.g., media, advertising) influence others, they deny the influence of these elements on their own behavior (the *third-person effect*; e.g., Davison, 1983; Douglas & Sutton, 2004; Innes & Zeitz, 1988).

The present findings are also consistent with a large body of research demonstrating that environmental stimuli that are outside of conscious awareness can influence goal pursuit (Bargh, Gollwitzer, Lee-Chai, Barndollar, & Troetschel, 2001), behavior (Bargh & Chartrand, 1999), and self-regulation (Fitzsimons & Bargh, 2004). Insofar as individuals lack awareness of the factors that influence their consumption, this ignorance will have important implications for excess intake, excess weight, and generally for individuals' health and well-being. To the extent that individuals make certain attributions about their food intake but ignore other important influences, it will be difficult for those individuals to make sensible changes to their eating behavior and to exercise personal control in an attempt to avoid excessive consumption. This problem can become particularly acute in a "toxic" food environment (Brownell & Horgen, 2004) featuring supersized portions and easy access to high-fat, calorie-dense foods.

Many people engage in "mindless eating" (Wansink, 2006) in which they are not consciously aware of the effects of the environment on how much food or beverage they consume. One way

to reduce mindless eating, and thereby facilitate healthier food choices, might be to increase mindfulness (Langer, 1990) and become more attuned to one's appetite and bodily needs (Albers, 2003). For example, learning to pay attention to the decisions involved in one's food selection, the sensory experience (e.g., tastes, textures, smells) related to the foods one eats, and the bodily sensations (e.g., fullness in the stomach) that accompany one's food intake can help reduce mindless eating (Albers, 2003). In many cases, however, simply being aware of the relationship between environmental influences and consumption will not, by itself, eliminate the biasing effects of those environmental influences. In fact, even those of us who conduct research on environmental influences on food intake remain susceptible to the effects of those environmental influences. An alternative approach is to modify the environment itself. For example, simply using smaller dishes at home, keeping extra food off the table during dinner, or repackaging larger packages of food into smaller single-serve portions, can help people avoid mindlessly overeating (Wansink, 2006). In addition, one's eating partners can perhaps be chosen more judiciously. In this way, people can use external environmental cues to "unconsciously" eat better.

Limitations and Future Research Directions

There are some limitations of the present studies. First, even though the external influences that we introduced appear to have successfully influenced participants' food intake in our laboratory studies, these studies did not include a control group, and thus no definitive statements can be made about the causes of participants' intake. However, past research has convincingly established causal effects of modeling (see Herman, Roth, et al., 2003) and social norms (Leone et al., 2007, Experiment 2) on food intake, increasing our confidence in the present findings. Second, the manipulated variables were not likely the only influences on food intake, and we therefore could not assess the validity of all of the reasons that participants provided to account for the amount that they ate. Nonetheless, the manipulated variables were reliably related to the amount of food that individuals ate. Thus, even though hunger, taste, and satiety are no doubt important influences that can account for a substantial proportion of the variance in food intake, it is clear that there are a number of other influences on intake that remain unacknowledged. Future research could attempt to determine the proportion of variance in people's food intake accounted for by each of the acknowledged and unacknowledged influences on food intake.

It would also be useful for future research to identify individual and cultural differences in people's awareness of, and susceptibility to, the external factors that can influence food intake. Identifying such individual differences would be valuable for developing interventions aimed at counteracting the effects of these external influences. For example, Lowe and colleagues (Lowe & Butryn, 2007; Lowe & Levine, 2005) have recently distinguished between homeostatic hunger (eating in response to negative energy balance) and hedonic hunger (eating in response to pleasure independent of energy needs). Their Power of Food Scale (Lowe & Butryn, 2007) was developed to assess individual differences in responsiveness to the rewarding properties of food, but might also prove useful as a measure of the extent to which individuals rely on internal versus external cues for intake. With respect to cultural

differences, recent research (Wansink, Payne, & Chandon, 2007) has shown that American and French respondents alike indicate that they rely more strongly on internal cues than on external cues to signal the end of a meal, but the preference for internal cues over external cues was more pronounced among French respondents.

Finally, it would be useful to distinguish between lack of awareness of the external factors that influence food intake and the refusal to acknowledge the influence of those factors. For example, we might simply be unaware that others' intake strongly affects our own intake, or we might be reluctant (even embarrassed) to admit that we are influenced by external cues to such a great extent. The reluctance to acknowledge external influences might stem from the belief that such factors ought not affect us because they are seemingly irrelevant or trivial, or perhaps because they impinge on our sense of personal autonomy. Teasing these apart would be an interesting and valuable exercise.

Conclusion

Food intake is a domain of behavior in which understanding fundamental causes has immediate implications for individual and social welfare. We have shown that there are certain external factors (e.g., the behavior of others) that influence people's food intake, but that people do not acknowledge. As long as such important influences on intake remain unacknowledged, making optimal food choices and maintaining a healthy diet will be a challenge, with long-term consequences for individuals' health and well-being.

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