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Is This a Meal or Snack? Environmental Cues or Timing that Drive Food Intake

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Abstract

Whether a person perceives an eating occasion as a meal or a snack could influence what and how much they eat. Participants who were assigned to eating conditions that were associated with meal cues (table settings of ceramic plates, silverware, cloth napkins) ate more food compared to those presented with snack cues (paper plates and napkins). The amount they ate was mediated by whether they saw the situation as a meal or a snack. In addition, the results were most pronounced among participants who were hungry. Possible implications for those findings were discussed.

Introduction

There is considerable evidence that environmental and situational cues influence food intake (Wansink, 2004). However, the specific psychological (e.g., cognitive, motivational) processes underling those relation were not well addressed. Those may be because, at least partly, psychological processes are difficult to capture in "real time" making explanation of them untenable. This research illustrates how potential cognitive and motivational variables can mediate and moderate the relation between environmental cues and food intake.

For instance, the hunger of a participant may influence whether they see a food as either a snack or meal. If they see it as a meal their hunger may lead them to increase their consumption – via goal fulfillment – more than if they had instead seen it as a snack. If environmental cues can lead to an increase or decrease in consumption based upon whether they suggest a food is a meal or snack, than a person's perception of such should mediate the relation between the related environmental cues and how much they eat.

There is sparse research examining the possibility of environmental cues affecting food perceptions in this context. One exception is a study where Pliner and Zec (2007) found that participants who ate foods (soup and sandwich) in a meal-like environment (seated at a dining table in a carpeted room) were more likely to describe the study using meal or lunch type words than those who ate the foods in the snack-like environment (standing at a kitchen counter). However, while the "meal" and "snack" environment led participants to engage in the intended cognitive processing, it did not lead to differences in consumption. This may have been because the food being used – soup and a sandwich

– was too “meal-related” and not sufficiently ambiguous. What is needed is research that provides ambiguous foods in environments that specifically suggest “snack” or “meal”. In this way, changes in consumption can be more clearly attributed the external cues from the environment and not from the food.

Although one’s intake may be mediated by external “meal or snack” cues, this may also depend on internal cues of hunger. For example, Strahan, Spencer, and Zanna (2002) demonstrated that people were more likely to drink when they were subliminally primed with drinking-related words only if they were thirsty. Similar findings were also reported by Veltkamp, Aarts, and Custers (2008). Thus, we expect that the meal-cue participants would eat more than the snack-cue participants, particularly if they were hungry (e.g., it had been a long time since they had previously eaten).

In summary, because research assessing psychological processes underlying the relation between environmental cues and intake is sparse, we introduce both a cognitive mediator—perception of the same food as a snack or meal—and a motivational moderator—motivation to eat (i.e., how hungry they are). We randomly assign undergraduate students to two experimental conditions in which they are instructed to eat ambiguous foods in an environment that was associated with either meal cues (ceramic plates, glasses, silverware, and cloth napkins) or snack cues (paper plates and napkins, plastic cups, and no utensils). We expect to see that meal-cue participants consume more than snack-cue participants. We also expect that the amount of food eaten will be mediated by the extent to which it is perceived as a meal or a snack. Finally, we expect that the strength of this relationship will be moderated by one’s motivational state and will be particularly strong among those who are hungry.

Method

Participants

One-hundred-twenty-two undergraduate students (75 men), with a mean BMI of 22.8 (*SD* = 3.38), were recruited at Cornell University through advertisement in seven large classes in fields outside of psychology and nutrition. In exchange for participation, students received extra credit and their name was entered into a drawing to win an iPod. The study had Institutional Review Board approval, and participants were treated in accordance with American Psychological Association guidelines.

Procedure and Materials

Participants signed up studies that were held at either noon or 3:30 p.m. In both sessions, participants were randomly assigned to either a meal-cue condition or a snack-cue condition. An average of 30 participants were scheduled for each session.

A focus group of 120 participants rated foods regarding how they perceive them as snack versus meal in a 9-point scale (1 = snack; 9 = meal). We used three foods, quesadillas, pizza, and chicken wings, that fell in to the middle of the range of the ratings (i.e., quesadillas = 4.04; pizza = 5.35; children wings = 4.81).[1]

During the meal-cue condition, participants walked into the room where the table in the room was already set with place settings that included a ceramic plate, a glass, and silverware wrapped in a napkin. Participants were told to choose any seat that they would like. They were then instructed to bring up their plates and form a line. They were told that each volunteer would go through the food line one by one. Participants also received a nametag before being allowed to proceed to the food. They were told that the purpose of the nametag was to promote socialization, however, it was actually so that the

experimenter could record how much food each person took during the study. Once they received a name tag, participants were told that they could take whatever food was desired, and that they could take as much as they would like. While taking food, the experimenter discretely recorded how many pieces of each food were taken.

Participants were instructed to raise their hands when they were done eating so that they could receive the questionnaire. Once they were finished completing the questionnaire, the experimenter instructed them to put it under their plates. Participants were then dismissed, debriefed, and thanked. After all of the participants had left, each participant's plate was weighed, with each left-over food item weighed separately. The weights were used to calculate their total caloric intake during the study.

The procedure of the snack-cue condition was identical except that the setting was altered to promote snack-like environmental cues. After the participants entered, they were instructed to take a paper plate and napkin from the front of the room. In addition, they were informed that they could not sit until they finished eating.

The questionnaire asked the participants for an estimation of the total calories eaten during the experiment. To examine participants' perception over the foods provided, they were also asked to indicate how meal-like or snack-like the foods they ate during the experiments were, (1 = more of a snack; 9 = more of a meal). Furthermore, they were asked to indicate how much of each food they took on a 9-point scale, (1 = not very much; 9 = a lot of), and how satiated they felt from those foods by completing 2 items, "I couldn't eat another bite of food" and "at this moment I feel full" (those two items were combined for a single index of satiety given high reliability, $\alpha = .73$). In addition, they were asked to indicate the number of hours since they last ate. Finally,

demographic and physical information of each participant was also taken (gender, age, weight, and height).

Results

Because there were no significant main or interaction effects of gender, age, and BMI, analyses were collapsed across those factors. On the other hand, there was a marginally significant main effect of the time of experiment (noon versus 3 p.m.) in that participants who showed up at noon ate directionally more than those who showed up at 3 p.m., F (1, 118) = 2.97, p = .09. However, because this main effect was only observed on their actual food intake, and because the interaction effects between this and the experimental manipulation did not reach conventional level of significance, p = .15, analyses were collapsed across the time of experiments. This factor was treated as a covariate in the following analyses.

As expected, participants in the meal-cue condition were more likely to report that the food they ate was a meal (M = 3.91, SD = 2.08) than those in the snack-cue condition (M = 3.13, SD = 1.73), F (1, 110) = 4.45, p = .04, η^2 = .04. As indicated in Table 1, the meal-cue participants' actual calorie intake was significantly greater (M = 531.79, SD = 246.92) than the snack-cue participants' (M = 416.39, SD = 192.92), F (1, 119) = 7.62, p = .007, η^2 = .06, in addition to reporting that they ate more, all ps < .05. Nevertheless, there was no effect of the meal versus snack cues on their satiety, p = .98.

To test if the effect of the situational cues on the food intake was mediated by participants' meal perception over the foods, we next conducted a series of simultaneous multiple regression (SMR) analyses to see if the significant association between the experimental condition and the dependent variables was reduced after controlling for the

meal perception (Baron & Kenny, 1986). In the first step, we predicted each dependent variable from (a) the experimental condition (a dichotomous variable; meal-cue versus snack-cue) and (b) the time of the experiment (a dichotomous variable; noon versus 3:30 p.m.) as a controlling factor. In the second step, we predicted participants' perception of the foods they ate from (a) the experimental condition and (b) the time of the experiment as in the first step. Finally, in the third step, we predicted each dependent variable from (a) the experimental condition (b) the time of the experiment, and (c) their perception of the foods to see if the experimental condition was still a significant predictor for the dependent variable.

These analyses revealed that the participants' meal perception partially mediated the relation between the environmental cues and the *actual* total food intake, whereas it did not mediate the relation with other variables (e.g., estimated total food intake). Specifically, the significant main effect of the experimental condition in the first step, β = .243, t (119) = 2.76, p = .007, was not significant in the third step, β = .143, t (109) = 1.58, p = .12 (see Figure 1). A Sobel (1982) test indicated that the meditational role of the meal perception was marginally significant, Z = 1.756, p = .08. Thus, in addition to conceptually replicating Pliner and Zec's (2007) findings, the present study showed the mediational role of the perception between environmental cues and food intake.

Finally, to determine if the relation between the experimental condition and participants' actual food intakes were moderated by their motivation to eat, operationally defined by their length of time since they had their eaten last meal, we conducted a SMR in which we predicted participants' actual food intake from (a) the experimental condition, (b) motivation (i.e., their length of time since they had eaten last meal), (c) the

time of the experiment as a controlling factor, and (d) a condition x motivation interaction term. In this analysis we centered the scores that went into these terms by subtracting the appropriate mean from each predictor (i.e., each main effect) before computing any interaction terms (Aiken & West, 1991). This analysis revealed that there was a significant interaction effect between the description and motivation, $\beta = .217$, t (117) = 2.30, $p = .02$. As indicated in Figure 2, simple slope tests demonstrated that among participants who were motivated (i.e. hungry) to eat (+1 *SD* above the mean), the condition was highly associated with increased intake, $\beta = .487$, t (117) = 3.73, $p < .001$, whereas no such association existed among those who were not motivated (-1 *SD* below the mean), $p = .72$.

Thus, consistent with general findings of the relation between cognition and deprivation-reducing behavior, the present results confirmed the moderational role of motivation. The influence of environment cues on eating behavior was observed only among participants who were motivated to eat. There was no effect of those cues among participants who were not motivated to eat. Indeed, the importance of motivation was further confirmed by an additional finding that the relation between the experimental condition and participant's satiety was also moderated by their motivation, $\beta = .005$, t (117) = 2.89, $p = .005$. Simple slope tests revealed that motivated participants were more satisfied when they were in the meal-cue condition, $\beta = 1.296$, t (117) = 2.17, $p = .03$, than when in the snack-cue condition. This could be because hungry participants were satisfied because they could eat more. In contrast, those who were not motivated were less satisfied when they were in the meal-cue condition, $\beta = -1.244$, t (117) = -2.18, $p = .03$.

General Discussion

Evidence is accumulating to suggest that specific meal and snack patterns influence overall food consumption, nutrient intake, and diet quality (Gatenby, 1997; Kerver, Yang, Obayashi, Bianchi, & Song, 2006; Longnecker, Harper, & Kim, 1997; Oltersdorf, Schlettwein-gsell, & Winkler, 1999). For example, Kerver et al. found that people who ate three meals per day (i.e., breakfast, lunch, and dinner) had higher intakes of micro-nutrients such as calcium, vitamins, and folic acid than did those who skipped breakfast or lunch. On the other hand, breakfast or lunch skippers who ate more than two snacks had higher intakes of energy on average than those who ate three meals, suggesting that eating snacks contributes to higher consumption of energy in spite of poorer diet quality. It is important to note, however, that how people perceive an eating occasion as a meal or a pre-dinner snack could influence what and how much they eat, and whether they decide to eat later. This may be especially true for ambiguous foods such as a sandwich or pizza that can be either perceived as a meal or a snack.

The present study demonstrated that environmental and situational cues associated with an eating occasion could influence overall food intake. People were more likely to eat ambiguous foods when they were associated with meal cues such as being seated at a table with a ceramic plate, a glass, and silverware wrapped in a napkin. Importantly, the present study reveals that the effect of these cues is uniquely intertwined by cognition and motivation. First, people were more likely to eat ambiguous foods by perceiving them as a meal rather than a snack. Second, this effect was only observed among those who were motivated to eat (i.e., hungry).

The first finding was particularly important in that it could fill in, at least partially, a gap between the effects of environmental cues and eating behavior. Although there is substantial research evidence indicating that food intake is influenced by environmental and situational cues such as portion size (Wansink, 2004), it is not well addressed how cognition plays a role in the relation. Although there are several potential psychological mediators between environmental cues and our food intake, the present study revealed that our perception of a meal could play a crucial role in the relation.

This is not to say that people are normally aware that they eat more foods when they perceive them as meal (see Nisbett & Wilson, 1977). Indeed, most evidence suggests that people are usually not aware of environmental or situational cues that influence their food intake (e.g., Vartanian, Herman, & Wansink, 2008; Wansink, Painter, & North, 2005). Hence, it is safe to assume that people pay attention to neither the environmental and situational cues associated with foods nor the perception towards the foods. It seems that our actual food intake is unconsciously influenced by such environmental cues associated with an eating occasion, which is partially mediated by our perception over the foods. This is perhaps why we failed to observe the meditational role of the perception in the relation between the experimental condition and their estimation of the total food intake.

At any rate, these findings have practical implications. Recall that breakfast or lunch skippers who ate more than two snacks had higher intakes of energy but poorer nutrient intake (Kerver et al., 2006). The present study may suggest that those types of people are more likely to eat ambiguous foods because they perceive them as meals rather than snacks. For instance, one may eat a Big Mac during a late morning (e.g., at

11:00 a.m.) brown bag meeting by thinking that they are eating a lunch and skip a subsequent real lunch at noon. Obviously they could consume substantial calories from the sandwich but the nutrient intake is not very dense. Based on our findings, one possible way to prevent this is to associate those ambiguous foods with snack cues. For instance, if one does not sit during the brown bag meeting, then they are less likely to eat a Big Mac during the meeting.

On the other hand, the second finding is also important because it revealed that the effect of environmental and situational cues is particularly pronounced when people are motivated. In other words, people are less likely to be influenced by environmental cues in an eating setting unless they are hungry. This is conceptually consistent with previous findings suggesting the moderating role of motivation in the relation between the priming and drinking behavior (Strahan et al., 2002; Veltkamp et al., 2008). After all, regardless of how people perceive a Big Mac as a meal or a snack, they have to have a physiological capacity to consume it. However, the fact that hungry participants consumed a similar amount of food as those who were not hungry when they were in the snack-cue condition has a particularly important implication for reducing and preventing overeating. Given the fact that subtle environmental and situational cues influence how much people eat, changing those cues may lead to reduction in overall food intake (see Wansink, 2004; Wansink & Van Ittersum, 2007). As suggested in the present study, asking people to eat foods in a snack-like environment as simple as standing can help obese people to reduce food intake.

Notes

1. Participants were also allowed to drink soda during the experiment.

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Table 1

How Meal versus Snack Cues Influence Food Intake, Estimated Food Intake, and Satiety

	Snack-cues		Meal-cues		*F*-Value
Variable	*M*	*SD*	*M*	*SD*	
Actual total food intake in calorie	416.39	192.92	531.79	246.92	7.62**
Estimated total food intake in calorie	488.53	323.26	700.18	444.93	8.36**
"How many quesadillas did you take?"[1]	3.13	1.81	4.04	2.06	6.04*
"How many pieces of pizza did you take?"[1]	2.46	1.70	3.54	2.17	7.43**
"How many chicken wings did you take?"[1]	4.16	2.07	4.93	2.20	4.11*
Satiety Index	3.95	2.40	3.92	1.99	.001

*$p < .05$. **$p < .01$ All p-values are 2-tailed

[1] Not very much = 1; A lot = 9

Figure Captions

Figure 1. Mediational role of the meal perception between the environmental cues and actual total food intake.

Figure 2. Actual total food intake as a function of the experimental condition and motivation.

Figure 1.

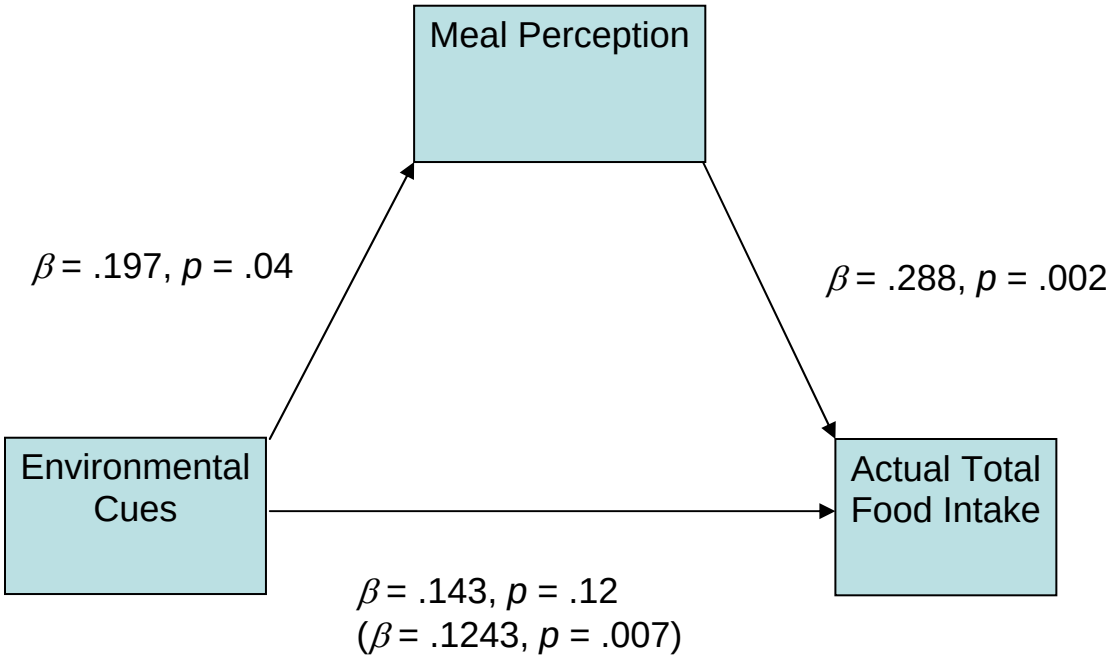
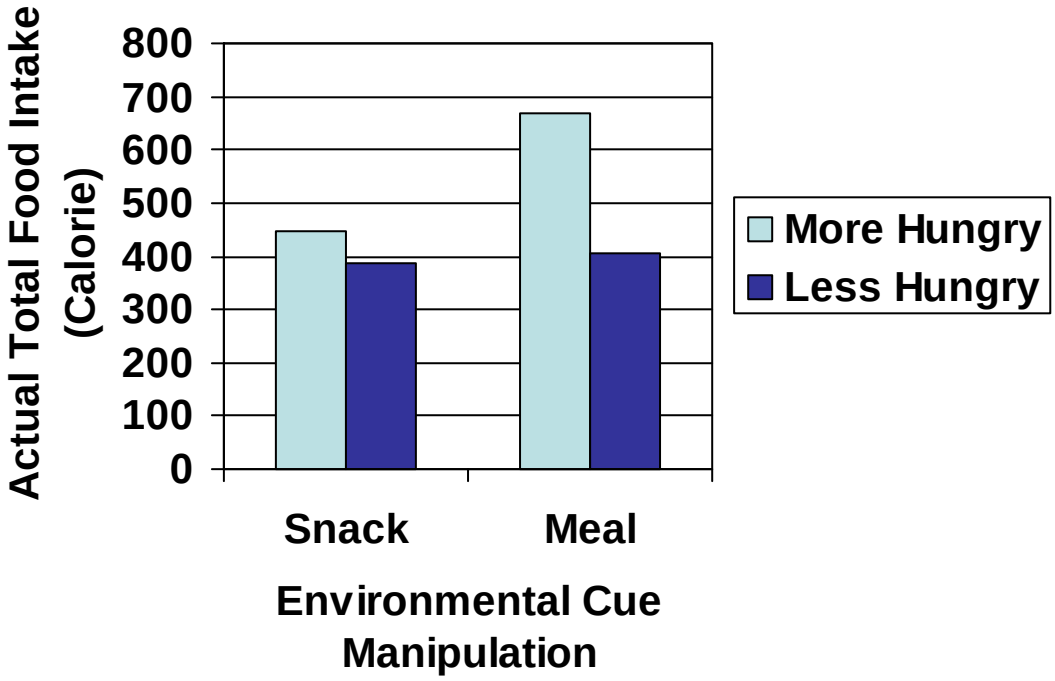

Meal Perception
β = .197, p = .04
β = .288, p = .002
Environmental Cues
Actual Total Food Intake
β = .143, p = .12
(β = .1243, p = .007)

Figure 2.


Actual Total Food Intake (Calorie)
800
700
600
500
400
300
200
100
0
Snack
Meal
Environmental Cue Manipulation
More Hungry
Less Hungry