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BRIEF REPORT

Conflicting Internal and External Eating Cues: Impact on Food Intake and Attributions

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Objective: Social factors have a powerful influence on people's food intake but people typically fail to acknowledge the influence of such external cues, instead explaining their food intake in terms of factors such as how hungry they are. We examined whether the tendency to explain one's food intake in terms of internal cues (i.e., hunger) rather than external cues (i.e., other people's behavior) would be apparent when those cues are in conflict with one another. ***Method:*** Female participants (n = 104) took part in a pizza taste test after having been food deprived for 18-hr or after consuming a meal-replacement preload. Half of the participants were also exposed to a social norm that conflicted with their deprivation condition: deprived participants were exposed to a low-intake norm, whereas preloaded participants were exposed to a high-intake norm. After completing the taste test, participants indicated the extent to which their food intake was influence by how hungry they were and how much other people ate. ***Results:*** Deprived participants ate less when exposed to a low-intake norm than when no norm was present, but reported that the behaviors of others had no impact on their food intake. In contrast, preloaded participants did not eat significantly more when exposed to a high-intake norm, but reported that the behavior of others made them eat more. ***Conclusions:*** Participants are generally inaccurate in the attributions they make for their food intake, and we suggest that these inaccuracies may be because of motivated misreporting.

Keywords: external influences, social norms, hunger, attributions

Social factors play an important role in a range of health-behaviors, such as smoking and alcohol consumption (Donovan, 2004; Tyas & Pederson, 1998). One domain in which social factors have been shown to have a particularly strong influence is eating behavior (Herman, Roth, & Polivy, 2003). Excess food intake is a key contributor to weight gain and obesity, and some researchers have suggested that social norms related to food intake can account for the spread of obesity in social networks (Christakis & Fowler, 2007). There is substantial evidence indicating that people tend conform to the eating behavior of their eating companion(s), eating more when the companion eats a relatively large amount and eating less when the companion eats a relatively small amount (Cruwys, Bevelander, & Hermans, 2015; Herman et al., 2003). A recent meta-analysis (Vartanian, Spanos, Herman, & Polivy, 2015) found a large overall modeling effect (r = .39), and further showed that social models have a stronger inhibiting effect (i.e., people eat less when eating with a companion who eats a relatively small amount) than an augmenting effect (i.e., people do not necessarily eat more when eating with a companion who eats a relatively large amount). It appears that social models set an upper limit for how much is appropriate to eat.

The robustness of the modeling effect is further demonstrated by two findings from the literature. First, the modeling effect is just as powerful when participants are simply informed about the behavior of previous participants in the study (the so-called remote-confederate design) as when the model is physically present (Feeney, Polivy, Pliner, & Sullivan, 2011). Second, social cues can override other cues that might be expected to influence food intake, such as how hungry the person is. For example, Goldman, Herman, and Polivy (1991) had participants refrain from eating for up to 24 hr before their experimental session and found the same strong modeling effect among participants who were food deprived and those who were not food deprived. These results speak to the power of social influences on food intake.

An intriguing finding from the literature is that, although the effects of social models on food intake have been well-documented, people typically fail to acknowledge the influence of such external cues on their behavior. Instead, participants tend to explain their food intake in terms of internal cues such as how hungry they are, sensory cues such as how good the food tastes, or

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factors such as the cost or healthiness of the food (Croker, Whitaker, Cooke, & Wardle, 2009; Vartanian, Herman, & Wansink, 2008; Vartanian, Sokol, Herman, & Polivy, 2013). A similar reluctance to acknowledge social influences on behavior has been observed in other domains as well (e.g., energy conservation; Nolan, Schultz, Cialdini, Goldstein, & Griskevicius, 2008). Subsequent research suggests that the failure to acknowledge social influences on food intake might reflect a motivated denial rather than a lack of awareness (Spanos, Vartanian, Herman, & Polivy, 2014, 2015).

To provide further insights into the potential motivated nature of food intake attributions, the present study examined whether the tendency to explain one's food intake in terms of internal cues rather than external cues would be apparent when those cues are in conflict with one another and the internal cue is no longer the most logical explanation for one's food intake. Female participants were either 18-hr food deprived or were given a meal-replacement preload before taking part in a taste test. Deprived participants were exposed to either a low-intake norm (cue conflict, in that deprivation should promote eating whereas the low-intake norm ought to suppress eating) or no norm (control condition); preloaded participants were exposed to a high-intake norm (cue conflict, with the preload expected to suppress intake and the high-intake norm expected to increase intake) or no norm (control condition). This study included only women because past research suggests that modeling effects are particularly strong among women, the only other study to examine modeling after a period of deprivation included only women (Goldman et al., 1991), and most of the research on attributions for food intake has been conducted with women. We predicted that food-deprived participants would eat less when exposed to a low-intake norm than when no norm was present, and that preloaded participants would eat more when exposed to a high-intake norm than when no norm was present. With respect to participants' explanations for their food intake, our hypotheses were more exploratory: It may be that people are willing to acknowledge external influences when their typical explanation (i.e., their hunger level) is no longer viable. However, it is also possible that people are so reluctant to acknowledge external influences that they continue to deny them despite clear evidence of external influence. The present study will disentangle these two possibilities.

Method

Participants

Participants were 104 women recruited from an undergraduate psychology course or from the community. Previous research on modeling of food intake has found large effects (Vartanian et al., 2015), as has research examining internal versus external attributions for food intake (e.g., Vartanian et al., 2013). A power calculation based on anticipated large effects indicated that we would need a sample size of 52 participants. However, given the novelty of the research questions being examined, we elected to double that sample size. Participants' mean age was 20.43 years (SD = 3.31), and their mean body mass index (BMI; kg/m^2) was 22.87 (SD = 3.47). Regarding ethnicity, 47 identified as White, 45 identified as Asian (22 were Australian-born), and 12 identified with other ethnicities. This study was approved by the university's ethics committee.

Materials and Procedure

Participants signed up for a study on "hunger and taste perception" with sessions scheduled to begin between 11 a.m. and 3 p.m. When participants signed up for the study, they were informed that they would need to refrain from eating for at least 18 hr before their experimental session, and they were also emailed a reminder notice the day before their session with the specific time past which they should not eat. The mean number of hours deprived was 17.97 (SD = 1.78), and all participants had refrained from eating for at least 12 hr before their session. Upon arrival, participants provided informed consent, reported when they last ate, and rated their current hunger on a 10-cm visual analogue scale anchored by *Not at all hungry* and *Extremely hungry*. Participants were then randomly assigned to one of the two deprivation conditions (preloaded or deprived) and to one of the two norm condition (cue conflict vs. no-cue control). Participants were distributed across conditions as follows: preloaded/cue conflict, n = 23; preloaded/no-cue control, n = 29; deprived/cue conflict, n = 25; deprived/noncue control, n = 27.

Participants in the preload condition were given a drink consisting of 400 ml of water and 160 g of vanilla Ensure powder (700 kcal; 26 g protein, 23 g fat, 93 g carbohydrate) that was described as a "nutritionally balanced meal replacement drink." They were asked to consume the entire drink. Participants in the deprived condition did not consume anything. Next, all participants watched a 15-min nature documentary, answered a few questions about that documentary, and rated their hunger again on a 10-cm visual analogue scale before proceeding to the taste test.

Norm information was conveyed using a remote-confederate manipulation. Participants in the cue-conflict conditions were exposed to bogus information about the food intake of 10 previous participants via a sheet of paper that was left on the table where participants were completing the taste test. For deprived participants, the remote-confederate sheet indicated that previous participants had eaten an average of four bite-size pieces of pizza; for participants in the preload condition, the remote-confederate sheet indicated that previous participants had eaten an average of 14 bite-sized pieces of pizza. These values were chosen because participants in a previous study using the same food ate an average of approximately nine bite-sized pieces of pizza (Spanos, Kenda, & Vartanian, 2015). Participants were told that the researchers had been asking previous participants to write down how much they ate so that the researchers would know how much food to order, but that the food had now all been ordered so there was no longer a need for participants to add their name to the list. Participants in the control conditions were not exposed to these lists. All participants were then given a plate with 30 bite-sized pieces of pizza, which they were asked to taste and rate on a variety of dimensions (e.g., how salty, how crunchy, and how fresh). Participants were given 12 min to complete the taste test.

After completing the taste test, participants completed a "reasons for eating" survey. Participants were asked to indicate the extent to which 19 separate factors influenced how much they ate during the taste test. The only two factors of interest in the present study were "How much other people in the study ate" and "How hungry I was." The rest of the items were filler items included to mask our interest in those two key factors. All items were rated on a 9-point scale ranging from −4 (*made me eat less than I normally do*) to 4 (*made me eat more than I normally do*), with 0 (*did not influence me*) as the midpoint. After completing all of the measures, participants completed a suspicion probe (no participants guessed the true purpose of the experiment), and were then debriefed.

Results

Preliminary Analyses

There were no differences across conditions in age, BMI, or ethnicity, $ps > .19$. There were also no group differences in hunger ratings at the beginning of the experiment ($M_{\text{deprived}} = 6.98$ vs. $M_{\text{preload}} = 6.71$; $F = 0.58$, $p = .45$, $\eta_p^2 = .01$). Before completing the taste test, however, the deprived group had significantly higher hunger ratings ($M = 6.77$, $SD = 2.36$) than did the preload group ($M = 3.72$, $SD = 2.56$; $F = 39.68$, $p < .001$, $\eta_p^2 = .28$), indicating that our manipulation was successful. With respect to the norm manipulation, participants exposed to the low-intake norm provided a lower estimate of previous participants' intake ($M = 5.50$, $SD = 2.64$) than did participants exposed to the high-intake norm ($M = 10.85$, $SD = 3.44$; $F = 36.93$, $p < .001$, $\eta_p^2 = .45$).

Food Intake

A 2 (deprivation condition: deprived vs. preloaded) × 2 (norm condition: conflicting norm vs. no norm) analysis of variance (ANOVA) was used to examine group differences in food intake. There were significant main effects of deprivation condition ($F(1, 100) = 15.21$, $p < .001$, $\eta_p^2 = .13$) and of norm condition ($F(1, 100) = 4.38$, $p = .04$, $\eta_p^2 = .04$), which were qualified by a significant Deprivation × Norm interaction ($F(1, 100) = 14.89$, $p < .001$, $\eta_p^2 = .13$). Simple effects analyses revealed that participants in the deprived condition ate significantly fewer pizza pieces when exposed to a low-intake norm than when no norm was present, $p < .001$, $\eta_p^2 = .15$. In contrast, for preloaded participants, there was no significant difference between those who were exposed to a high-intake norm and those in the no-norm control condition, $p = .22$, $\eta_p^2 = .02$ (see Figure 1).

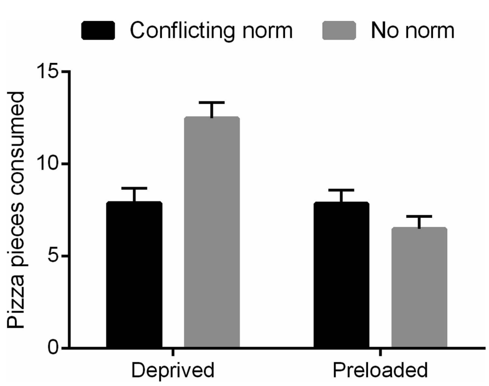

Figure 1. Mean number of pizza pieces consumed by condition. Error bars represent *SE*s.

Attributions for Food Intake

Separate mixed-model ANOVAs were conducted for participants in the deprivation and preload conditions, with norm condition as the between-subjects factor and attribution type as the within-subjects factor. In the deprivation condition, there was only a main effect of attribution type, $F(1, 49) = 74.89$, $p < .001$, $\eta_p^2 = .60$. Across both norm conditions, participants rated their hunger level as a stronger influence on their food intake ($M = 2.39$, $SD = 1.71$) than they rated the behavior of other people in the study ($M = -0.18$, $SD = 1.76$). Follow-up one-sample *t* tests indicated that, regardless of their norm condition, deprived participants rated hunger significantly above the midpoint of the scale ($ps < .001$), whereas ratings for the influence of other people's behavior did not differ from the neutral ("no influence") midpoint ($ps > .32$).

For the preload group, there was only a significant Modeling Condition × Attribution Interaction, $F(1, 50) = 9.17$, $p = .004$, $\eta_p^2 = .16$. Simple effects analyses indicated that, in the high-intake norm condition, participants rated the behavior of others ($M = 1.17$, $SD = 1.44$) as a stronger influence on their food intake than they rated hunger ($M = -0.17$, $SD = 2.46$), $p = .02$, $\eta_p^2 = .10$. In the no-norm condition, the difference between ratings of the influence of other people's behavior ($M = -0.03$, $SD = 1.01$) and hunger ($M = 0.90$, $SD = 2.41$) was not significant ($p = .07$, $\eta_p^2 = .07$). Follow-up analyses indicated that ratings for hunger were not different from the midpoint from the scale for either of the preloaded groups ($ps > .05$). Ratings for other people's behavior were not different from the midpoint of the scale for the no-norm group ($p = .86$), but were significantly above of the midpoint of the scale for the high-intake norm group ($p = .001$).

Discussion

This study examined the effect of conflicting eating cues on participants' food intake and on their explanations for why they ate as much or as little as they did. Participants who had been food deprived for 18 hr ate less when exposed to a low-intake norm than when no norm was present. In fact, the food intake of deprived participants in the low-norm condition was very similar to that of participants who had just consumed a preload. These findings extend the earlier research by Goldman et al. (1991) by demonstrating inhibited food intake among hungry participants exposed to low-intake confederates using a remote-confederate design. These remote-confederate findings suggest that it is the norm itself, rather than concerns with how one might be judged by a coeater, which is driving food intake. Participants who had filled up on a meal-replacement drink before the taste test ate slightly more when exposed to a high-intake norm than when no norm was present, but this difference was not statistically significant. These finding are consistent with the results of a recent meta-analysis indicating that social models have a more powerful inhibitory effect than augmenting effect on people's food intake (Vartanian et al., 2015).

In terms of their explanations for their food intake, participants who were food deprived, whether or not they were exposed to the remote confederate, indicated that their hunger made them eat more than they normally would. They also indicated that how much other people ate had no influence on their own food intake, despite the fact that those exposed to the low-intake confederates ate approximately 37% less food than did those in the no-norm condition. This failure to acknowledge the influence of external cues is consistent with past research (Vartanian et al., 2008, 2013), and further demonstrates how strongly people rely on internal eating cues (and deny external eating cues) to explain their food intake.

The pattern of attributions was different for participants in the preload conditions. Most notably, those who were exposed to the high-intake norm indicated that they ate more than they normally would have because of how much other people in the study ate, despite the fact that these participants did not actually eat significantly more than did participants in the no-norm condition. One explanation for this finding is that people might use external eating cues to justify their food intake when they believe that they may have eaten more than they should have. Spanos et al. (2014, 2015) have previously argued that people might be motivated to deny social influences on their food intake. It may also be the case, however, that under some circumstances people are motivated to *acknowledge* social influences (even if inaccurately). The suggestion that attributions for one's food intake might be motivated parallels the notion of a self-serving bias in attributions for behavior in general. People tend to explain their successes and failures in a way that reflects well on them (Zuckerman, 1979). Similar processes might be at play with regards to people's food intake such that the attributions they make might have implications for their self-esteem. In the present study, perhaps people who feared that they may have eaten too much seized upon hunger (as induced by the hunger manipulation) or the example of others (in the preloaded high-norm condition) as self-serving explanations for their behavior. The role of self-justification should be addressed more directly in future research, for example by measuring or manipulating the extent to which participants believe they have overeaten.

There are a number of limitations to the present study that should be noted. First, we had a fairly small sample, and it is possible that our study was underpowered to detect some effects (e.g., the increased food intake in the preloaded/high-norm condition). Second, our study included only female participants. There is some evidence that the modeling effect is weaker for men than it is for women (Vartanian et al., 2015), so it is possible that these effects would not be observed among men. It may also be that some groups of women (e.g., those who are dieting to lose weight) might be particularly motivated to make self-serving attributions about their food intake. Although research suggests that dieters and nondieters do not differ in the extent of their modeling (Roth, Herman, Polivy, & Pliner, 2001), their attributional styles may differ, particularly when intake is framed in evaluative terms (e.g., successful dieting vs. overeating). Similarly, our sample consisted predominantly of individuals with a BMI in the healthy range (75% had a BMI between 18.5 and 25.0), and it is possible that attributions for food intake could vary as a function of BMI. Third, although we had approximately equal numbers of White and Asian participants, our sample size was not large enough to test for moderation by ethnicity. Future research using a larger sample could explore individual differences in the attributions that people make for their food intake, and also the different circumstances surrounding those attributions. In addition to the limitations to our sample, our study consisted of a single eating occasion conducted in a laboratory setting, which could limit the generalizability of the findings. Replication of the results, across different contexts and longer time frames, would provide further insights into the nature and consequences of people's attributions for their food intake.

Overall, we found that social norms can override internal cues for eating (at least when people are quite hungry). Furthermore, people's attributions for their food intake were generally inaccurate: they denied social influences when they in fact affected their food intake (as in the deprived condition), and they implicated social influences when they in fact had little effect on their food intake (as in the preload condition). If individuals cannot identify (or will not acknowledge) the factors that influence their food intake, they may have difficulty appropriately regulating their eating behavior. Future research should focus on identifying whether attributional errors are more pronounced in some groups than in others (e.g., individuals with eating disorders or obesity), and what the practical significance is of these attributional errors (e.g., for understanding the development, maintenance, and treatment of diet-related problems).

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