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Research report

Social modeling effects on snack intake among young men. The role of hunger

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ABSTRACT

This study examined whether young men adjusted their snack-food intake to that of a same-sex eating companion. Additionally, hunger was assessed as a possible moderating variable. A total of 59 young men (*M* age = 21.73) participated. An interaction between participants' hunger and confederate's intake on the total amount of snack food (in grams) consumed was found. Only those males who were hungry at the start of the experiment modeled the intake of their eating companion. This finding suggests that hunger may play an important role in explaining the magnitude of social modeling among young men.

The association between environmental factors and human eating behavior has been studied extensively (see, e.g., Brug, 2008; Stroebele & de Castro, 2004; Van der Horst et al., 2007). These studies have consistently shown that food intake and food choice are affected by where, when and with whom one eats. Moreover, eating with or in the presence of other people might result in a different consumption pattern than solitary eating. Social facilitation studies have demonstrated that people eat more in the presence of others than when alone. It has been found repeatedly that as the number of people present increases, the amount of food consumed increases (e.g., de Castro & Brewer, 1992; Patel & Schlundt, 2001). Evidence for a direct effect of one's eating companion's intake on one's own intake can be found in the social modeling literature. These studies all find the same pattern: people tend to eat more when their eating companion eats more and less when their eating companion eats less (see Herman, Roth, & Polivy, 2003 for a review). One mechanism proposed to explain this effect is that in the absence of clear intake guidelines, people often engage in social comparison (Leone, Pliner, & Herman, 2007). More specifically, the amount eaten by the other might serve as a guide for appropriate intake. Most people are worried about being seen as eating excessively, because excessive eating is associated with negative connotations such as being deficient in self-control or the ability to delay gratification (Puhl, Schwartz, & Brownell, 2005); so the eating behavior of others might serve as an indication of how much is the appropriate (non-excessive) amount to eat. If the eating companion eats a large amount, one can safely eat a large amount too. However, if the eating companion eats only a small amount, then one must eat a small amount as well if one is to avoid eating excessively by comparison.

Until now, the vast majority of studies on social modeling among same-sex eating partners has focused almost exclusively on females (e.g., De Luca & Spigelman, 1979; Goldman, Herman, & Polivy, 1991; Hermans, Larsen, Herman, & Engels, 2008; Polivy, Herman, Younger, & Erskine, 1979; Rosenthal & Marx, 1979; Roth, Herman, Polivy, & Pliner, 2001). A few studies have been conducted on social modeling and food intake in men, and their results are mixed. One study that explicitly targeted males was the first study on modeling effects on eating behavior. Nisbett and Storms (1974) found that male participants consumed more food (i.e., crackers) in the presence of a male confederate who ate several (20) crackers and consumed less when in the presence of a confederate who ate only one cracker. These results were replicated in a study that compared modeling of food intake between male and female participants (Conger, Conger, Costanzo, Wright, & Matter, 1980), where it was found that participants' cracker intake increased with increases in the eating companion's intake for both males and females. In a more recent study, however, no similarities in food intake were found in dyads consisting of two male friends or two male strangers, indicating that men did not match each other's intake (Salvy, Jarrin, Paluch, Irfan, & Pliner, 2007).

We propose that sex differences in modeling of food intake might be explained by the notion that women and men possess divergent motivations when it comes to eating in social situations.

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If people adjust their intake to that of others to remove uncertainty about appropriate intake or to avoid negative judgments, then women are perhaps more likely to display social modeling of food intake. Eating, body image, weight and physical appearance are acknowledged as particularly salient concerns among women (Rodin, Silberstein, & Striegel-Moore, 1984) and therefore women may be more inclined to adjust their intake to that of their eating companion in order to avoid creating a negative impression. If these assumptions are correct, then the question arises to what extent men's intake is affected by their eating companion's intake. In this study, we focus exclusively on males in order to determine whether the modeling effect is restricted to females (cf. Hermans, Engels, Larsen, & Herman, 2009). Because social modeling effects of food intake among men have been examined mostly in laboratory taste-test designs (e.g., Conger et al., 1980; Nisbett and Storms, 1974), and therefore are not comparable with real-world eating situations, we unobtrusively observed male participants in a semi-naturalistic setting (i.e., a simulated living room) in order to maximize ecological validity.

Since eating behavior is multiply determined, it is important to take other important factors into account that may affect eating (and subsequently social modeling). An important and obvious factor might be an individual's level of hunger. Hunger is defined as a strong desire or need for food (Smith & Ferguson, 2008). Hunger is obviously associated with food intake and promotes food-seeking and ingestive behaviors (e.g., Castonguay, Applegate, Upton, & Stern, 1983; Nicolaidis & Even, 1985). There is not much research on the possible moderating role of hunger on social modeling of food intake. Goldman et al. (1991) were the first to manipulate hunger in a social-modeling experiment, pairing 12 or 24 h food-deprived individuals with a confederate instructed to eat either a lot or a little. The modeling effect was pronounced irrespective of (female) participants' feelings of hunger. So, regardless of what their body was telling them, the women's default response was to model their eating partner's food intake. This finding might be explained by the notion that women, more than men, are aware of their eating partner's intake and use this amount in order to determine their own intake (by matching their intake to that of the other person). For men, however, it might be that social modeling will play a role only if they are intrinsically motivated to eat. Their hunger level will make them more aware of the other's intake, which might lead consequently to a more prominent role of modeling of food intake. To our knowledge, this is the first study that examines whether hunger would promote social modeling among males.

In the present study, an experimental–observational design was used in which male participants spent a 15 min break, between two cover tasks, with a male confederate instructed to eat nothing, or a small amount, or a large amount of snack food. The main aim of this study was to examine whether young men adjusted their snack intake to that of another young man (previously unknown to them). Moreover, since not much is known about the role of males' hunger levels in the magnitude of modeling effects, we also examined the moderating effect of (measured, not manipulated) hunger levels on young men's social modeling of snack intake.

Method

Design

We employed a between-participants design with 3 experimental conditions in which male participants were exposed to male confederates who were instructed to eat nothing (no-intake confederate condition), 2 handfuls of cocktail nuts (low-intake confederate condition) or 10 handfuls of cocktail nuts (high-intake confederate condition).

Participants

A total of 61 young men (mainly undergraduate students) volunteered for the study. Participants were recruited via the sign-up system of the Behavioural Science Institute of the Radboud University Nijmegen or through direct approach by the experimenters in public places around the campus. Participants were awarded course credit (for educational requirements) or a €10 gift cheque for completing the study. Two participants were excluded from further analyses because they reported an allergy to peanuts and therefore could not eat the available test food. The final sample, then, consisted of 59 participants with a mean age of 21.73 (SD = 3.73) and a mean BMI of 23.13 (SD = 2.68). Table 1 displays the participants' characteristics across conditions.

Confederates

Four male students at the Radboud University Nijmegen acted as confederates. They had a mean age of 23.90 (SD = 2.91) and a mean BMI of 22.51 (SD = 1.58). Before the start of each session, we instructed the confederates regarding the amount of snack food that they had to consume (i.e., nothing, 2 handfuls, or 10 handfuls of cocktail nuts) during the break. The confederates were carefully instructed and trained in the procedure of picking the handfuls of nuts. They were randomly assigned to one of the three confederate-intake conditions. Further, the confederates were instructed not to take the initiative in the social interaction but to react naturally to remarks and questions from the participant (cf. Van Straaten, Engels, Finkenauer, & Holland, 2009).

Procedure

Under the pretext of a study on the evaluation of movie trailers, participants were asked to watch and evaluate three movie trailers. This was a cover story to prevent participants from becoming aware of the actual aim of the study (i.e., social modeling of food intake). The true nature of the study was discussed after the data collection of the whole study had been completed.

With the rationale of making the situation as naturalistic as possible, we furnished a small room as an ordinary living room (cf. Hermans et al., 2009). Participants were invited between 10 a.m. and 6 p.m., during the months of September–December 2008. Each session took approximately 60 min in total.

The experimenter met both the participant and the confederate at the front office of the lab facilities. After providing consent, both

Table 1
Participants' characteristics providing mean ± SE and range in parentheses.

	Total (N = 59)	No-intake condition (N = 18)	Low-intake condition (N = 20)	High-intake condition (N = 21)
Age (years)	21.73 ± 0.49 (15–35)	22.56 ± 0.86 (19–35)	21.00 ± 0.70 (18–32)	21.71 ± 0.94 (15–31)
BMI	23.13 ± 0.35 (18.41–31.25)	23.32 ± 0.73 (20.23–31.25)	23.58 ± 0.71 (19.04–30.86)	22.54 ± 0.35 (18.41–25.96)
Overweight (%)	15.3	16.8	25.0	4.8
Obese (%)	3.4	5.6	5.0	0
Hunger level	4.12 ± 0.31 (1–8)	4.06 ± 0.58 (1–7)	4.15 ± 0.54 (1–8)	4.14 ± 0.53 (1–8)

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men were accompanied to the laboratory where the procedure of the study was explained to them. First, they were told that they would individually evaluate the movie trailers of three popular Dutch movies (none of which contained references to weight or food). They were instructed not to engage in any discussion of their evaluations with the other person, or to talk about the movie in general. The experimenter then started the DVD and left the room. The task took approximately 10 min.

After this task, the experimenter entered the room again. On the pretext that there had to be an interval of time before the evaluation of the next set of movie trailers, participants were told that they would have a break. They were instructed to stay in the room, but they could spend their time as they wished. The experimenter did not indicate how long the break would last, unless specifically asked, in which case he told the participant. Finally, the experimenter put on some light background music (Ibiza Lounge, EMI Music Holland B.V., The Netherlands) and casually told the participants that they were free to help themselves to the water and the cocktail nuts. These instructions were identical across sessions. Participants were positioned at a 90° to each other, so that they could easily face each other. The bowl of nuts (described below) and the jug of water were within easy reach of both participants. Because our aim was to examine modeling of snack intake, the confederate always had to take the first handful of nuts at the beginning of the break. During all sessions, the confederate followed instructions to avoid making any remarks on the taste, color, smell or palatability of the available food snacks. Standardized time instructions were given by a small light in the corner of the room (visible only to the confederate). When the confederate saw the light flashing, he had to take a handful of nuts (cf. Hermans et al., 2008). In the low- and high-intake confederate conditions, the light flashed on two and ten occasions, respectively. Behavior during the experimental break was recorded with an unobtrusive camera hidden in the corner of the room. After exactly 15 min, the experimenter reentered the room and turned off the background music. Instructions were then given for the second evaluation task. Participants had to watch the same set of movie trailers, but were now free to discuss their evaluations. This task lasted approximately 10 min.

Finally, both participants had to complete some questionnaires. They were told that owing to privacy concerns, they would be separated from each other. The actual participant completed a questionnaire about his subjective rating of pre-experimental hunger, food-related allergies, and his awareness and perception of the other's snack intake. After he completed the questionnaire, the participant's height and weight were measured. Post-experimental interviews indicated that participants were naïve regarding the real aim of the study and that they were unaware that their snack consumption was being measured.

Measurements

Food intake

Because we intended to use popular, high-caloric snack food, we asked 15 young men (including the confederates) in a preliminary enquiry what kind of snack food they liked best when watching a movie. They reported cocktail nuts as one of their most preferred choices. The nuts were 'Knabbelnoten Oriëntal', produced by *Duyvis* (The Netherlands) and had a mean weight of 0.8 g per nut and contained a mean of 4.52 kcal/g. In order to create a setting as naturalistic as possible, we offered only one bowl of nuts, which the participants had to share. The content of the bowl was weighed to the nearest 0.1 g (Kern440, Kern & Sohn GmbH, Balingen, Germany) immediately before and after the sessions in order to determine the amount of snack food eaten. Because both participants were free to eat from the same bowl, we estimated the mean intake of the confederate in the low- and high-intake confederate conditions. In the low-intake condition (i.e., 2 handfuls of nuts), the confederate ate approximately 8 g of nuts. In the high-intake condition (i.e., 10 handfuls of nuts), the confederate ate approximately 40 g. Thus, each handful consisted of approximately 5 cocktail nuts (4 g).

We used the following formula to determine the amount of nuts (in grams) eaten by the participant: weight of the bowl before the experiment minus the weight of the bowl after the experiment minus 8 or 40 g in the low- or high-intake confederate condition, respectively. In the no-intake condition, in which the confederate ate nothing, the amount of food eaten was calculated as the weight of the bowl before the experiment minus the weight of the bowl after the experiment. Our dependent variable, then, was the total amount of nuts eaten (in grams) by each participant. Of course, the results would have been the same if we had used total number of kcal consumed, since using kcal involves a mere recoding of grams.

Hunger

Hunger was assessed using a 10-point rating scale, with possible responses ranging from 1 ('not at all hungry') to 10 ('very hungry') (cf. Hermans et al., 2008). We assumed that asking participants to refrain from eating for a certain period of time before the experiment, which is the best option for controlling individual variations in hunger (Polivy, Heatherton, & Herman, 1988), might have suggested the actual aim of the study and thereby distorted participants' natural eating behavior. To avoid this bias, we measured participants' pre-experimental hunger at the end of the experimental session (cf. Anschutz, Engels, Becker, & Van Strien, 2009; Hermans et al., 2008).

Height and weight

The research assistant measured each participant's height and weight following standard procedures (Lohman, Roche, & Martorell, 1998). Height was measured to the nearest 0.5 cm using a stadiometer (Seca 206, Seca GmbH & co., Hamburg, Germany) and weight was measured to the nearest 0.1 kg using a digital scale (Seca Bella 840, Seca GmbH & co., Hamburg, Germany). BMI was calculated as weight in kg divided by the square of height in meters.

Participants' awareness of confederate's intake

To measure participants' awareness of the confederate's intake, we asked them to indicate how many handfuls of cocktail nuts the other person had eaten.

Results

Manipulation checks

Participants estimated the intake of the confederate as higher ($M = 3.45$, SD = 2.39, 95% CI = 2.33–4.57) in the high-intake condition than in the low-intake condition ($M = 1.47$, SD = 0.98, 95% CI = 1.00–1.95), $t(37) = -3.35$, $p < 0.01$. All participants in the no-intake confederate condition ($N = 18$) reported that the confederate did not eat any nuts during the 15 min break.

Impact of confederate's intake condition and participants' hunger on intake

Before performing our main analysis, we first examined whether participants differed with respect to potential confounding variables. BMI and liking of the snack food available were not significantly correlated with participants' intake ($p > 0.10$) and therefore not included in the model as potential confounds. In

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Table 2
Total amount of energy dense food (in grams) consumed in the different conditions by participants with different levels of hunger.

	Below average hunger	Average hunger	Above average hunger
	M (SE)	M (SE)	M (SE)
No-intake confederate condition	0.27 (*3.95*)	3.32 (*2.83*)	6.37 (*4.06*)*
Low-intake confederate condition	5.62 (*3.84*)	7.21 (*2.68*)	8.80 (*3.79*)
High-intake confederate condition	0.99 (*3.74*)	11.97 (*2.62*)	22.94 (*3.70*)**

Note: *$p < 0.05$, **$p < 0.01$.

order to examine the moderating role of hunger on social modeling of snack intake, we added hunger as a linear variable to our statistical model. Prior to the ANCOVA analysis, participants' hunger was standardized. All analyses were performed with SPSS 15.0 (SPSS for Windows, Rel. 15.01.2006, Chicago: SPSS Inc.).

No main effect was found for the confederate's intake condition on the total amount of nuts eaten (in grams) eaten by the participant, $F(2, 53) = 2.54$, $p = 0.09$. In contrast, a main effect for hunger was found, $F(1, 53) = 10.87$, $p < 0.01$, indicating that participants who reported having been hungrier before the experiment ate more snack food during the break. Moreover, a significant interaction effect was found between confederate's intake condition and participants' hunger on the total amount of snack food consumed, $F(2, 53) = 3.55$, $p < 0.05$. To clarify the interaction, we conducted analyses of simple effects. We ran two regressions involving hunger levels one standard deviation above and one standard deviation below the standardized pre-experimental hunger score (Aiken & West, 1991). These analyses revealed no effect of confederate's intake condition for participants with a below-average hunger score, $F(2, 53) = 0.57$, p = n.s., but there was an effect of confederate's intake condition for participants with an above-average hunger score, $F(2, 53) = 5.55$, $p < 0.01$. In other words, only those participants with an above-average hunger score adjusted their intake to that of the confederate. They consumed more snack food when with a high-intake confederate than when with a low-intake confederate ($p < 0.05$) or a no-intake confederate ($p < 0.01$) (see Table 2).

Additional analyses

Although BMI was unrelated to intake, we examined whether omission of overweight participants would alter the results. Examining only the normal-weight ($18 < \text{BMI} < 25$) participants in our sample ($N = 48$), we found the same interaction between participants' pre-experimental hunger and confederate's intake condition on the total amount of nuts eaten, $F(2, 24) = 3.92$, $p < 0.05$. Furthermore, we checked whether the participants' hunger levels were related to the participants' estimations of the confederates' handfuls of nuts picked. A marginally significant interaction was found between confederate's intake condition and participants' level of hunger on the participants' estimations of confederate's number of handfuls picked, $F(1, 35) = 3.07$, $p = 0.09$, indicating that the participants with above-average hunger scores also reported that the high-intake confederate took more handfuls (see Table 3).

Table 3
Participants' estimations of confederates' handfuls picked by participants with different levels of hunger.

Confederate's intake condition	Participants' level of hunger	Mean	SE
Low-intake confederate (2)	Low	1.54	0.51
Low-intake confederate (10)	High	1.36	0.67
High-intake confederate (2)	Low	2.71	0.51
High-intake confederate (10)	High	4.56	0.62

Note: between parentheses is the actual number of handfuls picked by the confederates.

Discussion

Heretofore, the majority of studies on social modeling of food intake have focused almost exclusively on females (see Herman et al., 2003, for a review). This may be due to the fact that one of the mechanisms proposed to explain this effect (i.e., social norms regarding appropriate intake) is assumed to be more important for females than for males. In this study, we examined social modeling of snack-food intake among young men. Further, we investigated the possible moderating role of hunger on social modeling of snack-food intake.

This study showed, first, that men who were hungry prior to the experiment ate more snack food during the break. The effect of hunger on food intake is consistent with findings indicating that hunger is associated with food-seeking behaviors and actual intake (e.g., Castonguay et al., 1983; Nicolaidis & Even, 1985). Second, and more importantly, it was found that the modeling effect was qualified by the level of hunger. That is, only the men who reported high pre-experimental hunger adjusted their intake to that of their eating companion. They ate more snack food when the other ate more snack food, but they also refrained from eating when the other refrained from eating. This suggests that males' hunger levels were more readily expressed when the males were exposed to an eating companion eating a large amount of cocktail nuts.

We offer two possible explanations for the moderating effect of hunger found in the present study. First, it may be that men have to be in a state of hunger (and thus intrinsically motivated to satisfy one's hunger) before social modeling processes come to fore. It may be that hungry males eat as much as possible, but within the constraints imposed by their eating companion. Hunger is an excitatory process that arises from energy needs (Smith & Ferguson, 2008) and is defined as a strong desire or need for food. Therefore, the hungry males were simply more motivated to eat the available snack food in order to fulfill their bodily needs. Nonetheless, they still take into account their eating companion's intake in order not to eat appreciably more than the companion does. The males with moderate and low levels of hunger were not motivated to eat maximally. So, even though their eating companion ate a large amount, they were less likely to eat more (and thus did not model the other's intake). In sum, this first normative explanation suggests that hungry males exposed to an eating companion eating a little have inhibited their intake.

A second explanation may be that the males who were accompanied by a high-intake companion were more exposed to food-related sensory stimuli (e.g., sight and sounds), which may have led, in combination with their high levels of hunger, to a substantial increase in intake. Hunger makes people more responsive to these external food-related cues (Jacobs & Sharma, 1969; Kaufman, Herman, & Polivy, 1995) and individuals with high levels of hunger exhibit an attentional bias for food-related stimuli (Mogg, Bradley, Hyare, & Lee, 1998). In the high-intake condition, the males were exposed to another male who took a handful of cocktails nuts on 10 occasions (which amounts to a handful of nuts every 90 s). This means that they were regularly exposed to an eating person whose consumption was accompanied by the sound of crunching nuts. All in all, the sight and sound of the eating companion might have provided very powerful cues, which might

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have resulted in a substantial increase in intake among these hungry males. In the present study, it was found that hungry males were more accurate in their estimations of the amount eaten by the other person. This finding supports the assumption that hungry individuals are more responsive to external food-related cues. It would be interesting to investigate the specific role of hunger on responsiveness to food-related cues and modeling behavior in future studies.

One possible concern arises from the fact that the hunger ratings were made at the end of the experiment. It is conceivable that the males who ate a lot in the presence of a high-intake confederate rated themselves as hungry only retrospectively, in light of how much they ate. This potential artifact, however, cannot explain why males rated themselves hungry in the low- and no-intake conditions, in which they did not eat a lot even when the companion did.

Our results are not in line with the study of Goldman et al. (1991) who found that women modeled the intake of a same-sex eating companion regardless of their hunger levels. We propose that women's more intense social motives are responsible for this finding. It is widely assumed that self-presentational statements regarding food and eating are more important for women than for men (e.g., Berry, Beatty, & Klesges, 1985; Roth et al., 2001). Moreover, behaving appropriately with respect to one's eating behavior may be a particularly female concern. It might be that women, whether or not hungry, adjust their intake to that of another woman because they feel obliged (for social reasons) to do so. So, whereas for women adjusting one's intake to that of an other person seems to be the default response to avoid negative judgments (Roth et al., 2001), this study demonstrates that males may not be as concerned with social propriety.

A few limitations warrant discussion. Since the majority of our sample consisted of relatively young and normal-weight men, the question arises as to whether we should expect the same results for overweight or obese hungry men in older age groups. It might be the case that obese men will be more concerned with making a good impression (or avoiding negative judgments), and therefore be more likely to model the intake of their eating companion. Moreover, it may be that when examining same-sex and same-weight men, low-hunger obese men will model the high-intake model out of a sense of social obligation. Second, the men in our study were paired with a same-sex confederate who was previously unknown to them. The strange eating companion or the experimental setting might have led to a general inhibition of eating as reflected in the fact that the overall level of intake during the break was generally low. Although this finding is not uncommon in the modeling literature (cf. Hermans et al., 2009), the question remains as to whether the role of hunger on modeling of food intake would have been the same if the males were friends, family members or acquaintances. Third, we chose to offer only one specific snack food (nuts) which might have limited the generalizibility of our study results. Findings should be replicated with other types of snack food or complete meals.

Taking these limitations into account, our findings provide evidence for the fact that hungry males may be more aware of the amount eaten by their eating companion and therefore more likely to display social modeling behavior. We suggest that these results might be helpful in the development of prevention strategies focusing on overeating (or undereating) in social contexts. Insight into the question of why hungry males eat more or less just because an eating companion does may be help to explain the increase of human food intake in recent years. Moreover, prevention strategies might inform men of the social factors affecting their intake and make them more aware of these influences. In conclusion, the present study showed that young men modeled the intake of their same-sex eating companion only when they were in a state of hunger. This study provided the first experimental evidence that hunger may moderate men's modeling of snack-food intake. However, future studies are needed to further disentangle the effects of hunger and social motives on modeling of food intake.

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