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Modeling of food intake among restrained and unrestrained eaters

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ABSTRACT

The Theory of Normal Eating suggests that how much others eat sets an upper limit for how much it is appropriate to eat. This study tested the hypothesis that restrained eaters, who typically eat less than they want to, would be more responsive to a high-intake norm than would unrestrained eaters. Data were combined from 8 experimental studies (total $N = 735$ female participants; 305 restrained eaters, 430 unrestrained eaters). Each study: (a) included a low-intake norm, a high-intake norm, and a no-norm control condition; (b) measured participants' food intake; and (c) included the Restraint Scale as a measure of dietary restraint. There were no differences between restrained unrestrained eaters in the no-norm control condition or in the magnitude of the inhibition effect (i.e., the difference between the low-intake norm condition and the control condition). There was, however, a restraint difference in the magnitude of the augmentation effect (i.e., the difference between the high-intake norm condition and the control condition). Restrained eaters showed a larger augmentation effect ($d = 0.58$; 95% CI = 0.29, 0.87) than did unrestrained eaters ($d = 0.20$; 95% CI = −0.05, 0.45). Social norms provide an upper limit for acceptable food intake, with high-intake norms permitting (but not requiring) individuals to indulge themselves. The fact that restrained eaters were more responsive to the high-intake norm than were unrestrained eaters suggests that the high-intake norm gives restrained eaters permission to indulge when they typically eat less than they want to.

1. Introduction

Social influences play an important role in dictating how much people eat in a particular situation. One of the most robust social influences is "modeling," which refers to people's tendency to eat a similar amount to what their companions eat: people eat more when their eating companions eat a lot, and they eat less when their eating companions eat relatively little (Vartanian, Spanos, Herman, & Polivy, 2015). Modeling of food intake has been observed in both correlational and experimental studies, and with a variety of different foods (Herman, Polivy, Pliner, & Vartanian, 2019). Modeling is observed even when other factors (such as hunger) would be expected to be the primary determinants of how much people eat. For example, in one study (Vartanian, Spanos, Herman, & Polivy, 2017), participants were food deprived for 18-h prior to taking part in a pizza "taste test" (a cover story used to mask the true purpose of the study). Some of the participants did the taste test at the start of the experimental session (i.e., while they were still hungry); others were given a meal-replacement shake (700 kcal) to consume before taking part in the pizza taste test; and still others did not receive the meal-replacement shake but were instead exposed to a low-intake norm indicating that previous participants had eaten minimally in the taste test. Participants who consumed the meal-replacement shake ate around 50% less than did participants who completed the taste test while hungry, but so did hungry participants who were exposed to the low-intake norm. These findings highlight the potency of social influences on people's food intake.

The Theory of Normal Eating (Herman, Polivy, & Pliner, 2019; Herman, Polivy, Pliner, and Vartanian, 2019) was developed to explain how much people eat. In general terms, this theory postulates that, in the presence of palatable food, people will continue to eat until some inhibitory force intervenes (e.g., the food stops tasting good; the food is all gone; one starts feeling full). More specifically, the theory suggests that people are motivated to eat as much as they can without eating "excessively," and that excess is often defined by how much others are eating, rather than simply by how satiated one is feeling (see also Herman, Roth, & Polivy, 2003). In other words, how much other people eat provides an upper limit on acceptable food intake. Thus, if one's companions eat minimally, a low upper limit is set and one should also eat

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minimally. If one's companions eat a lot, however, one is not *required* to eat as much as they do, but one may eat as much as one wants, as long as one does not eat more than others do. This theoretical perspective suggests an asymmetry in how norms influence behavior such that the inhibitory norms created by others eating minimally should have a greater impact on food intake (always suppressing intake, except in those rare cases in which one is already inclined to eat minimally) than should the augmenting norms created by others eating a lot (where one may or may not eat as much as the elevated standard set by others). In support of this perspective, a meta-analysis of studies examining the effects of social norms on food intake showed that the average inhibitory effect on people's food intake is greater ($d = 0.47$) than is the average augmenting effect ($d = 0.29$) (Vartanian et al., 2015).

If high-intake norms give people permission to eat more or less as much as they want (at least up to an upper limit set by the high-intake norm), then one might expect that certain individuals or groups would be more likely than others to increase their food intake when exposed to a high-intake norm. Specifically, individuals or groups who ordinarily tend to eat less than they want to eat may use the high-intake norm as an opportunity to indulge. Restrained eaters (chronic dieters) could be one such group. Restrained eaters are individuals who regularly try to limit their food intake as a means of controlling their body weight/shape, but they are only intermittently successful at doing so (e.g., Polivy, 1998). Restrained eaters display disinhibited eating in a range of situations, including consuming a diet-breaking preload (e.g., Herman & Mack, 1975; Sin and Vartanian, 2012), experiencing negative mood (Schotte, Cools, & McNally, 1990), or engaging in a cognitively-taxing activity (Ward & Mann, 2000). One study even demonstrated that restrained eaters who were simply told that they would be beginning a diet the following day ate more during a taste test than did those who did not think that they were starting a diet the next day (Urbszat, Herman, & Polivy, 2002).

Some researchers have argued that dietary restraint (as measured by the Restraint Scale) is not necessarily associated with acute caloric restriction (e.g., Stice, Fisher, & Lowe, 2004), but rather that restrained eating might be better conceptualized as regularly eating less than one wants rather than less than one needs (Lowe & Levine, 2005; Markowitz, Butryn, & Lowe, 2008). From this perspective, the disinhibition observed among restrained eating can be understood as the result of appetitive drives to consume palatable foods overriding the self-imposed limits on consuming those foods. If restrained eaters typically eat less than they want to eat (of certain foods, at least), then one might expect that social norms that permit high levels of consumption would provide restrained eaters with an opportunity to indulge without compunction. Thus, restrained eaters should be particularly responsive to a high-intake social norm.

There is only one modeling study to date that specifically examined whether dietary restraint moderated the effects of social norms on participants' food intake, and that study reported no differences between restrained and unrestrained eaters in the impact of the social norm (Roth, Herman, Polivy, & Pliner, 2001). However, that study was not specifically designed or adequately powered to address this question (only 38% of the total sample were restrained eaters, resulting in fewer than 10 restrained eaters in any of the conditions). Thus, the question of whether there are restraint differences in modeling of food intake remains unanswered.

The aim of the present study was to provide a high-powered test of the hypothesized restraint differences in modeling of food intake. To do so, we pooled data from eight experimental studies (six published and two unpublished) each of which: (a) experimentally created a low-intake norm condition, a high-intake norm condition, and a no-norm control condition; (b) measured participants' food intake; and (c) measured dietary restraint with the Restraint Scale (Herman & Polivy, 1980). Meta-analytic procedures were used to examine restraint differences in intake separately for each condition (control, low-intake norm, and high-intake norm), and also to examine restraint differences in the size of the inhibition effect (i.e., the difference in intake between the low-intake norm condition and the no-norm control condition) and the size of the augmentation effect (i.e., the different in intake between the high-intake norm condition and the no-norm control condition). Following from the Theory of Normal Eating (Herman, Polivy, Pliner, and Vartanian, 2019) and prior work on restrained eating, it was predicted that restrained eaters would eat more than would unrestrained eaters in the high-intake norm condition and would also show a larger augmenting effect than would unrestrained eaters. If restrained eaters are generally more responsive to social cues, then one might also expect restrained eaters to eat less than unrestrained eaters in the low-intake norm condition, and to demonstrate a stronger inhibition effect than unrestrained eaters.

2. Method

Data were pooled from eight previous studies. The six published studies were: Cruwys et al. (2012), Feeney, Pliner, Polivy, and Herman (2017; Session 1 data), Pliner and Mann (2004; Experiment 1), Roth et al. (2001; non-observed condition), and Vartanian, Sokol, Herman, and Polivy (2013; Experiments 1 and 3). Raw data were also available from two unpublished studies (Feeney, 2011; Palandra, 2006).

2.1. Participants

Combined across studies, there were a total of 735 female participants (305 restrained eaters, 430 unrestrained eaters). Participant characteristics and details of the experimental design for each study are presented in Table 1.

2.2. Modeling manipulation

All of the studies included in this meta-analysis had three norm conditions: a high-intake norm, a low-intake norm, and a no-norm control. Five of the studies used a remote-confederate design to convey the normative information. In four of these studies, a sheet of paper ostensibly listing the food intake of 10 previous participants was affixed to the table at which participants were seated for the taste test. The information presented on the sheet was modified to convey a low-intake norm or a high-intake norm. In the control condition, participants were not provided with any norm information. Participants in these studies were told that the researchers had been asking previous participants to record how much they were eating so that the researchers could know how much food to order, but that all of the food had now been ordered so the participant did not need to add her information to the list. The fifth remote-confederate study used a video to present the normative information: Before themselves taking part in the taste test, participants watched a model taking part in a taste test. The model was shown eating either a small amount or a large amount. (In the control condition, no video was shown.) The three remaining studies used a live-confederate manipulation. In one study, participants had incidental access to food while completing a problem-solving task either alone (control condition) or with a confederate who was posing as another participant in the study. In a second study, participants had incidental access to the food while watching a program on television either alone (control condition) or with an experimental confederate. In both cases, the confederate was instructed to eat minimally (low-intake norm condition) or to eat a large amount (high-intake norm condition). The third live-confederate study took a different approach: Participants met the confederate as the participant was coming in to the study and the confederate was supposedly leaving. The confederate mention in passing that she had eaten all of the popcorn (or none of the popcorn) that was given to her as part of the study. There was no confederate in the control condition.

Table 1
Participant characteristics and experimental design for each study.

	N of Restrained/ Unrestrained	Mean age (*SD*)	Mean BMI (*SD*)	Type of confederate	Type of food	Low-intake norm	High-intake norm
Cruwys et al. (2012)	38/67	19.48 (2.62)	21.73 (3.77)	Live	Popcorn	0 g (ate none of the popcorn)	50 g (ate all of the popcorn)
Feeney et al. (2017)	46/85	18.79 (1.87)	–	Remote (written)	Mimi pizza pieces	3	18
Feeney unpublished thesis	35/57	19.25 (1.78)	–	Live	Mini pizza pieces	3	17
Palandra unpublished thesis	45/59	–	22.91 (4.33)	Remote (video)	Mini cookies	4	16
Pliner and Mann (2004)	21/52	19.9 (2.6)	–	Remote (written)	Mini cookies	4	14
Roth et al. (2001)	26/41	23 (4.03)	–	Remote (written)	Mini cookies	4	14
Vartanian et al. (2013; Exp. 1)	43/28	21.07 (2.23)	21.49 (2.49)	Remote (written)	Mini cookies	4	14
Vartanian et al. (2013; Exp. 3)	51/41	20.52 (2.32)	21.91 (3.84)	Live	M&Ms	2	35

2.3. Food intake

In all studies, the dependent variable was the amount of food (pizza, cookies, popcorn or M&Ms) consumed, measured either in terms of the number of units consumed or the weight of the food consumed. The food items were counted and/or weighed before and after the experimental session to calculate the total amount consumed by each participant.

2.4. Dietary restraint

In each study, participants completed the Restraint Scale (Herman & Polivy, 1980), a 10-item measure of weight fluctuations and concern for dieting. Although there was been some debate in the literature regarding whether or not the Restraint Scale is a valid measure dietary restriction (e.g., Stice et al., 2004), there is ample evidence that the measure does capture a tendency to overindulge under certain conditions in laboratory experiments (Polivy & Herman, 2020). Thus, the measure is suitable for testing the hypotheses in this study. In each study, participants were classified as restrained eaters if they scored 15 or high and were classified as unrestrained eaters if they scored 14 or lower.

2.5. Meta-analytic procedure

Effect sizes were calculated as Cohen's *d*s and were derived from the means and standard deviations reported in the published paper or were extracted from the data file provided by the original authors. Fixed-effects models were used to test the hypotheses because fixed-effects models are ideally suited for making inferences about a set of observed studies (Hedges & Vevea, 1998) and because random-effects models are less suitable when there are relatively few studies included in the analysis (Guolo & Varin, 2017). The present study involved five separate meta-analyses: The first set of analyses examined whether there were restraint differences in intake (a) when participants ate alone under normal laboratory conditions (the control condition), (b) when participants were exposed to a low-intake norm, and (c) when participants were exposed to a high-intake norm. The second set of analyses examined (d) whether there were restraint differences across studies in the inhibition effect (i.e., the difference in intake between the control condition and the low-intake norm condition), and (e) whether there were restraint differences in the augmentation effect (i.e., the difference in intake between the control condition and the high-intake condition). All meta-analyses were conducted using Comprehensive Meta-Analysis v3.1. The significance of the overall effect size for each analysis is represented by the *Z*-statistic, 95% Confidence Interval, and corresponding *p*-value. Between-groups heterogeneity (i.e., restraint differences in the magnitude of the inhibition/augmentation effects) are represented by the Q-statistic and corresponding *p*-value.

3. Results

3.1. Restraint differences by condition

Restraint differences in food intake (separately for each condition) are displayed in Fig. 1. In the control condition, restrained eaters ate slightly less, on average, than did unrestrained eaters ($d = -0.13$; 95% CI $= -0.39, 0.13$), but this effect was highly variable across studies, and the overall difference was not significant, $Z = -1.00$, $p = .316$. There was also no difference between restraint and unrestrained eaters in the low-intake norm condition, $d = 0.07$, 95% CI $= -0.19, 0.34$, $Z = 0.54$, $p = .591$. Consistent with our hypothesis, however, restrained eaters did eat significantly more than did unrestrained eaters in the high-intake norm condition ($d = 0.44$, 95% CI $= 0.17, 0.71$), and this pattern was consistent across studies, $Z = 3.15$, $p = .002$.

3.2. Inhibition effect

The overall inhibition effect was significant, $d = -0.41$, 95% CI $= -0.61, -0.22$, $Z = -4.26$, $p < .001$, indicating that participants in the low-intake norm condition ate less than did participants in the control condition. Across studies, restrained eaters showed a slightly smaller inhibition effect ($d = -0.33$; 95% CI $= -0.62, -0.04$; $p = .03$) than did unrestrained eaters ($d = -0.48$; 95% CI $= -0.74, -0.23$; $p < .001$), but this difference was not statistically significant, $Q\ (1) = 0.63$, $p = .428$ (see Fig. 2).

3.3. Augmentation effect

The overall augmentation effect was significant, $d = 0.36$, 95% CI $= 0.17, 0.55$, $Z = 3.72$, $p < .001$, indicating that participants in the high-intake norm condition ate more than did participants in the control condition. Consistent with our hypothesis, across studies, restrained eaters showed a larger augmentation effect ($d = 0.58$; 95% CI $= 0.29, 0.87$; $p < .001$) than did unrestrained eaters ($d = 0.20$; 95% CI $= -0.05, 0.45$; $p = .125$), $Q\ (1) = 3.89$, $p = .049$ (see Fig. 3).

4. Discussion

Modeling of food intake is a robust phenomenon, with numerous studies showing that people eat more when eating with a companion who eats a lot than when eating with a companion who eats only a little. According to the Theory of Normal Eating (Herman, Polivy, Pliner, and Vartanian, 2019), the eating behavior of others sets an upper limit for acceptable food intake. A low-intake norm pressures individuals to suppress their food intake, whereas a high-intake norm permits people to eat much more (as long as they do not exceed the amount that other high-intake eaters are eating). The present study addressed the question

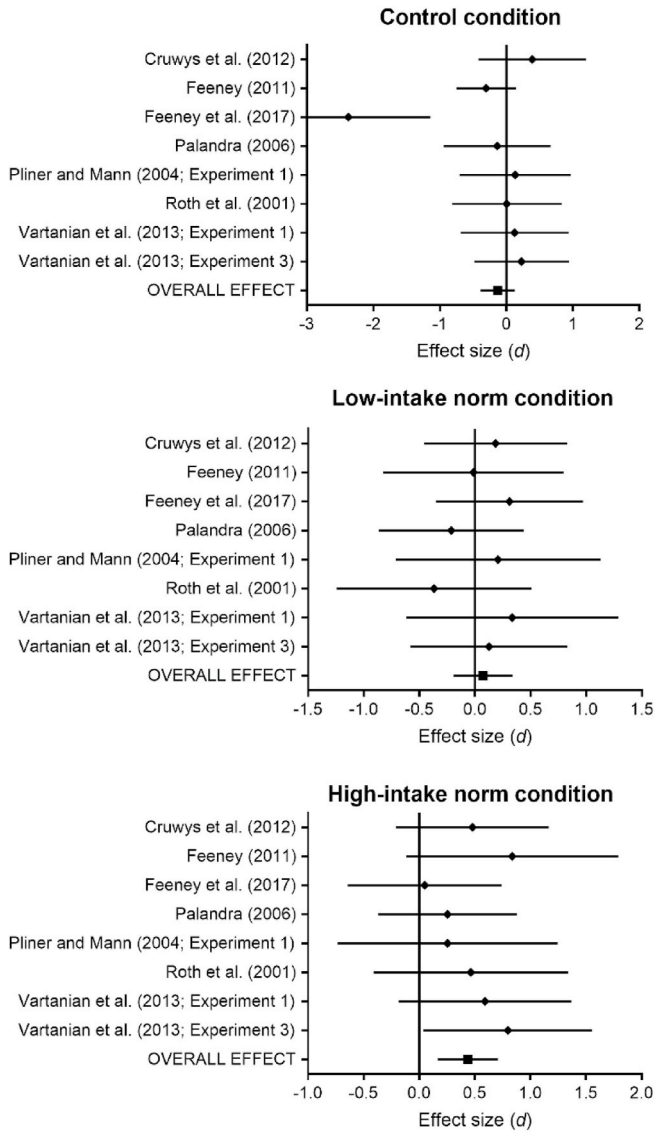

Fig. 1. Forest plot of effect sizes comparing intake between restrained and unrestrained eaters, separately for each condition. Positive values indicate greater food intake among restrained eaters than among unrestrained eaters.

of whether restrained and unrestrained eaters respond differently to high-intake norms. Insofar as restrained eaters typically eat less than they want to eat (Lowe & Levine, 2005), they were expected to be particularly responsive to the high-intake norm manipulation, because they should be motivated to take advantage of situations in which they are "allowed" to indulge their usually thwarted desire to eat more food. The results of the present study supported this expectation.

The first analysis showed that, although restrained eaters ate somewhat less than did unrestrained eaters in the eat-alone control condition (i.e., when no explicit norm was present), the mean effect size was small and the difference was not statistically significant. This finding is consistent with the argument that the Restraint Scale does not necessarily capture acute caloric restriction (Stice et al., 2004; Williamson et al., 2007), and that restrained eating may be characterized as eating less than one wants rather than as eating less than one needs (Lowe & Levine, 2005). The absence of a difference in the control condition also suggests that any observed differences in responsiveness in the social-norm conditions cannot be attributed to differences in intake under normal conditions and are thus the result of the experimental manipulations.

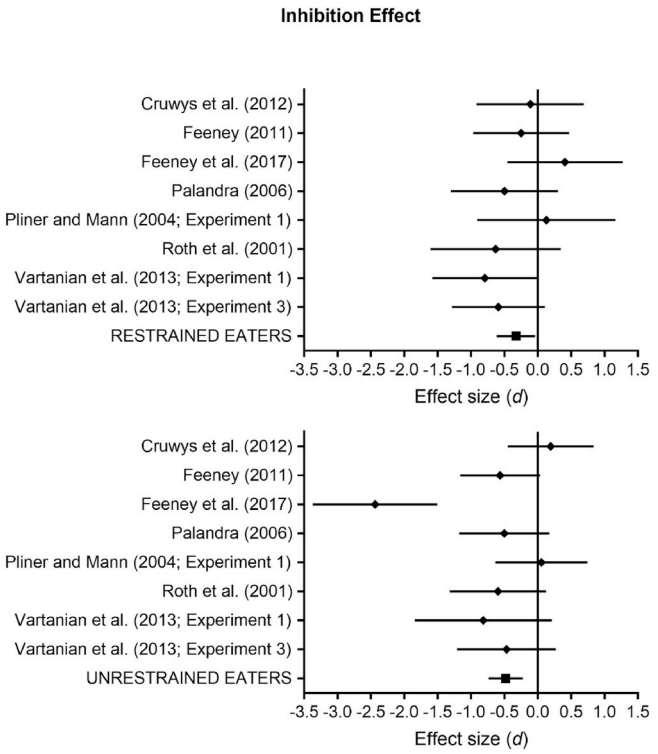

Fig. 2. Forest plot of effect sizes for the inhibition effect, separately for restrained eaters (top panel) and unrestrained eaters (bottom panel).

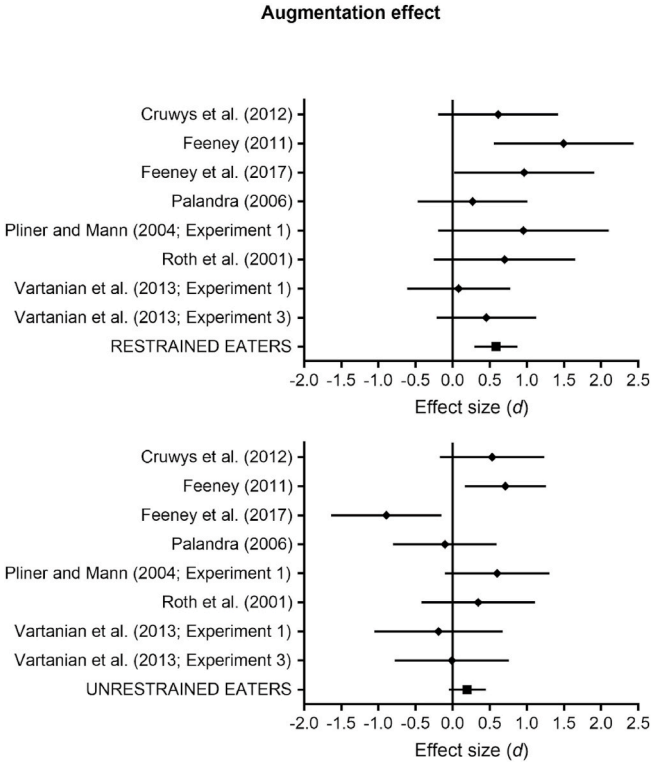

Fig. 3. Forest plot of effect sizes for the augmentation effect, separately for restrained eaters (top panel) and unrestrained eaters (bottom panel).

Restrained and unrestrained eaters did not differ in how much they ate in the low-intake norm condition, and there was also no significant difference between restrained and unrestrained eaters in the magnitude

of the inhibition effect. If anything, restrained eaters showed a somewhat smaller inhibition effect, perhaps because restrained eaters ate slightly less than did unrestrained eaters in the control condition (and therefore were already closer to the "low ceiling" set by the low-intake norm). Importantly, this finding indicates that restrained eaters are not, in general, more responsive to normative cues than are unrestrained eaters. When one's eating companions eat minimally, they set a low ceiling for acceptable food intake and provide a clear signal that one should inhibit one's food intake. Restrained and unrestrained eaters alike respond to that norm by reducing their food intake.

The main question of interest in this study was whether restrained and unrestrained eaters differ in their response to the augmentation norm. Across studies, restrained eaters ate more than unrestrained eaters did in the high-intake norm condition, and also showed a substantially larger augmentation effect than did unrestrained eaters. In fact, the augmentation effect among restrained eaters was moderate ($d = 0.58$) and statistically significant, whereas the augmentation effect among unrestrained eaters was small ($d = 0.20$) and not statistically significant. Presumably unrestrained eaters did not eat substantially more in the high-intake norm condition than in the no-norm control condition because, in either case, they were effectively eating as much as they wanted to eat. In contrast, restrained eaters ate substantially more in the high-intake norm condition than in the no-norm condition. If restrained eaters generally eat less than they want to as a result of some self-imposed limit on intake (Lowe & Levine, 2005), then the high-intake norm seems to give them permission to indulge.

Disinhibition among restrained eaters has often been discussed in the context of a "what the hell" effect, in which breaking one's diet subsequently leads to abandoning one's dieting goals and consequently overeating (Herman & Polivy, 1984). However, research suggests that there are a number of alternative pathways through which disinhibition may also occur, and breaking one's diet does not appear to be necessary. For example, restrained eaters have been shown to indulge even when they were simply informed that they were going to start a diet the following day (Urbszat et al., 2002). In that case, no diet had been broken; rather, the context may have given restrained eaters permission to eat as much as they wanted (but typically would not have allowed themselves to eat). Similarly, observing that others are eating a large amount might communicate to restrained eaters that it is acceptable to eat a large amount without compunction. It would be interesting for future research to explore whether the various different pathways to disinhibition (e.g., diet violation vs. contextual permission; see Herman & Polivy, 2007) have different affective consequences (e.g., feelings of guilt after eating) and different behavioral consequences (e.g., compensation at a later eating occasion).

A strength of this study is that, by pooling across a number of studies, this meta-analysis provided a high-powered test of the hypotheses related to restraint differences in the modeling of food intake. There are, of course, some limitations that should be noted. First, the sample across studies was fairly homogenous, consisting primarily of young female university students who, on average, had a body mass index in the normal range. Thus, these findings might not be generalizable to other populations (although the studies were conducted in different countries and even different continents). Second, because this study involved an analysis of pre-existing data, the analysis was limited to addressing questions about the magnitude of the effect of the social norm on participants' food intake, and was unable to explore other important questions such as the mechanisms underlying the observed restraint differences. A third limitation is that our analysis centered on the conceptualization of restraint captured by the Restraint Scale (Herman & Polivy, 1980). Other researchers have argued that the Restraint Scale can be separated into a "Concern for dieting" subscale and a "Weight fluctuations" subscale or, more generally, that the notion of dietary restraint can be represented by a "restriction" component (i.e., the tendency to restrict one's food intake) and a "disinhibition" component (i.e., the tendency to overindulge in the face of temptation) (see, for example, the Three-Factor Eating Questionnaire; Stunkard & Messick, 1985). It is possible that responsiveness to social cues would vary according to these sub-components of restraint such that, for example, individuals high in weight fluctuation/disinhibition would be particularly responsive to high-intake norms, whereas individuals high in concern for dieting/restriction would be more responsive to low-intake norms.

The present analysis also points to an opportunity for future research on individual or group differences in responsiveness to social cues. Specifically, there may be other groups who also show enhanced susceptibility to the augmentation effect of high-intake norms. For example, there is some evidence that men eat more in response to larger portions than women do (Zlatevska, Dubelaar, & Holden, 2014), and men may also show stronger social facilitation effects than women do (Bellisle, Dalix, & de Castro, 1999). Larger portions and social facilitation are both contexts in which increased food intake is typically observed (Ruddock, Brunstrom, Vartanian, & Higgs, 2019; Zlatevska et al., 2014). Perhaps men might also be more responsive to social cues that promote increased food intake. A previous meta-analysis on modeling of food intake (Vartanian et al., 2015) suggested that studies including only men tended to show smaller effects than did studies including only women or studies with both men and women, but those analyses did not separate augmenting norms from inhibiting norms as was done in the current analysis. It is possible that men show stronger augmenting effects than do women (unrestrained women, at least), whereas women show stronger inhibiting effects than do men. This hypothesis could be directly tested in future research.

5. Conclusion

The present study demonstrated that restrained eaters are more responsive to augmenting norms than are unrestrained eaters, but are not generally more responsive to social cues. These findings are consistent with the Theory of Normal Eating (Herman, Polivy, Pliner, and Vartanian, 2019) and suggest that social norms provide an upper limit for acceptable food intake, with high-intake norms permitting (but not requiring) individuals to indulge themselves. These findings also provide support for the view that restrained eaters typically eat less than they want to, whether or not they are restricting food intake in an objective sense (Lowe & Levine, 2005). Finally, the data suggest that restrained eaters may be looking for an opportunity to eat more, and are therefore particularly responsive to social norms of enhanced intake. Future research might explore whether there are other circumstances that permit greater food intake than usual, with restrained eaters especially likely to take advantage of that opportunity.

Ethics disclosure

This study involved an analysis of pre-existing data, and therefore no ethics approval was required.

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