Unhealthy how?: Implicit and explicit affective evaluations of different types of unhealthy foods

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A B S T R A C T

The present study examines the utility of distinguishing nutritional characteristics in implicit and explicit affective evaluations of foods, both nomothetically and idiographically. To this end, we employ indirect and direct versions of the affect misattribution procedure (AMP; Payne, Cheng, Govorun, & Stewart, 2005) to assess affective evaluations of foods that vary along dimensions of added fat and added sugar. Normatively, both added fat and added sugar are associated with more positive affective evaluations. Idiographically, both hunger and external eating are associated with more positive fat-based affective evaluations. Patterns of results were similar across implicit and explicit affective evaluations, inconsistent with a dual-process conceptualization of affective evaluation. Overall, the current work supports the utility of continuing to employ more stringently characterized image stimuli with known nutritional properties, as well as structurally similar measures of implicit and explicit affective evaluations in future work.

1. Introduction

More positive affective evaluations (i.e., emotional responses to or judgments) of foods enhance approach (Chen & Bargh, 1999) and consumption (Drewnowski & Hann, 1999; Winkelman, Berridge, & Wilbarger, 2005), particularly when self-regulatory resources are low (Hofmann, Rauch, & Gawronski, 2007). In fact, affective evaluations predict or are linked to a variety of eating-related outcomes, including food choice (e.g., Friese, Wanke, & Plessner, 2006; Karpinski & Hilton, 2001), purchasing of foods (e.g., Prestwich, Hurling, & Baker, 2011), and eating-related individual differences factors (e.g., Barnes-Holmes, Murtagh, Barnes-Holmes, & Stewart, 2010). Furthermore, affective evaluations are associated with myriad other clinically and socially relevant phenomena (e.g., Blair, 2002; Roefs et al., 2011; Wiers & de Jong, 2006). However, the extent to which nutritional characteristics (e.g., added-sugar or added-fat content) drive affective evaluations of foods is unclear. Most affective evaluation studies to date distinguish stimuli coarsely as healthy versus unhealthy, high versus low calorie, or palatable versus unpalatable. Such distinctions do not permit nomothetic (i.e., normative) examination of the relevance of specific nutritional characteristics to affective evaluations. It would be of particular interest to differentiate the effects of added fat and added sugar on affective evaluations of food, given the well documented negative health consequences of immoderate consumption of refined sugar, added fat, and hyperpalatable processed foods (Francis & Stevenson, 2011; Pritchett & Hajnal, 2011; Swinburn et al., 2011). Moreover, recent work in related areas of food perception supports the potential utility of distinguishing nutritional characteristics. Nominally, for example, young women’s judgments of food healthiness are related much more strongly to fat than sugar content (Rizk & Treat, 2014), and food cravings among overweight women are associated positively with fat but negatively with sugar when the two nutritional characteristics vary simultaneously but independently (Gearhardt, Treat, & Rizk, 2014). Differentiating the role of added fat and added sugar in affective evaluations also would allow us to examine novel idiographic questions about the extent to which nutritional characteristics’ effects on affective evaluation are moderated by individual differences factors, such as hunger or eating in response to external cues. Here too, recent related work illustrates the potential utility of distinguishing fat- and sugar-based affective evaluations by documenting that disinhibited eaters show stronger fat-based liking and (at a trend level) craving of foods, in comparison to their peers, but disinhibited eating is unrelated to sugar-based liking and craving (Gearhardt et al., 2014).

In addition to characterizing the relative importance of fat versus sugar to nomothetic and idiographic affective evaluations, we also extend the existing literature by relying on a recently developed social
cognition paradigm to examine both implicit and explicit affective evaluations (Cameron, Brown-Iannuzzi, & Payne, 2012). Our simultaneous examination of implicit and explicit affective evaluations in tasks that are near-identical procedurally is designed to enhance our understanding of the role of affective evaluation in eating behaviors that are more thoughtful and deliberate versus more impulsive and spontaneous, respectively.

2. Overview of the present study

The present study explores associations between affective evaluations and characteristics of both (a) the foods being evaluated (i.e., nomothetic links) and (b) the evaluating individuals (i.e., idiothetic links). To this end, we assess implicit and explicit affective evaluations of foods with known nutritional properties (including added-fat and added-sugar content) using structurally identical indirect and direct affective misattribution procedure (AMP) tasks, respectively (De Houwer, 2006; Payne, Burkley, & Stokes, 2008; Payne, Cheng, Govorun, & Stewart, 2005). This strategy improves structural fit (i.e., minimizes procedural dissimilarities between assessments of implicit and explicit affective evaluations), thereby reducing uncontrolled method variance which contributes to the typically low correlations observed between implicit and explicit measures of the same construct (Hofmann, Gawronski, Gschwendinger, Le, & Schmitt, 2005). We also use images, instead of words, to facilitate affective responses (Codispoti, Bradley, & Lang, 2001) and to enhance ecological validity.

We examine both state hunger and external eating (i.e., externally cued eating) as potential moderators of nutrient-specific affective evaluations. Hungry women tend to evaluate foods more positively (Seibt, Häfner, & Deutsch, 2007), and to do so to a greater degree for some (nutritionally heterogeneous) foods more so than others (Stoeckel, Cox, Cook, & Weller, 2007). In addition, external eaters evidence an attentional bias toward foods that is moderately to strongly associated with their explicit pleasantness ratings of foods (Brignell, Griffiths, Bradley, & Mogg, 2009). We explore whether hunger and external eating will positively predict fat- and sugar-based affective evaluations of food.

2.1. Method

2.2. Participants

310 female undergraduate students between the ages of 18 and 30 participated for class credit or pay, of whom 72 were dropped: 41 knew Chinese, 23 had food allergies, 6 knew Chinese and had food allergies, 1 participated in a pilot study, and 1 was over age 30. The final sample of 238 participants had a mean age of 18.98 (SD = 1.72) years and 90.3% identified as White.

2.3. Stimuli

Food stimuli were 120 food images available on the internet or photographed by study personnel. Nutrition facts for each food were recorded from the brand’s website, nutritional label, or www.nutritiondata.com. These foods were grouped by added fat and added sugar content: Sweets (high added fat, high added sugar), Fried foods (high added fat, low added sugar), Candies (low added fat, high added sugar), and Healthy foods (low added sugar, low added fat; see Fig. 1). High added-fat foods contained more than 15 g of fat (M = 28.06 g, SD = 11.02 g), whereas low added-fat foods contained fewer than 5 g of fat (M = 0.95 g, SD = 1.19 g). Similarly, high added-sugar foods contained more than 15 g of sugar (M = 40.64 g, SD = 20.45 g), whereas low added-sugar foods contained fewer than 6 g of sugar (M = 2.12 grams, SD = 1.70 grams). One image was misclassified and dropped from all analyses, resulting in 119 food images.

2.4. Measures

2.4.1. AMP tasks

Participants viewed a series of randomly selected, rapidly presented pairs of images: a food image (75 ms); 125 ms later, a Chinese character (i.e., a neutral stimulus; 100 ms); and a mask that remained on the screen until response (see Fig. 2; task structure is identical to that of Payne et al., 2005).

On the Direct AMP, participants were instructed to rate the visual pleasantness of the food image on a 4-point scale from very unpleasant to very pleasant, without allowing the Chinese character to affect their ratings of the food image (Payne et al., 2008). On the Indirect AMP, however, participants were instructed to rate the visual pleasantness of the Chinese character, without allowing the food image to affect their ratings of the character. Participants completed 240 trials (two per exemplar) in each task (Payne et al., 2005). Good reliability was demonstrated; average split half correlations for Direct and Indirect AMPS were .871 and .742, respectively.

2.4.2. Self-reported measures

Body mass index (BMI) was computed from self-reported height and weight. Participants completed the external eating subscale of the Dutch Eating Behavior Questionnaire (DEBQ-Ex; Van Strien, Frijters, Bergers, & Defares, 1986), which assesses eating in response to external food cues (α = .87). A visual analogue scale (VAS: Flint, Raben, Blundell, & Astrup, 2000) assessed state hunger.

2.5. Procedure

Participants provided informed consent and then completed the hunger VAS, AMP tasks, and questionnaires before being debriefed. The indirect AMP always preceded the direct AMP, consistent with Payne et al. (2005) in which the indirect AMP always preceded the explicit assessments.

2.6. Analytic approach

A linear mixed effects model was fit to the data using the lmer function in package lme4 (Bates, Maechler, Bolker, & Walker, 2014) in
version 3.1.1 of R (R Core Team, 2014). We retrieved $p$ values and degrees of freedom using the lmerTest package (Kuznetsova, Brockhoff, & Christensen, 2014). Added Sugar, Added Fat, and Measurement Type (i.e., whether the affective evaluation was directly or indirectly measured) were effect coded; $+1$ corresponded to high sugar, high fat, and direct measurement. The maximal random effects structure supported by the data included random intercepts across subjects and food photos, as well as random slopes for Measurement Type, Added Fat and Added Sugar across subjects (Jaeger, 2008). Fixed effects included main effects for Hunger (log-transformed and centered), External Eating (centered), Measurement Type (direct or indirect), Added Fat (high or low), and Added Sugar (high or low). The two continuous predictors were not permitted to interact to simplify the model under consideration. However, interactions among the three repeated-measures factors were included. Finally, interactions between each of the two continuous predictors and the three repeated-measures factors were included in the fixed effects model, permitting evaluation of the extent to which Hunger and External Eating moderated associations between affective evaluations of foods and Added Fat, Added Sugar and Measurement Type. All significant findings ($p < .05$) are reported below.

### 3. Results

#### 3.1. Sample characteristics

Means (SDs) for indirectly and directly measured affective evaluations, as well as their correlations, are provided in Table 1. Average self-reported BMI was 23.19 (SD = 4.10), with 5.9% underweight and 20.6% overweight or obese. The average hunger rating was 24.33 (SD = 21.91) and average endorsement of external eating (DEBQ-X) was 3.11 (SD = 0.67). Multicollinearity was within acceptable limits.

#### 3.2. Nomothetic findings

A reliable three-way interaction emerged among Added Fat, Added Sugar, and Measurement Type, $t(54.970.0) = 4.099, p < .001$. The two-way interactions between Added Fat and Added Sugar subsequently were examined for both indirect and direct measurement strategies (see Fig. 3). The bivariate interaction between Added Fat and Added Sugar predicted directly measured, $t(115.0) = 2.029, p = .045$, but not indirectly measured affective evaluations, $t(115.0) = 1.441, p = .152$. 

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**Fig. 2.** Sample trials for direct and indirect versions of the AMP task.
suchated by Measurement Type, 3.3.2. External eating evaluations. pleasantness of only directly assessed, not of indirectly assessed, but not the pleasantness of foods low in Added Fat, = .601 (see Fig. 4). Hunger also moderated the effect of Added Fat on affective evaluations of foods, (232.0) = 3.579, p < .001, relative to indirectly measured affective evaluations of foods, (233.0) = 2.002, p = .047.

The interaction between Added Sugar and External Eating was also moderated by Measurement Type, (54,980.0) = 2.346, p = .019. The magnitude of the External Eating by Added Sugar effect was slightly greater for directly measured affective evaluations of foods, (232.0) = 1.947, p = .052, than indirectly measured affective evaluations of foods, (233.0) = 1.234, p = .218, but neither effect was reliable.

External Eating also moderated the effect of Added Fat on affective evaluations, (232.0) = 3.442, p < .001, such that the positive effect of External Eating on affective evaluations of foods was greater for foods higher in Added Fat, (232.0) = 4.054, p < .001, than for foods lower in Added Fat, (232.0) = 2.097, p = .037. Finally, External Eating reliably positively predicted affective evaluations of foods, (233.0) = 3.287, p = .001, as evidenced by the non-zero slopes in Fig. 5.

4. Discussion

Prior work examining the role of affective evaluations of foods in eating- and weight-related concerns has typically made coarse distinctions between healthy versus unhealthy or palatable versus unpalatable food stimuli. The current work extends these efforts by employing image stimuli that vary along known dimensions of added fat and added sugar. As expected, added fat and added sugar independently predict more positive affective evaluations nomothetically. These findings highlight the utility of distinguishing different kinds of unhealthiness on the basis of nutritional characteristics, as foods high in both added fat and added sugar (i.e., sweets) are rated more positively than other unhealthy foods high in only added fat (e.g., fried foods) or only added sugar (e.g., candy).

Individual differences in both hunger and externally cued eating positively predicted fat-based affective evaluations. These findings

Table 1
Descriptive statistics for indirect and direct affective evaluations of foods varying in added fat and added sugar.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean (SD) Indirect ratings</th>
<th>Mean (SD) Direct ratings</th>
<th>( r_{ID} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweets (high added fat, high added sugar)</td>
<td>2.71 (0.44)</td>
<td>2.92 (0.59)</td>
<td>.45**</td>
</tr>
<tr>
<td>Fried foods (high added fat, low added sugar)</td>
<td>2.58 (0.41)</td>
<td>2.65 (0.60)</td>
<td>.51**</td>
</tr>
<tr>
<td>Candies (low added fat, high added sugar)</td>
<td>2.62 (0.40)</td>
<td>2.65 (0.54)</td>
<td>.48**</td>
</tr>
<tr>
<td>Healthy foods (low added fat, low added sugar)</td>
<td>2.55 (0.41)</td>
<td>2.56 (0.55)</td>
<td>.33**</td>
</tr>
</tbody>
</table>

SD = standard deviation. \( r_{ID} \) = Spearman correlation between indirect and direct affective evaluations.

Two reliable two-way interactions also emerged. Measurement Type moderated the effects of Added Fat, (55,020.0) = 8.968, p < .001, and Added Sugar, (55,010.0) = 5.796, p < .001, respectively, on affective evaluations of foods. As can be seen in Fig. 3, directly measured affective evaluations were more sensitive to nutritional characteristics (Added Fat: (165.0) = 3.645, p < .001; Added Sugar: (185.0) = 3.778, p < .001) than indirectly measured affective evaluations (Added Fat: (168.0) = 2.222, p = .030; Added Sugar: (187.0) = 3.560, p < .001).

Finally, reliable positive main effects emerged for Added Fat, (163.0) = 3.340, p = .001; Added Sugar, (185.0) = 3.778, p < .001; and Measurement Type, (232.0) = 2.887, p = .004. High levels of added fat and added sugar, as well as direct measurement, were associated with more positive affective evaluations of foods.

3.3. Idiographic findings

3.3.1. Hunger

Hunger moderated the effect of Added Fat on affective evaluations of foods, (232.0) = 3.275, p = .001, such that hunger enhanced the pleasantness of foods high in Added Fat, (233.0) = 2.469, p = .014, but not the pleasantness of foods low in Added Fat, (233.0) = 0.524, p = .601 (see Fig. 4). Hunger also moderated the effect of Measurement Type, (232.0) = 2.683, p = .008, such that hunger enhanced the pleasantness of only directly assessed, (232.0) = 2.429, p = .016, and of not indirectly assessed, (233.0) = 0.146, p = .884, affective evaluations.

3.3.2. External eating

The interaction between Added Fat and External Eating was moderated by Measurement Type, (54,980.0) = 3.929, p < .001 (see Fig. 5), such that External Eating potentiated the positive effect of Added Fat to a greater degree for directly measured affective evaluations of foods, (232.0) = 3.579, p = .001, relative to indirectly measured affective evaluations of foods, (233.0) = 2.002, p = .047.

The interaction between Added Sugar and External Eating was also moderated by Measurement Type, (54,980.0) = 2.346, p = .019. The magnitude of the External Eating by Added Sugar effect was slightly greater for directly measured affective evaluations of foods, (232.0) = 1.947, p = .052, than indirectly measured affective evaluations of foods, (233.0) = 1.234, p = .218, but neither effect was reliable.

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Individual differences in both hunger and externally cued eating positively predicted fat-based affective evaluations. These findings
extend those of Gearhardt et al., who showed that disinhibited eating among overweight women positively predicted fat-based liking and craving of foods, but did not predict sugar-based craving and liking of food (Gearhardt et al., 2014). Taken together, these studies suggest that there are important individual differences in nutritionally based food preferences, and that disinhibited eating is associated with enhanced fat-based liking, craving, and/or affective evaluation among overweight women from the community and enhanced fat-based affective evaluation among undergraduate women. Future work should examine the extent to which men’s affective evaluations of foods show similar patterns, as well as the extent to which nutritional characteristics other than added fat and added sugar (e.g., sodium, fiber) influence affective evaluations of foods.

The pattern of findings was similar on the direct and indirect AMPs, albeit stronger on the direct AMP. This suggests that both implicit and explicit affective evaluations are sensitive to nutritional information, but that they do not diverge to the extent suggested by dual-process models. The moderate-to-strong degree of convergence between the two tasks (see \( r_{\text{con}} \) column in Table 1) contrasts with prior work examining affective evaluations of foods and of other motivationally relevant stimuli, in which clearer dissociations between implicit and explicit affective evaluations tended to emerge (Roefs et al., 2011; Wiers & de Jong, 2006). Perhaps prior accounts of implicit/explicit ambivalence toward appetitive stimuli have been influenced non-negligibly by uncontrolled method variance. Replication and extension of our findings with continued enhancement of structural fit would address the outstanding question of whether a single process or a dual-process model better characterizes affective evaluations of foods (Payne et al., 2008). Future work would be further enhanced by counterbalancing indirect and direct assessments, as well as by sampling individuals facing more significant eating- and weight-related difficulties.

### 4.1 Conclusions

The present work found that added fat and added sugar are important determinants of affective evaluations of foods nonmotthetically, and that hunger and disinhibited eating are associated idiosyncratically with more positive fat-based affective evaluations. Finally, patterns of results were similar across implicit and explicit affective evaluations. Future research pertaining to affective evaluations of foods would benefit from continuing to employ structurally similar measures of implicit and explicit affective evaluations, as well as more stringently characterized image stimuli with known nutritional properties. Use of such nuanced stimuli permits the examination of more complex theoretical questions about what nutritional characteristics drive pleasantness evaluations and downstream eating behaviors, as well as the extent to which individual differences factors such as hunger or disinhibited eating enhance affective evaluations of foods.

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### Contributors

Authors HEW and TAT designed the study. Author HEW collected the data. Authors TAT and HEW planned and conducted the statistical analysis. Author HEW conducted literature searches and wrote the first draft of the manuscript. All authors have contributed to and approved the final manuscript.

### Conflict of interest

All authors declare that they have no conflicts of interest.

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