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Sources of Bias in Peoples' Social-Comparative Estimates of Food Consumption

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Understanding how healthfully people think they eat compared to others has implications for their motivation to engage in dietary change and the adoption of health recommendations. Our goal was to investigate the scope, sources, and measurements of bias in comparative food consumption beliefs. Across 4 experiments, participants made direct comparisons of how their consumption compared to their peers' consumption and/or estimated their personal consumption of various foods/nutrients and the consumption by peers, allowing the measurement of indirect comparisons. Critically, the healthiness and commonness of the foods varied. When the commonness and healthiness of foods both varied, indirect comparative estimates were more affected by the healthiness of the food, suggesting a role for self-serving motivations, while direct comparisons were more affected by the commonness of the food, suggesting egocentrism as a nonmotivated source of comparative bias. When commonness did not vary, the healthiness of the foods impacted both direct and indirect comparisons, with a greater influence on indirect comparisons. These results suggest that both motivated and nonmotivated sources of bias should be taken into account when creating interventions aimed at improving eating habits and highlights the need for researchers to be sensitive to how they measure perceptions of comparative eating habits.

Keywords: nutrition, comparative bias, optimistic bias, egocentrism, measurement issues

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Obesity rates have increased substantially over the last three decades in the United States (Flegal, Carroll, Ogden, & Curtin, 2010; Kuczmarski, Flegal, Campbell, & Johnson, 1994). Perceived social norms about eating habits—specifically, judgments of how people's own food consumption compares to that of peers—may play an important role in the current obesity epidemic. While there is no direct evidence connecting perceived social norms about eating to the obesity epidemic, two lines of research provide suggestive evidence for the role of perceived social norms. The first line of research highlights that people tend to believe they eat more healthily than others (Klein & Kunda, 1993; Klein, 1996; Miles & Scaife, 2003; Perloff & Fetzer, 1986; Raats, Sparks, Geekie, & Shepherd, 1999; Sparks, Shepherd, Wieringa, & Zimmermanns, 1995; Weinstein & Klein, 1995). For example, most people believe they eat less fatty and sugary foods compared to the average person (Klein & Kunda, 1993; Klein, 1996). This is important, given that comparative information is often more influential than absolute information in guiding related judgments and behavior (e.g., Blalock, DeVellis, Afifi, & Sandler, 1990; Goffin & Olson, 2011; Klein, 2002, 2003; Lipkus & Klein, 2006; Mahler, Kulik, Gerrard, & Gibbons, 2010). The second line of research highlights how perceptions about the consumption of others exerts

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a powerful influence on an individual's own eating. Specifically, social modeling research has demonstrated that people tend to eat more when they observe or believe that others eat more and eat less when they observe or believe that others eat less (Cruwys, Bevelander, & Hermans, 2015; Vartanian, Spanos, Herman, & Polivy, 2015). Consistent with this research on social modeling is the finding that obesity spreads across social networks (Christakis & Fowler, 2007; Pachucki, Jacques, & Christakis, 2011). Taken together, the research described above suggests that people's food consumption is influenced by the actual and perceived eating habits of others and that people believe that they already eat more healthily than their peers. If people believe they eat more healthfully than others, then motivation for dietary change may be weak and may even lead to an increase in unhealthy eating, since people tend to assimilate toward the eating behaviors of similar others (see Polivy & Pliner, 2015 for a recent review). Additionally, since people minimally process or ignore messages that seem irrelevant (Chen & Chaiken, 1999; Clark, 2014; Petty & Cacioppo, 1981), health campaigns and recommendations may seem personally inapplicable and unworthy of notice by even the most relevant recipients if they already think that they eat more healthily than others. Consequently, understanding the scope, sources, and measurements of bias when people make comparative estimates about food consumption is critical for understanding how to effectively create interventions to promote healthier eating (Miles & Scaife, 2003; Scaife, Miles, & Harris, 2006).

Scope of Bias

Although existing experiments document instances of bias when individuals compare their eating to the consumption of others, they are not definitive about the scope of the bias (Miles & Scaife, 2003; Scaife et al., 2006). Specifically, experiments have not systematically varied the foods about which people are queried, leaving open the possibility that the direction and perhaps magnitude of observed comparative biases are narrowly restricted to particular food items or, alternatively, are so broad-based as to simply reflect that people generally underestimate their food consumption, even for many healthy foods. Stated differently, observed biases in comparative food consumption may reflect idiosyncrasies of the specific foods chosen in the previous research (Wells & Windschitl, 1999), in which case interventions based on this research may only be effective for these specific foods. Alternatively, observed biases in comparative food consumption may reflect a general bias that affects all comparative food estimates relatively equally, suggesting that interventions could focus on any food. A third possibility, which we will argue for in the next section, is that the different attributes of food may introduce different sources of bias so that foods chosen as targets in an assessment or intervention should be done so with attention to these attributes. As a result, the present work assessed comparative biases across numerous food items that varied on key dimensions of theoretical and applied interest.

Sources of Bias

While the previous research on comparative consumption biases has either explicitly or implicitly attributed the source of bias to motivated causes (e.g., Klein, 1996), research on biases in social-comparative judgments has revealed a role for both motivated and nonmotivated causes of bias (Alicke, 1985; Chambers & Windschitl, 2004; Weinstein, 1980). Motivated causes for the bias are implicated when people's judgments help to address a motivated concern or goal (e.g., feeling good about oneself, reducing anxiety about possible negative events; e.g., Alicke, 1985; Klein & Kunda, 1993). The potential relevance of motivated sources of bias on comparative judgments about eating is easy to imagine. For example, people might underestimate their personal consumption of unhealthy foods compared to others in order to avoid anxiety about long-term consequences of their unhealthy eating practices (Suls, Wan, & Sanders, 1988) or to appear healthier than others (Herman, Fitzgerald, & Polivy, 2003; Vartanian, Herman, & Polivy, 2007; Vartanian, 2015).

Nonmotivated causes of bias do not serve a motivated goal. These biases might result from how the specifics of the judgment task interact with attentional tendencies, knowledge limitations, or information-processing limitations (Chambers & Windschitl, 2004). The relevance of nonmotivated sources of bias for comparative judgments about eating may be less apparent, but nonetheless very important. The nonmotivated bias of particular interest in this paper is egocentrism—the tendency for thoughts about the self to loom larger than thoughts about others when making judgments that should involve consideration of both the self and others (Chambers, Windschitl, & Suls, 2003; Ross & Sicoly, 1979). When asked for a social-comparative judgment like "How many donuts do you eat compared to other people?," people may focus on how few donuts they eat while failing to fully consider that other people also eat very few donuts. Because eating donuts is relatively rare (i.e., consumption tends to be low and relatively infrequent), an egocentric focus will tend to lead most people (i.e., too many people) to estimate they eat less donuts than most other people like them. As illustrated by this example, a nonmotivated source of bias might lead to overly positive or flattering judgments in a given context, but this is by circumstance (e.g., rarity of the food), not fueled by motivation (e.g., a desire to feel better about oneself regarding one's onion ring consumption). While egocentrism may systematically decrease social-comparative assessments of consumption of rare foods, it may systematically increase assessments about common foods. For example, if asked about a more common food like bread, most respondents may say they eat more than others do. It is important to note that we are using the term *bias* to refer to systematic responses in a particular direction and not necessarily as a synonym for *inaccurate* (Jussim, 2005; West & Kenny, 2011).

Motivated and nonmotivated sources of bias are not mutually exclusive. They can work together or in opposition within a given judgment context. Even though they can, at times, work in concert, they remain conceptually distinct sources of bias that have important implications for determining why someone might be resistant to changing their eating habits. For example, a person who stops for donuts before work three times a week may be resistant to reducing their number of donut stops not because they are resistant to the idea that this is an unhealthy habit, but because they think they eat a low number of donuts compared to other people—without realizing that others also eat a low number of donuts. The present work assessed comparative biases across numerous food items that varied in healthiness of the food—to introduce a potential motivated source of bias in consumption estimates—and the frequency with which the food is generally consumed—to introduce a potential nonmotivated source of bias.

Measurement of Bias

Finally, prior experiments on comparative biases regarding food have not systematically examined differences between the two major methods of measuring comparative bias—the direct and indirect methods (Miles & Scaife, 2003; Scaife et al., 2006). With the *direct method*, the respondent is asked to make a comparison between the self and a referent, such as a generic peer. An example involving donut consumption would be: "In a typical week, how many donuts do you eat compared to other people your age and gender?" With the *indirect method*, participants make absolute estimates separately for the self and for a specified referent, such as a generic peer (e.g., "How many donuts do you eat in a typical week? How many donuts do other people your age and gender eat in a typical week?), and a difference or ratio score between the two answers is calculated by the researcher. Although these two methods seem to overlap, they are semi-independent and are sometimes differentially sensitive to motivated and egocentric sources of bias (Giladi & Klar, 2002; Klar & Ayal, 2004; Otten & Van Der Pligt, 1996; Rose, Suls, & Windschitl, 2011; Weinstein, Lyon, Rothman, & Cuite, 2000; for a review, see Chambers & Windschitl, 2004). For example, egocentrism does not apply to the indirect method in the same way it does to the direct method. In the indirect method, the peer's standing cannot easily be neglected by the participant since the method specifically requires the participant to focus on the peer in their response (e.g., asking how many donuts the average person eats).

As mentioned earlier, previous experiments of comparative bias in the eating domain have used either the direct or indirect method, with little attention to whether these two methods are sensitive to the same psychological mechanisms and whether they can be used interchangeably (Scaife et al., 2006). This has important implications for the measurement of comparative biases in eating. If a person exhibits bias in their comparative consumption estimates on a direct measure, it could be wrong to infer that the source of this bias is a motivated source of bias, since the direct measure may actually be picking up on nonmotivated sources of bias, such as egocentrism. As a result, the present work assessed comparative biases across numerous food items that allowed the comparison of direct and indirect measures.

Our Approach and Predictions

We report four experiments with overlapping conceptual aims. Two of the experiments involved adult residents of Iowa and two involved college students. In each experiment, we assessed people's beliefs about their consumption of various foods or nutrients relative to their peers. Depending on the experiment or condition, we used either a direct or indirect method to solicit comparative beliefs. We also selected foods that varied along two critical dimensions—their general healthiness/unhealthiness and the rarity/commonness with which they are consumed. This strategy allowed us to obtain novel information about when and why people exhibit bias (whether motivated or nonmotivated) in their social comparative beliefs about food consumption.

We expected to find evidence of both motivated and nonmotivated (specifically egocentric) sources of bias in perceptions of comparative food consumption, with the role of these biases shifting in magnitude as a function of the measurement method (direct vs. indirect) being used and the specific foods/nutrients appearing on the survey. We intentionally selected foods that varied in healthiness/unhealthiness to allow us to examine the impact of motivated sources of bias. Since physical health is highly valued and people are motivated to view themselves as healthy (Dunning, Heath, & Suls, 2004), we expected people would indicate that they eat less of a food than their peers when the food is unhealthy compared to when it is healthy. The fact that we intentionally selected foods that varied in rarity/commonness allowed us to examine the impact of egocentrism as a source of nonmotivated bias on direct measures. Consistent with a role for egocentrism, we expected people would indicate that they eat less of a food than their peers when the food is uncommon (such as cauliflower) compared to when it is common (such as apples) due to participants' focus on their own consumption, while neglecting the consumption of others.

Conceptually consistent with research findings on other forms of comparative judgment (Chambers et al., 2003; Rose et al., 2011), we expected that the impact of food commonness would be modest in biasing responses solicited with the indirect method (i.e., soliciting separate judgments for the self and for peers). That is, egocentrism should not play a significant role for this method, because participants are required to report on their perceptions of the eating behaviors of others. However, the impact of food healthiness (i.e., motivated sources of bias) should show a different pattern. Namely, we expected that evidence for motivated sources would be found using both types of measures. The evidence might be particularly strong on the indirect measures since, as discussed earlier, egocentrism effects are essentially removed under this method leaving other biases more room for influence and detection (for examples from outside of the nutrition domain; see Heine & Hamamura, 2007; Rose, Endo, Windschitl, & Suls, 2008; Rose et al., 2011).

To summarize our hypotheses:

> *Hypothesis 1*: Individuals will indicate that they eat less of a food than their peers when the food is unhealthy compared to when it is healthy, and indirect measures will be more affected than direct measures by the healthiness of the food.

> *Hypothesis 2*: Individuals will indicate that they eat less of a food than their peers when the food is uncommon compared to when it is common, and direct measures will be more affected than indirect measures by the commonness of the food.

Experiment 1

Experiment 1 employed direct and indirect methods for assessing community residents' beliefs about their consumption—relative to peers' consumption—of eight foods that varied in commonness and healthiness.

Method

Participants. Participants were 102 adult residents of the state of Iowa. Characteristics of the sample can be found in the online supplemental material, Table S1, along with population statistics for Iowa (U.S. Census Bureau, 2010).

Procedure. Participants were recruited via advertisements in several newspapers published across Iowa and in a daily newsletter distributed at a large university-affiliated medical center serving much of the state. The advertisement indicated that the study was about people's habits and perceptions about different foods. Those who wished to participate were instructed to e-mail or call a member of the research team. Participants were then given a link to the online survey as well as a code to receive payment. After consenting online, participants completed the survey, which consisted of several measures of perceptions of food consumption (see below). Additional items were completed after the measures of interest, but are not reported because they are irrelevant to the aims of this paper. At the conclusion, participants submitted their name and postal address via e-mail to receive a $10 gift card, which was recorded separately from the survey responses. This procedure allowed survey responses to remain anonymous. Institutional review board approval was obtained prior to conducting all experiments in this paper.

Design. A 2 (food commonness: uncommon, common) × 2 (food healthiness: unhealthy, healthy) × 2 (measure: indirect, direct) within-subject design was used.

Materials. For inclusion in the study, we identified two foods for each category defined by a common/uncommon × healthy/unhealthy classification. The foods were selected on the basis of pilot testing, consultation with nutrition experts, and research team discussion (see Results for information that validates the selections). Participants made judgments regarding two healthy-common foods (apples, yogurt); healthy-uncommon foods (spinach, cauliflower); unhealthy-common foods (cheese, french fries); and unhealthy-uncommon foods (waffles, onion rings).

Measures. There were three types of consumption measures. Direct-comparisons questions asked participants "In a typical week, how does your consumption of each of the foods listed below compare to others your age and gender?" (-2 = *much less* to + 2 = *much more*). Self-estimate questions asked participants "In a typical week, how many servings of [food] do you consume?," and the other-estimate question was "In a typical week, how many servings of [food] does the typical person your age and gender consume?" An example of a serving was provided (e.g., "Think of a serving as one apple"), and responses were open-ended. Indirect comparisons were calculated by subtracting other-estimates from self-estimates for each food. Consequently, as with the direct-comparisons estimates, a positive (negative) score on the indirect-comparison index indicates greater (lesser) relative consumption.

The questions were organized in blocks by the three judgment types (i.e., participants answered the same question for the eight foods before moving on to another type of question). We counterbalanced whether the direct-comparative block came first or last, as well as whether the self-estimate block preceded or followed the other-estimate block. Preliminary analyses indicated no significant order effects ($ps > .31$). After the consumption-question blocks, there was a block of healthiness questions. Participants indicated the extent to which they thought each food was bad or good for their health, from *very bad* (1) to *very good* (5).

Results and Discussion

Manipulation checks and general trends. Recall that we preselected foods to fit the common/uncommon × healthy/unhealthy classification scheme. Preliminary results generally validate these selections. The healthy foods were indeed judged as more healthy ($M = 4.66$, $SD = 0.49$) than the unhealthy foods ($M = 2.08$, $SD = 0.42$), $t(101) = 38.5$, $p < .001$, $d = 3.81$. Table 1 displays the mean healthiness ratings for each individual food. Also, the common foods were reportedly consumed more by participants ($M = 2.47$, $SD = 1.24$) than the uncommon foods ($M = 0.51$, $SD = 0.57$), $t(100) = 16.8$, $p < .001$, $d = 1.66$.

Consistent with the social norm that "overeating is unhealthy" (Herman, Roth, & Polivy, 2003), there was an overall tendency (i.e., across all food types) for people to report consuming less than peers. This was true for both the direct measure ($M = -0.80$, $SD = 0.51$), $t(101) = -15.71$, $p < .001$, $d = 1.57$, and the indirect measure ($M = -0.72$, $SD = 0.84$), $t(101) = -8.66$, $p < .001$, $d = 0.86$. While an interesting finding, we want to stress that this general tendency for low comparative estimates is orthogonal to our main predictions and to the key results reported below.

Main analyses. For comparative consumption estimates elicited via the direct method, four aggregate scores were created per participant (see Table 1)—one each for healthy-common foods (apples, yogurt), healthy-uncommon foods (spinach, cauliflower), unhealthy-common foods (cheese, french fries), and unhealthy-

Table 1
Experiment 1 Perceived Healthiness of Foods and Direct and Indirect Estimates of Consumption

Category	Food	Healthiness (*SD*)	Direct (*SD*)	Indirect (*SD*)
Healthy, Common	**Combined**	**4.59 (.56)**	**−.52 (1.09)**	**−.35 (2.18)**
	Apple	4.86 (.51)	−.58 (1.30)	−.33 (2.76)
	Yogurt	4.31 (.78)	−.46 (1.40)	−.42 (2.75)
Healthy, Uncommon	**Combined**	**4.74 (.56)**	**−.92 (1.02)**	**−.36 (1.00)**
	Spinach	4.81 (.56)	−.93 (1.22)	−.30 (1.32)
	Cauliflower	4.66 (.65)	−.91 (1.19)	−.42 (1.21)
Unhealthy, Common	**Combined**	**2.35 (.51)**	**−.42 (.81)**	**−1.11 (1.53)**
	Cheese	3.43 (.92)	.14 (1.08)	−.45 (2.18)
	French fries	1.27 (.45)	−.98 (1.03)	−1.75 (1.67)
Unhealthy, Uncommon	**Combined**	**1.80 (.56)**	**−1.34 (.72)**	**−1.05 (1.00)**
	Waffles	2.30 (.77)	−1.32 (.82)	−1.15 (1.17)
	Onion rings	1.29 (.65)	−1.36 (.98)	−.94 (1.24)

Note. Items in bold represent aggregate values across all foods in a given category.

uncommon foods (waffles, onion rings). These aggregates were submitted to a repeated-measures ANOVA with commonness (common, uncommon) and healthiness (healthy, unhealthy) as within-subject factors. The same creation of aggregate scores and analysis were completed for the indirect measures of consumption.

The aggregates were also submitted to a repeated-measures ANOVA with measurement method (direct, indirect), commonness (common, uncommon), and healthiness (healthy, unhealthy) as within-subject factors to test for the differential impact of commonness and healthiness based on measurement method.

Main findings. As expected, the direct comparison estimates of consumption were strongly influenced by the commonness of the food, such that participants gave lower direct comparative estimates for uncommon foods ($M = -1.14$, $SD = 0.59$) than for common foods ($M = -0.47$, $SD = 0.66$), $F(1, 100) = 86.9$, $p < .001$, $\eta_p^2 = .47$. Once again, while participants indicated that they thought they ate less food than their peers, this effect was magnified for uncommon foods. This influence of commonness on direct comparisons is a pattern that is clearly consistent with the hypothesis that egocentrism influenced the magnitude of bias (or is a source of bias) in these comparison estimates. The effect of food healthiness on direct estimates was not significant ($M_{healthy} = -0.73$, $SD = 0.90$; $M_{unhealthy} = -0.88$, $SD = 0.65$), $F(1, 100) = 1.80$, $p = .18$, $\eta_p^2 = .02$.

As predicted, the indirect comparison estimates of consumption were influenced by the healthiness of the food, $F(1, 98) = 17.57$, $p < .001$, $\eta_p^2 = .15$. Specifically, the indirect comparative estimates were lower for unhealthy foods ($M = -1.08$. $SD = 1.06$) than for healthy foods ($M = -0.36$, $SD = 1.33$), consistent with an influence of a motivation to view oneself as eating more healthily than one's peers. In other words, while participants thought they ate less food overall than their peers, this effect was magnified for unhealthy foods. There was no significant effect of commonness on the indirect estimates ($M_{common} = -0.74$, $SD = 1.34$; $M_{uncommon} = -0.71$, $SD = 0.66$), $F(1, 98) = 0.12$, $p = .73$, $\eta_p^2 = .00$, and no significant interaction between commonness and healthiness, $F(1, 98) = .06$, $p = .81$, $\eta_p^2 = .00$.

There was also an unanticipated healthy × commonness interaction, such that individuals reported a larger discrepancy in their comparative estimates between healthy and unhealthy foods for uncommon foods rather than common foods, $F(1, 100) = 16.1$, $p < .001$, $\eta_p^2 = .14$. The reason for this interaction is not clear and changes directions in a subsequent experiment (Experiment 3a), so we will not discuss it further.

Critically, the three-factor repeated-measures ANOVA revealed an interaction between measurement method and food commonness, $F(1, 97) = 18.12$, $p < .001$, $\eta_p^2 = .16$, with commonness influencing direct, but not indirect, estimates, consistent with a nonmotivated source of bias on direct estimates. Additionally, there was an interaction between measurement method and food healthiness, $F(1, 97) = 36.61$, $p < .001$, $\eta_p^2 = .27$, with healthiness influencing indirect, but not direct, estimates, consistent with a motivated source of bias on indirect estimates. The differential impact of motivated and nonmotivated sources of bias depending on measurement method was highlighted by a three-way interaction between measurement method, food commonness, and food healthiness, $F(1, 97) = 7.86$, $p = .006$, $\eta_p^2 = .08$, with the main effects simply reflecting the results described earlier under the direct and indirect measure analyses.

In summary, this overall set of results reveals the influence of both motivated and nonmotivated (egocentric) sources of bias. The importance of these sources depended on the measurement method being used. Direct estimates were significantly influenced by food commonness and the indirect estimates were significantly influenced by food healthiness. This is consistent with the notion that comparative bias detected with direct measures of comparative consumption may be substantially shaped by nonmotivated egocentrism, whereas bias detected with indirect measures may be substantially shaped by motivated concerns.

Experiment 2

Experiment 1 demonstrated that people do indeed exhibit comparative biases about specific food items (e.g., spinach, fries), but the reasons and magnitude of the bias depends on how it is measured. The fact that we surveyed people about specific food items in Experiment 1, and that we varied them in healthiness and commonness, was very useful for testing the roles of motivated and nonmotivated sources of bias. However, from an applied perspective, there might be more interest in how people perceive their comparative consumption of important and well-known food categories or elements (e.g., fruits and vegetables, calories, saturated fats). Therefore, in Experiment 2 we surveyed people's beliefs about eight of these food categories or elements, which are of clear importance to issues of public health. Given that our selection of these was guided by their importance for health, we did not systematically vary commonness. Of the eight items being surveyed, two were healthy and six were unhealthy.

Method

Participants and procedure. The same recruitment methods used in Experiment 1 obtained a sample of 91 Iowa residents (see characteristics in the online supplemental material, Table S1). Survey administration and participant payment procedures were also the same as in Experiment 1.

Design. A 2 (food category/element healthiness: unhealthy, healthy) × 2 (measure: indirect, direct) within-subject design was used.

Materials. Eight well-known food categories and elements were included in the survey. Two are generally considered healthy (fruits and vegetables, fiber), whereas the remaining six (red meat, saturated fat, total fat, calories, salt, and sugar) are not (confirmed in results described below). A greater proportion of less healthy food categories and elements were chosen due to the emphasis on unhealthy foods, food categories, and food elements in previous research on food comparative estimates (Miles & Scaife, 2003; Scaife et al., 2006).

Measures. The perceived healthiness and direct comparisons of each category/element were measured in the same way as Experiment 1. Because it is unlikely that individuals track the quantities of nutrients in terms of servings, changes were made to the wording of the self- and other-estimate questions (i.e., the items used to calculate the indirect estimates). Participants were asked: "In a typical week, how much of the following do you eat?" and "In a typical week, how much of the following do other people your age and gender eat?" (1 = *none or very little*; 5 = *a lot*). The order of the question blocks (direct, self, and other) were again counterbalanced across participants. Preliminary analyses indicated no significant order effects (*p*s $> .24$).

Results and Discussion

Manipulation checks and general trends. Consistent with our assumptions about perceived healthiness, participants rated fruits and vegetables and fiber as being healthier ($M = 4.81$, $SD = 0.49$) than red meat, saturated fat, total fat, calories, sodium, and sugar ($M = 2.19$, $SD = 0.53$), $t(90) = 30.11$, $p < .001$, $d = 3.16$ (see Table 2). As in Experiment 1, both the direct and indirect methods revealed that, overall, participants believed that they consumed less foods/elements than their peers (see Table 2 for each food/element). The average direct estimate was -0.13 ($SD = 0.53$), $t(91) = -2.34$, $p = .02$, $d = 0.25$ and the average indirect estimate was -0.22 ($SD = 0.66$), $t(87) = -3.15$, $p = .002$, $d = 0.33$.

Main analyses. Separate aggregates for the direct and indirect comparative indices were created for healthy foods/elements (fruits and vegetables, fiber) and for unhealthy foods/elements (red meat, saturated fat, total fat, calories, salt, sugar). These healthy and unhealthy aggregates were compared using a paired *t* test for both the direct and indirect measures. These aggregates were also submitted to a repeated-measures ANOVA with measurement method (direct, indirect) and healthiness (healthy, unhealthy) as within-subject factors.

Main findings. Unlike Experiment 1, direct estimates showed evidence of the impact of healthiness on perceptions of comparative consumption. Participants gave significantly lower direct comparative estimates for unhealthy foods/elements ($M = -0.26$, $SD = 0.77$) than for the healthy foods/elements ($M = 0.26$, $SD = 1.04$), $t(90) = -3.31$, $p = .001$, $d = 0.35$. The indirect measures also provided evidence for the impact of the healthiness of the food/element. Participants gave significant lower indirect comparative estimates for unhealthy foods/elements ($M = -0.51$, $SD = 1.06$) than for the healthy foods/elements ($M = 0.63$, $SD = 1.39$), $t(86) = -4.83$, $p < .001$, $d = 0.52$. While the healthiness of the food impacted both direct and indirect measures, there was a significant interaction between measurement method and healthiness, $F(1, 86) = 20.21$, $p < .001$, $\eta_p^2 = .19$, with the healthiness of the food having a larger influence on indirect estimates relative to direct estimates. This interaction is theoretically consistent with the results of Experiment 1 demonstrating that indirect measures are more sensitive to motivational sources of bias compared to direct measures.

In short, when people are surveyed about food categories and elements that are widely perceived as important for human healthiness or unhealthiness, their pattern of responses reveal clear biases. Specifically, the pattern of biases is consistent with the notion that motivated factors are important. This is true whether a direct or indirect method of measurement is used.

Experiments 3a and 3b

Experiments 1 and 2 produced a number of empirical results at the sample level that reveal systematic biases in social comparative beliefs about food consumption. If entirely unbiased, we would have expected that for every food item, the sample mean for estimates would be roughly at 0 (meaning same as other people). This would be true regardless of method used or the level of healthiness and commonness of a given food. However, in both experiments, grand means from the sample tended to fall below 0, suggesting general underestimation of comparative food consumption. In Experiment 1, the means from direct measures shifted as a function of food commonness, suggesting a role for egocentrism. Finally, in both experiments, food healthiness produced a main effect on indirect measures (and direct measures in Experiment 2), suggesting a significant role for a motivated source of bias.

These findings are very important for understanding sources of bias in comparative judgments of food consumption and worth replicating with new samples. Also, a key limitation from Experiment 1 was that we utilized only a small number (two) of foods per group. Therefore, we conducted two additional experiments (3a and 3b), this time with college student samples. These experiments provided an opportunity to replicate the key findings from Experiment 1, but with a much larger set of foods. They also provided an opportunity to replicate the key findings from Experiment 2 (with no changes to the list of 8 important food categories or elements).

As a pair, Experiments 3a and 3b covered the same conceptual territory as Experiments 1 and 2, but they were organized differently. Recall that Experiments 1 and 2 differed from each other in their food lists, but they shared the fact that all participants were

Table 2
Experiment 2 Perceived Healthiness of Food Categories/Elements and Direct and Indirect Estimates of Consumption

Category	Food Category/Element	Healthiness (*SD*)	Direct (*SD*)	Indirect (*SD*)
Healthy	**Combined**	**4.81 (.49)**	**.26 (1.04)**	**.63 (1.39)**
	Fruits and vegetables	4.89 (.48)	.24 (1.25)	.67 (1.63)
	Fiber	4.74 (.61)	.30 (1.08)	.59 (1.42)
Unhealthy	**Combined**	**2.19 (.53)**	**−.26 (.77)**	**−.51 (1.06)**
	Calories	2.77 (.85)	.12 (.87)	−.15 (1.19)
	Red meat	2.57 (.93)	−.44 (1.14)	−.66 (1.52)
	Total fat	2.22 (.84)	−.28 (1.05)	−.23 (1.24)
	Sodium/Salt	2.04 (.82)	−.51 (.89)	−.83 (1.35)
	Sugar	1.96 (.77)	−.10 (1.08)	−.60 (1.43)
	Saturated fat	1.57 (.83)	−.38 (1.02)	−.57 (1.29)

Note. Items in bold represent aggregate values across all food categories/elements in a given category.

tested with direct and indirect methods. Experiments 3a and 3b shared the same food lists, which included 32 specific foods as well the same eight important food categories as used in Experiment 2. To avoid participant fatigue in answering direct and indirect measures for all 32 foods, Experiment 3a used the direct method whereas 3b used the indirect method.

Method

Participants, procedures, and measures. The participants for our experiments (Experiment 3a $n = 20$; Experiment 3b $n = 35$) were University of Iowa students from an introductory psychology course. In Experiment 3a, participants provided estimates of how their consumption of different food items (see Foods below) compared to their peers (i.e., direct estimates). In Experiment 3b, participants provided separate, open-ended estimates of how much they consume of the items and estimates of how much their peers consume, in a counterbalanced order. We used these responses to compute the indirect estimates. After responding to a set of additional items, all participants provided responses to demographics questions and were debriefed.

Design. A 2 (food healthiness: unhealthy, healthy) × 2 (food healthiness: unhealthy, healthy) within-subject design was used.

Materials. Both experiments used the same list of food items. This included 32 specific foods, selected on the basis of the same common/uncommon × healthy/unhealthy classifications from Experiment 1. The list also included the same eight food categories and elements used in Experiment 2 (e.g., fiber, red meat, salt). We counterbalanced whether people first responded to a random order of 32 foods or to a random ordering of the eight food categories/elements.

Among the 32 specific foods, there were eight healthy-common foods (apples, yogurt, chicken, bananas, milk, oranges, salad, 100% fruit juice), eight healthy-uncommon foods (spinach, cauliflower, tofu, kiwi, salmon, black beans, pinto beans, asparagus), eight unhealthy-common foods (cheese, fries, burgers, chips, tacos, mayo, pizza, ice cream), and eight unhealthy-uncommon foods (waffles, onion rings, corn dogs, pudding, breadsticks, cheesecake, pie, and sausage). Note that the food items used in Experiment 1 are included within the larger set of 32 foods.

Results and Discussion

General trends. Once again, there was an overall tendency to report consuming less of the specific foods than peers, for the direct measures in Experiment 3a ($M = -0.48$, $SD = 0.43$), $t(19) = -4.99$, $p < .001$, $d = 1.11$, and the indirect measures in Experiment 3b ($M = -1.12$, $SD = 1.08$), $t(34) = -6.13$, $p < .001$, $d = 1.04$. A similar pattern was found for the indirect measures of food categories/elements ($M = -0.40$, $SD = 0.46$), $t(19) = -5.17$, $p < .001$, $d = 0.87$, and directionally, but not significantly, for the direct measures ($M = -0.16$, $SD = 0.53$), $t(19) = -1.31$, $p = .21$, $d = 0.30$.

Main analyses. Direct and indirect measures were calculated and aggregated in the same way as Experiments 1 and 2. Similar to Experiment 1, the four aggregates from the 32 specific foods were submitted to a 2 (healthiness) × 2 (commonness) repeated-measures ANOVA. As in Experiment 2, the two aggregates from the food categories/elements were analyzed using paired-samples t tests.

Main findings.

Direct estimates for the 32 specific foods (Experiment 3a). Replicating Experiment 1—and consistent with an effect of a nonmotivated source of bias (re: egocentrism)—direct comparison estimates were strongly influenced by the commonness of the food, such that participants gave significantly lower estimates for uncommon foods ($M = -0.73$, $SD = 0.40$) than for common foods ($M = -0.23$, $SD = 0.52$), $F(1, 19) = 39.33$, $p < .001$, $\eta_p^2 = .67$. The main effect of food healthiness was marginally significant, with participants' comparative estimates being lower for unhealthy foods ($M = -0.68$, $SD = 0.54$) than healthy foods ($M = -0.28$, $SD = 0.68$), $F(1, 19) = 4.21$, $p = .054$, $\eta_p^2 = .18$. This trend suggests a role for a motivated source of bias. Power analysis using G*Power 3.1 conducted after we ran Experiments 3a indicated finding a within-subject difference in means with a moderate effect size ($\eta_p^2 = .06$) with 80% power and two-tailed α probability of .05, requires a sample size of $n = 32$, suggesting that this marginal effect may be the results of Study 3a being underpowered to detect moderate effects. Finally, there was also an unanticipated healthiness × commonness interaction, such that individuals reported a larger discrepancy in their comparative estimates between healthy and unhealthy foods for common foods rather than uncommon foods, $F(1, 19) = 8.74$, $p = .008$, $\eta_p^2 = .32$ (see Table 3). This interaction pattern was the reverse of the pattern observed in Experiment 1. It is unclear why the interaction pattern reversed, but it may have shifted due to the inclusion of the 24 new foods. When only looking at the foods from Experiment 1, the interaction was not significant, $F(1, 19) = 1.31$, $p = .27$, $\eta_p^2 = .06$, but the trend is in the same direction as the results with all 32 food items.

Indirect estimates for the specific foods (Experiment 3b). Consistent with the results of Experiment 1, and in contrast with the direct comparison results, the commonness effect was not significant, ($M_{common} = -1.18$, $SD = 1.31$; $M_{uncommon} = -1.05$, $SD = 1.05$), $F(1, 34) = 0.76$, $p = .39$, $\eta_p^2 = .02$, but the healthiness effect was significant, $F(1, 34) = 28.73$, $p < .001$, $\eta_p^2 = .46$. More specifically, the indirect estimates were lower for unhealthy foods ($M = -1.73$. $SD = 1.22$) than for healthy foods ($M = -0.52$, $SD = 1.32$), consistent with an effect of motivated concerns (see Table 3). The factors of commonness and healthiness did not interact, $F(1, 34) = 0.12$, $p = .73$, $\eta_p^2 = .00$.

Direct and indirect estimates for the eight food categories/elements (Experiments 3a and 3b). The pattern of results is essentially identical to that found in Experiment 2. The direct comparative estimates (Experiment 3a) were higher for healthy food categories/elements ($M = 0.23$, $SD = 0.95$) than the unhealthy food categories/elements ($M = -0.28$, $SD = 0.68$), $t(19) = 1.83$, $p = .08$, $d = 0.41$. While the p value for this effect was marginally significant (two-tailed), the effect size is of the same general magnitude as detected in Experiment 2. Also, the indirect comparative estimates (Experiment 3b) were again significantly higher for healthy food categories/elements ($M = 0.56$, $SD = 1.01$) than the unhealthy food categories/elements ($M = -0.72$, $SD = 0.66$), $t(34) = 5.37$, $p < .001$, $d = 0.91$ (see

Table 3
Experiments 3a and 3b Direct and Indirect Estimates of Consumption for Each Food

Category	Food	Experiment 3a Direct (*SD*)	Experiment 3b Indirect (*SD*)
Healthy, Common	**Combined**	**.12 (.71)**	**−.57 (1.72)**
	Apple	−.15 (1.23)	.20 (1.89)
	Yogurt	.35 (1.46)	−.87 (1.66)
	Chicken	.35 (1.39)	.16 (4.20)
	Bananas	−.05 (1.36)	−.63 (2.62)
	Milk	.35 (1.27)	−1.07 (4.90)
	Oranges	−.30 (1.13)	−.27 (2.28)
	Salad	.20 (1.54)	−.94 (3.60)
	Fruit juice	.20 (1.32)	−1.10 (2.63)
Healthy, Uncommon	**Combined**	**−.68 (.77)**	**−.47 (1.27)**
	Spinach	−.30 (1.56)	−.19 (1.80)
	Cauliflower	−.85 (1.31)	−.29 (1.31)
	Tofu	−1.05 (1.47)	−.37 (1.56)
	Kiwi	−.90 (1.07)	−.60 (1.19)
	Salmon	−.10 (1.65)	−.67 (2.13)
	Black beans	−.45 (1.32)	−.69 (1.98)
	Pinto beans	−1.15 (1.09)	−.81 (2.10)
	Asparagus	−.65 (1.46)	−.14 (1.81)
Unhealthy, Common	**Combined**	**−.58 (.59)**	**−1.82 (1.47)**
	Cheese	−.20 (1.36)	−1.71 (2.92
	French fries	−.75 (1.12)	−1.70 (2.17)
	Burgers	−.85 (1.04)	−1.74 (2.60)
	Chips	−.95 (1.00)	−2.69 (2.91)
	Tacos	−.60 (1.19)	−1.49 (2.33)
	Mayo	−1.05 (1.19)	−1.34 (1.35)
	Pizza	−.05 (1.00)	−1.76 (2.70)
	Ice cream	−.15 (1.09)	−2.11 (2.61)
Unhealthy, Uncommon	**Combined**	**−.79 (.62)**	**−1.63 (1.15)**
	Waffles	−.25 (1.25)	−2.13 (1.17)
	Onion rings	−1.30 (1.03)	−1.59 (1.31)
	Corn dogs	−1.40 (.82)	−1.60 (1.63)
	Pudding	−.50 (1.05)	−1.66 (1.57)
	Breadsticks	−.35 (1.18)	−1.86 (1.83)
	Cheesecake	−.85 (1.27)	−1.00 (1.18)
	Pie	−.90 (1.21)	−1.23 (1.92)
	Sausage	−.75 (1.07)	−2.00 (2.27)

Note. Items in bold represent aggregate values across all foods in a given category.

Table 4). As in Experiment 2, these differential patterns suggest again that, for these important food categories/elements, motivation is a key source of bias with either method, and but it is especially strong with the indirect measures.

Summary. Overall, the results from Experiments 3a and 3b replicate those from Experiments 1 and 2 with a different sample and an expanded number of specific foods, providing confidence about the generalizability of the findings.

General Discussion

Our goal was to investigate the scope, sources, and measurements of bias in comparative food consumption beliefs. Regarding the scope of bias, our experiments revealed that there is a general trend for people to believe they eat less than their peers, regardless of whether the foods are healthy or unhealthy. This finding is not surprising, given the existence of the social norm that "overeating is unhealthy" (Herman, Fitzgerald et al., 2003; Higgs, 2015). However, it is worth noting the pervasiveness of this result across foods, given that the previous literature has tended to focus on the consumption of specific foods (Higgs, 2015). Given that this social norm also affects the consumption of healthy foods, future interventions should focus on disentangling healthy foods from the "overeating is unhealthy" social norm. While there are obviously other barriers to promoting healthy eating, giving people license to "overindulge" on healthy foods may be an effective way of improving the eating habits of individuals who have difficulty controlling their food consumption.

Both the healthiness and commonness of the food moderated the tendency to report consuming less than their peers, implicating the influence of both motivated and nonmotivated sources of bias. This effect was exaggerated for unhealthy foods compared to healthier foods, supporting the common narrative that biases in comparative beliefs about food consumption are the result of self-enhancement (e.g., Klein, 1996). However, this effect was exaggerated for rare foods compared to more common foods, suggesting that comparative beliefs about food consumption are also susceptible to a nonmotivated source of bias, such as egocentrism. Furthermore, the method used to assess comparative beliefs about food consumption also mattered. Responses on the indirect measures were particularly sensitive to the healthiness of food items, indicating a greater sensitivity to motivated sources of bias. Alternatively, responses on the direct measures were particularly sensitive to the commonness of food items, indicating a greater sensitivity to nonmotivated sources of bias such as egocentrism. Overall, these results reveal that whether people will exhibit a bias in perceptions of comparative food consumption will depend on the type of items being surveyed, the solicitation method used, and both the commonness and healthiness of the individual food items.

Applications

These results reveal a critical need for researchers to be mindful of the design and interpretation of studies involving comparative estimates of relative food consumption. Here we mention three examples relevant to this point. First, a wealth of research in psychology reveals that social comparisons and perceived social comparative standing have influences on behavior (Blalock et al., 1990; Goffin & Olson, 2011; Klein, 2002, 2003; Lipkus & Klein, 2006; Mahler et al., 2010). Also, soliciting perceived social com-

Table 4
Experiments 3a and 3b Direct and Indirect Estimates of Consumption for Each Food Category/Element

Category	Food Category/Element	Experiment 3a Direct (*SD*)	Experiment 3b Indirect (*SD*)
Healthy	**Combined**	**.23 (.95)**	**.56 (1.01)**
	Fruits and vegetables	.60 (1.27)	.71 (1.31)
	Fiber	−.15 (.88)	.40 (1.24)
Unhealthy	**Combined**	**−.28 (.68)**	**−.72 (.66)**
	Saturated fat	−.45 (.89)	−.89 (.93)
	Total fat	−.75 (.91)	−.86 (.94)
	Calories	.05 (.99)	−.43 (.82)
	Salt	−.20 (1.05)	−.89 (1.02)
	Sugar	.35 (.81)	−.89 (1.13)
	Red meat	−.70 (1.34)	−.37 (1.40)

Note. Items in bold represent aggregate values across all food categories/elements in a given category.

parative standing on food/nutrient consumption is a relatively easy and efficient way to survey people about their food behavior. Consequently, we would not be surprised to see an increase in surveys aimed at measuring such beliefs. However, without appreciating the lessons offered in the present work, a researcher might select an overly narrow set of food items (e.g., all uncommon foods), that would leave systematic patterns of bias (e.g., systematic below-average estimates) open to dueling interpretations. Even researchers who survey people about the social comparative beliefs about just one particular item (e.g., fiber, coffee) should still find our main point to be important for interpreting any bias (or the absence of overall bias) they observe. The importance of these lessons extend beyond surveys about the sort of specific foods or nutrients we examined—into other categories of interest (e.g., "How much organic food do you purchase relative to other shoppers? How many home cooked meals do you prepare relative to other parents?").

Second, a researcher who is specifically interested in ego-protective biases and/or other motivations as a source of bias in comparative beliefs about food consumption should be deliberate in choice of methodology. An indirect measure of comparative beliefs about food consumption can be used to reduce the effect of nonmotivated sources of bias and better isolate the role of motivated effects. Better isolating motivated effects might improve a researcher's ability to detect not only how motivation impacts bias, but how it might operate as a mediator driven by other respondent characteristics (e.g., being currently overweight vs. not, being a teenage vs. older adult). Indirect measures may also be a better choice for assessing the impact of interventions that strive to reduce motivations people might have to perceive their eating behavior as more healthy than their peers.

Third, the current research also suggests that nonmotivated sources of bias could be considered or even harnessed when crafting interventions to promote healthy eating. For example, a person might be much more open to changing their eating habits or receiving information about ways to change their eating habits if they are first asked to focus on their consumption of common, unhealthy foods (e.g., pizza) compared to if they are asked to focus on their consumption of uncommon, unhealthy foods (e.g., onion rings). Regarding healthy foods, focusing people on whether they eat as many apples (a common food) as their peers might be less productive than focusing them on whether they eat as much spinach as others (a less common food).

Limitations

It is worth noting that the current experiments relied upon small samples of community residents and university undergraduates from Iowa. Although these limitations constrain the assumed generalizability of the results, the role of food commonness and healthiness were consistent with predictions from basic research about motivated and cognitive factors affecting the perception of social norms (e.g., Rose et al., 2008) and the results and effects sizes were consistent across our two rather different samples. Consequently, we suggest that these motivated and cognitive factors should play similar roles across regions and populations, albeit perhaps shifting in relative influence. Of course, the interpretations of what foods are deemed healthy and common would be subject to cultural variation. An additional limitation of the experiments is that we asked participant to respond about others their age and gender. By not focusing participants on a particular part of the distribution of their peers, such as their "average" peer, it is possible that participants used different referents for different types of foods. For example, they may have focused on unhealthy peers when providing judgments about unhealthy foods and focused on healthy peers when providing judgments about healthy foods. While this could be a topic for follow-up research (e.g., comparing "peer" judgments to "average peer" judgments), it is unclear how shifting referents within a group would account for the impact of food commonness on comparative judgments or the differential sensitivity of the direct measures to the commonness of the foods and the indirect measures to the healthiness of the foods.

Remaining Questions

While we have highlighted how the results of the current experiments have implications for the interventions aimed at increasing healthy eating and the measurement of comparative biases in food consumption, there are additional research questions. One important future direction will be the examination of the consequences of comparative biases on behavioral intentions to change eating habits. Relatedly, more research is needed to determine how traditional moderators of social comparison effects influence eating behavior (Polivy & Pliner, 2015). As an example, a potentially important consideration for future research is the comparison target. The current experiments focused on comparisons to same-age, same-gender peers. However, individuals might actually be more sensitive to local comparisons, such as family, friends, or coworkers, which might attenuate or exaggerate the findings of the current experiments (Bruchmann & Evans, 2013; Miller, Turnbull, & McFarland, 1988; Zell & Alicke, 2010). Additional avenues of research include manipulating the perceived healthiness of an ambiguously healthy food and assessing the impact on both direct and indirect measures of comparative beliefs about food consumption; assessing the implications of the detected biases for various forms of accuracy (such as deviations of subjective assessments from objective comparative standing); and examining whether individual differences, such as whether the person is on a diet or not, moderate any of the effects observed in the current experiments.

Conclusion

Practitioners and public health campaigns often draw attention to individuals' levels of food consumption to promote increased healthy eating. Ironically, the results of the current experiments suggest that a majority of the individuals believe that they already eat more healthily than their peers, which may cause these messages to be disregarded by some of the individuals for which the appeals are targeted. However, the reason why, and extent to which individuals report that they eat more healthily than their peers may be dependent on how they are asked about their perceptions of comparative consumption. The nonequivalence of measurement methods highlights the need for researchers to be sensitive to how they measure perceptions of comparative eating habits in future research.

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