ALEXANDER CHERNEV and DAVID GAL*

How do consumers evaluate combinations of items representing conflicting goals? In this research, the authors examine how consumers form value judgments of combinations of options representing health and indulgence goals, focusing on how people estimate the calorie content of such options. The authors show that when evaluating combinations of healthy (virtue) and indulgent (vice) options, consumers tend to systematically underestimate the combined calorie content, such that they end up averaging rather than adding the calories contained in the vice and the virtue. The authors attribute this bias to the qualitative nature of people's information processing, which stems from their tendency to categorize food items according to a good/bad dichotomy into virtues and vices. The authors document this averaging bias in a series of four empirical studies that investigate the underlying mechanism and identify boundary conditions.

Keywords: categorization, vice, virtue, value, information processing, calorie, estimation

Categorization Effects in Value Judgments: Averaging Bias in Evaluating Combinations of Vices and Virtues

Consumers often are presented with choices involving options representing conflicting goals. For example, consumers often choose between high-price/high-quality and low-price/low-quality options, between high-risk/high-reward and low-risk/low-reward options, or between high-price/low-involvement and low-price/time-consuming options. In this research, we examine how consumers evaluate options that represent conflicting health and indulgence goals, focusing on how they estimate the calorie content of combinations of such options.

The decision to study how people derive calorie estimates in a food consumption context is determined by two key factors. First, because most people are familiar with the concept of calories, calorie estimation is a natural context in which to examine value-construction processes. Second, people's ability to estimate the calorie content of various foods has important public policy implications. Managing calorie intake has been singled out by the U.S. Department of Health and Human Services as the primary method to maintain optimal body weight (Thompson and Veneman 2005). Calorie (over)consumption has also been identified as one of the primary sources contributing to the obesity epidemic in the United States (Centers for Disease Control 2006; Olshansky et al. 2005). Assessment and regulation of calorie intake has further been documented to play a central role in the prevention and treatment of many diseases, including diabetes, coronary heart disease, and some forms of cancer (Allison et al. 1999; Goodhart and Shils 1980; Keys 1997; Must et al. 1999; United States Department of Agriculture 2008).

Despite the importance of calorie-related information, this information is rarely available to consumers at the time of food selection. Even when nutritional information is readily available, it typically describes the calorie content per serving, rather than the content of the entire meal. This further complicates the estimation of the total calorie intake because the packaging of most foods and drinks involves multiple servings, and consumers are typically unaware of or unable to estimate the recommended serving size. The unavailability of meal-specific nutritional information at the

time of food selection raises the question of how consumers evaluate the calorie content of individual items and how they integrate these estimates into an overall estimate of the calories contained in a particular meal.

Conventional wisdom suggests that deriving calorie estimates of combinations of food items should be fairly trivial: The calorie content of a meal comprising several individual items should be equal to the sum of the individual estimates of these items. However, we argue that this is not always the case and that people display systematic biases in evaluating the calorie content of combinations of items. In particular, we argue that when evaluating combinations of items representing indulgence and health goals, consumers tend to underestimate their calorie content.

Consider, for example, a calorie-conscious person who is choosing between two meals: a lone hamburger or the same hamburger with a side salad. After some deliberation, the consumer chooses the second meal even though, objectively, the two-item meal contains more calories and therefore is inconsistent with his or her primary goal of consuming fewer calories. The preference for combinations of healthy and indulgent items is not unusual and has been fodder for stand-up comedy acts that poke fun at consumers who believe that by purchasing Diet Coke with their double cheeseburger and chili fries, they are making a virtuous choice.

What drives consumers to act in a way that is inconsistent with their goals? We argue that when faced with a meal comprising both healthy and indulgent items, consumers tend to systematically underestimate its calorie content, such that they may perceive the combined meal not only as having fewer calories than the sum of its individual components but also as having fewer calories than the indulgent item alone. In the context of the foregoing example, this leads to the paradoxical prediction that the combination of a hamburger and a salad will be perceived as having fewer calories than the hamburger alone. We present the rationale for this prediction, the empirical methodology, and the results in more detail in the following sections.

THEORETICAL BACKGROUND

A cornerstone assumption of this research is that people categorize food options according to a good/bad dichotomy of virtues and vices (Rozin, Ashmore, and Markwith 1996). Building on prior research (Wertenbroch 1998; see also Read, Loewenstein, and Kalyanaraman 1999), we define virtues as options that are consistent with long-term self-control goals (e.g., losing weight) but do not necessarily offer immediate gratification. In contrast, we define vices as options that are consistent with short-term goals of immediate gratification (e.g., eating a chocolate cake) but are inconsistent with longer-term self-control goals (e.g., losing weight).

To illustrate, vegetables and fruits are often considered inherently healthy and thus are classified as virtues. In contrast, "indulgent" foods (e.g., chocolate, burgers, fries) are considered inherently unhealthy and thus are classified as vices. In the same vein, options described by qualifiers such as "organic," "light," "fat-free," and "low-fat" tend to be classified as virtues, whereas options described by qualifiers such as "regular," "whole" (e.g., milk), "rich," "creamy," and "decadent" are more likely to be classified as vices

(Wertenbroch 1998). For simplicity, in this research, we treat the vice/virtue descriptors as a binary attribute; in reality, these could be considered endpoints of a continuum characterizing the degree of "virtuousness" and "viceness" of an option.

In addition to products perceived as having inherent vice or virtue characteristics, many products could be represented as either vices or virtues depending on the decision context. For example, reduced-fat milk can be represented as a virtue when compared with whole milk and as a vice when compared with fat-free milk. Similarly, light salad dressing can be viewed as a virtue when compared with regular dressing and as a vice when compared with fat-free salad dressing. Thus, while the general principle of classifying foods into vices and virtues is common across consumers, the classification of specific items often depends on the individual characteristics of the decision maker and the decision context.

How do consumers evaluate combinations of vices and virtues? Building on the notion that people tend to automatically classify food items into vices and virtues, we propose that when evaluating combinations of food items that represent indulgence and health goals, people tend to average their benefits, which leads them to believe that the combination of a virtue and a vice is healthier than the vice alone. To illustrate, people tend to think that a hamburger and a salad is healthier than a hamburger alone. Thus, the overall evaluation of the healthiness of a vice/virtue combination is a result of balancing out their individual evaluations.

We further argue that in the absence of readily available calorie information, people are inclined to rely on their impressions of a meal's overall healthiness to infer its calorie content. Because people tend to believe that healthier meals have fewer calories than unhealthy meals (Chandon and Wansink 2007a; Raghunathan, Naylor, and Hoyer 2006), adding items that make the meal seem healthier can lower its perceived calorie content. This line of reasoning leads to the erroneous conclusion that because the combination of a vice and a virtue seems healthier than the vice alone, the combined meal is likely to have fewer calories.

The paradox here is that adding a healthy option can lower the perceived calorie content of the combined meal even when the actual number of calories has not changed or even has increased. For example, people might believe that a meal comprising a hamburger and a green salad has 500 calories even though they believe the hamburger alone has 600 calories when they evaluate it separately. In turn, this might lead consumers to the erroneous belief that by consuming a virtue (e.g., salad) in addition to a vice (e.g., hamburger), they can actually decrease rather than increase the amount of calories consumed.

From a conceptual standpoint, we attribute the averaging bias to the qualitative nature of the information associated with the vice/virtue categorization of the available options (Rozin, Ashmore, and Markwith 1996). Specifically, we argue that when evaluating combinations of healthy and indulgent food items, people tend to focus on their qualitative aspects as reflected by the vice/virtue categorization rather than on their quantitative nature (e.g., calorie content). This tendency to focus on qualitative aspects of the food items leads people to evaluate vice/virtue combinations in a compensatory way, such that the health benefits of

the virtue make up for the unhealthy aspects of the vice. In this context, the averaging bias in estimating the calorie content of vice/virtue combinations can be attributed to consumers' treatment of these options in categorical fashion as instances of competing goals.

To summarize, we posit that according to the degree to which food items represent health/indulgence goals, people tend to categorize them into vices and virtues. We further theorize that when evaluating combinations of food items that represent indulgence and health goals, people use a balancing rule, which leads them to believe that the combination of a vice and a virtue is healthier than the vice alone. Because people tend to believe that healthier meals have fewer calories than indulgent meals, adding items that make the meal seem healthier can lower its perceived calorie content even though the actual number of calories has increased. Thus, people might erroneously conclude that because the combination of a vice and a virtue seems healthier than the vice alone, the combined meal has fewer calories. We investigate this averaging bias, its antecedents, and its consequences in a series of four empirical studies.

EXPERIMENT 1

The goal of this experiment was to demonstrate the presence of an averaging bias in consumer estimations of calorie content of virtue/vice combinations. In particular, it aimed to show that the combination of a virtue and a vice is perceived as having fewer calories than the vice alone.

Method

Respondents were 188 people recruited through Mechanical Turk—an online service offered by Amazon.com that provides access to a diverse population of paid respondents. Respondents were randomly assigned to one of three conditions and were asked to estimate the caloric content of (1) a hamburger, (2) the combination of the hamburger and a broccoli salad, or (3) the combination of the hamburger and a chocolate chip cookie.

The stimuli included verbal descriptions ("hamburger," "broccoli salad," and "chocolate chip cookie") and a pictorial representation. The design of the stimuli (a hamburger representing a vice and broccoli salad representing a virtue) is consistent with prior research (Chandon and Wansink 2007b; Raghunathan, Naylor, and Hoyer 2006; Wertenbroch 1998).

To reduce the variance resulting from people's lack of precise calorie-content knowledge (Burton et al. 2006; Seiders and Petty 2004; Sharpe, Staelin, and Huber 2008), respondents in all three conditions were also shown another hamburger and told that it had 500 calories. This hamburger was expected to serve as a reference point, calibrating respondents' calorie estimates. Thus, respondents in all conditions were shown two meals: the reference hamburger (referred to as Meal B) and a second meal (referred to as Meal A) that consisted of a hamburger, the hamburger with a broccoli salad, or the hamburger with a cookie. Respondents were then asked to provide a numerical estimate of the caloric content of Meal A.

Results and Discussion
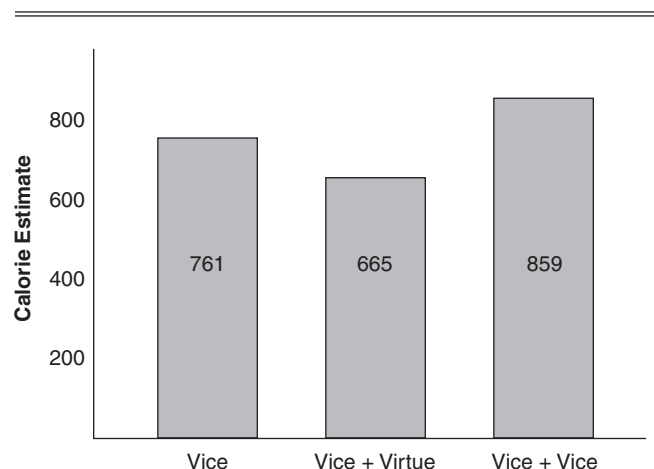
We argue that combinations of a vice and a virtue are often perceived as having fewer calories than the vice alone.

The data show that respondents (N = 62) who evaluated the hamburger alone gave it a mean calorie-count rating of 761 (SD = 225). In contrast, respondents (N = 69) who evaluated the calorie content of a meal comprising the same hamburger with a salad rated the entire meal as having 665 calories on average (SD = 181). Thus, adding a salad to the hamburger lowered the perceived calorie content of the entire meal by 96 calories, or 12.6% (see Figure 1). This decrease was significant ($F(1, 187) = 3.97$, $p < .05$), lending support to the notion that adding a virtue to a vice can decrease the calorie content of the combined meal.

The data further show that adding a cookie instead of the broccoli salad had the opposite effect, increasing rather than decreasing the perceived calorie content of the combined meal. In particular, respondents (N = 57) perceived the burger/cookie combination as having 859 calories (SD = 391), significantly more than the burger alone ($F(1, 187) = 3.97$, $p < .05$). Thus, adding a cookie to the hamburger increased the perceived calorie content of the entire meal by 98 calories, or 12.9%. This finding is consistent with the prediction that the averaging bias is likely to occur only for virtue/vice combinations and should not occur in combinations of two vices.

We theorize that the decrease in the calorie content of the combined meal can be attributed to the vice/virtue categorization of the available options. An alternative (and potentially simpler) explanation can be attributed to respondents' beliefs that the broccoli salad actually had negative calories. This prediction is consistent with the popular belief that certain foods have "negative" calories because the energy used to digest these foods exceeds their caloric content. To rule out this explanation, we asked a separate group of respondents from the same population to estimate the caloric content of the broccoli salad only. The data show that respondents perceived its calorie content as greater than zero (M = 67, SD = 55, N = 85; $t(84) = 11.23$), indicating that the observed underestimation effect cannot be attributed to people's beliefs that the broccoli salad actually had negative calories. The finding that respondents evaluated the healthy

Figure 1
THE IMPACT OF COMBINING VICES AND VIRTUES ON CALORIE ESTIMATES (EXPERIMENT 1)

Notes: Adding a virtue to a vice decreases the perceived calorie content of the combined meal, whereas combining two vices increases it.

options as having positive calories lends further support to the vice/virtue categorization theory of the averaging bias.

The finding that people tend to underestimate combinations of a virtue and a vice but not two vices enables us to rule out diminishing marginal sensitivity as an alternative account for the observed averaging bias. The diminishing marginal sensitivity principle in meal-size estimation can be related to a more general psychophysical bias in people's estimation of the size of an object (Stevens 1975), in which people tend to exhibit diminishing sensitivity to meal size changes as the size of the meal increases (Chandon and Wansink 2007b; Wansink and Chandon 2006b). The notion that people tend to underestimate calories of larger meals is consistent with the diminishing marginal utility principle, according to which the marginal utility of an option decreases as its quantity (e.g., size) increases (Bernoulli 1738; Chandon and Ordabayeva 2009; Nowlis and Simonson 1996; Tversky and Kahneman 1991).

The diminishing marginal sensitivity/value argument implies that because people are more likely to underestimate the calorie content of a larger than a smaller meal, they are likely to perceive a meal as having fewer calories than the sum of the estimates of its individual components. However, the averaging bias implied by the diminishing marginal sensitivity/value principle is limited to explaining an outcome in which the estimate of the combined meal is lower than the sum of the estimates of its individual components. Because it implies a summation of nonnegative values, it cannot account for an outcome in which a combination of items is viewed as having a lower value than one of its individual components. In contrast, we show that adding a virtue to a vice produces a subtraction effect that actually lowers the perceived calorie content of the vice. Moreover, because the diminishing sensitivity principle does not differentiate between vices and virtues, it would predict that an averaging bias should be equally likely to occur for vice/virtue and vice/vice combinations. In contrast, we find the categorization (subtraction) bias only in the context of vice/virtue combinations, not in the context of vice/vice combinations. This finding lends further support to the categorization account of the vice/virtue averaging bias advanced in this research.

In general, the categorization theory of evaluating options combining a vice and a virtue implies that people tend to form an overall impression of such options that balances out the vice/virtue aspects of its individual components. This implies that the vice/virtue categorization and the averaging bias associated with it are likely to be a function of the degree to which people perceive the individual items as virtues or vices. Thus, if our theory is correct, varying the strength of the virtue added to a vice should produce different levels of averaging bias, such that combining a vice with a stronger virtue should lead to a greater averaging bias. We test this prediction empirically in Experiment 2.

EXPERIMENT 2

The goal of this experiment was to test the impact of categorization on the averaging bias in vice/virtue combinations. In particular, it examines the magnitude of this bias as a function of the perceived strength of the virtue.

Method

Respondents were 231 students, recruited to participate in a survey on consumer food preferences. They were asked to estimate the calorie content of a meal and were randomly assigned to one of three conditions. Some of the respondents were shown a meal comprising a cheeseburger and a Caesar salad, others were shown a meal comprising a cheeseburger alone, and the remainder were shown the Caesar salad alone.

We manipulated the degree of the virtuousness of the Caesar salad by giving respondents an evaluation task that asked them to compare the healthiness of the Caesar salad with a reference meal. Some of the respondents were asked to evaluate the healthiness of the Caesar salad relative to a broccoli salad, and others were asked to evaluate the healthiness of the Caesar salad relative to a black bean chili salad. The rationale for this manipulation was that comparing the Caesar salad with a chili salad would highlight its healthiness, whereas comparing it with a broccoli salad would make the Caesar salad appear less healthy.

The study involved a 3 (evaluation type: vice versus virtue versus virtue + vice) × 2 (virtue type: strong versus weak) between-subjects design in which each respondent was given the initial comparison task (Caesar salad versus broccoli salad, or Caesar salad versus black bean chili salad), followed by a calorie estimation task (a cheeseburger, a Caesar salad, or the cheeseburger and the salad). The stimuli included verbal descriptions ("cheeseburger," "Caesar salad," "broccoli salad," and "black bean chili salad") as well as pictorial representations. The experiment was conducted online, and participants evaluated the items at their own pace. At the end of the experiment, they received participation credit and were entered in a drawing for a monetary prize.

Results and Discussion

We manipulated the virtuousness of the Caesar salad by comparing it with either a less healthy chili salad or a healthier broccoli salad. Consistent with the manipulation procedure, the data show that respondents perceived the Caesar salad as having fewer calories when it was compared with the chili salad than when it was compared with the broccoli salad ($M_{Salad\_StrongVirtue} = 102$, SD = 42, N = 32 versus $M_{Salad\_WeakVirtue} = 164$, SD = 69, N = 31; $F(1, 61) = 18.51$, $p < .001$).

We argued that the averaging bias reported in the first experiment is a function of the strength of the virtue augmenting the vice, such that stronger virtues are likely to result in a greater averaging bias. The data summarized in Figure 2 show that respondents who were initially asked to compare the Caesar salad with the chili salad (strong-virtue condition) perceived the subsequent meal as having fewer calories than respondents in the weak-virtue condition, who were initially asked to compare the Caesar salad with a broccoli salad ($M_{Meal\_StrongVirtue} = 583$, SD = 273, N = 41 versus $M_{Meal\_WeakVirtue} = 779$, SD = 254, N = 40; $F(1, 230) = 11.13$, $p < .001$).

More important, manipulating the perceived healthiness of the Caesar salad had a significant impact on respondents' propensity to underestimate the calorie content of vice/virtue combinations ($F(1, 230) = 6.03$, $p < .01$). Thus, respondents perceived a meal comprising a cheeseburger

and a "healthier" (compared with a black bean chili salad) Caesar salad as having fewer calories than the cheeseburger alone ($M_{Meal\_StrongVirtue} = 583$, SD = 273, N = 41 versus $M_{Burger\_StrongVirtue} = 698$, SD = 260, N = 44; $F(1, 230) = 5.42$, $p < .01$). In contrast, combining the cheeseburger with the "less healthy" (compared with a broccoli salad) Caesar salad resulted in a directionally opposite effect ($M_{Meal\_WeakVirtue} = 779$, SD = 254, N = 40 versus $M_{Burger\_WeakVirtue} = 721$, SD = 271, N = 43; $F(1, 230) = 1.32$, not significant [n.s.]). These findings are consistent with the proposition that the averaging bias we found in Experiment 1 is a function of the extremity of the vice/virtue aspects of the individual components of the evaluated meal.

We further note that though we observed the subtraction bias (estimation of the calorie content of the combined meal is lower than one of its components) only in the presence of a strong virtue (chili salad condition), both conditions produced an averaging bias, such that respondents perceived the combined meal as having fewer calories than the sum of its individual components (in the strong virtue condition, $M_{Meal} = 583$ versus $M_{Burger + Salad} = 800$; in the weak virtue condition, $M_{Meal} = 779$ versus $M_{Burger + Salad} = 885$). This finding lends further support to the proposition that people tend to underestimate the calorie content of combinations of vices and virtues.

We argued that the reported underestimation effect is caused by people forming an overall evaluation of the healthiness of a meal comprising both vices and virtues. Following this line of logic, we could also predict that the underestimation effect should be less pronounced, or even eliminated, when people form separate evaluations of the items. This prediction is consistent with prior research, which distinguishes between holistic processing, in which people form an overall evaluation of choice options, and piecemeal processing, in which people form an overall

Figure 2

THE IMPACT OF VIRTUE TYPE ON CALORIE ESTIMATES
(EXPERIMENT 2)

Notes: The underestimation bias resulting from combining a virtue and a vice is greater when the virtue is perceived as stronger (more extreme).

impression by adding up the impressions of individual components (Meyers-Levy 1991). In this context, people processing information holistically are likely to form an overall impression of the vice/virtue combination, resulting in an underestimation of its caloric content. In contrast, people processing information in a piecemeal way are likely to form an overall evaluation of the calorie content of the meal by adding up their evaluations of the meal's individual components, resulting in a more accurate estimation of its calorie content. Thus, if the prediction that forming an overall impression of the healthiness of the meal comprising a vice and a virtue is essential for the occurrence of the averaging bias, this bias is likely to be less pronounced when respondents estimate the calorie content of the individual items. We test this prediction in Experiment 3.

EXPERIMENT 3

The goal of this experiment was to test the proposition that people's overall impression of the healthiness of a meal comprising a vice and a virtue moderates the estimate of its calorie content. In particular, it aimed to show that piecemeal evaluation attenuates the averaging bias documented in the first two experiments.

Method

Respondents were 241 students, recruited to participate in a survey on consumer food preferences. The experimental task involved estimating the calorie content of a meal. Some of the respondents were shown a meal comprising a cheeseburger and a green salad, whereas others were shown a meal comprising the same cheeseburger and a cheesecake instead of a salad. The stimuli included verbal descriptions ("cheeseburger," "organic salad," and "decadent cheesecake") and pictorial representations.
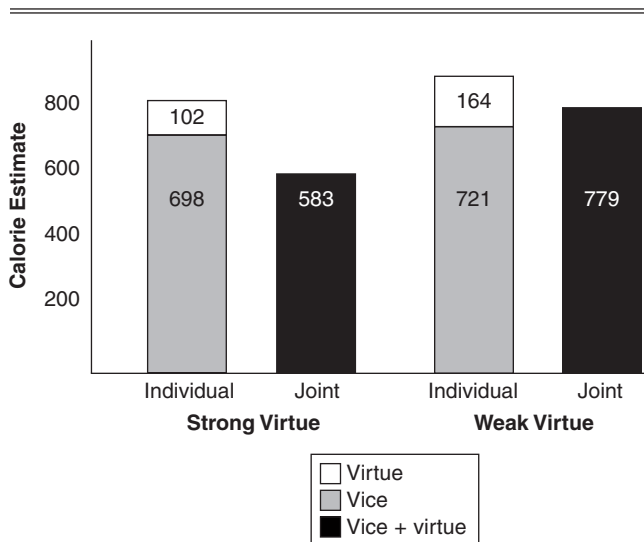
We manipulated the likelihood of forming an overall impression of the vice/virtue combination by asking some respondents to estimate the calorie content of the entire meal and others to estimate the calorie content of the individual components. Thus, respondents shown the cheeseburger-and-salad combination estimated the calorie content of either the entire meal ("How many calories are in this entire meal?") or the cheeseburger and the salad individually ("How many calories are in the cheeseburger/salad?"). In both cases, the meal respondents viewed was exactly the same; only the manner of estimate solicitation (overall versus piecemeal) differed. In the same vein, respondents shown the cheeseburger-and-cake combination estimated the calorie content of either the entire meal or the cheeseburger and the cake individually.

The study involved a 2 (evaluation type: overall versus piecemeal) × 2 (option type: vice/virtue versus vice/vice) between-subjects design. The experiment was conducted online, and participants evaluated the items at their own pace. At the end of the experiment, they received participation credit and were entered in a drawing for a monetary prize.

Results and Discussion
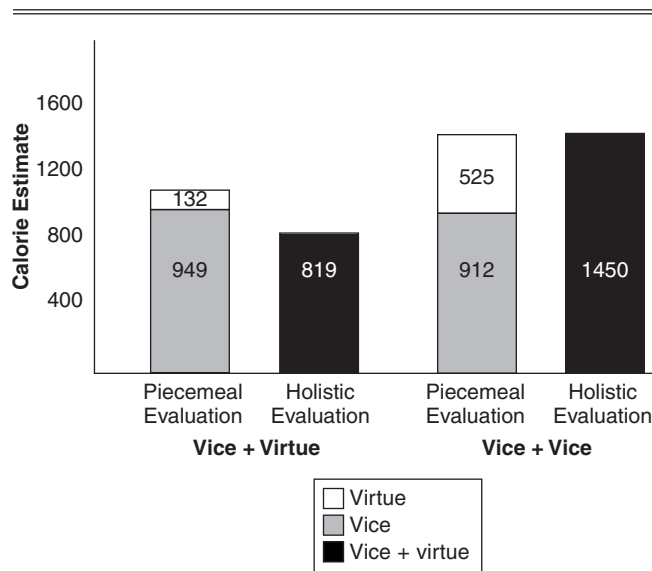
We argue that the nature of the evaluation task (overall versus piecemeal) will moderate people's calorie estimation of meals comprising a vice and a virtue. The data illustrated in Figure 3 show that respondents in the overall evaluation

Figure 3
THE IMPACT OF EVALUATION TYPE ON CALORIE ESTIMATES
(EXPERIMENT 3)

Notes: The underestimation bias in combining a virtue and a vice is greater when consumers form an overall evaluation of the items than when they evaluate the items in a piecemeal way.

condition who estimated the calorie content of a meal comprising a vice and a virtue perceived it as having fewer calories than respondents who estimated the calorie content of its individual components ($M_{Meal} = 819$, SD = 305, N = 64 versus $M_{Burger + Salad} = 1082$, SD = 512, N = 61; $F(1, 240) = 9.34$, $p < .001$). These data show that an overall evaluation of the available options leads to lower calorie estimates than piecemeal evaluation. The data also show that respondents perceived the combined meal as having fewer calories than the cheeseburger itself ($M_{Meal} = 819$ versus $M_{Burger} = 949$; $F(1, 240) = 2.97$, $p < .05$), a finding consistent with the main proposition that adding a virtue to a vice can decrease the perceived calorie content of the combined meal.

The data further show that the underestimation effect in the overall versus individual evaluations is a function of the type of combined options and can be observed in meals that combine a vice and a virtue but not in meals comprised of two vices ($F(1, 240) = 4.92$, $p < .05$). Thus, respondents estimated the combination of two vices (a cheeseburger and a cake) to have virtually the same calorie content when evaluating its individual components and when evaluating the meal as a whole ($M_{Meal} = 1450$, SD = 564, N = 60 versus $M_{Burger + Cake} = 1437$, SD = 514, N = 56; $F(1, 240) < 1$, n.s.). This finding lends further support to the proposition that the underestimation effect reported in the first two experiments is a function of the type of the evaluated options and is more likely to occur in evaluating meals comprising both virtues and vices.

Overall, the data furnished by this experiment support the notion that people base their calorie estimates of vice/virtue combinations on their evaluations of the overall healthiness of the combined meal. The data further suggest that the observed bias cannot be readily attributed to a "halo" effect (Beckwith and Lehmann 1975; Chandon and Wansink

2007a; Cooper 1981; Nisbett and Wilson 1977), in which the mere presence of the virtue changes the perceived healthiness of the vice. Indeed, if the observed underestimation was a result of a healthiness "spillover" from the virtue to the vice, the underestimation effect should have persisted regardless of the nature of the decision task (overall versus piecemeal) because respondents in both conditions saw the virtue and vice next to each other. In contrast, we show that the observed underestimation effect has its own antecedents that go beyond the halo effect, a finding that lends further support to the categorization theory of evaluating vice/virtue combinations. The finding that the piecemeal evaluation of the available options mitigates the averaging bias documented in this research is also consistent with prior research indicating that a piecemeal estimation procedure tends to improve people's estimates of a meal's calories (Chandon and Wansink 2007a).

In general, we argue that because people tend to rely on their evaluations of a meal's overall healthiness to infer its calorie content, adding a virtue to a vice can actually decrease, rather than increase, the perceived calorie content of the combined meal. However, note that in addition to changing people's perceptions of a meal's healthiness, combining two items also results in an increase in a meal's size. Consistent with the notion that larger meals are perceived as having more calories (Chandon and Wansink 2007b; Scott et al. 2008; Wansink and Chandon 2006b), these size-based inferences are likely to work in a direction opposite to health-based inferences, leading to an increase, rather than a decrease, in the perceived calorie content of the combined meal in relation to its individual components. Therefore, we might expect that when people use alternative means, such as a meal's size, to infer its calorie content, the underestimation effect associated with people's evaluations of a meal's healthiness is likely to be attenuated or even disappear. We test this prediction in Experiment 4.

EXPERIMENT 4

The goal of this experiment was to test the proposition that categorization type (vice/virtue versus size) influences the underestimation effect reported in the first three experiments. In particular, we expected that invoking size-based categorization (relative to vice/virtue categorization) should attenuate or even eliminate people's tendency to underestimate the calorie content of combinations of vice and virtue items.

Method

Respondents were 214 students, recruited to participate in a survey on consumer food preferences. The experimental task involved estimating the calorie content of a meal. Some of the respondents were shown a meal comprising a cheeseburger, others were shown a meal comprising a carrot-and-celery salad, and the rest were shown a meal comprising the cheeseburger and the carrot-and-celery salad. The stimuli involved pictorial representations similar to those used in the first three experiments.

To examine the role of vice/virtue categorization on calorie estimation, all respondents were initially presented with three pairs of items: a cake and an apple, a tomato and a burger, and a chocolate chip cookie and a kiwi. Some of the respondents were asked to indicate which item in each of

the three pairs was healthier, and the others were asked to indicate which item in each pair was bigger. The rationale for this manipulation was that health-based evaluations are more likely to promote averaging along the vice/virtue dimension, leading to underestimation of the calorie content of the options. In contrast, size-based evaluations are more likely to promote the use of an additive rather than an averaging rule in evaluating the calorie content of the available options and thus are likely to attenuate the calorie underestimation effect.

The study involved a 3 (evaluation type: vice versus virtue versus virtue + vice) × 2 (categorization type: health-based versus size-based) between-subjects design in which each respondent was given an initial categorization task followed by a calorie estimation task (a cheeseburger, a celery-and-carrot salad, or the cheeseburger and the salad). The experiment was conducted online, and participants evaluated the items at their own pace. At the end of the experiment, they received participation credit and were entered in a drawing for a monetary prize.

Results and Discussion

We argue that the observed bias in calorie estimation of vice/virtue combinations can be attributed to contrast effects caused by an implicit categorization of items into vices and virtues. In particular, we argue that an underestimation effect will be more pronounced when respondents are given a vice/virtue-based evaluation task than when they are given a size-based evaluation task.

The data summarized in Figure 4 show that the type of categorization had a significant impact on the nature of the underestimation effect ($F(1, 213) = 9.63$, $p < .005$). In particular, respondents who compared the initially presented meals according to their healthiness displayed an averaging

Figure 4
THE IMPACT OF CATEGORIZATION ON CALORIE ESTIMATES
(EXPERIMENT 4)

Notes: The underestimation bias in combining a virtue and a vice is greater when consumers focus on the vice/virtue properties of the options than when they focus on unrelated factors such as size.

bias in which the meal comprising a cheeseburger and a salad had fewer calories than the cheeseburger alone ($M_{Burger + Salad} = 511$, $SD = 214$, $N = 37$ versus $M_{Burger} = 597$, $SD = 235$, $N = 39$; $F(1, 213) = 3.99$, $p < .05$). For respondents who compared the initially presented meals by size, we observed no underestimation effect; respondents estimated the burger/salad combination as having significantly more calories then the cheeseburger alone ($M_{Burger + Salad} = 681$, $SD = 189$, $N = 36$ versus $M_{Burger} = 576$, $SD = 193$, $N = 38$; $F(1, 213) = 5.71$, $p < .05$).

Further analysis shows that the averaging bias (the sum of the estimates of the vice and the virtue alone is greater than their joint estimate) was significant only in the vice/virtue evaluation condition ($M_{Meal} = 511$ versus $M_{Burger + Salad} = 686$) and was essentially nonexistent in the size evaluation condition ($M_{Meal} = 681$ versus $M_{Burger + Salad} = 689$). These findings lend further support to the vice/virtue categorization account of the underestimation effect in evaluating combinations of items with varying degrees of healthiness. In particular, we show that the mere act of providing healthiness-based evaluations of the available options is likely to lead to an underestimation effect, whereas providing size-based evaluations is likely to lead to more accurate estimates.

GENERAL DISCUSSION
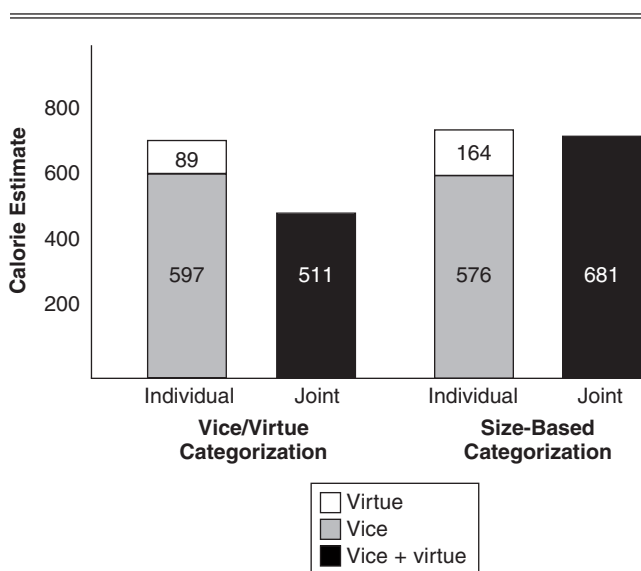
Summary of Findings

In this research, we argue that people's estimates of the calorie content of a meal are a function of the vice/virtue categorization of its individual components and that people tend to underestimate the calorie content of meals comprised of a vice and a virtue. The theory builds on three key propositions: (1) People tend to categorize food items according to a good/bad dichotomy into vices and virtues, (2) people perceive a meal combining a virtue and a vice as being healthier than the vice alone, and (3) people rely on their evaluations of a meal's overall healthiness to infer its calorie content. These propositions lead to the prediction that when people's calorie estimates are based exclusively on their perceptions of a meal's healthiness, adding a virtue to a vice can actually decrease, rather than increase, the perceived calorie content of the combined meal. We document this underestimation bias across all four experiments.

Experiment 1 documented the existence of the bias and showed that adding a virtue to a vice can lead to a subtraction effect, such that the vice/virtue combination is perceived as having fewer calories than the vice alone. Experiment 2 further investigated the averaging bias by documenting that it is likely to be a function of the extremity of the virtue added to the vice and is likely to be more pronounced in the presence of more extreme virtues. Building on these findings, Experiment 3 investigated the impact of the nature of the evaluation task (overall versus piecemeal evaluations) on the averaging bias, documenting that it is more pronounced when people form an overall impression of the separate components of a meal. Finally, Experiment 4 examined the role of the availability of alternative means for inferring calorie content, showing that the averaging bias can be attenuated and even reversed when option size is made salient and people use it to infer calorie content.

The findings also indicate that people might not always underestimate the calorie content of a combination of a

virtue and a vice. Thus, the strength of the averaging bias is likely to be a function of the degree to which people perceive a given meal as a virtue or a vice and is likely to be more pronounced when combining items perceived to be at the extreme ends of the vice/virtue continuum (Experiment 2). Furthermore, as we document in Experiment 3, the averaging bias is less likely to occur when people do not form overall evaluations of the available options but rather consider these options in a piecemeal way. Finally, the strength of the averaging bias is likely to be a function of the availability of other cues for inferring a meal's calorie content. In this context, we show that focusing people's attention on the size of the consumed meal tends to weaken or even reverse the reported averaging bias in evaluating vice/virtue combinations (Experiment 4).

Theoretical Contributions

From a theoretical standpoint, this research sheds light on how people form quantitative judgments of options comprised of qualitatively disparate items. Contrary to the intuitive prediction that the evaluation of the combination of items should be equivalent to the sum of the individual evaluations of its components, we identify conditions in which people tend to systematically underestimate combinations of items. Using food consumption as a context, we show that when estimating the calorie content of a meal combining both health and indulgence goals, people tend to display an averaging bias, in which they perceive the meal as having not only fewer calories than the sum of calorie estimates for all its components but also fewer calories than the estimate for one of its components.

We attribute the observed averaging bias to a dual-level judgment process in which people's quantitative estimates are influenced by their qualitative evaluations of the available options. In particular, we posit that when evaluating options classified into opposite categories (e.g., virtues and vices), people tend to balance out their evaluations using an averaging rather than an additive rule. When translating the qualitative evaluation into a quantitative estimate, this averaging leads to a subtraction effect in which combining two options can lead to lower quantitative estimates.

The finding that adding a virtue to a vice can decrease the perceived value of their combination cannot be readily accounted for by alternative theories commonly used to explain summation bias in people's decision making. Indeed, theories of diminishing sensitivity and diminishing marginal utility predict that though people are likely to discount their valuations of the individual components, adding an item will always increase rather than decrease their numeric valuation of the combined option. In contrast, we show that combinations of qualitatively opposite options are often estimated to have lower numeric value than one of the individual components.

This research further contributes to the literature on goal pursuit by identifying perceptual biases in deriving quantitative estimates of combinations of options representing conflicting goals. Prior research has shown that making goal-consistent decisions, such as choosing a meal containing a healthy option (virtue), provides people with an "excuse" to choose indulgent, unhealthy items (vice). This argument builds on the notion that when people have satisfied a particular goal (e.g., to reduce calorie intake), they

gain license to act in a way that is consistent with a competing goal (e.g., to indulge; Dhar, Huber, and Khan 2007; Khan and Dhar 2006). In the same vein, it has been argued that low-fat nutrition labels can lead to overconsumption by acting as a guilt-reduction mechanism (Wansink and Chandon 2006a). Unlike the licensing effect routed in motivational processes, vice/virtue categorization and the averaging decision rule associated with it are cognitive in nature. Indeed, it can be argued that the averaging biases reported in this research may serve as antecedents to goal-related processes, such as licensing, because these processes are typically based on existing perceptions of a meal's healthiness. This implies that if people underestimate the calorie content of a meal combining virtues and vices, they may feel unduly licensed to pursue indulgent goals.

Because the averaging bias represents a general pattern of decision making, it is not limited to combinations of virtues and vices in food consumption but can be extended to other scenarios in which people evaluate combinations of options classified into opposite categories. For example, similar to categorizing food items into virtues and vices, people often form qualitative impressions in other categories, such as prices (e.g., expensive versus cheap) and probabilities (e.g., likely versus unlikely). The theory advanced in this research implies that the averaging bias should hold in these cases as well, such that items classified into opposite categories will tend to be undervalued when considered jointly rather than when considered independently from each other (Chernev 2011).

Public Policy Implications

This research has important managerial and public policy implications. There is converging evidence that despite the increase in the proportion of healthier options available to consumers, the proportion of overweight people has increased, a finding often referred to as "the American obesity paradox" (Chandon 2009; Chandon and Wansink 2007a; Heini and Weinsier 1997; Wansink 2006). The current research identifies calorie underestimation as a potential cause for overconsumption. In particular, we show that consumers tend to underestimate the calorie content of combinations of healthy (virtues) and indulgent (vices) products. This finding casts a shadow on recent attempts by many fast-food restaurants to add healthy options to their menus. While the introduction of healthier options provides an alternative to people who are interested in a healthier lifestyle, ironically it can lead to overconsumption stemming from underestimation of the calorie content of the considered meals (see Chernev 2010; Chernev and Chandon 2010). In this context, an important implication of the findings reported herein is that providing calorie information at the time of food selection could help minimize the overconsumption resulting from the reported averaging bias. Indeed, although the calorie content for packaged goods is readily available, restaurants are not required to provide nutrition information, and although many restaurant chains already provide calorie information on their Web sites, posters, or tray liners, this information is rarely available to consumers at the time of food selection. Consumers' tendency to underestimate the calorie content of the available options documented in this research underscores the impor-

tance of providing calorie information in a user-friendly format at the time of meal selection.

The findings also raise important questions regarding the implications of people's reliance on vice/virtue classifications to make their consumption decisions. Categorizing foods according to their healthiness is rooted in the actions of many government and private institutions, which use such categorizations to help consumers regulate their food intake (Centers for Disease Control 2006; Thompson and Veneman 2005; United States Department of Agriculture 2008). Yet the findings suggest that this approach can sometimes yield the opposite results when it comes to monitoring calorie intake, such that health-based categorization can lead to underestimation of the calorie content of combinations of healthy and indulgent items. In turn, this can lead to counterproductive behaviors because, though people think they are eating a healthier, less caloric meal, they actually are consuming more calories than they realize.

REFERENCES

Allison, D.B., K.R. Fontaine, J.E. Manson, J. Stevens, and T.B. VanItallie (1999), "Annual Deaths Attributable to Obesity in the United States," *Journal of the American Medical Association*, 282 (16), 1530–38.

Beckwith, Neil E. and Donald R. Lehmann (1975), "The Importance of Halo Effects in Multi-Attribute Attitude Models," *Journal of Marketing Research*, 12 (August), 265–75.

Bernoulli, Daniel (1738), "Specimen Theoriae Novae De Mensura Sortis," *Commentarii Academiae Scientiarum Imperialis Petropolitanae*, 175–92 (English translation in *Econometrica*, 1954, Vol. 22, pp. 23–36).

Burton, Scot, Elizabeth H. Creyer, Jeremy Kees, and Kyle Huggins (2006), "Attacking the Obesity Epidemic: The Potential Health Benefits of Providing Nutrition Information in Restaurants," *American Journal of Public Health*, 96 (9), 1–6.

Centers for Disease Control (2006), *Overweight and Obesity: Contributing Factors*. Washington, DC: Centers for Disease Control and Prevention Online.

Chandon, Pierre (2009), "Estimating Food Quantity: Biases and Remedies," in *Sensory Marketing: Psychological Research for Consumers*, Aradhna Krishna, ed. New York: Taylor and Francis, 323–42.

——— and Natalya Ordabayeva (2009), "Supersize in One Dimension, Downsize in Three Dimensions: Effects of Spatial Dimensionality on Size Perceptions and Preferences," *Journal of Marketing Research*, 46 (December),739–53.

——— and Brian Wansink (2007a), "The Biasing Health Halos of Fast-Food Restaurant Health Claims: Lower Calorie Estimates and Higher Side-Dish Consumption Intentions," *Journal of Consumer Research*, 34 (October), 301–314.

——— and ——— (2007b), "Is Obesity Caused by Calorie Underestimation? A Psychophysical Model of Meal Size Estimation," *Journal of Marketing Research*, 44 (February), 84–99.

Chernev, Alexander (2010), "The Dieter's Paradox," working paper, Kellogg School of Management, Northwestern University.

——— (2011), "Semantic Anchoring in Sequential Evaluations of Vices and Virtues," *Journal of Consumer Research*, forthcoming.

——— and Pierre Chandon (2010), "Calorie Estimation Biases in Consumer Choice," in *Leveraging Consumer Psychology for Effective Health Communications: Lessons About Obesity*, Rajeev Batra, Punam Anand Keller, and Victor Strecher, eds. Armonk, NY: M.E. Sharpe.

Cooper, William H. (1981), "Ubiquitous Halo," *Psychological Bulletin*, 90 (2), 218–44.

Dhar, Ravi, Joel Huber, and Uzma Khan (2007), "The Shopping Momentum Effect," *Journal of Marketing Research*, 44 (August), 370–78.

Goodhart, Robert Stanley and Maurice E. Shils (1980), *Modern Nutrition in Health and Disease*, 6th ed. Philadelphia: Lea & Febiger.

Heini, Adrian F. and Roland L. Weinsier (1997), "Divergent Trends in Obesity and Fat Intake Patterns: The American Paradox," *American Journal of Medicine*, 102 (March), 259–64.

Keys, Ancel (1997), "Coronary Heart Disease in Seven Countries," *Nutrition*, 13 (March), 250–52.

Khan, Uzma and Ravi Dhar (2006), "Licensing Effect in Consumer Choice," *Journal of Marketing Research*, 43 (May), 259–66.

Meyers-Levy, Joan (1991), "Elaborating on Elaboration: The Distinction Between Relational and Item-Specific Elaboration," *Journal of Consumer Research*, 18 (3), 358–67.

Must, A., J. Spadano, E.H. Coakley, A.E. Field, G. Colditz, and W.H. Dietz (1999), "The Disease Burden Associated with Overweight and Obesity," *Journal of the American Medical Association*, 282 (16), 1523–29.

Nisbett, Richard E. and Timothy D. Wilson (1977), "The Halo Effect: Evidence for Unconscious Alteration of Judgments," *Journal of Personality and Social Psychology*, 35 (April), 450–56.

Nowlis, Stephen M. and Itamar Simonson (1996), "The Effect of New Product Features on Brand Choice," *Journal of Marketing Research*, 33 (February), 36–46.

Olshansky, S.J., D.J. Passaro, R.C. Hershow, J. Layden, B.A. Carnes, J. Brody, et al. (2005), "A Potential Decline in Life Expectancy in the United States in the 21st Century," *New England Journal of Medicine*, 352 (March), 1138–45.

Raghunathan, Rajagopal, Rebecca Walker Naylor, and Wayne D. Hoyer (2006), "The Unhealthy = Tasty Intuition and Its Effects on Taste Inferences, Enjoyment, and Choice of Food Products," *Journal of Marketing*, 70 (October), 170–84.

Read, Daniel, George Loewenstein, and Shobana Kalyanaraman (1999), "Mixing Virtue and Vice: Combining the Immediacy Effect and the Diversification Heuristic," *Journal of Behavioral Decision Making*, 12 (December), 257–73.

Rozin, Paul, Michele Ashmore, and Maureen Markwith (1996), "Lay American Conceptions of Nutrition: Dose Insensitivity, Categorical Thinking, Contagion, and the Monotonic Mind," *Health Psychology*, 15 (November), 438–47.

Scott, Maura L., Stephen M. Nowlis, Naomi Mandel, and Andrea C. Morales (2008), "The Effects of Reduced Food Size and Package Size on the Consumption Behavior of Restrained and Unrestrained Eaters," *Journal of Consumer Research*, 35 (3), 391–405.

Seiders, Kathleen and Ross D. Petty (2004), "Obesity and the Role of Food Marketing: A Policy Analysis of Issues and Remedies," *Journal of Public Policy & Marketing*, 23 (Fall), 153–69.

Sharpe, Kathryn M., Richard Staelin, and Joel Huber (2008), "Using Extremeness Aversion to Fight Obesity: Policy Implications of Context Dependent Demand," *Journal of Consumer Research*, 35 (3), 406–422.

Stevens, Stanley Smith (1975), *Psychophysics: Introduction to Its Perceptual, Neural, and Social Prospects*. New York: John Wiley & Sons.

Thompson, Tommy G. and Ann M. Veneman (2005), *Dietary Guidelines for Americans*, 6th ed. Washington, DC: U.S. Government Printing Office.

Tversky, Amos and Daniel Kahneman (1991), "Loss Aversion in Riskless Choice: A Reference-Dependent Model," *Quarterly Journal of Economics*, 106 (November), 1039–1061.

United States Department of Agriculture (2008), "MyPyramid.gov: Steps to a Healthier You," [available at http://www.mypyramid.gov/].

Wansink, Brian (2006), *Mindless Eating: Why We Eat More Than We Think*. New York: Bantam Books.

——— and Pierre Chandon (2006a), "Can 'Low-Fat' Nutrition Labels Lead to Obesity?" *Journal of Marketing Research*, 43 (November), 605–617.

——— (2006b), "Meal Size, Not Body Size, Explains Errors in Estimating the Calorie Content of Meals," *Annals of Internal Medicine*, 145 (September), 326–33.

Wertenbroch, Klaus (1998), "Consumption Self-Control by Rationing Purchase Quantities of Virtue and Vice," *Marketing Science*, 17 (Fall), 317–37.