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

ALEXANDER CHERNEV

DAVID GAL*

*Alexander Chernev is Associate Professor of Marketing and David Gal is Assistant Professor of Marketing, Kellogg School of Management, Northwestern University, Evanston, IL 60208. The

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Abstract

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

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

Consumers often are presented with choices involving options representing conflicting goals. For example, consumers often have to 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 representing conflicting health and indulgence goals, focusing on how they estimate the calorie content of combinations of such options.

Our decision to study how people derive calorie estimates in a food consumption context is determined by two key factors. Because most people are familiar with the concept of calories, calorie estimation is a natural context in which to examine value-construction processes. More important, 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 (CDC 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 (Goodhart and Shils 1980; Keys 1997; USDA 2008; Must et al. 1999; Allison et al. 1999).

Despite the importance of calorie-related information, this information is rarely available to consumers at the time of food selection. Even in cases 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 since 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. We argue, however, that this is not always the case and that individuals 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 a calorie-conscious person who is choosing between two meals: a lone hamburger or the same hamburger with a side green salad. After some deliberation, she chooses the second meal even though, objectively, the two-item meal contains more calories and is, therefore, inconsistent with 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 the combined meal can be perceived 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 above example, this leads to

the paradoxical prediction that the combination of a cheeseburger and a salad will be perceived as having fewer calories than the cheeseburger alone. The rationale for this prediction, the empirical methodology, and the results are presented 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 vices and virtues (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, vices are defined 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 (e.g., broccoli, lettuce, and arugula) and fruits (e.g., apple, grapes, and berries) are often considered to be inherently healthy and, hence, classified as virtues. In contrast, “indulgent” foods (e.g., chocolate, burgers, and fries) are considered to be inherently unhealthy and, hence, 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 as endpoints of a continuum characterizing the degree of “virtuousness” and “viceness” of an option.

In addition to products perceived to have 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 to whole milk, and as a

vice when compared to fat-free milk. Similarly, light salad dressing can be viewed as a virtue in comparison with regular dressing and as a vice in comparison 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 the 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 in cases when the actual number of calories has not changed or even has increased. For example, people might think that a meal comprising a cheeseburger and a green salad has 500 calories even though they believe the cheeseburger alone to have 600 calories

when they evaluate it separately. This, in turn, might lead to the erroneous belief that by consuming a virtue (e.g., salad) in addition to a vice (e.g., cheeseburger) one 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 fashion, 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, based on the degree to which they represent health/indulgence goals, people tend to categorize food items into vices and virtues. We further theorize that when evaluating combinations of food items representing indulgence and health goals, people use a balancing rule, which leads them to believe that the combination of 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. This averaging bias, its antecedents and consequences are investigated in a series of four empirical studies discussed in more detail below.

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.

Method

Respondents were 188 individuals 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 numeric estimate of the caloric content of Meal A.

Results and Discussion

We argue that combinations of a vice and a virtue are often perceived to have fewer calories than the vice alone. The data show that respondents ($N = 62$) asked to evaluate the hamburger alone had a mean rating of its calorie content $M = 761$ ($SD = 225$). In contrast, respondents ($N = 69$) asked to evaluate the calorie content of a meal comprising the same hamburger with a salad rated the entire meal to have 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% (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.

Figure 1

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 to have 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 our 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 people's beliefs that the broccoli salad actually had negative calories. This prediction is consistent with the popular belief that certain foods have "negative" calories since 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 caloric content to be 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 fact that respondents evaluated the healthy options as having positive calories lends further support to the categorization theory of the averaging bias.

The finding that people tend to underestimate combinations of a virtue and a vice but not two vices allows ruling 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), whereby 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 individuals 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; Nowlis and Simonson 1996; Tversky and Kahneman 1991; Chandon and Ordabayeva 2009).

The diminishing marginal sensitivity/value argument implies that because people are more likely to underestimate the caloric content of a larger than a smaller meal, they are likely to perceive that a meal has fewer calories than the sum of the estimates of its individual components. This averaging bias implied by the diminishing marginal sensitivity/value principle, however, 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 non-negative 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 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 combination, 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 individuals perceive the individual items to be 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, whereby combining a vice with a stronger virtue should lead to a greater averaging bias. This prediction is empirically tested in the following experiment.

EXPERIMENT 2

The goal of this experiment was to test the categorization theory of the averaging bias in evaluating vice/virtue combinations by examining 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.

The degree of the “virtuousness” of the Caesar salad was manipulated by giving respondents an evaluation task in which they were asked to compare the healthiness of the Caesar salad to a reference meal. Some of the respondents were asked to evaluate the healthiness of the Caesar salad relative to a broccoli salad, whereas 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 to a chili salad would highlight its healthiness, whereas comparing it to a broccoli salad would make the Caesar salad appear less healthy.

The study involved a 3 (evaluation type: vice vs. virtue vs. virtue + vice) X 2 (virtue type: strong vs. weak) between-subjects design in which each respondent was given the initial comparison task (Caesar salad vs. broccoli salad, or Caesar salad vs. 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

The “virtuousness” of the Caesar salad was manipulated by comparing it to either a less healthy chili salad or to a healthier broccoli salad. Consistent with the manipulation procedure, the data show that respondents perceived the Caesar salad to have fewer calories when it was compared to the chili salad than when it was compared to the broccoli salad ($M_{Salad_StrongVirtue} = 102, SD = 42, N = 32$ vs. $M_{Salad_WeakVirtue} = 164, SD = 69, N = 31$; $F(1,61) = 18.51$; $p < .001$).

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 to have fewer calories than respondents in the weak-virtue condition, who were initially asked to compare the Caesar salad with a broccoli salad ($M_{Meal_StrongVirtue} = 583, SD = 273, N = 41$ vs. $M_{Meal_WeakVirtue} = 779, SD = 254, N = 40$; $F(1,230) = 11.13$; $p < .001$).

Figure 2

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 to a black bean chili salad) Caesar salad to have fewer calories than the cheeseburger alone ($M_{Meal_StrongVirtue} = 583, SD = 273, N = 41$ vs. $M_{Burger_StrongVirtue} = 698, SD = 260, N = 44$; $F(1,230) = 5.42$; $p < .01$). In contrast, combining the cheeseburger with the “less healthy” (compared to a broccoli salad) Caesar salad resulted in a

directionally opposite effect ($M_{Meal_WeakVirtue} = 779$, $SD = 254$, $N = 40$ vs. $M_{Burger_WeakVirtue} = 721$, $SD = 271$, $N = 43$; $F(1,230) = 1.32$; NS). These findings are consistent with the proposition that the averaging bias reported in the first experiment is a function of the extremity of the vice/virtue aspects of the individual components of the evaluated meal.

It can further be noted that even though subtraction bias (estimation of the calorie content of the combined meal is lower than one of its components) was observed only in the presence of a strong virtue (chili condition), both conditions produced an averaging bias, whereby the combined meal was perceived to have fewer calories than the sum of its individual components ($M_{Meal} = 583$ vs. $M_{Burger+Salad} = 800$ in the strong virtue condition and $M_{Meal} = 779$ vs. $M_{Burger+Salad} = 885$ in the weak virtue condition). This finding lends further support to the proposition that people tend to underestimate the calorie content of combinations of vices and virtues.

Overall, we argued that the reported underestimation effect is caused by individuals forming an overall evaluation of the healthiness of a meal comprising both vices and virtues. Following this line of logic, one could also predict that the underestimation effect should be less pronounced, or even eliminated, in cases when individuals form separate evaluations of the items. This prediction is consistent with prior research, which has distinguished between relational, holistic processing in which people form overall evaluation of choice options and piecemeal processing in which people form an overall 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, individuals processing information in a piecemeal fashion would be more 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 our 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, then this bias is likely to be less pronounced when respondents are asked to estimate the calorie content of the individual items. We test this prediction in the following experiment.

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.

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.

The likelihood of forming an overall impression of the vice/virtue combination was manipulated by asking some of the respondents to estimate the calorie content of the entire meal and asking the others to estimate the calorie content of the individual components. Thus, respondents shown the cheeseburger-and-salad combination were asked to estimate 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 viewed by respondents was exactly the same; only the manner of estimate solicitation (overall vs. piecemeal) differed. In the same vein, respondents shown the cheeseburger-and-cake combination were asked to estimate the calorie content of either the entire meal or the cheeseburger and the cake individually.

The study involved a 2 (evaluation type: overall vs. piecemeal) X 2 (option type: vice/virtue vs. 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 vs. 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 condition who were asked to evaluate the calorie content of a meal comprising a vice and a virtue perceived it to have fewer calories than respondents who were asked to estimate the calorie content of its individual components ($M_{Meal} = 819, SD = 305, N = 64$ vs. $M_{Burger+Salad} = 1082, SD = 512, N = 61; F(1,240) = 9.34; p < .001$). 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 to have fewer calories than the cheeseburger itself ($M_{Meal} = 819$ vs. $M_{Burger} = 949; F(1,240) = 2.97; p < .05$)—a finding consistent with the main proposition that adding a virtue to a vice can decrease the perceived calorie content of the combined meal.

Figure 3

The data further show that the underestimation effect in the overall vs. individual evaluations reported above is a function of the type of combined options and can be observed in meals combining 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 $M_{Meal} = 1450, SD = 564, N = 60$ vs. $M_{Burger+Cake} = 1437, SD = 514, N = 56; F(1,240) < 1; NS$). 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 evaluation of the overall healthiness of the combined meal. The data further suggest that the observed bias cannot be readily attributed to a "halo" effect (Cooper 1981; Nisbett and Wilson 1977; Beckwith and Lehmann 1975; Chandon and Wansink 2007a), whereby 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, then the underestimation effect should have persisted regardless of the nature of the decision task (overall vs. piecemeal), since respondents in both conditions saw the virtue and vice next to one another. 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 piecemeal estimation procedure tends to improve people's meal calorie estimations (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. Note, however, that in addition to changing people's perceptions of a meal's healthiness, combining two items also results in an increase in this meal's size. Consistent with the notion that larger meals are perceived to have 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 vis-à-vis its individual components. Therefore, one can 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 the following experiment.

EXPERIMENT 4

The goal of this experiment was to test the proposition that categorization type (vice/virtue vs. 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 the ones 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, while 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, we expected that 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 are thus likely to attenuate the calorie underestimation effect.

The study involved a 3 (evaluation type: vice vs. virtue vs. virtue + vice) X 2 (categorization type: health-based vs. 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 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 were asked to compare the initially presented meals according to their healthiness displayed averaging bias in which the meal comprising a cheeseburger and a salad had fewer calories than the cheeseburger alone ($M_{Burger+Salad} = 511, SD = 214, N = 37$ vs. $M_{Burger} = 597, SD = 235, N = 39$; $F(1,213) = 3.99; p < .05$). For respondents who were asked to compare the initially presented meals by size no underestimation effect was observed, and the burger/salad combination was estimated to have significantly more calories than the cheeseburger alone ($M_{Burger+Salad} = 681, SD = 189, N = 36$ vs. $M_{Burger} = 576, SD = 193, N = 38$; $F(1,213) = 5.71; p < .05$).

Figure 4

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 ($M_{Meal} = 511$ vs. $M_{Burger+Salad} = 686$) and was essentially non-existent in the size-evaluation condition ($M_{Meal} = 681$ vs. $M_{Burger+Salad} = 689$). 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 is 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. Our 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 to be 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. This underestimation bias is documented across all four experiments.

The first experiment documented the existence of the bias and showed that adding a virtue to a vice can lead to a subtraction effect whereby the vice/virtue combination is perceived to have fewer calories than the vice alone. The second experiment 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 that it is likely to be more pronounced in the presence of more extreme virtues. Building on these findings, the third experiment investigated the impact of the nature of the evaluation task (overall vs. piecemeal evaluations) on the averaging bias, documenting that it is more pronounced in cases when individuals form an overall impression of the separate components of a meal. Finally, the fourth experiment examined the role of the availability of alternative means, such as option size, for inferring calorie content, showing that the averaging bias can be

attenuated and even reversed when option size is made salient and individuals use it to infer calorie content.

Our findings also suggest 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 individuals 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 in cases when individuals do not form overall evaluations of the available options but rather consider these options in a piecemeal fashion. 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 into 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, whereby they perceive the meal to have 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 individuals' 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), individuals 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 naturally 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 even though people are likely to discount their valuations of the individual components, adding an item will always increase rather than decrease the 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 individuals with an "excuse" to choose indulgent but unhealthy items (vice). This argument builds on the notion that once individuals have satisfied a particular goal (e.g., to reduce calorie intake), they gain license to act in a way consistent with a competing goal (e.g., to indulge; Khan and Dhar 2006; Dhar, Huber, and Khan 2007). 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 that is routed in motivational processes, vice/virtue categorization and the averaging decision rule associated with it are cognitive in nature. In fact, one can argue that the averaging biases reported in this research may serve as antecedents to goal-related processes such as licensing, since these processes are typically based on already existing perceptions of a meal's healthiness. This implies that if individuals underestimate the calorie content of a meal combining virtues and vices, they may unduly feel licensed to pursue indulgent goals.

Because it represents a general pattern of decision making, the averaging bias is not limited to combinations of virtues and vice in food consumption and can be extended to other scenarios in which individuals 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 vs. cheap) and probabilities (e.g., likely vs. unlikely). The theory advanced in this research implies that the averaging bias reported in this research should hold in these cases as well, such that items classified into opposite categories tend to be undervalued when considered jointly relative to when considered independently from one another (see also Chernev 2009).

Public Policy Implications

The research presented in this paper 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 individuals has increased, a finding often referred to as "the American obesity paradox" (Chandon and Wansink 2007a; Chandon 2009; Heini and Weinsier 1997; Wansink 2006). Our research identifies calorie underestimation as one 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 providing an alternative to individuals interested in a healthier lifestyle, the introduction of healthier options ironically can lead to overconsumption stemming from underestimation of the calorie content of the considered meals (see also Chernev and Chandon 2009). In this context, an important implication of the findings reported in this research is that providing calorie information at the time of food selection could help minimize the overconsumption resulting from the reported averaging bias. Indeed, while the calorie content for packaged goods is readily available, restaurants are not required to provide nutrition information. And even though 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 importance of providing calorie information in a user-friendly format at the time of meal selection.

Our findings also raise important questions regarding the implications of people's reliance on vice/virtue classification 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 (Thompson and Veneman 2005; USDA 2008; CDC 2006). Yet, our findings suggest that this approach can sometimes yield exactly the opposite results when it comes to monitoring calorie intake, whereby health-based categorization can lead to underestimating the calorie content of combinations of healthy and indulgent items. This, in turn, can lead to counterproductive behaviors because although people think they are eating a healthier and less caloric meal, they actually are consuming more calories.

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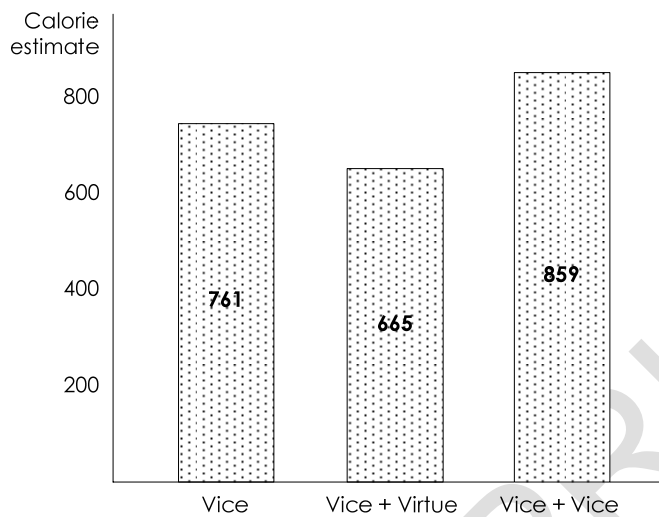
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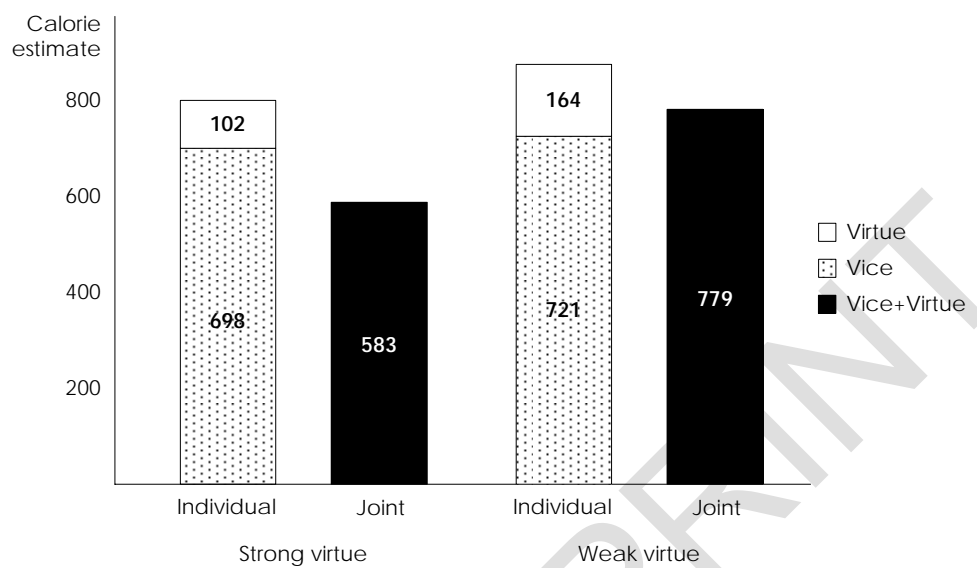
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FIGURE 1: THE IMPACT OF COMBINING VICES AND VIRTUES ON CALORIE ESTIMATES (EXPERIMENT 1)



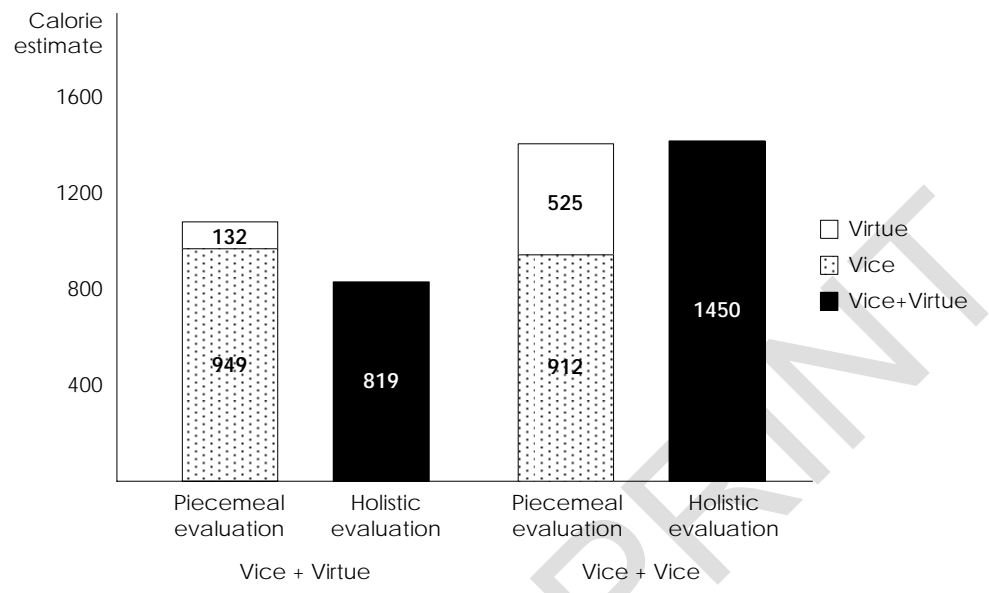
Note:—Adding a virtue to a vice decreases the perceived calorie content of the combined meal whereas combining two vices increases it.

FIGURE 2: THE ROLE OF VIRTUE TYPE ON CALORIE ESTIMATES (EXPERIMENT 2)



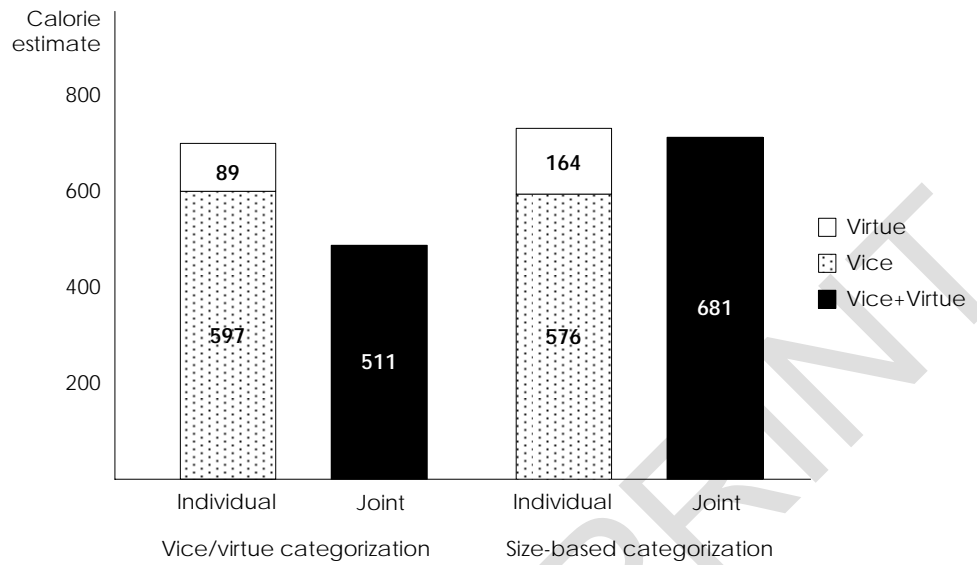
Note:—The underestimation bias resulting from combining a virtue and a vice is greater when the virtue is perceived to be stronger (more extreme).

FIGURE 3: THE ROLE OF EVALUATION TYPE ON CALORIE ESTIMATES (EXPERIMENT 3)



Note:—The underestimation bias in combining a virtue and a vice is greater when consumers form an overall evaluation of the items than when the items are evaluated in a piecemeal fashion.

FIGURE 4: THE ROLE OF CATEGORIZATION ON CALORIE ESTIMATES (EXPERIMENT 4)



Note:—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.