Drivers, Consequences, and Remedies of Biased Size Perceptions in Marketing

Nailya Ordabayeva [a,*]

Pierre Chandon [b]

December 14, 2016

[a] Carroll School of Management, Boston College, 140 Commonwealth Avenue, Chestnut Hill, MA, 02467, USA. Email: nailya.ordabayeva@bc.edu. Tel.: 617-552-2928.

[b] L'Oréal Chaired Professor of Marketing, Innovation and Creativity, INSEAD, Boulevard de Constance, 77305 Fontainebleau, France. Email: pierre.chandon@insead.edu. Tel.: +33160724987.

* Corresponding author. This chapter is based on a publication by the same authors (Ordabayeva & Chandon 2016), updated with the most recent findings in this field of research.

Drivers, Consequences, and Remedies of Biased Size Perceptions in Marketing

Abstract

The sizes of packages and portions have changed dramatically in the recent decades, impacting consumers' food consumption decisions as well as their health. Understanding – and mitigating – biases in their perceptions of package and portion sizes is imperative. This chapter discusses five biases in consumers' size perceptions: underestimation, dimensionality, directionality, labels, and affect. We explore the causes of these biases, outline their implications for consumption decisions, and offer tactics to mitigate these biases and encourage healthier consumption choices. Unresolved theoretical and practical issues are outlined, as are potential avenues for future research.

Keywords: Size perception; Estimation; Packaging; Portion Size; Food

Drivers, Consequences, and Remedies of Biased Size Perceptions in Marketing

The size of food and beverage portions and packaging has increased significantly in recent years: by over 60% for salty snacks and by 52% for sodas, for example (Nestle, 2003; Rolls, Morris, & Roe, 2002; Nielsen & Popkin, 2003). The supersizing trend has been identified as one of the key drivers of the obesity epidemic and related health concerns (Ledikwe, Ello-Martin, & Rolls, 2005; Young & Nestle, 2003). Partly in response to these concerns, and partly out of cost considerations, some marketers have reduced product sizes. Their initiatives have been successful in some cases, but have backfired in others. For example, TGI Friday's downsized "Right Portion, Right Price" menu garnered a positive consumer response, whereas Ruby Tuesday's downsized portions led to a sales dip and were discontinued just five months after introduction (Deutsch 2007; Horovitz, 2007; Martin, 2007). In some instances, marketers have been accused of deceiving consumers by charging the same price for a smaller size (Grynbaum, 2014).

In view of these developments, it is critical to understand how consumers perceive the sizes of packages and portions, and how those perceptions shape their consumption decisions. Studies in health, nutrition science, psychology, and marketing have established that quantity judgments drive a host of consumption decisions including consumption quantity, product choice, and willingness to pay (Chandon & Ordabayeva, 2009; Chandon & Wansink, 2012; Raghubir & Krishna, 1999; Wansink & Van Ittersum, 2003; see Wansink & Chandon, 2014 for a review). Studies have revealed that consumers often *underestimate* the importance of quantity judgments in their food decisions and *overestimate* that of food quality judgments. A large proportion of consumers think that monitoring the *type* rather than the *amount* of food consumed is more important to lose weight (Collins, 1996; Rozin, Ashmore, & Markwith, 1996). For example, they believe that weight gain is more likely to occur after consuming a small portion of unhealthy food (e.g., a mini-Snickers® bar containing 47 calories) than a large portion of healthy food (e.g., a cup of low-fat cottage cheese, three carrots and three pears totaling 569 calories) (Oakes, 2005).

Yet, a growing body of evidence reports that size perceptions are the primary driver of portion size decisions, and that biases which hinder the accuracy of consumers' size perceptions can lead to unhealthy choices. In this chapter we outline five systematic biases in consumers' perceptions of package and portion size. We discuss their implications for consumption decisions and offer effective remedies. We conclude with a discussion of important gaps in the literature and fruitful avenues for future research.

BIASES IN SIZE PERCEPTION

Despite the increased availability of size information on food packaging and restaurant menus, upwards of 70% of consumers do not check this information to make quantity judgments (Lennard, Mitchell, et al., 2001). Various explanations for this have been advanced. Some people find size information confusing, especially when it contains non-metric information (Viswanathan, Rosa, & Harris, 2005). Many rely on the packaging as a cue for how much food is contained inside, using their visual impressions instead of actual size information to make decisions (Chandon & Wansink, 2012; Wansink & Chandon, 2014).

This presents a significant challenge because research indicates that visual perceptions of size, and changes in size, are inaccurate. We identify five biases related to the underestimation of package and portion size changes, the dimensionality of size changes, the directionality of size changes, labeling effects, and affective influences, which hinder the accuracy of size estimations as well as healthy consumption choices. We describe each of these biases, discuss their implications for consumption decisions, and offer potential remedies.

Underestimation

Bias. According to the psychophysics literature, perceptions of object size follow a power function of actual size (Stevens, 1986), a relationship captured by the formula below:

$$\text{ESTSIZE} = a \times \text{ACTSIZE}^{\,b},$$

where ESTSIZE represents the estimated size of the object, ACTSIZE represents its actual size, a is a constant term, and b is the power exponent that represents the elasticity (or sensitivity) of perceived size to actual size. Studies have reported that for physical objects, the power exponent tends to be lower than 1, indicating that perceived object size grows more slowly than actual size, implying that the underestimation of object size and size change is more pronounced for large objects than small ones.

Marketing studies have corroborated these findings for packages and portions, with the reported power exponent ranging between .5 and .8, suggesting that the changes in package and portion size are also significantly underestimated, although more accurate estimations (a power exponent of 1) emerge for one-dimensional objects such as lines (Krishna 2007, 2012). In other words, consumers underestimate size and size changes in packages and portions, more for large packages and portions than for small ones.

Implications. The underestimation bias has significant implications for consumption decisions. Consumers' growing insensitivity to actual size as packages and portions become larger leads to greater food intake. In short, they eat more because they do not realize just how much supersized packages and portions actually contain.

Chandon and Wansink (2007a) documented this effect in a series of studies in which participants' underestimation of food portions was linked to the size chosen or consumed. In one study, when patrons of US fast food restaurants in three cities were asked to estimate the calorie content of meals that they had ordered, diners significantly underestimated the size of their meals: meals on average contained 744 calories but were believed to contain 544 calories, a 27% underestimation. The bias was greater for large meals: large meals containing on average 1144 calories were believed to contain 687 calories, a 40% underestimation; small meals containing on average 484 calories were believed to contain 433 calories, an 11% shortfall. This bias was found to persist regardless of whether participants were lean or overweight, whether they had a limited or an extensive interest in nutrition, for foods of different shapes, and whether food was about to be consumed, already consumed, or stored in the pantry (Chandon & Wansink, 2006a, 2007a; Krider, Raghubir, & Krishna, 2001).

Remedies. Since the underestimation bias occurs regardless of consumers' weight and nutrition expertise, even professional dieticians are susceptible to the bias (Chandon & Wansink, 2007a) which would suggest that visual biases are hardwired (Raghubir 2007). Indeed it has been shown that the underestimation bias cannot be eliminated through manipulations of consumer attention, motivation, or information. Specifically, studies have shown that providing information about the underestimation bias does not reduce that bias (Chandon & Wansink, 2007a; Ordabayeva & Chandon, 2013). Neither does boosting consumers' attention to the estimated object (Folkes & Matta, 2004), nor boosting their intrinsic or extrinsic motivation to be accurate – by providing a financial reward (Ordabayeva & Chandon, 2013; Raghubir, 2007).

Conversely, recasting the task from estimating an entire meal to estimating its individual components (e.g., estimating the main course, the side, and the drink, separately) can effectively reduce the underestimation bias and improve the accuracy of size estimates. As shown in Figure 1, the power exponent describing meal size estimations improves from .38 in the control condition (in which participants estimated the size of the whole meal) to .83 in the piecemeal estimation condition (in which they estimated the size of individual meal components prior to estimating the size of the whole meal), regardless of participants' weight.

--- Insert Figure 1 about here ---

Since piecemeal estimation – which requires individuals to estimate components that are individually smaller than the whole meal – produces less underestimation than the meal as a whole, it also makes consumers less likely to choose large meals, and more likely to make healthier consumption decisions (Chandon & Wansink, 2007a).

Furthermore, there is evidence that improving the accuracy of consumers' size estimations boosts eating enjoyment, which suggests that large portions accelerate sensory satiation and reduce sensory pleasure (Cornil & Chandon, 2015; Garbinsky, Morewedge, & Shiv, 2014).

Dimensionality

Bias. Perceptions of size are influenced by the shape of the size change. Products can grow or shrink along a single spatial dimension (e.g., length), along two dimensions (e.g., length and width or base), or three dimensions (height, width and length). Dimensions may change in the same direction (all dimensions increase simultaneously) or in opposite directions (some dimensions increase while others decrease – e.g., elongation reduces the base while increasing length (Raghubir & Krishna, 1999; Wansink & Van Ittersum, 2003). Hence, the accuracy of size perception depends on the number of changing dimensions as well as the direction in which those dimensions change.

Psychophysics studies have reported that estimation accuracy is higher for one-dimensional objects (e.g., lines: power exponent b = 1) than for two-dimensional objects (e.g., squares: b = .7 to .8) or three-dimensional objects (e.g., cubes: b = .6) (see Krishna 2007 for a review). Similarly, the accuracy of size change estimation is greater when an object changes in a single dimension (e.g., when a box of crackers grows in length alone) than in two dimensions (e.g., when it grows in length and width) or three dimensions (e.g., when it grows in height, width and length) (Chandon & Ordabayeva, 2009). Estimation accuracy declines even further when the dimensions of a package change in opposite directions (e.g., when the base shrinks but the length increases) (Ordabayeva & Chandon, 2013). In a study by Chandon and Ordabayeva (2009), six candles were perceived to be smaller when they grew in height *and* diameter from one size to the next (b = .63) than when they grew in height alone (b = .87), as illustrated in Figure 2.

--- Insert Figure 2 about here ---

The dimensionality bias occurs because estimating volume change requires individuals to integrate information across three product dimensions – in multiplicative fashion – hence the estimation task is increasingly complex. Indeed studies have shown that consumers' size perceptions are consistent with an additive (rather than multiplicative) model of dimension integration. Simply put, people tend to add rather than multiply the changes in the individual dimensions to arrive at their estimate of total volume change (Ordabayeva & Chandon, 2013).

For example, a box that proportionately grows by 26% in height, width and length is judged to have grown by 78% (= 26% + 26% + 26%), instead of 100% ($1.26 \times 1.26 \times 1.26 = 2$), in total volume.

Implications. The dimensionality bias has been found to spill over from consumers' perceptions of product size to their expectations of product price, product choice, and consumption volume (Chandon and Ordabayeva, 2009). Consumers expect to pay less for supersized products (e.g., in our studies they demanded up to 57% larger discounts) when the package size increases in three (vs. one) dimensions. Interestingly, this tendency mirrors the lower prices that marketers charge for products supersized along all three (vs. one) dimensions (e.g., for shaving cream supersized in height and diameter vs. height only). Consumers are (up to 32%) less likely to choose supersized products when the supersizing occurs in three (vs. one) dimensions. In another setting – serving drinks – people are more likely to over-serve beverages (by up to 19%) when they use conical glasses in which liquid volume increases in height and diameter than when it increases only in height.

Remedies. Because the dimensionality bias is caused by consumers' inability to multiplicatively integrate the changes in three dimensions, the bias is reduced when the change in product volume is linearized from multiple dimensions to just one. Hence, if marketers wish to increase the appeal of supersized products, boost willingness-to-pay for such products and lower the risk of overconsumption, they should supersize their products in just one dimension. Conversely, to boost the appeal of downsized products they should downsize their products in multiple dimensions since such changes are less likely to be detected. In one study, consumers were 21% more likely to choose a downsized soda when the bottle shrank in height and diameter (vs. just height) (Chandon & Ordabayeva, 2009).

In an extreme case, product downsizing can go completely undetected if it is implemented through package elongation when the dimensions change in opposite directions such that the magnitude of the increase in one dimension perfectly counter-balances that of the decrease in the other two dimensions. This principle was verified in a study where participants were shown four candles that shrank by 8% from one size to the next. The downsizing occurred either in height alone (1D downsizing condition), or through elongation (elongated downsizing condition) such that the candle's volume shrank as it became more elongated, with the increase in height perfectly counter-balanced by the decrease in base. While participants perceived a significant reduction in volume in the 1D condition (a candle that was 24% smaller than the reference was perceived to be 20% smaller), they missed the downsizing in the elongated downsizing condition (the same candle was believed to be just 2% smaller than the reference).

In a different study, the package of an established food brand was downsized through a 1D change by shrinking its height, or through elongation in height (shrinking the base and increasing the height) or through elongation in width (shrinking the height and increasing the width). As shown in Table 1, whereas the appeal of the package compared to the original significantly dropped when it was downsized in 1D, it did not drop when the package was downsized through elongation (Ordabayeva & Chandon, 2013).

--- Insert Table 1 about here ---

Another tactic to mitigate the dimensionality bias would be to allow consumers to use additional senses other than vision, such as touch/feel, to evaluate portion size. Allowing participants to weigh products by hand, in addition to inspecting products visually, has been found to minimize the dimensionality bias (Ordabayeva & Chandon, 2013).

A final strategy to counteract the dimensionality bias may be to use transparent packages that make it easier for consumers to see the quantity contained in the package (Deng & Srinivasan, 2013). However, the desirability of transparent packaging depends on the type of product: it may be an advantage to monitor healthy products but could backfire if unhealthy products appear to be more tempting when the package is transparent (rather than opaque).

Directionality

Bias. The accuracy of size perceptions depends on the direction of the size change: consumers are more sensitive to quantity decreases than increases. Whereas they significantly underestimate quantity increases, they are more accurate (even, in certain cases, perfectly accurate) when estimating quantity decreases.

To illustrate: In one study, we prepared three plates with a small (S), medium (M), and large (L) portion of nuts (Chandon & Ordabayeva, 2017). In the increasing quantity condition, participants were told the number of nuts in the small portion and asked to estimate the number of nuts in the medium and large portions. In the decreasing condition, they knew the number of nuts in the large portion and had to estimate the number of nuts in the medium and small portions. As shown in Figure 3, portion sizes were strongly underestimated in the supersizing condition: while portion L (637 nuts) was actually 12.25 times larger than portion S (52 nuts), it was perceived to be only 4.9 times larger (273 nuts; the corresponding beta was .68). Estimations were more accurate in the downsizing condition: portion S was perceived to be 7.0 times smaller than portion L (74 nuts; b = .86).

--- Insert Figure 3 about here ---

The directionality bias persists for countable and non-countable foods, among novice and expert estimators (even professional cooks), across a wide range of products and size changes, using various units (weight, volume, calories). This bias does not occur because of loss aversion (the encoding of quantity decrease as a loss, and of increase as a gain) or anchoring effects (it occurs even when the same quantity serves as a reference), but emerges because physical quantity has a lower zero bound and can never be negative. As a result, when judging quantity decreases, individuals estimate the size of a target that will fall between the larger reference size and the natural zero bound, whereas when judging quantity increases, the estimated size of the target will fall between the smaller reference size and infinity (with no upper bound) – a more difficult task.

Implications. The directionality bias impacts various consumer judgments, including how they determine the value of the product and which product they choose. For example, in the above study involving small, medium and large portions of peanuts, when informed about the unit price of the small and the large portion (held constant across the supersizing and downsizing conditions), participants were more likely to think that the large portion provided better value for money (which was objectively true) in the downsizing (vs. supersizing) condition because the perceived difference in the sizes of two portions was bigger (Chandon & Ordabayeva, 2017). Furthermore, consumers' reluctance to accept product downsizing, as reported in the media and in prior literature (Deutsch, 2007; Grynbaum, 2014; Martin, 2007), may be at least partly driven by greater perceptual sensitivity to quantity decreases than to quantity increases. Studies have shown that reducing consumers' perceptual sensitivity to quantity decreases boosts their acceptance of downsizing (Ordabayeva & Chandon, 2013).

Remedies. The psychological source of the directionality bias (individuals' reliance on extrapolation to estimate size decreases vs. interpolation to estimate size increase) provides valuable information about whether strategies to eliminate the bias will succeed. Since the bias is not driven by loss aversion (Kahneman & Tversky, 1979), strategies that change the valence or appeal of the product (and hence change the natural encoding of size increases as gains, and of decreases as losses) will not be effective. In contrast, strategies that change the presence of bounds (by either providing an upper bound on estimations of increase, or by taking away the lower zero bound from estimations of size decreases) should effectively reduce the asymmetry between estimations of supersizing and downsizing.

To test this notion, in one study participants were asked to judge the size increase or decrease in portions of jellybeans and iced tea (Chandon & Ordabayeva, 2017). To manipulate product valence, participants tasted sweet (positive valence) or salty (negative valence) iced tea, and jellybeans of regular (positive valence) or novelty flavors such as pencil shavings, vomit and baby diapers (negative valence). To manipulate the presence of bounds, participants either had to estimate the increase or decrease in portions presented on the table (which involved a natural zero bound for size decreases and no tangible upper bound for size increases), or to pour the same portions into or out of a glass (which highlighted the lower bound for size decreases – i.e. the quantity contained in the glass could not go below the bottom of the glass; and the upper bound for increases – i.e. quantity could not exceed the top of the glass). The results showed that the directionality bias emerged regardless of the valence of the products, but it disappeared when estimation bounds were implicitly provided in the pouring task. Specifically, participants were less sensitive to volume changes when visually estimating increasing portions (than decreasing portions) but they were just as sensitive to volume changes when *pouring* increasing portions as when pouring decreasing portions. The role of estimation bounds was corroborated in a follow-up study, which provided an explicit numeric bound for estimates of increasing sizes.

Labels

Bias. Consumers' perceptions of package and portion size are further biased by labels describing food quality and quantity in advertising and packaging. Labels that describe package and portion size as "small", "medium", and "large" significantly bias consumers' expectations of how much food is contained inside. Aydınoğlu and Krishna (2011) found that consumers expected portions to be smaller when they were labeled "small" rather than "medium" or "large" even if the amount contained in these portions was equal or reversed. This finding is significant because labels are commonly used to set expectations of portion size, and in the absence of strict standards they vary significantly across outlets (Young & Nestle, 1998). For example, Regal Cinemas' "small" popcorn (800 calories) is larger than AMC Theatres' "medium" popcorn (680 calories); Burger King's "small" fries (116 grams) is almost identical to the "medium" fries sold at McDonald's (117 grams).

Labels that describe food quality (e.g., describe the ingredients) influence expectations about food quantity. Generally, labels that highlight a food's healthiness lower perceptions of its calorie content. For example, when food is labeled "low-fat", consumers will think it has fewer calories (Wansink & Chandon, 2006b). Similarly, consumers expect meals that combine foods framed as "healthy" and "unhealthy" to contain fewer calories than meals consisting of "unhealthy" items, even if their actual calorie content is identical or reversed. In one study Chernev and Gal (2010) showed participants a meal consisting of (i) a hamburger or (ii) a hamburger and broccoli. Participants perceived the meal to have fewer calories when it had broccoli on the side (665 calories) than when it did not (761 calories), even though the actual caloric content of the combined meal was higher.

Similar effects emerge when food outlets and restaurant chains emphasize healthiness in their positioning and advertising. For example, studies have shown that meals at McDonald's (a chain that has an unhealthy image) are expected to be larger (more caloric) than comparable meals at Subway (a chain that tries to position and advertise itself as healthy). In one study, a 1000-calorie meal was believed to contain 744 calories if served at McDonald's, but 585 calories if served at Subway (Chandon & Wansink, 2007b).

Beyond quantity and quality labels, the mere design of a package label can change perceptions of package size. Deng and Kahn (2009) found that a package was perceived to be larger if its label featured a product image at the bottom, on the right or bottom-right (vs. the top, on the left, or top-left). This bias is driven by consumers' intuitive associations between the physical position of a product and its weight.

Implications. Labeling biases have significant implications for consumption decisions. Labels that reduce consumers' expectations of size lead to greater consumption. Aydınoğlu and Krishna (2011) found that labelling a food portion "small" led to greater consumption than portions labelled "medium" or "large", as individuals believe that they are consuming less. Similarly, a "low-fat" label boosts consumption because it reduces perceptions of portion size as well as consumption guilt. As a result, hedonic foods and overweight consumers are more susceptible to the effects of "low-fat" labels because they are more sensitive to manipulations that change consumption guilt (Wansink & Chandon, 2006b). Healthy restaurant positioning, too, leads individuals to consume more. Participants on average consumed 1011 calories using a coupon from Subway vs. 648 calories using a coupon from McDonald's, while believing that they had consumed less (i.e. 487 calories at Subway vs. 600 calories at McDonald's) (Chandon & Wansink, 2007b). Figure 4 summarizes this result.

--- Insert Figure 4 about here ---

Remedies. A number of strategies can be used to counteract labeling biases. Clearly, reinforcing consumers' categorization of foods into healthy and unhealthy types exacerbates labeling effects (Levin & Gaeth, 1988; Raghunathan, Naylor, & Hoyer, 2006). For example, the averaging bias (the belief that combined meals consisting of healthy and unhealthy components have fewer calories than meals consisting of purely unhealthy components) becomes stronger if participants are asked to assess the healthiness of individual meal components prior to estimating the meal's calorie content (Chernev & Gal, 2010). Instead, strategies that highlight the quantity, rather than the quality, of meals, can be effective. For example, having participants assess the size of individual meal components prior to estimating meal size reduces the averaging bias (Chernev & Gal, 2010).

Similarly, providing information about the number of servings in a food package or portion can curb the detrimental effect of "low-fat" labels on consumption. However, this strategy only works for normal-weight individuals who consume "low-fat" foods mainly because they appear to contain fewer calories; it does not work for overweight individuals who consume "low-fat" foods mainly because those reduce consumption guilt (Wansink & Chandon, 2006b).

Strategies that downplay the link between labels and food quality can further reduce labeling biases. For example, when consumers were asked to think how restaurants' health claims may not translate to the healthiness of individual items on the menu, the effect of those claims on consumption was curbed (Chandon & Wansink, 2007b).

Finally, the bias arising from product image positioning (heavy position = bottom-right vs. light position = top-left) on front-of-pack labels can be curbed if the product is placed next to other products with similar label design/positioning. In other words, a product with a its image positioned in the bottom-left (top-right) of its label is perceived to be less heavy (light) if it is surrounded by other products on the shelf that display the product image in the bottom-left (top-right) of their labels (Deng & Kahn, 2009).

Affect

Bias. Consumers' emotional reaction to food can bias their perceptions of size. A number of classic studies have documented how objects appear to be bigger to those who desire them than to those who do not. Cigarettes look bigger to smokers, coins look bigger to the powerless, water looks more proximate to thirsty people, and a muffin looks bigger to restrained eaters (Balcetis & Dunning, 2010; Brendl, Markman, & Messner, 2003; Dubois, Rucker, & Galisnky 2010; van Koningsbruggen, Stroebe, & Aarts, 2011). However, new evidence suggests that the biased impression of desired objects may stem not from just desire alone, but from the combination of desiring an object and perceiving it as dangerous. In the context of food, consumers are more sensitive to package and portion size if they desire the food and perceive it to be a potential risk to their health (Cornil, Ordabayeva, Kaiser, Weber, & Chandon, 2014). This effect likely occurs because the tension between desire and perceived risk boosts physiological arousal and changes the way individuals visually process food stimuli, with the result that emotional conflict leads consumers to be more sensitive – and hence more accurate when estimating package and portion size. This effect has been documented among adults and also among children, whose estimations of increasing portions of chocolate were more accurate when their desire for chocolate conflicted with the realization that their parents would scold them for eating it.

Implications. Emotional conflict may have beneficial outcomes for consumption regulation. Since conflicting emotions towards a food increases sensitivity to its size, then consumers should make more informed consumption decisions and be less tempted to overeat. Conversely, if conflicting emotions about unhealthy food are reduced, then vigilance about portion sizes will drop and consumers will eat more. Accordingly, studies found that "low-fat" labels on unhealthy foods increased consumption, particularly among overweight individuals, to a large extent because they reduced the emotional conflict or guilt individuals felt about eating them (Wansink & Chandon, 2006b).

Remedies. Since the conflict between desire and the perceived health risk sensitizes consumers to portion size, strategies that heighten this emotion may help consumers regulate their food intake. Cornil and colleagues (2014), for example, proposed a strategy that simultaneously heightened consumers' desire for hedonic food and highlighted the food's unhealthy attributes. In one study, researchers had participants evaluate portions of gummy chews. To manipulate the health risk, the chews were described as "gummy candies" (unhealthy) or as "nutrition chews with vitamins" (healthy). To manipulate desire, researchers asked participants to sample the candies prior to estimating their portion size (prior research suggests that sampling a small amount of a particular food boosts the desire for it, Wadhwa, Shiv, & Nowlis, 2008). The results revealed that size perceptions were the most accurate when consumers both perceived the chews as unhealthy and desired them following initial sampling. This implies that to improve the accuracy of size perceptions, manipulations of desire and perceived risk need to be implemented at the same time, as emotional conflict only occurs when both are heightened. Interestingly, a similar effect occurred in a different study among individuals who felt inherently conflicted towards hedonic foods (restrained eaters who felt conflicted towards potato chips) (Papies, Stroebe, & Aarts, 2008; Scott, Nowlis, Mandel, & Morales, 2008).

THE ROAD AHEAD

In this chapter we have outlined five biases that shape consumers' perceptions of size and consequent consumption decisions, and have proposed a number of strategies to mitigate their detrimental effects. Table 2 outlines the basic principles discussed in the chapter. Although the research reviewed in this chapter provides a solid foundation for understanding consumers' size perceptions, many theoretical and practical issues are still unresolved.

---Insert Table 2 about here ---

From a theoretical perspective, existing studies have focused on either cognitive or affective processes in size perception. For example, some focus on the cognitive strategies (additive integration of package dimensions, bounded vs. unbounded estimation tactics) that consumers use to estimate package and portion size; others on the role of emotions (desire, fear, conflict). Yet considerations of how cognition and affect may *interact* in shaping consumers' size perceptions have been largely overlooked, opening up an avenue for future research.

Prior work has shown that mood can change the cognitive strategies that consumers use to process information (Pham, 2007). Some studies have suggested that positive mood induces people to use heuristic processing, while negative mood may induce more systematic processing (Keller, Lipkus, & Rimer, 2002). This raises the question of whether mood can influence the type of cognitive strategies that consumers use to estimate size. Can positive mood lead people to use heuristic strategies (e.g., additive rules) and negative mood lead people to use more systematic strategies (e.g., more integrative, multiplicative rules) to estimate size?

Furthermore, little is known about the role of multi-sensory experience and pleasure in consumers' perceptions of portion size and consumption choices. The existing evidence suggests that small portions are associated with higher sensory pleasure (Cornil & Chandon, 2016; Morewedge, Huh, & Vosgerau, 2010) but it is unclear whether highlighting sensory pleasure can change perceptions of portion size. If this is indeed the case, there is an opportunity for a win-win solution to reduce consumers' food intake while boosting their consumption pleasure. In pursuing this quest, it would be interesting to find strategies that can effectively enhance sensory pleasure. One option could be to promote the use of rituals (such as one's closing eyes before eating) that have been linked to the heightened pleasure of consuming certain foods (Vohs, Wang, Gino, & Norton, 2013).

In examining the role of multi-sensory experience, it is important to integrate the roles of non-visual senses (e.g., sound, touch, smell) in driving size perceptions. Research has found that consumers associate the texture of food with its calorie content: soft foods are believed to have more calories (Biswas, Szocs, Krishna, & Lehmann, 2014). It would be interesting to understand how all five senses (and non-size-related visual product attributes such as color), and their interactions, influence consumers' perceptions of package and portion size, and how these sensory factors drive consumption decisions.

Similarly, scholars should pay more attention to the role of environmental factors (in contrast to the product-specific factors that have been researched in the past) that have previously been linked to consumption choices. One study, for example, showed how the contrast between the food and the plate on which it was served influenced perceptions of portion size: portions appeared to be smaller when served on big plates rather than small plates (Van Ittersum & Wansink, 2012). Another area of potential interest would be to explore whether other environmental factors such as background music and store atmospherics can change consumers' perceptions of the size of packages and portions when shopping.

From a practical perspective, it is essential for future studies to examine potential de-biasing strategies that can be smoothly integrated in stores and restaurants. For example, does highlighting the product's unit price improve the accuracy of consumers' perceptions of its size? A significant association between unit price and package size has been documented: large packages are assumed to have lower unit price (Nason & Della Bitta, 1983; Wansink, 1996), hence it is possible that highlighting the higher-than-expected unit price of a supersized package may sensitize consumers to its size. However, the fact that many shoppers do not pay attention to unit prices displayed in stores, and unit price information is sometimes hard to integrate with quantity information, presents challenges that need to be overcome (Vanhuele & Drèze, 2002). A study by Mohan, Chandon, and Riis (2015) found that consumers thought that a 50% increase in volume for free provided similar value to a 50% reduction in price (even though it is equivalent to a 33% (vs. 50%) drop in unit price). Clearly there is an opportunity and a need for new research on strategies that ease the interpretation and integration of unit price information in consumers' size judgments and decisions.

Likewise, much remains unknown about how consumers integrate information about product costs in their assessments of product price and size. While recent downsizing attempts in the marketplace have largely been motivated by marketers' desire to absorb rises in the cost of raw materials and production (Clifford & Rampell, 2011), it is unclear whether consumers take cost information into account.

In exploring these issues, researchers need to adopt more inclusive assumptions and methodologies to establish the generalizability of the findings to a variety of practical and theoretical settings. Specifically, they need to get out of the lab environment and into the field – where food consumption actually takes place. They need to examine broader participant populations (including vulnerable segments such as children and consumers with health issues related to eating and weight). They need to measure a broader set of outcomes, not just the estimation of food that is ready to be consumed, but also of food that is cooked, served, or simply stored, and food that is wasted. They need to study repeat behaviors that are more likely to contribute to long-term health outcomes than the abundantly studied one-time hypothetical choices. Finally, they need to recognize that their own moral judgments (e.g., about what constitutes "good" vs. "bad" food, good vs. bad consumption practice – e.g., salt, fat, – good vs. bad participant population, etc.) have an influence on their endeavors to uncover the truth about portion size, health, and wellbeing (Askegaard et al., 2014).

REFERENCES

Askegaard, S., Ordabayeva, N., Chandon, P., Cheung, T., Chytkova, Z., Cornil, Y., Corus, C., Edell Britton, J. A., Junghans, A. F., Kristensen, D. B., Mathras, D., Mikkonen, I., Miller, E. G., Sayarh, N., & Werle, C. (2014). Moralities in food and health research. *Journal of Marketing Management*, 30 (17-18), 1800-1832.

Aydinoglu, N., & Krishna, A. (2011). Guiltless gluttony: The asymmetric effect of size labels on size perceptions and consumption. *Journal of Consumer Research*, 37 (6), 1095-1112.

Balcetis, E., & Dunning, D. (2010). Wishful seeing: More desired objects are seen as closer. *Psychological Science*, 21, 147–152.

Biswas, D., Szocs, C., Krishna, A., & Lehmann, D. R. (2014). Something to chew on: The effects of oral haptics on mastication, orosensory perception, and calorie estimation. *Journal of Consumer Research*, 41 (2), 261-73.

Brendl, C. M., Markman, A. B., & Messner, C. (2003). The devaluation effect: Activating a need devalues unrelated objects. *Journal of Consumer Research*, 29, 463–473.

Chandon, P., & Ordabayeva, N. (2009). Supersize in one dimension, downsize in three dimensions: Effects of spatial dimensionality on size perceptions and preferences. *Journal of Marketing Research*, 46 (6), 725–738.

——— (2017). The accuracy of less: Natural bounds explain why quantity decreases are estimated more accurately than quantity increases. *Journal of Experimental Psychology: General*, 146 (2), 250-268.

Chandon, P., & Wansink, B. (2006). How biased household inventory estimates distort shopping and storage decisions. *Journal of Marketing*, 70 (October), 118–35.

——— (2007a). Is obesity caused by calorie underestimation? A psychophysical model of meal size estimation. *Journal of Marketing Research*, 44 (February), 84–99.

——— (2007b). 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), 301–14.

——— (2012). Does food marketing need to make us fat? A review and solutions. *Nutrition Reviews*, 70, 571-593.

Chernev, A., & Gal, D. (2010). Categorization effects in value judgments: Averaging bias in evaluating combinations of vices and virtues. *Journal of Marketing Research*, 47 (4), 738–747.

Clifford, S., & Rampell, C. (2011). Food inflation kept hidden in tinier bags. *The New York Times*, March 28.

Collins, K. (1996). *New Survey on Portion Size: Americans Still Cleaning Plates*. Washington, DC: American Institute for Cancer Research.

Cornil, Y., & Chandon, P. (2016). Pleasure as a substitute for size: How multisensory imagery can make people happier with smaller food portions. *Journal of Marketing Research*, October.

Cornil, Y. Ordabayeva, N., Kaiser, U., Weber, B., & Chandon, P. (2014). The acuity of vice: Attitude ambivalence improves visual sensitivity to increasing Portion Sizes." *Journal of Consumer Psychology*, 24 (2), 177-87.

Deng, X., & Kahn, B. E. (2009). Is your product on the right side? The "location effect" on perceived product heaviness and package evaluation. *Journal of Marketing Research*, 46 (6), 725-738.

Deng, X., & Srinivasan, R. (2013). When do transparent packages increase (or decrease) food consumption. *Journal of Marketing*, 77 (4), 104-117.

Deutsch, C. H. (2007). Incredible shrinking packages. *The New York Times*, (May 12), (accessed August 12, 2009). Available at http://www.nytimes.com/2007/05/12/business/12package.html.

Dubois, D., Rucker, D. D., & Galinsky, A. D. (2010). The accentuation bias: money literally looms larger (and sometimes smaller) to the powerless. *Social Psychological and Personality Science*, 4, 199–205.

Folkes, V., & Matta, S. (2004). The effect of package shape on consumers' judgments of product volume: Attention as a mental contaminant. *Journal of Consumer Research*, 31 (2), 390-401.

Garbinsky, E. N., Morewedge, C. K., & Shiv, B. (2014). Interference of the end: Why recency bias in memory determines when a food is consumed again. *Psychological Science*, 25, 1466-1474.

Grynbaum, M. M. (2014). New York's ban on big sodas is rejected by final court. *The New York Times*, June 26.

Horovitz, B. (2007). Friday's, Subway tailor meals for health-conscious. *USA Today*, March 1.

Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica*, 47 (March), 263–291.

Keller, P.A., Lipkus, I.M., & Rimer, B.K. (2002). Depressive realism and health risk accuracy: the negative consequences of positive mood. *Journal of Consumer Research, 29,* 57-69.

Krider, R. E., Raghubir, P, & Krishna, A. (2001). Pizzas: Pi or square? Psychophysical biases in area comparisons. *Marketing Science*, 20 (4), 405–425.

Krishna, A. (2007). Spatial perception research: An integrative review of length, area, volume, and number perception. In M. Wedel & R. Pieters (Eds.) *Visual Marketing: From Attention* *to Action* (167-93). Mahwah, NJ: Lawrence Erlbaum Associates.

——— (2012). An integrative review of sensory marketing: Engaging the senses to affect perception, judgment and behavior. *Journal of Consumer Psychology*, 22 (3), 333–51.

Ledikwe, J. H., Ello-Martin, J., & Rolls, B. J. (2005). Modifying the food environment: Energy density, food costs, and portion size. *Journal of Nutrition*, 135 (4), 905–909.

Lennard, D., Mitchell, V-W., McGoldrick, P., & Betts, E. (2001). Why consumers under-use food quantity indicators. Int*ernational Review of Retail, Distribution & Consumer Research*, 11 (2), 177–99.

Levin, I. P., & Gaeth, G. J. (1988). How consumers are affected by the framing of attribute information before and after consuming the product. *Journal of Consumer Research*, 15, 374-378.

Martin, A. (2007). Will diners still swallow this? *The New York Times*, March 25.

Mohan, B., Chandon, P., & Riis, J. (2015). Percentage cost discounts always beat percentage benefit bonuses: Helping consumers evaluate nominally equivalent percentage changes. *Journal of Marketing Behavior,* 1 (1), 75-107.

Morewedge, C. K., Huh, Y. E., & Vosgerau (2010). Thought for food: Imagined consumption reduces actual consumption. Science, 303, 1530-1533.

Nason, R. W. & Della Bitta, A. J. (1983). The incidence and consumer perceptions of quality surcharges. *Journal of Retailing*, 59 (2), 40–54.

Nestle, M. (2003). Increasing portion sizes in American diets: More calories, more obesity. *Journal of the American Dietetic Association*, 103, 39–40.

Nielsen, S. J., & Popkin, B. M. (2003). Patterns and trends in food portion sizes, 1977-1998. *Journal of American Medical Association*, 289 (4), 450–53.

Oakes M. E. Stereotypical thinking about foods and perceived capacity to promote weight gain. *Appetite*, 44(3), 317-324.

Ordabayeva, N., & Chandon, P. (2013). Predicting and managing consumers' package size impressions. *Journal of Marketing*, 77, 123–137.

Ordabayeva, N., & Chandon, P. (2016). In the eye of the beholder: Visual biases in package and portion size perceptions. *Appetite, 103*, 450-457.

Papies, E. K., Stroebe, W., & Aarts, H. (2008). The allure of forbidden food: On the role of attention in self-regulation. *Journal of Experimental Social Psychology*, 44, 1283–1292.

Pham, M. (2007). Emotion and rationality: A critical review and interpretation of empirical evidence. *Review of General Psychology*, 11 (2), 155-178.

Raghubir, P. (2007). Are visual perception biases hard-wired? In Visual Marketing: From Attention to Action. In M. Wedel & R. Pieters (Eds.) *Visual Marketing: From Attention to Action* (143-66). Mahwah, NJ: Lawrence Erlbaum Associates.

Raghubir, P., & Kirshna, A. (1999). Vital dimensions in volume perception: Can the eye fool the stomach? *Journal of Marketing Research*, 36, 313–326.

Raghunathan, R., Naylor, R. W., & Hoyer, W. D. (2006). The unhealthy = tasty intuition and its effects on taste inferences, enjoyment, and choice of food products. *Journal of Marketing*, 70, 170–184.

Rolls B. J., Morris E. L., Roe L. S. (200). Portion size of food affects energy intake in normal-weight and overweight men and women. *American Journal of Clinical Nutrition*, 76(6), 1207-121.

Rozin, P., Ashmore, M., & Markwith, M. (1996). Lay American conceptions of nutrition: Dose insensitivity, categorical thinking, contagion, and the monotonic mind. *Health Psychology*, 15 (6), 438–447

Scott, M. L., Nowlis, S. S., Mandel, N., & Morales, A. C. (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.

Stevens, S. S. (1986). *Psychophysics: Introduction to Its Perceptual, Neural, and Social Prospects*. Oxford: Transaction Books.

Vanhuele, M., & Dreze, X. (2002). Measuring the price knowledge shoppers bring to the store. *Journal of Marketing*, 66, 72.

Van Ittersum, K., & Wansink, B. (2012). Plate size and color suggestibility: The Delboeuf illusion's bias on serving and eating behavior. *Journal of Consumer Research*, 39, 215–228.

van Koningsbruggen, G. M., Stroebe, W., & Aarts, H. (2011). Through the eyes of dieters: Biased size perception of food following tempting food primes. *Journal of Experimental Social Psychology*, 47, 293–299.

Viswanathan, M., Rosa, J. A., & Harris, J. E. (2005). Decision making and coping of functionally illiterate consumers and some implications for marketing management. *Journal of Marketing*, 69 (January), 15–31.

Vohs, K. D., Wang, Y., Gino, F., & Norton, M. I. (2013). Rituals enhance consumption. *Psychological Science*, 24 (9), 1714-1721.

Wadhwa, M., Shiv, B., & Nowlis, S. M. (2008). A bite to whet the reward appetite: The influence of sampling on reward-seeking behaviors. *Journal of Marketing Research*, 45, 403–413.

Wansink, B. (1996). Can package size accelerate usage volume? *Journal of Marketing*, 60 (July), 1–14.

Wansink, B., & Chandon, P. (2006a). Meal size, not body size, explains errors in estimating the calorie content of meals. *Annals of Internal Medicine*, 145, 326-332.

——— (2006b). Can 'low-fat' nutrition labels lead to obesity. *Journal of Marketing Research*, 43 (November), 605–17.

——— (2014). Slim by design: Redirecting the accidental drivers of mindless overeating. *Journal of Consumer Psychology*, 24, 413-431.

Wansink, B., & Van Ittersum, K. (2003). Bottoms up! The influence of elongation on pouring and consumption volume. *Journal of Consumer Research*, 30, 455–463.

Young, L. R., & Nestle, M (1998). Variation in perceptions of a 'medium' food portion: implications for dietary guidance. *The Journal of American Dietetic Association*, 98 (April), 458-59.

——— (2003). Expanding portion sizes in the US marketplace: Implications for nutrition counseling. *The Journal of American Dietetic Association*, 103 (February), 231-34.

TABLE 1

USING THE DIMENSIONALITY BIAS TO INCREASE THE APPEAL OF DOWNSIZING

	Original size (control)	1D downsizing	Elongated downsizing (height)	Elongated downsizing (length)
Net weight (lbs.)	8.0	5.0	5.0	5.0
Height (cm)	45.0	34.4	48.3	41.3
Length (cm)	20.5	20.5	19.3	26.5
Width (cm)	12.8	12.8	9.7	8.3
Shape				
Choice share vs. competitors (%)	49.2	25.0*	57.1	53.3

Note: Package dimensions and choice share of the target brand (vs. competition) among regular customers of the brand in the control condition (regular pack size), 1D downsizing condition (pack was downsized in height), and two elongated downsizing conditions (pack was downsized through elongation in height or width). * indicates a statistically difference of the choice share in the downsizing condition compared to the choice share in the control condition at $p < .05$. Identifying package information was removed to ensure brand confidentiality. Reprinted with permission from the American Marketing Association (77, September, 2013): Table 4 in Ordabayeva, N., & Chandon, P. (2013). Predicting and managing consumers' package size impressions. *Journal of Marketing*, 77, 123–137.

TABLE 2

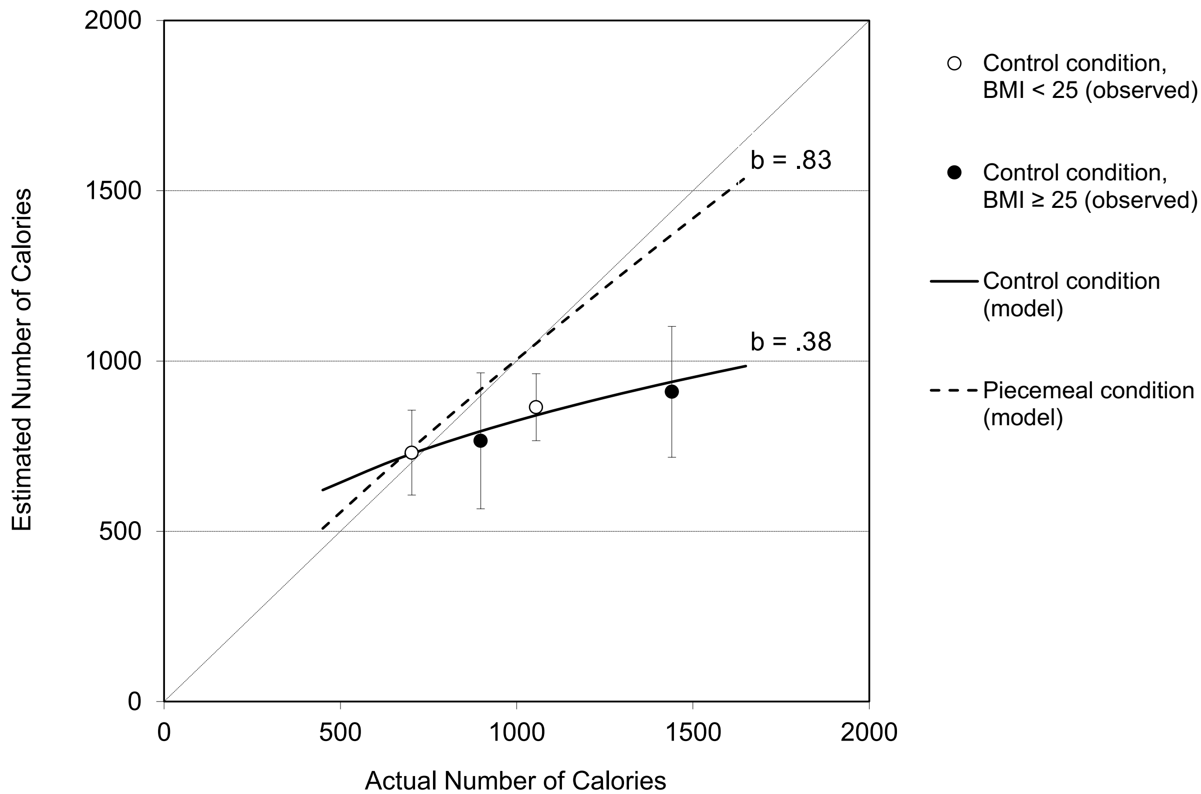
FIVE BIASES IN CONSUMERS' SIZE PERCEPTIONS

Bias	*Description*	*Remedies*	*Literature*
Underestimation	Consumers underestimate the sizes of packages and portions, more so for large portions than for small ones.	- Providing information about the bias, drawing attention to the object or the estimation task, and motivating individuals to be accurate through intrinsic or extrinsic (financial) means do not mitigate the bias. - Prompting a piecemeal estimation of individual food items before estimation of the entire meal mitigates the bias.	Chandon & Wansink (2006; 2007a) Stevens (1986) Krider, Raghubir, & Krishna (2001) Krishna (2007)
Dimensionality	Consumers are more sensitive to changes in size that occur along one pack dimension than to changes that occur along all three pack dimensions (length, width, and height), especially if dimensions change in opposite directions (e.g., if the height of a package grows while its length and width shrink).	- Linearizing the size change from multiple pack dimensions to a single dimension mitigates the dimensionality bias, increases the appeal of supersizing, and informs consumers about the actual size of supersized portions. - Implementing the size change through multiple dimensions, especially if dimensions change in opposite directions, increases the appeal of downsizing. - Enhancing the ease of monitoring product volume by using transparent packaging or by allowing the use of additional, non-visual, sensory information (e.g., weight products by hand) mitigates the dimensionality bias.	Chandon & Ordabayeva (2009) Deng & Srinivasan (2013) Krishna (2007) Ordabayeva & Chandon (2013) Raghubir & Krishna (1999) Wansink & Van Ittersum (2003)
Directionality	Consumers are more sensitive to decreases in product quantity than to increases in quantity. Whereas consumers significantly underestimate size increases, they almost perfectly estimate size decreases.	- Changing the valence (palatability) of the product or the magnitude of the reference do not mitigate the directionality bias. - Imposing implicit or explicit bounds to estimations of increasing portions by providing a numeric bound or by having participants pour, instead of estimate, portions increase consumers' sensitivity to size increases and mitigates the directionality bias. - Removing the zero bound from estimations of decreasing portions by having participants estimate the factor of change in portion size, instead of the final portion size, desensitizes	Chandon & Ordabayeva (2016)

		consumers to size decreases and mitigates the directionality bias.	
Labels	Consumers believe that a product is smaller, lighter, or less caloric when it has a label highlighting its small size, healthy components, healthy positioning, or when the product is shown on the top-left (vs. bottom-right) of the package label.	- Highlighting the healthiness (or unhealthiness) of the meal or its components exacerbates the labeling bias. - Highlighting the size of the meal or its components by either having participants evaluate the size of individual meal components or by providing serving size information reduces the labeling bias, but only among normal-weight individuals who pay more attention to the perceived reduction in product size in the result of health labels, but not among overweight individuals who pay more attention the reduction in their consumption guilt in the result of health labels. - Downplaying the healthiness of individual products served at restaurants positioned as healthy (by having participants consider why individual products at these restaurants may not be as healthy as expected) mitigates the bias created by healthy restaurant positioning. - Placing products with "heavy" product image positioning (bottom-right) on the label next to other products with similar labels reduces the positioning bias created by the location of the product image on the label.	Aydinoglu & Krishna (2011) Chandon & Wansink (2007, 2007b) Chernev & Gal (2010) Deng & Khan (2009) Wansink & Chandon (2006)
Affect	Consumers are more sensitive to package and portion sizes when they feel conflicted between their desire for the product contained in the package and their perception of the product's potential health risk.	- Consumers who inherently experience high conflict between desire for hedonic food and fear of its unhealthiness (e.g., dieters) are more accurate in their estimations of portion size. - Simultaneously inducing both desire (by having participants sample the food before consumption) and the perceived danger of food (by highlighting its unhealthy nature or components) can improve the accuracy of size perceptions.	Balcetis & Dunning (2010) Cornil, Ordabayeva, Kaiser, Weber, & Chandon (2014) van Koningsbruggen, Stroebe & Aarts (2011)

FIGURE 1

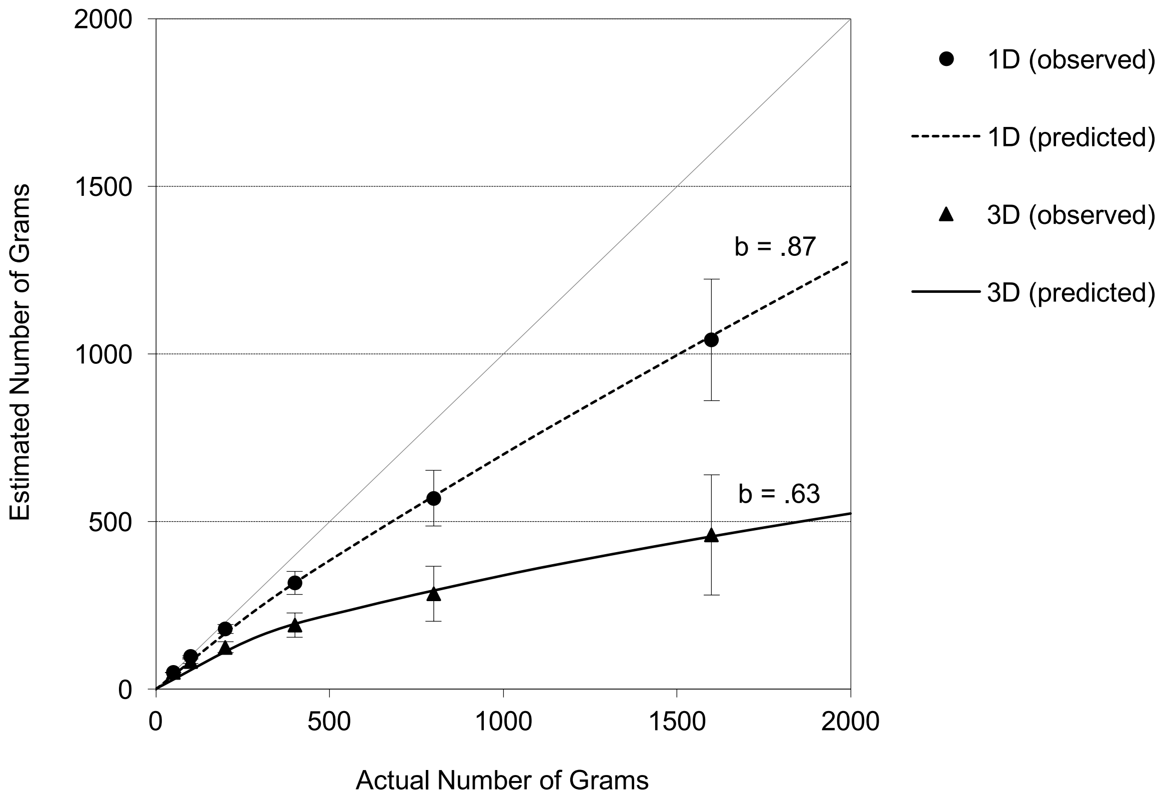
PIECEMEAL ESTIMATION MITIGATES THE UNDERESTIMATION BIAS (OBSERVED GEOMETRIC MEANS, 95% CONFIDENCE INTERVALS, MODEL PREDICTIONS)



Note: The actual and the estimated size of meals served at a fast-food chain restaurant observed among normal-weight and overweight individuals (classified based on the median split of participants' body-mass-index) in the control condition (estimation of the size of the entire meal) and the piecemeal condition (estimation of the size of each meal component prior to the estimation of the size of the entire meal). Reprinted with permission from the American Marketing Association (44, 1, 2007): Figure 3 in Chandon, P., & Wansink B. (2007). Is obesity caused by calorie underestimation? A psychophysical model of meal size estimation. *Journal of Marketing Research*, 44 (1), 84-99.

FIGURE 2

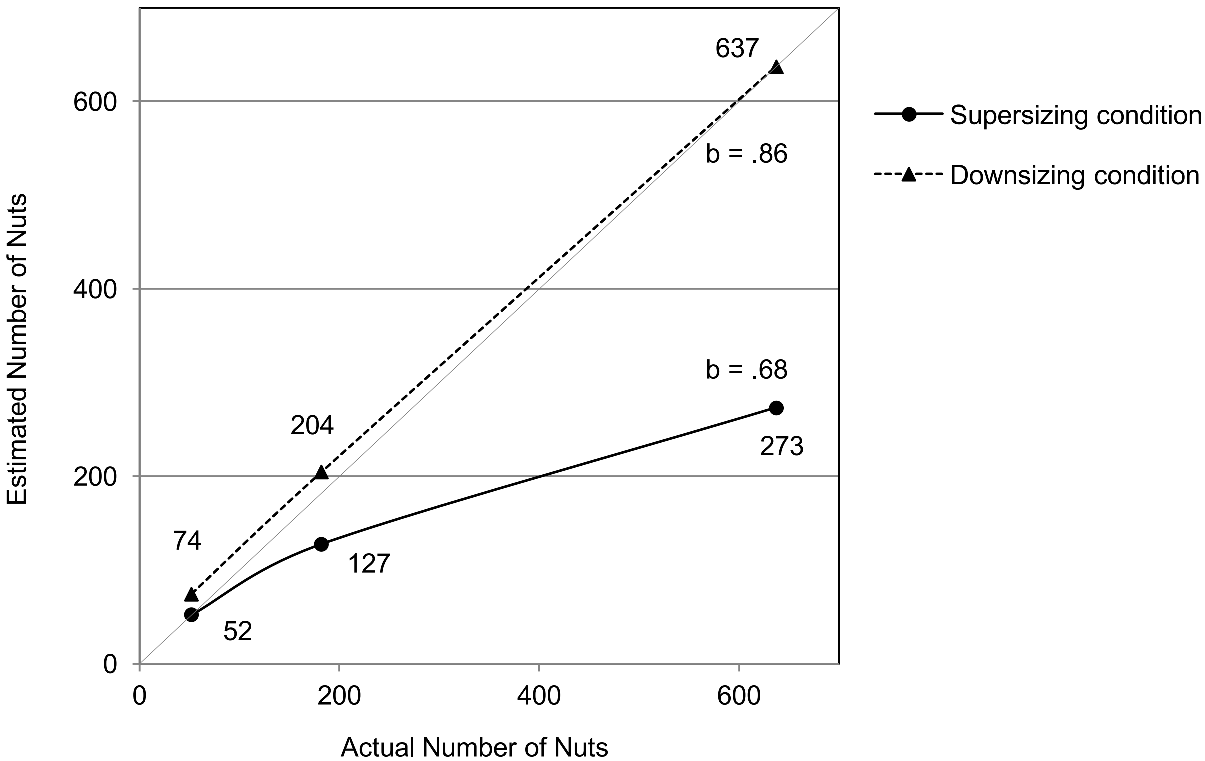
THE DIMENSIONALITY BIAS (OBSERVED GEOMETRIC MEANS, 95% CONFIDENCE INTERVALS, MODEL PREDICTIONS)



Note: The actual and the estimated size of a candle in the 1D condition (the candle increased in height only) and the 3D condition (the candle increased in diameter and height). Reprinted with permission from the American Marketing Association (46, 6, 2009): Figure 1 in Chandon, P., & Ordabayeva, N. (2009). Supersize in one dimension, downsize in three dimensions: Effects of spatial dimensionality on size perceptions and preferences. *Journal of Marketing Research*, 46 (6), 725–738.

FIGURE 3

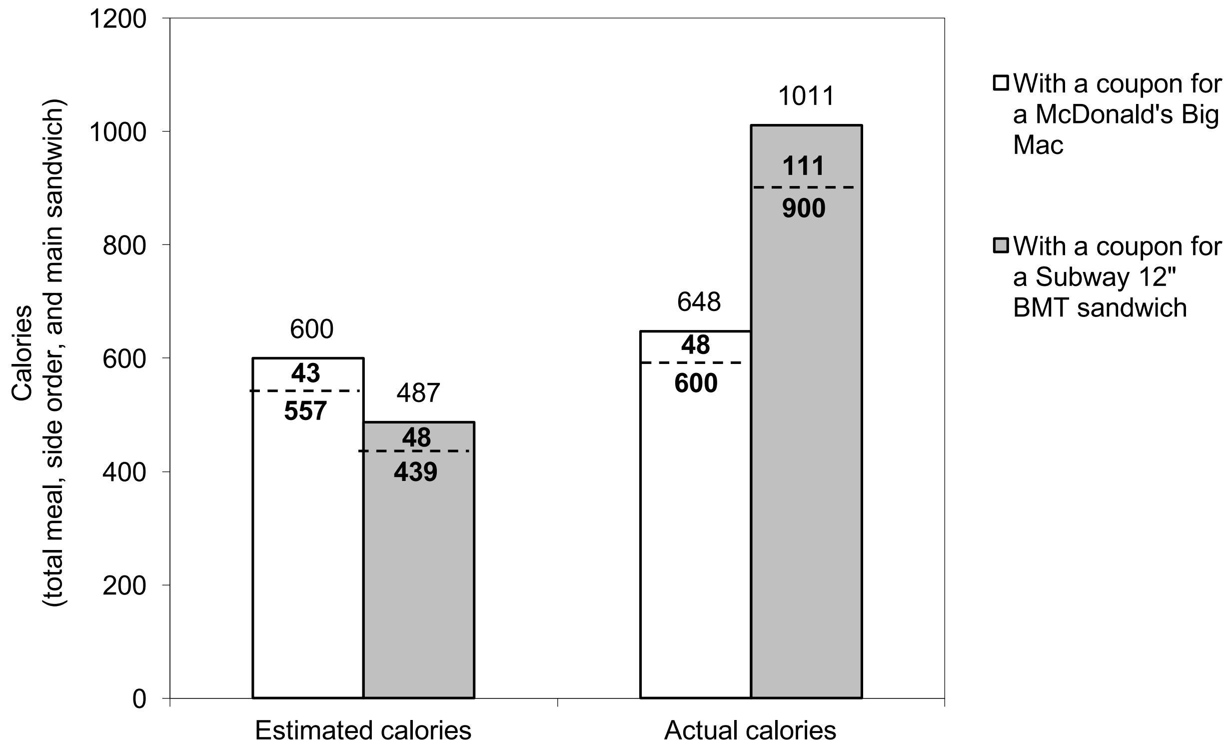
THE DIRECTIONALITY BIAS (OBSERVED GEOMETRIC MEANS, 95% CONFIDENCE INTERVALS, MODEL PREDICTIONS)



Notes: The actual and the estimated size of a small, medium, and large portion of nuts in the supersizing condition (given the size of a small portion, participants estimated the size of each remaining portion in ascending order) and the downsizing condition (given the size of a large portion, participants estimated the size of each remaining portion in descending order).

FIGURE 4

BIASING EFFECT OF HEALTHY RESTAURANT POSITIONING (ESTIMATED AND ACTUAL CALORIC CONTENT OF A MEAL CONSISTING OF THE MAIN DISH AND THE SIDE DISH)



Notes: Estimated and actual number of calories contained in a meal (total meal consisting of the main dish and the side dish) consumed when given a coupon from McDonald’s (positioned as unhealthy) and Subway (positioned as healthy). Reprinted with permission from Oxford University Press (34, October, 2007): Figure 3 in Chandon, P., & Wansink, B. (2007b). 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), 301–14.