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In the eye of the beholder: Visual biases in package and portion size perceptions

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ABSTRACT

As the sizes of food packages and portions have changed rapidly over the past decades, it has become crucial to understand how consumers perceive and respond to changes in size. Existing evidence suggests that consumers make errors when visually estimating package and portion sizes, and these errors significantly influence subsequent food choices and intake. We outline four visual biases (arising from the underestimation of increasing portion sizes, the dimensionality of the portion size change, labeling effects, and consumer affect) that shape consumers' perceptions of package and portion sizes. We discuss the causes of these biases, review their impact on food consumption decisions, and suggest concrete strategies to reduce them and to promote healthier eating. We conclude with a discussion of important theoretical and practical issues that should be addressed in the future.

1. Introduction

When making decisions about food, consumers tend to rely more on judgments of food quality than food quantity. For example, the vast majority of consumers think that to lose weight, it is more important to monitor what they eat than how much they eat (Collins, 1996; Rozin, Ashmore, & Markwith, 1996). This focus on quality over quantity is reflected in many dietary guidelines and weight-loss programs which prioritize eliminating certain types of foods or nutrients (e.g., sodas, carbohydrates) over regulating the total food intake (Thompson & Veneman, 2005). As such, consumers may expect to gain more weight from eating very small portions of a food perceived as "unhealthy" (e.g., one mini-Snickers® bar containing 47 calories) than from eating a very large quantity of "healthy" food (e.g., one cup of low-fat cottage cheese, three carrots and three pears, with a combined calorie count of 569 calories) (Oakes, 2005).

In the meantime, the sizes of food packages and portions have changed dramatically (Nestle, 2003; Rolls, Morris, & Roe, 2002). Portions grew by 60% for salty snacks and 52% for soft drinks in the course of just 20 years (Nielsen & Popkin, 2003). Due to public concerns about the negative implications of supersized portions for consumer health (Ledikwe, Ello-Martin, & Rolls, 2005; Young & Nestle, 2003), some marketers have attempted to downsize their products, but with mixed results (Deutsch, 2007). A few downsizing attempts have successfully attracted health and budget-conscious consumers (e.g., T. G. I. Friday's "Right Portion Right Price" menu, Horovitz, 2007). However, other downsizing attempts have tried to pass all the cost to consumers (e.g., by charging the same price for a smaller size) or to conceal the size reduction through product packaging (e.g., by replacing some of the product in a package with air). These tactics have drawn strong criticism for deceiving unsuspecting consumers who typically fail to check quantity information (Grynbaum, 2014).

In view of these trends, it has become crucial to understand how consumers perceive and respond to changes in package and portion size. In this article, we review four systematic visual biases that drive consumers' perceptions of package and portion size, show how these biases influence food consumption decisions, and suggest how they can be reduced. We conclude with a discussion of potential directions for future research.

2. Four types of biases and their remedies

Although information about food quantity is increasingly easy to find, including in restaurants, consumers rarely consult quantity

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labels (Wansink & Chandon, 2014). Instead, consumers tend to base their food purchase and consumption decisions on instant visual impressions of package and portion size. This is because they expect the package to be a reliable proxy for the amount of food inside (Lennard, Mitchell, McGoldrick, & Betts, 2001), and because some people find quantity information difficult to process, especially when it is presented in non-metric units (Viswanathan, Rosa, & Harris, 2005).

Unfortunately, visual perception is not a reliable indicator of food portion or package size because of four types of visual biases, which pertain to the underestimation of package or portion size, dimensionality effects, labeling and affective biases. Below we outline the consequences of these biases for consumption decisions and discuss the effectiveness of various debiasing strategies.

2.1. Underestimation biases and their remedies

The first bias in perceptions of package and portion size is the underestimation of the magnitude of the increase in the actual size of a package or a portion, whereby the perceived size grows more slowly than the actual size. Essentially, when consumers encounter a new supersized product (e.g., a new extra-large can of soda), they underestimate how much larger it is compared to the existing smaller size that they remember from prior purchase or that is displayed next to the supersized product on store shelves or on restaurant counters.

A stream of literature in psychophysics has established that the underestimation bias arises because people's visual perceptions of the size of physical objects follow an inelastic power function of actual size, as captured by the following mathematical expression (Stevens, 1986):

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

where ESTSIZE is estimated object size, ACTSIZE is actual object size, a is a constant term and b is the power exponent denoting the sensitivity of size estimations to changes in actual size.

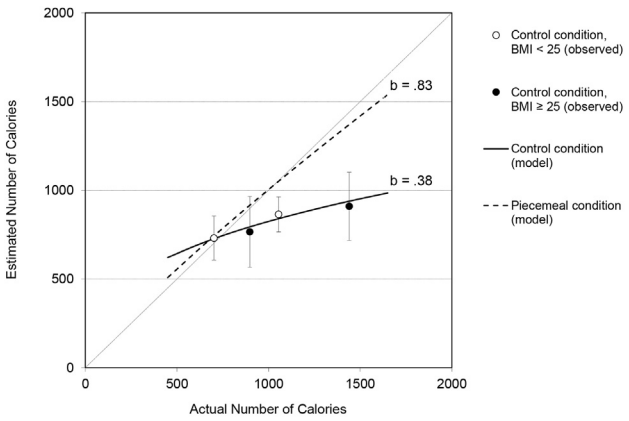
In the context of food packages and portions, marketing studies have demonstrated that the power exponent b of consumers' size perceptions typically ranges between .5 and .8 (Krishna, 2007, 2012), with values close to 1 observed only for one-dimensional figures such as lines which are rarely encountered in the food domain. This means that the sensitivity of consumers' size estimations to actual size diminishes as packages and portions grow bigger, resulting in the underestimation of large sizes. In other words, consumers become increasingly desensitized to package and portion size as packages and portions grow bigger, with the result that they choose and consume larger portions without realizing just how large these portions really are.

To test these predictions, Chandon and Wansink (2007a) asked the customers of fast food restaurants in three US cities to estimate the number of calories contained in meals that they had purchased. The results showed that consumers underestimated the size of their meals (the average estimated size was 546 calories compared to the actual 744 calories, a 27% underestimation); more so for large meals (estimated size was 687 calories vs. actual 1144 calories, a 40% underestimation) than small meals (estimated size was 433 calories vs. actual 484 calories, an 11% underestimation). This underestimation bias was replicated for round and square shapes (e.g., pizzas, Krider, Raghubir, & Krishna, 2001), when quantity increased or decreased (Chandon & Ordabayeva, 2009), as well as for food kept in the pantry (Chandon & Wansink, 2006).

Importantly, the prevalence and the magnitude of the underestimation bias did not depend on body mass or people's knowledge about nutrition and portion size. The same authors (Chandon & Wansink, 2007a; Wansink & Chandon, 2006a) reported a similar pattern of underestimation among normal-weight and overweight individuals, among people with a high or low interest in nutrition, and even among trained dieticians. These findings are consistent with the prevailing view that visual biases are hardwired (Raghubir, 2007), suggesting that information-, attention-, and motivation-based strategies directed at debiasing size perceptions have limited effects. Accordingly, providing information about the underestimation bias does not improve the accuracy of consumers' size perceptions (Chandon & Wansink, 2007a; Ordabayeva & Chandon, 2013). Drawing attention to the product does not improve estimation accuracy (Folkes & Matta, 2004), neither does consumers' motivation to produce accurate estimates, be it inherent or induced through financial incentives (Ordabayeva & Chandon, 2013; Raghubir, 2007).

Instead, studies have found that piecemeal estimation, consisting of breaking up a large meal into its individual components (e.g., the main dish, the side dish, and the beverage) is an effective way to reduce the underestimation bias. This is because the individual components of a meal have a smaller size than the total meal and therefore the perception of their size is more accurate. Thus piecemeal estimation of food portions improves consumers' perceptions of total meal size and, as a result, weakens preferences for large meals, even among dieticians (Chandon & Wansink, 2007a). To illustrate, in one study dieticians were asked to estimate the sizes of small, medium and large fast-food meals containing a sandwich, chips, and a drink. They then indicated which of the three meals they would choose to consume. Those dieticians who estimated the size of individual meal components had more accurate size estimates and were more likely to choose a small meal than those who estimated the size of the full meal directly. Fig. 1 summarizes these findings.

Helping people realize just how large today's supersized portions really are may also enhance the sensory pleasure that people derive from the meal. Indeed, studies have shown that supersized portions often yield lower sensory pleasure because of sensory-specific satiation (Cornil & Chandon, 2015a, 2015b; Garbinsky, Morewedge, & Shiv, 2014).



Note: Actual and estimated calories of small and large fast-food meals (determined via median split for regular-weight or overweight consumers). Increasing meal size, not body size (designated by BMI, body-mass index), leads to the underestimation of meal size, but separate estimation of the sandwich, side, and beverage contained in the meal eliminates the bias. Adapted from 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.

Fig. 1. The underestimation bias is reduced with piecemeal estimation (observed geometric means, 95% confidence intervals, and model predictions).

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