



Short communication

Container size influences snack food intake independently of portion size[☆]David Marchiori^{a,*}, Olivier Corneille^b, Olivier Klein^a^a *Social Psychology Unit, Université Libre de Bruxelles, CP 122, 50, Avenue F.D. Roosevelt, B-1050 Bruxelles, Belgium*^b *Research Institute for Psychological Science, Catholic University of Louvain, Belgium*

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ABSTRACT

While larger containers have been found to increase food intake, it is unclear whether this effect is driven by container size, portion size, or their combination, as these variables are usually confounded. The study was advertised as examining the effects of snack food consumption on information processing and participants were served M&M's for free consumption in individual cubicles while watching a TV show. Participants were served (1) a medium portion of M&M's in a small ($n = 30$) or (2) in a large container ($n = 29$), or (3) a large portion in a large container ($n = 29$). The larger container increased intake by 129% (199 kcal) despite holding portion size constant, while controlling for different confounding variables. This research suggests that larger containers stimulate food intake over and above their impact on portion size.

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Introduction

Recent changes in the food and eating environment contribute to the obesity epidemic (Hill & Peters, 1998; Young & Nestle, 2002). Observational data show that the size of the food portions suggested in recipes, the package sizes sold in supermarkets, the portions served in restaurants, fast-foods or at home have all increased in recent years (Nielsen & Popkin, 2003; Rolls, 2003; Wansink & Payne, 2009; Young & Nestle, 2002, 2003). In general, food portions are nowadays 2–5 times larger than twenty years ago (Young & Nestle, 2003). Also, when served larger portions, individuals tend to consume 18–25% more food at lunch meals and 30–45% at snacking occasions. The food market tends to use larger containers (Young & Nestle, 2003) to accommodate larger portions, usually rich in calories, thereby leading to excess energy intake (Ledikwe, Ello-Martin, & Rolls, 2005; Rolls, Morris, & Roe, 2002; Wansink, 2004). For example, in a study by Wansink and Kim (2005), moviegoers ate 33.6% more popcorn when offered large containers (i.e., 240 g) than medium containers (i.e., 120 g) of popcorn. The ubiquitous effect of oversized portions of food is substantiated by research indicating that portion size effects are indiscriminate of people (e.g., gender, BMI, age, status, etc.), eating location (e.g. supermarkets, restaurants,

fast-foods, recipes, etc.) and food type (e.g. burgers, pasta, muffins, etc.; Wansink, 2004; Young & Nestle, 2002).

However, as illustrated in the above example, studies on the effect of portion size (PS) on food consumption tend to confound container size (CS) with PS. Insofar, no study has varied CS independently of PS. Therefore, it is unclear whether larger PS, larger CS, or their combination influence food intake. In particular, it is unclear whether CS may influence food intake independently of the served portion. The main goal of this paper was to examine this question. That is, does CS influence food intake despite holding PS constant?

Two predictions can be made. First, individuals may exclusively rely on consumption norms that make them think they are served adequate portions (Herman & Polivy, 2005; Wansink, 2004). Individuals are generally uncertain as to how much to eat on a given occasion and the food portion served subtly suggests a cue to gauge or determine how much they should consume. In the study by Wansink and Kim (2005), participants adapted their intake to the portion served by consuming more when more food was offered, regardless of whether the popcorn was fresh or stale (i.e., 14 days old). Hence, people may rely on the offered PS of snacks to adjust their food consumption and remain relatively unaffected by CS variations when PS is held constant. In this view, increased food intake is expected when PS increases, but not necessarily when only CS increases.

Alternatively, larger containers may provoke a size-contrast illusion, where a similar amount of food is perceived to be smaller on a large plate or in a large container. For example, the amount of mashed potatoes is underestimated when served on a 12-in. compared to an 8-in. plate (van Ittersum & Wansink, 2007). This

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“perceptual contrast” may decrease consumers’ feelings of guilt toward food consumption or elicit psychological reactance if they think they are served inadequately small food portions. If so, increased food intake may be observed when snacks are served in a larger CS, independently of PS.

In the present study, participants took part in a typical snacking situation (Wansink, 2004): they were served M&M’s for free consumption in individual cubicles while watching a TV show. Participants were served either a medium portion of M&M’s in a small container (condition 1), a medium portion in a large container (condition 2) or a large portion in a large container (condition 3). We examined whether greater food intake would be observed with larger containers despite holding food portion constant (i.e., comparison between first and second conditions). In addition, we examined whether further increasing food portion would increase food intake (i.e., comparison between second and third conditions).

Method

Subjects and experimental design

Eighty-eight undergraduate students ($M_{age} = 20.1 \pm 2.1$; $M_{BMI} = 22 \pm 3.8$; 61 Belgians, 26 male participants) were recruited in exchange for course credits, on condition that they regularly consumed a snack in the afternoon (Osterholt, Roe, & Rolls, 2007). Subjects provided written, informed consent to participate in the study reviewed and approved by the Ethical Committee of the Faculty of Psychological Sciences of the *Free University of Brussels*. Participants were randomly assigned to three conditions: medium PS/small CS ($n = 30$), medium PS/large CS ($n = 29$) and large PS/large CS ($n = 29$). The third condition was included in order to explore whether a larger PS would further increase food intake independent of CS. A fourth condition with a small CS and large PS was not included due to physical constraints (i.e., containers cannot contain food that exceed their volume).

Procedure

The study was advertised as examining the effects of snack food consumption on information processing. It was run from 2 pm to 6 pm in individual cubicles in a psychology laboratory. Participants were ensured of their anonymity by being identified solely by a 3-digit code. As a commonly consumed snack food, M&M’s (Mars Inc., Virginia, USA) were chosen, with portion sizes of 200 vs. 600 g for the medium and large PS conditions, respectively. Food amount was purposely selected to be larger than average intake in order to avoid artificially inducing restriction in this experimental setting. The volume (and dimensions) of the aluminum containers (Fun Favours, N.V. Copimex S.A., Halle, Belgium) was 250 ml (6.5 cm wide, 9 cm long and 3.5 cm deep) for the small container size and 750 ml (9.9 cm wide, 16.3 cm long and 4.3 cm deep) for the large container size. Hence, in conditions 1 and 3, containers were stuffed, while in condition 2 containers were approximately half-full. Before and after consumption, participants used visual analog scales (VAS) to rate their hunger, prospective consumption (how much food they thought they could eat) and fullness (Rolls, Roe, & Meengs, 2007). For example, subjects answered the question “How hungry are you right now?” by marking a 100-mm line that was anchored on the left by “not at all hungry” and on the right by “extremely hungry.” Scores regarding hunger were aggregated ($\alpha = .82$ and $.83$ for before and after consumption, respectively). Liking of foods was also assessed before and after consumption with VAS by having participants take one M&M and rate pleasantness of taste, appearance and quality (Rolls et al., 2007).

Scores regarding liking of foods were aggregated ($\alpha = .93$ and $.94$ for before and after consumption, respectively).

Participants then watched a 22-min TV show (Scrubs, Season 1, Episode 1) while snacking. This setting was chosen because snack foods are usually consumed on a voluntary basis when individuals are distracted by other activities such as work or watching television (Wansink, 2004). Snack food was removed when the TV show ended. Plate cleaning tendency was assessed with the same question used by Rolls, Roe, Kral, Meengs, and Wall (2004) and the two questions used by Wansink and colleagues (2005). Answers to these questions were aggregated into a single score ($\alpha = .93$). Consumption monitoring was assessed consistent with Wansink et al. (2005). Mood was measured with the two items used by Wansink and Kim (2005) and the four items used by Reinbach, Martinussen, and Møller (2010). Answers to these questions were aggregated into a single score ($\alpha = .7$). Plate cleaning tendency, consumption monitoring and mood were translated into French and assessed on agreement scales anchored (-3) strongly disagree and ($+3$) strongly agree. Dieting behavior was assessed with the French translation (Leichner, Steiger, Puentes-Neuman, Perreault, & Gottheil, 1994) of the Eating Attitude Test (EAT-26; Garner, Olmsted, Bohr, & Garfinkel, 1982). Binge eating was assessed by a question from the Eating Disorders Examination (Fairburn & Cooper, 1993): “Have there been any times when you have eaten a large amount of food in a short amount of time and you had a sense of loss of control about your eating?” Demographics measured were: age, weight, height and conjecture about the purpose of the experiment. Foods were weighed before and after food intake to determine gram weight consumed (within 0.1 g; Digital Kitchen Scales, Brabantia Solid Company, Valkenswaard, Netherlands).

Statistical analysis

One-sample Kolmogorov–Smirnov test was used to examine deviations from normality. Analysis of variance followed by pairwise comparisons with Bonferroni corrections was used to examine differences between conditions regarding gram weight intake and participant characteristics. Analysis of covariance was used to examine the influence of participant characteristics (hunger, liking of the M&M’s, plate cleaning tendency, mood, consumption monitoring, dieting (EAT-26), binge eating, age and BMI) on the relationship between portion and container sizes and gram weight intake. Analyses were performed with the statistical software SPSS for Windows (release 14.0.0, 2005, SPSS Inc., Chicago, IL).

Results

No participant asked for a refill or consumed more than 95% of the food. Distributions of food intake did not violate normality assumptions ($z = .9$, $p > .2$). There were no significant differences across conditions in ratings of participant characteristics ($ps > .07$; see Table 1). When controlling for these characteristics, PS and CS still significantly influenced gram weight ($F(2, 69) = 6.26$, $p < .005$, $\eta^2 = .15$). Therefore, these variables are not further discussed.

The experimental condition significantly influenced food intake ($F(2, 85) = 7.93$, $p < .005$, $\eta^2 = .16$). Participants in the medium PS/small CS condition consumed significantly less M&M’s ($M = 30.4$ g, $SE = 5.3$; 155 kcal, 0.65 MJ) than participants in the medium PS/large CS condition ($M = 69.5$ g, $SE = 8$; 354 kcal, 1.48 MJ; $p < .005$) and participants in the large PS/large CS condition ($M = 59.8$ g, $SE = 8.2$; 305 kcal, 1.28 MJ; $p < .02$), who did not differ from each other ($p > .9$) (see Fig. 1). In other words, a larger container increased intake by 129% when PS was kept constant, and by 97% when it was also associated with a larger PS.

Table 1

Means (and standard deviations) of participant characteristics in a study examining snack intake differences between conditions differing in portion size (PS) served and container size (CS).

	Medium PS/small CS	Medium PS/large CS	Large PS and CS
Age	20.6 (2.5)	20 (2.2)	19.8 (1.6)
BMI	21.2 (2.7)	23.3 (5.3)	21.6 (2.8)
Hunger before	44.8 (25.5)	41.1 (19.8)	44.9 (18)
Liking before	76.5 (23.8)	76.5 (20.6)	85.1 (14.9)
Hunger after	37.5 (24.8)	28 (22.3)	29.4 (19.4)
Liking after	72.9 (20.9)	74.9 (17.7)	82.2 (18)
Plate cleaning tendency	1.5 (1.8)	1.6 (1.5)	2.2 (1)
Consumption monitoring	−.9 (2.2)	−1.2 (1.9)	−1.5 (1.5)
Mood	1.4 (1.1)	1.7 (.8)	1.6 (1.1)
Eat-26	10.9 (7)	12.5 (8.3)	13.2 (8.7)
Binge eating	4.5 (1.4)	4.4 (1.5)	4.4 (1.3)

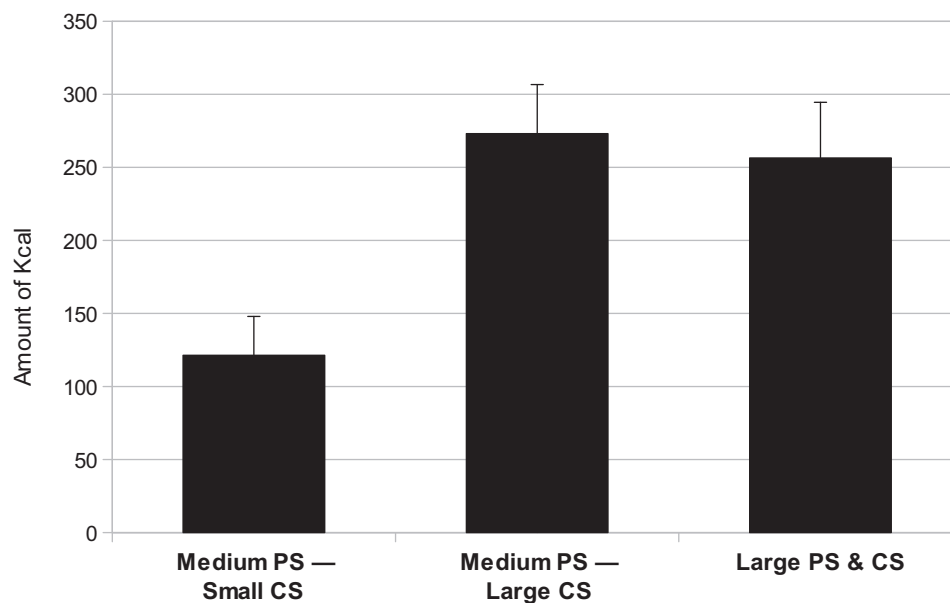


Fig. 1. Differences in mean energy intake (i.e., kcal) across conditions of different portion sizes (PS; 200 vs. 600 g) and containers sizes (CS; 250 vs. 750 ml).

Discussion

The important message emerging from this research is that CS influences food intake for high-energy food *even* when PS is kept constant. Hence, not only do people serve themselves larger food portions in larger plates, bowls or containers (Wansink & Cheney, 2005; Wansink, van Ittersum, & Painter, 2006), they also eat more when they are served food portions of similar sizes in larger containers. As a matter of fact, calories intake increased by more than 100% when increasing CS by 300%. Food consumption did not further increase when additionally increasing PS by 300%, presumably because of a ceiling effect. In other words, the selection of a somewhat smaller food portion for the large PS condition may have resulted in a PS effect independent of CS.

PS and CS are generally confounded on the food market. Therefore, although theoretically stimulating, one may question the societal implications of the present finding. These should become obvious when considering that consumers ultimately face medium quantities of food in larger containers as they are progressively emptying large food packages. For instance, a remaining 75 g of M&M or potato chips may stimulate more food consumption when appearing at the bottom of a 350 g than in the middle of a 150 g bag.

It is unlikely that a CS effect emerged here due to the perception that products in larger containers have a lower unit cost (Wansink, 1996). In the present study, M&M's were delivered for free and

placed in experimental containers rather than in their usual commercial packaging. It seems more reasonable to assume that the size of containers or packages activates implicit consumption norms against which consumers calibrate their food intake (Herman & Polivy, 2005; Wansink, 1996, 2004). In eating situations such as when snacking or in a laboratory, unrestrained eaters usually do not have any specific knowledge about the appropriate quantity of food to consume or about their intended food intake amount, rendering situational cues all the more important as an indicator of how much one should consume (Herman & Polivy, 2005; Hermans, Herman, Larsen, & Engels, 2010). This may be due in part to individuals being unable to accurately estimate actual portion sizes of foods (Hernandez et al., 2006). Consistently, when food amount was increased by stuffing the small and large containers, participants relied on the PS served (and/or the CS, as both were equivalent) to estimate food intake, falling prey to the PS effect. When PS was held constant however by filling only half of the large container, energy intake did still increase with CS. A given amount of food is usually perceived as smaller in a large than a small plate. The perception of half-filled portions (i.e., a medium portion in a large container) may have led participants to conclude that they were offered a more than reasonable (or possibly an unreasonably small) food portion, thereby motivating increased food consumption. Admittedly, consumers' reliance on consumption norms may be particularly effective in conditions of diverted attention,

such as when snacking while watching TV, because of decreased consumption monitoring (Higgs & Woodward, 2009; Wansink, 2004).

A caloric increase caused by a CS variation may have important implications for body weight regulation, especially given that snacks have increased in energy density, frequency and contribution to daily caloric intake (Piernas & Popkin, 2010). In this view, researchers, health organizations and dieting programs have all recommended the use of smaller containers (Weight Watcher; National Institutes of Health, National Heart, Lung, and Blood Institute, 1999; U.S. Department of Agriculture, Center for Nutrition Policy and Promotion, 2002). The present findings suggest that this recommendation indeed is very sensible indeed, not only because larger containers usually come with larger food portions, but also for another reason established here: larger containers, *per se*, stimulate food intake.

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