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# Smaller Food Item Sizes of Snack Foods Influence Reduced Portions and Caloric Intake in Young Adults

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**ABSTRACT**

Studies considering the impact of food-size variations on consumption have predominantly focused on portion size, whereas very little research has investigated variations in food-item size, especially at snacking occasions, and results have been contradictory. This study evaluated the effect of altering the size of food items (ie, small vs large candies) of equal-size food portions on short-term energy intake while snacking. The study used a between-subjects design (n=33) in a randomized experiment conducted in spring 2008. In a psychology laboratory (separate cubicles), participants (undergraduate psychology students, 29 of 33 female, mean age 20.3±2 years, mean body mass index 21.7±3.7) were offered unlimited consumption of candies while participating in an unrelated computerized experiment. For half of the subjects, items were cut in two to make the small food-item size. Food intake (weight in grams, kilocalories, and number of food items) was examined using analysis of variance. Results showed that decreasing the item size of candies led participants to decrease by half their gram weight intake, resulting in an energy intake decrease of 60 kcal compared to the other group. Appetite ratings and subject and food characteristics had no moderating effect. A cognitive bias could explain why people tend to consider that one unit of food (eg, 10 candies) is the appropriate amount to consume, regardless of the size of the food items in the unit. This study suggests a simple dietary strategy, decreasing food-item size without having to alter the portion size offered, may reduce energy intake at snacking occasions.

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The effects of food-portion size variations on the volume of food consumed (1-4) are usually analyzed without considering the determinants of portion size (5-7). A food unit corresponds to the amount of a certain food usually consumed at one eating occasion (ie, portion). A unit can correspond to a single food item (pizza) or to several food items (cookies). Portion-size studies keep item size constant and manipulate the size of the overall amount of food (eg, a 10-oz vs 20-oz bucket of chicken nuggets, with each nugget weighing 1 oz), whereas food-item size studies keep the overall amount of food constant and manipulate the size of food items (eg, a 10-oz bucket of chicken nuggets, containing 10 1-oz chicken nuggets vs 20 0.5-oz chicken nuggets). Until now, studies have predominantly focused on manipulating portion size because of the preference to serve amorphous-shaped foods. Amorphous foods assume the shape of the container, such as tossed salad, soup, and rice, where a food-item size manipulation is technically impossible. Prevention strategies therefore suggest educating people in assessing appropriate portion sizes or on reducing them to overcome the difficulties in estimating the portion size of amorphous foods (4,8). However, some authors have suggested that when foods with a distinct shape are served (strawberries, cookies), people estimate their consumption in numbers rather than in quantities (7,9).

Investigating this influence at snacking occasions is of utmost importance with regard to prevention strategies because weight loss programs specifically target snack foods (3) due to their impact on daily energy intake (10). Surveys conducted in the United States between 1978 to 2006 reveal that snacks have increased in energy density, frequency of consumption, and contribution to daily energy intake (11). Furthermore, the 2005 Dietary Guidelines for Americans reported that energy intake from snack consumption substantially exceeded the recommended quantity (12).

Studies by Osterholt and colleagues (13) offered two types of a similar familiar snack that differed in air content and found that participants consumed a greater volume, but less weight and energy, of the more aerated snack. However, due to the differences in energy density and total gram weight, differences in energy intake could be due as much to the food characteristics (eg, the altered energy density) as to the visual cue (eg, the altered food-item size). In contrast, experiments by Geier and colleagues (7) specifically manipulated the item size of snack foods. Containers of a specific snack food were placed in building entry halls, varying food-item size each day of the week while leaving the total amount of food constant.

The intake ratio for the larger items (entire pretzel or Tootsie Rolls [Tootsie Roll Industries, Chicago, IL]) was 1.67 and 2.27 times bigger than for the smaller items (half pretzels or quarter Tootsie Rolls). However, food selection rather than food consumption was assessed and measures were based on aggregated scores rather than on separate ratings of individual consumption.

In a study examining individual consumption, participants were offered nibble- vs bar-size snacks and received either no instruction or had to pay attention to their consumption (ie, chew the snacks properly and swallow each bite before taking the next one) (14). Small food-item size led to a decreased gram weight intake in the control condition. However, participants were not allowed to choose whether to consume or not and were aware of the food-related purpose of the experiment because no other distraction was provided. In contrast, snack foods are usually consumed on a voluntary basis when individuals are distracted by other activities, such as work or watching television (15).

Compared with previous studies, this is the first study examining the effect of modifying food-item size of snack foods on subsequent portion and energy intake in an individualized (increasing internal validity) and free-consumption setting (increasing ecological validity). The hypothesis was that greater food intake will occur with larger pieces of snack foods.

## METHODS

### Participants

Undergraduate psychology students obtained two course credits of the six required annually in exchange for their participation in the study (computerized and candy experiment, both conducted in a psychology laboratory at the Université Libre de Bruxelles). Students were aware that they could refuse participation once they had signed up for an experiment provided they had a valid reason. Exclusion criteria were: presence of food allergies, weight problems, overweight (body mass index [BMI]>25), dieting behavior, and personal food intake control in order to gain or lose weight. Based on the effect size (means and standard deviations) of similar studies analyzing food-item size variations (6,13,14), a sample size of 30 or more participants is sufficient to obtain a power more than 0.7 when assessing energy intake, at $\alpha$=.05 (16). Subjects gave their written, informed consent to participate in this study, which was approved by the Ethical Committee of the Faculty of Psychological Sciences of the Université Libre de Bruxelles.

### Materials

Foods offered were cherry-shaped gummy candies (Happy Cherries, Haribo, Bonn, Germany) and sweet-sour red gummy ribbons (Flexi Fizz, Lamy Lutti, Manage, Belgium). The US Food and Drug Administration defines a serving of candy as 40 g (1.41 oz). This amount was increased to ensure that the amount of candies served would not be limiting. Consequently, a 90-g (3.17-oz) portion was served to each participant. Total possible calorie content was 318 kcal (1,341 kJ).

### Design

The study used a between-subjects design with two experimental conditions. In the first condition, candies were left unchanged, resulting in 10 normal-sized red candies and 10 normal-sized cherry candies. In the second condition, all candies were cut in half: 20 half-sized red ribbon candies (2 g each) and 20 half-sized cherry shaped candies (2.5 g each). In contrast to the experiments by Geier and colleagues (7), the food-item size effect was analyzed in a randomized experiment, providing a control for food and participant characteristics as well as ascertaining that different hunger levels were evenly distributed across conditions.

### Procedure

The experiment was conducted during an unrelated computerized experiment (decision-making task about four objects after sequential information presentation), which lasted from 12:00 PM to 5:00 PM. Each experimental session lasted 30 minutes. Participants were seated in individual cubicles, and next to each computer screen was a plate containing candies. Participants were told that the candies were offered for free consumption in recognition for their participation and that they could eat as much as they wanted. Participants were asked to not take any food out, which was further ensured by the experimenter. After the conclusion of the experiment, participants were given a questionnaire in which they were told that the candies were actually part of an experiment about eating habits.

### Data Collection

To avoid cueing participants to the issue of food intake, consumption was not experimentally induced nor were premeal hunger ratings assessed. However, a retrospective measure of prestudy hunger was taken and used as a covariate in the analyses (17). Moreover, individualized consumption measures were taken to avoid a measure confound of the number of items consumed by each individual and the number of individuals who consumed at least one item. Using 7-point Likert scales, participants rated their prestudy hunger, their liking of the candies, the extent to which they consumed candies on a regular basis, and the extent to which they controlled their food intake. These questions were validated in preliminary studies with identical populations. The distribution of the responses are congruent with similar measures found in portion-size studies (2,3). Finally, they reported exercise frequency (hours/week) and assessed the cost and the energy content (kcal) of the entire plate. Demographic measures were: age, sex, nationality, weight, height, primary language, and dieting behavior.

The candy plate was weighed before and after the experiment (Digital Kitchen Scales, Brabantia Solid Co, Valkenswaard, the Netherlands) to determine the amount consumed (within 0.1 g). Energy intake (kcal) was determined by data from the manufacturers. The number of candies consumed was assessed by subtracting the number of candies left from the initial count.

### Statistical Analyses

Analyses of variance were used to analyze the main outcomes of food intake (number of candy items, gram weight, and energy intake). Food-item size was entered