



Is portion size selection associated with expected satiation, perceived healthfulness or expected tastiness? A case study on pizza using a photograph-based computer task



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ABSTRACT

Increasing portion sizes over the last 30 years are considered to be one of the factors underlying over-consumption. Past research on the drivers of portion selection for foods showed that larger portions are selected for foods delivering low expected satiation. However, the respective contribution of expected satiation vs. two other potential drivers of portion size selection, i.e. perceived healthfulness and expected tastiness, has never been explored. In this study, we conjointly explored the role of expected satiation, perceived healthfulness and expected tastiness when selecting portions within a range of six commercial pizzas varying in their toppings and brands. For each product, 63 pizza consumers selected a portion size that would satisfy them for lunch and scored their expected satiation, perceived healthfulness and expected tastiness. As six participants selected an entire pizza as ideal portion independently of topping or brand, their data sets were not considered in the data analyses completed on responses from 57 participants. Hierarchical multiple regression analyses showed that portion size variance was predicted by perceived healthfulness and expected tastiness variables. Two sub-groups of participants with different portion size patterns across pizzas were identified through post-hoc exploratory analysis. The explanatory power of the regression model was significantly improved by adding interaction terms between sub-group and expected satiation variables and between sub-group and perceived healthfulness variables to the model. Analysis at a sub-group level showed either positive or negative association between portion size and expected satiation depending on sub-groups. For one group, portion size selection was more health-driven and for the other, more hedonic-driven. These results showed that even when considering a well-liked product category, perceived healthfulness can be an important factor influencing portion size decision.

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1. Introduction

The prevalence of obesity among youth and adult populations has dramatically increased over the past decades (Ogden, Carroll, Kit, & Flegal, 2014). Although a causal link has not yet been established (Livingstone & Pourshahidi, 2014), an increase in food portion sizes has been associated with this increased prevalence of overweight (Young & Nestle, 2012). As 92% of self-served food is eaten (Wansink & Johnson, 2015), understanding the mechanisms behind portion selection could help to promote nutritionally responsible consumption.

Several factors that may impact portion selection were classified into three categories by English, Lasschuijt, and Keller (2015): the food environment (e.g., package size, plate size, social influences), food-related characteristics (e.g., food shape, palatability, energy density) and individual characteristics (e.g., oral eating behavior, weight status, age).

In addition to these characteristics, some consumer beliefs about the foods have also been shown to impact portion size choice. First, the higher the satiation the food is expected to deliver, the lower the self-selected portion size (Brunstrom & Rogers, 2009; Brunstrom & Shakeshaft, 2009). Expected satiation for food is thought to result from associative learning between the food's sensory properties, mainly the visual cues, and the remembered satiation after eating (Brunstrom, 2007; Higgs, 2008). Expected liking was also shown to be a predictor of portion size (Brogden &

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Almiron-Roig, 2010). Finally, foods expected to be healthy tend to be selected in larger portions (Faulkner et al., 2014), presumably because those foods are assumed by consumers to be lower in energy density and hence could be eaten in larger quantities (Wansink & Chandon, 2006). Besides, it has been shown in a series of four experiments that US participants believed that unhealthy foods are tastier leading to reduced expected tastiness for foods perceived to be healthier (Raghunathan, Naylor, & Hoyer, 2006). A recent review discussing the ambivalence attitude toward healthfulness and hedonic-related food choices suggests that individuals considering dietary longer-term health consequences can better resist palatable food cues when making food choices (Higgs, 2016).

The impact of expected satiation, expected liking and perceived healthfulness on self-selected portion size has never been studied conjointly within a single product category. In this context, the objective of this work was to assess the relative contribution of expected satiation of perceived healthfulness and expected tastiness to self-selected portion size within a range of commercial frozen pizzas. We chose this product category to test our hypothesis because it is of interest from a public health perspective to understand portion size motivational drivers for one of the most popular meals available worldwide (Masset, Vlassopoulos, & Lehmann, 2016).

2. Materials and methods

2.1. Products and participants

The products were six commercial frozen pizzas available in Swiss supermarkets with similar round shape and size, including three topping variants: ham-mushroom, tomato-mozzarella, and vegetable, as labelled on the front of the package. For each variant, two different brands (A and B) were included, differing in topping size, distribution and ratio.

Sixty-three participants with a mean age of 39.4 years old ($SD = 12.3$) from the Lausanne area took part in the study. Only participants familiar with the three types of pizza and pasta Bolognese (used as comparative meal for the expected satiation measure) were recruited, i.e. with a consumption frequency above five times a year. Participants did not report any specific food intolerances, aversions or dietary restrictions (i.e. vegetarians, pork aversion). Each participant signed an informed consent form before participating in the study and received an incentive following the completion of the study for their time. Since estimates of expected satiation and portion size were likely to co-vary depending on the participant's level of hunger, participants were asked to follow their normal diet the day before the study and not to eat for three hours before the start of the study. In addition, each participant rated his level of hunger at the beginning of the session using a 100 mm visual analogue scale anchored from "not all hungry" to "extremely hungry". The session started at 11:00 a.m. The study was assessed and approved internally as having met the ethical criteria to be considered as a consumer and sensory study.

2.2. Food photography

To reflect the way people typically cut and eat a pizza, i.e. in wedges, forty-eight photographs of portions of increasing surface area were prepared with a 10° central angle increment between successive portions. The largest portion represented an entire pizza (360° central angle) plus a wedge of a second pizza with a 120° central angle. Each portion was photographed with a high-resolution digital camera on a white plate with cutlery to provide a frame of reference for the participants' judgment of portion size and expected satiation. The plate containing the pizza portion was

presented in a meal context including a fixed portion of fresh lettuce, fruit salad, vanilla custard and a glass of water (Fig. 1). The set-up for the meal photography kept the lighting, viewing angle and camera focus constant across photos. The following text was included on each pizza photograph: "Tomato-mozzarella brand A", "Tomato-mozzarella brand B", "Vegetable brand A", "Vegetable brand B" and "Ham-mushroom brand A", "Ham-mushroom brand B". In the present paper, these are referred to as "MOZZ-A", "MOZZ-B", "VEG-A", "VEG-B", "HAM-A", "HAM-B". Pizzas were labelled with brand "A" and "B" to avoid any potential impact of the brand naming on the test results.

2.3. Measures

2.3.1. Portion size

The method of adjustment Brunstrom and Shakeshaft (2009) was used to quantify self-selected portion size for each pizza. A computer task using E-Prime 2.0 software (Schneider, Eschman, & Zuccolotto, 2012) was developed to display the pizza plate at the center of a PC monitor screen. Participants were asked to answer to the following question: "Imagine your lunch today includes fresh lettuce, pizza, fruit salad and vanilla custard. In this context, select the pizza portion that would satisfy you." Participants were instructed to adjust the portion of the pizza by pressing the "up" or "down" arrows on the keyboard to display a photograph of a larger or smaller pizza portion photograph until the satisfying portion was displayed. Each participant performed the task for all six pizza variants in a sequential monadic design, with variant order balanced across participants. The output measure for each pizza was the surface of the selected portion expressed in percentage of the entire pizza surface, e.g. 100% being the entire pizza.

2.3.2. Expected satiation

The "Matched Fullness" task developed by Brunstrom and Rogers (2009) was used to measure expected satiation for each pizza. This measure consisted of increasing and decreasing portion size of a familiar meal (pasta Bolognese) presented on the right side of the screen (called the "comparison" meal) until it matched the fullness they expected from the entire pizza. The amount of pasta selected as the comparison meal (in kcal) gives a measure of the expected satiation of the entire pizza and allows comparisons across the pizza variants. Forty-eight portions of pasta Bolognese with an incremental increase of 25 kcal were prepared and photographed similarly to the pizza photograph procedure but without the additional meal items. A photograph of a whole pizza without the additional meal items was also taken and used for this task. The expected satiation measure was performed for each pizza, in a presentation order balanced across participants. The output measure for each pizza was the number of kcal contained in the familiar meal at the "point of subjective equality".

2.3.3. Perceived healthfulness and expected tastiness

The photographs of each entire pizza presented without the other meal items were used for the assessment of expected tastiness and perceived healthfulness. Assessment were conducted on a 100 mm VAS displayed below each whole pizza photograph. The VAS was anchored at the left and right extremities with "Not at all" and "Extremely", respectively. Participants first rated the expected tastiness of the 6 variants, and then proceeded to rate their perceived healthfulness. For both measures, the order of the pizzas was balanced across participants.

2.4. Data analysis

Before measuring the associations between self-selected

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