

Research and Professional Briefs

Effect of Portion Size Information on Food Intake

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ABSTRACT

The term *portion size* is used differently by food manufacturers, regulatory agencies, and consumers. As such, it is unclear how information about portion size may influence perceived satiety and intake of foods by consumers. The objective of this study was to examine how portion size information influences satiety and intake, and how consumers interpret the term portion size. A randomized controlled design was used in which subjects were served a lunch meal consisting of a preload of pasta followed by ad libitum servings of the same pasta. In each of three separate sessions the subjects were told that the preload meal constituted ½, 1, or 1½ portions of pasta. Thirty-three normal-weight subjects (22 males and 11 females) were recruited from a 250-member volunteer employee panel at Natick Research, Development, and Engineering Center during January 2005. Main measures were pre- and post-preload hunger/fullness ratings, liking ratings, amount consumed of the pasta after the preload, and Likert ratings of statements about different definitions of portion size. Results showed that portion size information did not influence satiety ratings or total intake. Consumers associated portion size more with daily nutrient requirements than with an ideal quantity for a satiating meal ($P < 0.01$). Information about portion size may not be a good tool to manipulate food-intake behavior. Consumers' concept of portion size is associated more with objective measures of food than with personal experience about the amount that would be appropriate to eat.

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Portion size is a vague concept to many consumers. In the United States, the serving sizes used in federal food-intake recommendations are not the same as portion sizes cited by the food industry on food packages (1). The former are recommended amounts for optimal

nutrition, the latter are based on amounts of food "customarily consumed per eating occasion." Portion sizes offered to consumers in restaurants are not consistent with either definition, nor are they consistent from restaurant to restaurant. In addition, portion sizes have increased over the years without accompanying explanation (1,2). Lastly, the food industry uses phrases such as "super-size" and "healthy portion" to describe their servings. This practice further increases confusion among consumers as to what the terms *portion* or *portion size* mean. Understanding how consumers interpret the meaning of these terms would provide useful data for an overall strategy to regulate food intake.

Several studies have examined the role of portion size on food intake and satiety (3-6). Increasing the size of a preload or test meal increases total food intake, even though some compensation occurs after the preload (3,4). Similarly, manipulating information about the caloric and/or fat content of foods has been shown to influence perception, choice, and consumption of foods (5,6). Because information about calorie-related aspects of food influences intake, it is reasonable to ask whether information about portion size affects consumers' food intake and perceptions of satiety.

This study investigated how consumers interpret and utilize portion-size information. The study was designed to examine how manipulating information about the portion size of a preload (cognitive manipulation) influences satiety ratings and total food intake at that meal and how consumers interpret portion size. The working hypothesis with respect to the first objective was that cognitive manipulation of portion size would have a substantial influence on satiety ratings and intake at a meal.

METHODS

Subjects

Participants were recruited from a volunteer test panel of civilian employees at the US Army Natick Research, Development, and Engineering Center in Natick, MA. The volunteer test panel was comprised of 250 individuals who had stated their willingness to participate in food-related research (Institutional Review Board approval: United States Army Research Institute of Environmental Medicine Log #A-1886). Participants in the test panel were screened for medical conditions and dieting prior to enlistment. All members of the test panel signed a written consent form to participate in food-related consumer tests upon enlistment in the panel. Subjects for this study were invited by e-mail and asked "to participate in a meal test to determine how different formulations of a pasta dish influence the feeling of satiety." Thirty-three subjects (11 females, 22 males) volunteered for the study. Subjects were informed through written instructions that

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the meals were "in development" and that four different formulations would be presented at four different test sessions over 2 weeks. Subjects were not included in the study if they were dieting, using medication that could influence appetite or satiety, or if they did not like pasta.

Information Conditions

Pasta (Barilla, medium shells; Barilla America, Inc, Bannockburn, IL) with tomato sauce (Classico, tomato and basil; International Gourmet Specialties Company, Pittsburgh, PA) was selected as the test food, because it is generally well-liked and easy to manipulate. The three information conditions consisted of different written descriptions of the portion size of the preload: 1) "This is 1/2 of a normal portion of this pasta," 2) "This is 1 normal portion of this pasta," and 3) "This is 1 1/2 times a normal portion of this pasta." The order of conditions was counterbalanced among participants and the sessions were spaced in time to reduce the possibility that the subjects would remember and compare the serving sizes between sessions. Although there were three information conditions/sessions, a fourth session was included (always second in the series) in which the preload was increased by 50% to reinforce the belief that preload portions were varying from session to session. Data from this session were not used in data analysis.

Procedure

Participants reported to the test dining area between 1130 and 1230 hours. In the first session, all participants were provided with instructions describing the purpose of the study. They were informed that the aim was to measure the satiating effects of different pasta meals that varied in energy content and portion size. The same amount of pasta, 200 g, was served regardless of information condition. In all sessions, participants rated their hunger/fullness immediately prior to receiving the preload. After rating their satiety, they were provided a tray with a preload consisting of pasta, an information sheet describing the portion size that they had received, and a closed dish with 400 g additional pasta. They were then asked to consume the preload portion and to rate their hunger/fullness, liking/disliking for the pasta, and whether or not the preload portion constituted a "satisfactory lunch meal." Subsequently, they were offered either water or a no-calorie beverage and told that they could eat "as much or as little as they wished" of the preweighed pasta that was contained in the second bowl. The amount remaining in the second bowl was weighed after the participants had departed. The amount of beverage consumed was not recorded.

Questionnaire and Measurements

Hunger/fullness ratings were made using the Satiety Labeled Intensity Magnitude scale before and after serving the preload. This scale is a 100-mm vertical line scale labeled at the bottom with 0="greatest imaginable hunger," and at the top with 100="greatest imaginable fullness." Between these two end points the scale is demarcated with verbal labels corresponding to varying levels of hunger and/or fullness. This scale was validated and

tested for reliability and sensitivity in previous research (7). Liking/disliking ratings were made on a Labeled Affective Magnitude scale (8). This scale is a 100-mm vertical line scale labeled at the bottom with 0="greatest imaginable dislike" and at the top with 100="greatest imaginable like." Between these two end points the scale is demarcated with verbal labels corresponding to varying levels of dislike and/or like. This scale had also been previously validated and tested for reliability and sensitivity (8). On the last day, participants were given a questionnaire that asked them to rate their agreement with nine statements concerning the meaning of the term portion size on a scale from 1=completely disagree to 7=completely agree. The statements were constructed based on previous uses of the term portion size in the literature.

Statistical Analysis

Number of subjects in the study was based on power and sample size tables where it was determined that a 10-unit difference [established as meaningful from prior research (7)] could easily be detected with a sample size of 30 when α was set to 0.05 and power >0.80. Repeated measures analysis of variance using session order as a between-subjects factor showed no main effect and no session order by portion size interaction for any of the main variables. Thus, session order (ie, carry-over effect) was dropped from subsequent analyses. Summary statistics were calculated for all measures, and portion size and portion size by sex were analyzed using two-way analysis of variance. Pearson product-moment correlations were calculated among hunger/fullness ratings before and after the preload, liking of the meal, and total amount consumed. Multiple comparisons with Bonferroni adjustments were conducted on the nine portion-size questions along with independent *t*-tests. A standard Varimax-rotated principal components analysis was used to analyze the portion-size questionnaire. All data were double-entered, scanned for verification, and analyzed using SPSS for Windows (version 12.0, 2003, SPSS Inc, Chicago, IL).

RESULTS AND DISCUSSION

Information Condition

No effect of portion-size information was found on satiety ratings or on total food intake. Two thirds of participants thought that the preload portion of pasta was inadequate for a lunch meal, but this did not differ between information conditions; 79% ($n=26$), 75% ($n=24$), and 59% ($n=19$) in the 0.5, 1.0, and 1.5 portion conditions, respectively. There was an expected substantial change in the hunger/fullness ratings following the preload, but the change in satiety did not differ among the information conditions. Furthermore, the total amount of pasta consumed after the preload was similar in all three conditions, implying that the respondents ate until they achieved a comfortable level of satiety, irrespective of the portion size that they were told they had received. Two-way analysis of variance with information and sex as fixed factors showed an expected significant difference between men and women with respect to total amount consumed ($F[1,31]=22.83$; $P<0.01$), and there was a ten-

Table 1. Consumers' reported satiety ratings and liking of the preload and total amount of pasta consumed for each information condition, mean scores of ratings (number of subjects=33, number of observations=99)

	Information Condition			P value
	Told 0.5 portion	Told 1.0 portion	Told 1.5 portion	
	<i>mean ± standard deviation</i>			
Before preload hunger/fullness (0-100) ^a	29.97±8.07	31.09±9.97	32.15±11.64	NS ^b
After preload hunger/fullness (0-100) ^a	52.36±16.58	54.39±14.19	54.48±14.54	NS
Liking of meal (0-100) ^c	67.03±10.0	65.58±8.71	65.15±11.88	NS
Hunger/fullness change (-100 to +100)	22.39±16.37	23.30±14.35	22.33±14.50	NS
Total amount of pasta consumed (g)	373.3±134.3	396.1±142.6	367.7±141.8	NS
Women (g), n.obs ^d =33	262.7±84.1	272.8±61.6	262.7±81.6	NS
Men (g), n.obs=66	428.6±120.4	457.7±131.3	420.2±137.1	NS

^a0=greatest imaginable hunger; 100=greatest imaginable fullness. Higher score indicates higher fullness.
^bNS=not significant.
^c0=greatest imaginable dislike; 100=greatest imaginable like. Higher score indicates higher liking.
^dn.obs=number of observations.

Table 2. Consumers' agreement with portion size statements: Principal Component Analysis and mean scores of ratings^a (n=32^b)

	Components ^c			Mean scores	Mean scores (SD ^d)
	1 Personal experience	2 Fixed size	3 Inconsistency		
It is the amount that an average person would eat	0.781^e	0.149	-0.025	4.4	1.7
A portion is the amount that is natural for me to eat	0.713	0.061	0.399	3.6	1.8
It should be enough to make me feel full	0.703	0.122	-0.085	4.1	1.9
It is based on how much a man would eat	0.701	-0.214	-0.135	3.2	1.6
Of the same dish, I would normally eat one portion for lunch and two portions for dinner	0.066	0.694	-0.097	3.1	1.8
It contains enough calories for a meal	0.337	0.693	-0.280	4.9	1.6
It is a measure of how much of the daily nutrient requirements it contains	0.017	0.649	0.351	5.5	1.5
A portion is not a fixed size	0.122	-0.618	-0.182	4.8	1.8
For the same product, portion size information will vary from producer to producer	-0.039	0.054	0.921	4.8	1.8

^a1=completely disagree; 7=completely agree.
^bOne person did not answer the portion-size questions.
^cComponent labels were derived to describe the types of questions from the portion-perception questionnaire that loaded on each component.
^dSD=standard deviation.
^eNumbers in boldface indicate to which component the corresponding statements belong.

dency for women to feel more full after the preload (Table 1). No other differences were found between sexes. There was a significant positive correlation ($r=0.37$; $P<0.01$) between liking and total amount consumed across all groups and a significant negative correlation ($r=-0.26$; $P<0.01$) between total amount consumed and the change in level of hunger/fullness from pre- to postmeal. The implications of this are that the preload was not sufficient to appease hunger and that the change in hunger/fullness rating was therefore small, leading to a large subsequent intake of pasta. The results also show that hunger is the best cook, as there was a high negative correlation between how hungry they were before the meal, liking of

the meal ($r=-0.43$; $P<0.01$), and consumption of food afterwards ($r=-0.33$; $P<0.01$).

Interpretations of Portion Size

The portion-size questionnaire showed that consumers interpreted portion size to be a standardized index of the nutritional content of a food/meal, rather than as an index by which to estimate personal food intake. The factor analysis performed on the nine statements defining portion size resulted in three components (Table 2). The first component consisted of statements related to personal experience with portion size. Participants neither

agreed nor disagreed strongly with these definitions of portion size. However, they tended to relate portion size more with the amount an average person would eat rather than a man or with personal experience. The second component consisted of statements describing portion size as an objective or fixed amount of food. Participants agreed with statements linking portion size to daily nutrient requirements and caloric content but disagreed that portion size was a fixed physical size. The third component was comprised of one item stating that portion size was variable from producer to producer and likely represents the inconsistency with which portion size, as reported by producers, is perceived by consumers.

Thus, portion-size information did not seem to be a good tool for regulating food intake.

It may be that the type of information must be more specific and product-related to have an effect on food intake (5). Our finding that portion size is associated with objective information, such as caloric content or nutrient requirements, but not with personal experiences, supports this interpretation.

In a study investigating the effect of social norms on food-intake behavior, Herman and colleagues (9) found a substantial effect of information on hunger ratings, but this was not reflected in consumption. They concluded that this lack of effect was a result of consumers' actual hunger being more important for consumption than the hunger they reported based on information. One of the reasons that information about portion size did not influence consumption in our study could be the fact that participants did not attribute portion-size information to personal experience and expectations of fullness, as was our hypothesis.

Limitations

The lack of body mass index data is a limiting factor in generalizing these findings to other groups, and future studies should consider a larger sample size as well as controlling for body mass index.

CONCLUSION

Information about portion size was not found to be a good tool to manipulate food-intake behavior in this study. In addition, consumers' interpretation of portion size was associated more with objective information about food than with the amount that would be appropriate to eat. Implications are that consumers would benefit from a better understanding of actual macronutrient and caloric content of specific foods and diets. Nutritional advisors should provide specific, objective information about portion sizes (eg, gram weights) when advising consumers, because the term portion size is not associated with "an appropriate amount to eat" in the mind of the consumer.

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