



Research report

Influence of dietary restraint and environmental factors on meal size in normal-weight women. A laboratory study

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ABSTRACT

In a previous study, we observed that the level of dietary restraint in normal-weight women moderated the stimulating effect of environmental stimuli on meal intake. The present study was designed to confirm and extend this observation. The influence of factors previously shown to affect meal size was investigated: presence of other people, television viewing and listening to radio. Two groups of 20 women were recruited, characterized by high versus low restraint. They participated in five standardised ad libitum lunches, under controlled laboratory conditions: subjects ate alone; in groups; listening to a detective story on the radio; watching television (no food cues); watching food advertisements on television. Lunches had identical menu (main dish and dessert) and were scheduled at 1-week intervals. Visual analogue scales were used to assess hunger, fullness and test-meal palatability. Repeated measures ANOVAs revealed no significant main effect of level of restraint and no interaction with meal conditions. Energy and main dish intakes were lower in the group meal condition than in the other four, which did not significantly differ. Group meals were followed by less intense fullness than the other conditions. These observations raise questions about the factors affecting social influence at meal times; gender, level of acquaintance and inhibitory norm are discussed. Our results also suggest that the intake stimulating effects of various external sources of distraction at meal time could vary in different populations.

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Introduction

The size of meals in human eaters is determined by a particularly complex set of interacting factors. Physiological mechanisms of hunger and satiation involve complex sensory and systemic influences (Hellström et al., 2004). At the time of meals, sensory stimulation from the foods served (their palatability, their variety, the portion size, etc.) constitutes a potent factor determining total energy intake (Rolls et al., 1981; Rolls, Roe, & Meengs, 2006; Rolls, Roe, & Meengs, 2007). As food is ingested, internal signals from the digestive tract and the endocrine system progressively allow satiation to develop and terminate the meal (Hellström et al., 2004). In addition to these food-related events, non-food-related stimuli present in the environment at the time of intake can affect the human consumer's response. For example, it has been reported that eating while viewing television can stimulate intake (Bellisle, Dalix, & Slama, 2004; Francis & Birch, 2006) or that eating occurs more often when the television is on in one's environment (Stroebele & de Castro, 2004). Listening to music while eating is associated with longer, larger meals in the

natural environment (Stroebele & de Castro, 2006). Other distractors in the environment can exert a similar stimulating effect: listening to a detective story while eating a meal stimulates intake just as much as watching television during the meal (Bellisle & Dalix (2001); Bellisle et al., 2004).

One important source of environmental influence is the presence of other persons sharing the meal. Studies based on a food-diary declarative method have shown that meal size is significantly affected by the number of persons present at the meal (de Castro, 1990, 1995; de Castro et al., 1997). A power function has been proposed to describe the stimulating effect of an increasing number of guests (de Castro & Brewer, 1991). All meals are reportedly affected by this social facilitation effects: breakfast, lunch, dinner, meals taken at home and out of home, with and without alcohol, etc.

In the laboratory, eating with companions has diverse effects that can be moderated by gender and familiarity. Bellisle and Dalix (2001) found no evidence of a social facilitation of intake during laboratory meals in groups of unacquainted women. Eating alone in a laboratory or in pairs in a cafeteria did not affect amount eaten by lean men and women following preloads of varying energy content (Kim & Kissileff, 1996). Eating with same sex strangers did not increase the size of a laboratory meal, but eating with same sex friends did (Hetherington, Anderson, Norton, & Newson, 2006).

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Eating with female strangers suppressed women's intake and a significant "matching effect" on eating was reported in dyads of female eaters (Herman, Koenig-Nobert, Peterson, & Polivy, 2005; Salvy, Jarrin, Paluch, Irfan, & Pliner, 2007). A laboratory study (Feunekes, de Graaf, & van Staveren, 1995) suggested that social facilitation of meal intake was actually mediated by extra time spent at the table, rather than by an independent influence of the presence of other consumers.

In addition to external influences, psychological factors such as dietary restraint and disinhibition might affect meal size, either per se, or in interaction with the specific conditions of the meal situation. For many decades, some experts have argued that dietary restraint is likely to alter regulatory mechanisms and trigger anti-physiological eating responses, such as hyperphagia, under a variety of meal conditions (Herman & Mack, 1975; Herman & Polivy, 1980). In extreme cases, dietary restraint could lead to eating disorders and chronic problems with body weight control (Cannon & Einzig, 1983). In one of our previous works, we showed that susceptibility to eat more during a meal under the influence of external "distractors" was correlated with the intensity of dietary restraint in women (Bellisle & Dalix, 2001). Although we could not replicate this effect in one other study (Bellisle et al., 2004), there seems to be a possibility that some form of behaviour or attitude associated with dietary restraint might make a person more vulnerable to overeat when the usual restraint mechanisms are offset by external distractors. Our inconsistent results suggest that further investigation is required to identify the actual conditions where dietary restraint can be offset by external factors, leading to increased eating.

In the present experiment, we attempted to extend our previous observations about the factors influencing meal size in healthy, normal-weight women. We examined how dietary restraint, which in one of our earlier works was shown to modulate the response to environmental stimuli, interacts with various psychological and external factors known to affect meal size. Two groups of participants were recruited, representing high versus low level of dietary restraint, as assessed using a validated questionnaire (Stunkard & Messick, 1985). The women then participated in a series of standardised meals under controlled laboratory conditions, during which their ad libitum intake of familiar foods was measured. In addition to experimental conditions previously shown to exert a stimulating effect on intake (presence of others, television and auditory stimulus), one meal condition tested the effects of an explicit incitation to eat: eating while watching food commercials on television. Based on our previous observations, we hypothesized that women with high dietary restraint would be more susceptible to the potential stimulating effects of external distracting stimuli than women with low dietary restraint.

Methods

Participants

Healthy women were recruited in the vicinity of the Hôpital Avicenne. Posters describing the study procedure (a series of five ad libitum lunch meals to be consumed under laboratory conditions) and listing the main inclusion criteria (female, normal weight, no declared pathology, not pregnant, etc.) were placed in various locations at the Avicenne hospital and medical school building. Responders were screened during a telephone interview and those meeting all inclusion criteria were invited to a first visit to the laboratory. During this visit, they filled out the eating inventory questionnaire (Stunkard & Messick, 1985). Based on the French validation study of the questionnaire (Lluch, 1995), it was considered that a score over 10 for dietary restraint was high.

Women with high restraint levels were included. Women with low restraint scores (5 or lower) were selected to constitute the control group. All selected participants were seen by the laboratory's physician who confirmed their good health status and measured their height and weight. The protocol was explained in more details to the participants who signed an informed consent form. It was verified that all the participants liked the foods to be used in test meals. They were paid for their participation in the study.

The local Ethical Committee for the protection of persons participating in biomedical studies approved the protocol.

Test meals

Familiar lunch foods were bought at a local supermarket. Popular commercial brands were used. Foods were served on plain serving dishes without any indication of brands or nutritional content. The menu was identical for all participants on all test days:

- Main dish: Hachis parmentier (ground beef and mashed potatoes) (1 kg) (composition for 100 g: 414 kJ; 7.1 g proteins; 3.4 g fat; 9.9 g CHO).
- Dessert: fruit sherbets (400 g) (composition for 100 g: 472 kJ; 0.34 g proteins, 0.14 g fat, 27.7 g CHO).
- Plain water (1.5 l).

The main dish was heated according to standard recipe immediately before being served. It was kept on a plate warmer for the duration of the meals. Sherbets were taken out of the freezer about 15 min before the beginning of the meal.

The subjects helped themselves from the serving dishes and transferred the amount of food they wanted onto their plates. The amounts available were thus always the same, as well as the appearance of the food stimuli, but the actual "serving" or "portion" size was determined by the participants themselves. They were instructed to eat as much or as little as they wanted. It was made clear that they could eat the whole amount served. The total amount of energy from the food presented (over 6000 kJ or 1440 kcal, according to information found on packaging) was much higher than all the lunch intakes observed in our previous experiments on adult women.

Experimental meal conditions

Participants were tested under five experimental lunch conditions, presented in random order. For each participant, meals were scheduled 1 week apart, at the same time of day, on the same day of the week. One of our previous studies (Bellisle et al., 2004) has established that a 1-week interval is sufficient to avoid the development of boredom with the experimental foods and to maintain constant levels of intake over time.

The subjects were instructed to eat and drink as much or as little as they pleased. The duration of the participants' presence in the experimental room was 30 min at least, so as to insure minimum exposure to the experimental conditions, but the meal could last for as long as the subject wanted beyond 30 min. The five conditions were:

1. Participants ate alone in a quiet room, undisturbed.
2. Participants ate in groups of 3.
3. Participants ate alone while the television was on. The television program contained no food-related cue.
4. Participants ate alone while the television was on. The television program presented a series of advertisements for various foods.
5. Participants ate alone while listening to a radio recording of a detective story.

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