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See food diet? Cultural differences in estimating fullness and intake as a function of plate size

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ABSTRACT

Previous research has suggested that manipulations of plate size can have a direct impact on perception of food intake, measured by estimated fullness and intake. The present study, involving 570 individuals across Canada, China, Korea, and New Zealand, is the first empirical study to investigate cultural influences on perception of food portion as a function of plate size. The respondents viewed photographs of ten culturally diverse dishes presented on large (27 cm) and small (23 cm) plates, and then rated their estimated usual intake and expected fullness after consuming the dish, using 100-point visual analog scales. The data were analysed with a mixed-model ANCOVA controlling for individual BMI, liking and familiarity of the presented food. The results showed clear cultural differences: (1) manipulations of the plate size had no effect on the expected fullness or the estimated intake of the Chinese and Korean respondents, as opposed to significant effects in Canadians and New Zealanders ($p < 0.05$); (2) Canadian (88.91 ± 0.42) and New Zealanders (90.37 ± 0.41) reported significantly higher estimated intake ratings than Chinese (80.80 ± 0.38) or Korean (81.69 ± 0.44; $p < 0.05$), notwithstanding the estimated fullness ratings from the Western respondents were comparable or even higher than those from the Asian respondents. Overall, these findings, from a cultural perspective, support the notion that estimation of fullness and intake are learned through dining experiences, and highlight the importance of considering eating environments and contexts when assessing individual behaviours relating to food intake.

1. Introduction

Eating is a multi-sensory experience that is often pleasurable. Today, as foods become more diverse and accessible in many countries, identifying factors that control food intake is an important goal. While knowledge is expanding about physiological mechanisms involved in eating (Chambers Adam, Sandoval Darleen & Seeley Randy, 2013), research has also recognised some deep-seated perceptual mechanisms for controlling food intake (Brunstrom, 2011, 2014; Sobal & Wansink, 2007; Sorensen, Moller, Flint, Martens, & Raben, 2003).

Decisions on portion size largely depend on perception of food portion (Brunstrom & Rogers, 2009; Brunstrom & Shakeshaft, 2009), which is often measured by the estimated satiation (or fullness) or estimated intake of the food. By definition, the expected fullness is the relative feeling of fullness to be expected after consuming different foods when compared on a calorie-for-calorie basis, which is acquired by a learned association between sensory properties of food and their abilities to promote satiation. Estimated intake is referred to as estimated consumption volume of food (Wansink, Painter, & North, 2005). While it has been suggested that people are extremely adept at estimating these entities (Brunstrom, 2014), research has also found that these estimations are highly susceptible to environmental factors (Rolls, Morris, & Roe, 2002; Wansink, 2004).

Manipulations of plate size have been shown to have a direct effect on perception of food intake (Van Ittersum & Wansink, 2012;

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Wansink & Kim, 2005; Wansink et al., 2005; van Ittersum & Wansink, 2007). Often, people underestimate the quantity of food if it is presented on a large plate (i.e., a low Food/Plate ratio), or conversely overestimate the food quantity on a small plate (i.e., a high Food/Plate ratio). This effect is referred to as the plate-size-effect (Holden, Zlatevska, & Dubelaar, 2016). Although it remains unclear whether the plate-size-effect can be related to reduction of food intake (Koh & Pliner, 2009; Libotte, Siegrist, & Bucher, 2014; Robinson et al., 2014; Rolls, Roe, Halverson, & Meengs, 2007), this effect is widely demonstrated with estimated fullness or intake (McClain et al., 2014; Wansink & van Ittersum, 2013; Wansink, van Ittersum, & Painter, 2006; van Kleef, Shimizu, & Wansink, 2012).

The underlying mechanism that underpins the plate-size-effect is yet to be distinguished (Holden et al., 2016). Previous research has considered the Delboeuf illusion – when the surrounding context influences the perception of object size – to be a potential explanation for the plate-size-effect (see 11). It is postulated that people use plate size as a yardstick when estimating their food intake, and in turn changes in plate size impact on perception of food portion. This theory highlights a learned association between eating environments and estimations of food intake.

Notably, the plate-size-effect has only been investigated in Western countries. A typical Western dining setting (see Fig. 1) involves planning food portion size based on the expected fullness elicited by the presentation of food, and serving food onto individual dishware prior to the start of a meal, (Brunstrom, 2014). With this dining approach, visual cues are critical for portion selection, and for indicating the amount of food consumed (Wadhera & Capaldi-Phillips, 2014). By contrast, Asian countries employ a communal dining approach (Belk, 2010), in which individuals share a variety of dishes, with food served in bite-sized portions over the course of a meal (see Fig. 1). In this case, planning for food intake is not at the beginning of a meal, instead it is a continuous task over the course of a meal.

Cultural differences between the Western and Asian dining styles provide an interesting outlet for testing the association between eating environments and people's perception of food portion. Specifically, the present study tests for cultural effects on using plate size as a perceptual cue for estimating expected fullness and estimated intake. With the Asian dining approach, plate size is thought to be a less salient perceptual cue for estimating food portion, as an individual's food intake and the plate size are not as strongly correlated as they are in the Western eating environment. We hypothesise that individuals who are used to the communal dining approach are less susceptible to manipulations of plate sizes, in comparison to individuals who are accustomed to the Western dining approach. Findings from this study are expected to provide additional insights into cultural influences on people's ability to estimate satiation and food intake, and more broadly implicate general effects of environmental factors on eating behaviours.

2. Method

2.1. Respondents

Respondents were recruited in medium-to-large sized cities in two Western countries (Canada and New Zealand; NZ) and two Asian countries (China and Korea), through the networks of the associated researchers in each of the countries. Recruiting processes included using university websites, previous participant databases, student associations, and local social media. Participants contributed to this study without receiving a reimbursement.

A total of 570 individuals, residing in New Zealand (N = 149), China (N = 161), Korea (N = 131) and Canada (N = 129), participated in this study. The respondents were informed about the study and provided their consent by completing an online questionnaire. Thus, data from incomplete questionnaires were eliminated. In addition, data given by respondents who lived in their current country of residence for less than 20 years were excluded from the analysis. This served to minimise cases where the respondent's dining approach was not representative of the country assessed. Originally, a total of 1120 participants activated the questionnaire link, giving an overall completion rate of 56.3%.

This study complied with ethical considerations in all of the assessed countries (Otago Human Ethics Committee: 16/01B; University of Guelph Research Ethics Board: 16AU005).

2.2. Questionnaire design

The online questionnaire was developed and distributed using

Fig. 1. Illustration of a typical Western (A) and Asian (B) dining setting for four people.