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Using plate mapping to examine portion size and plate composition for large and small divided plates

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ABSTRACT

Does the size of a plate influence the serving of all items equally, or does it influence the serving of some foods – such as meat versus vegetables – differently? To examine this question, we used the new method of plate mapping, where people drew a meal on a paper plate to examine sensitivity to small versus large three-compartment divided plates in portion size and meal composition in a sample of 109 university students. The total drawn meal area was 37% bigger on large plates than small plates, which showed that the portion of plate coverage did not differ by plate size. Men and women drew bigger vegetable portions and men drew bigger meat portions on large plates when compared to small plates. These results suggest that men and women are differentially sensitive to plate size for overall meal size and for meal composition. Implications for decreasing portion size and improving meal balance are that plate size may influence portion size and change the proportions of foods served.

1. Introduction

Food portion size is an important influence upon what people eat and the nutrients that enter their bodies. Plates are vessels for serving and holding foods for consumption, and the size and shape of plates can influence how much food people put on their plates. While past studies have focused on undivided plates, this study examined how people portrayed meals on different sized divided plates. Moreover, it applies a new method – plate mapping – that offers a potentially useful technique for future research about the amount and types of foods served.

Divided plates segregate a plate surface into separate areas using raised ridges. Plates are objects of material culture into which eating values and norms are physically inscribed. Most plates are circular, and most divided plates have three compartments. One compartment is usually larger than the other two, representing Western cultural norms of a core "main course" (often a meat/protein food) plus two secondary "side dishes" (often a starch food and vegetable food) as represented by the cultural formula for a "proper" meal structure of A + 2b (Charles & Kerr, 1988; Douglas, 1972; Murcott, 1982). Divided plates are also known as compartmentalized, partitioned, or segmented plates, and are widely used for feeding children, informal outdoor eating events, and institutional foodservice (Finley, 1996). Prior studies have used divided plates and manipulated the size of foods in compartments (Kral, Kabay, Roe, & Rolls, 2010), but have not quantitatively examined the relationship of divided plate size with conceptions of appropriate food servings. This study used divided plates to examine how food portions and meal composition are associated with plate size.

Plate mapping asks participants to accurately draw and label the foods in a meal on a paper plate (Sharp & Sobal, 2012) to represent their cognitive schema of a platescape (Sobal & Wansink, 2007). Plate maps project cultural scripts for appropriate meal portions and sizes of food into plate drawings. Plate mapping has been previously used among college students (Sharp & Sobal, 2012) to examine plate sensitivity and plate composition.

Plate sensitivity refers to how people react to different types and sizes of plates. Research about plate size for non-divided plates shows that people draw bigger portions of specific foods and bigger overall meal sizes on larger plates (Sharp & Sobal, 2012). Laboratory studies, however, report mixed plate size effects on food serving and consumption (DiSantis et al., 2013; Koh & Pliner, 2009; Rolls, Roe, Halverson, & Meengs, 2007; Shah, Schroeder, Winn, & Adams-Huet, 2011; Wadhera & Capaldi-Phillips, 2014; Yip, Wiessing, Budgett, & Poppitt, 2013).

Plate composition describes the types of foods on plates as represented by the number and proportions of main and side dishes. Research about non-divided plate size has shown that people draw bigger main courses and vegetable portions on larger plates (Sharp & Sobal, 2012).

Plate size communicates information about the types and amount of food expected to be served on and eaten from a plate. Overall, larger

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plates and other food containers encourage people to serve and eat more food (Wansink, 2006) and different types of foods (Sharp & Sobal, 2012). Previous studies of plate size have largely been conducted in laboratory settings (DiSantis et al., 2013; Koh & Pliner, 2009; Rolls et al., 2007; Shah et al., 2011; Yip et al., 2013), but such direct observational methods are time consuming, expensive, and involve high response burden for participants. An alternative procedure for evaluating plate size is "plate mapping" (Sharp & Sobal, 2012).

Gender has been studied in food and eating and shown to have an influence on both food choices and eating (O'Doherty Jensen & Holme, 1999). Men tend to be less concerned about health and may be more sensitive than women about plate size when they make food choices, serving less healthy foods like meats on their plates rather than fruits and vegetables (Rolls, Fedoroff, & Guthrie, 1991; Wardle et al., 2004). Gender may operate as a moderating variable in relationships between plate size and the sizes and types of foods on a plate, with women drawing bigger vegetable portions on larger non-divided plates (Sharp & Sobal, 2012). Prior plate size studies typically have not examined gender moderation or reported mixed results. Koh and Pliner (2009), Yip et al. (2013), and Shah et al. (2011) studied only female participants, while Penaforte et al. (2013) and Wansink, van Ittersum, and Painter (2006) reported findings from mixed gender samples without stating whether responses differed significantly by gender. While Rolls et al. (2007) examined gender and found no difference in food consumption amounts when plate size was changed, Sharp and Sobal (2012) found that gender differences were significant when estimating expected meal size.

Divided plates have rarely been studied in food choice research, despite the common use for eating. To fill this gap in knowledge, we used plate mapping to compare foods drawn on large and small divided plates.

We propose four hypotheses about divided plate sizes and plate mapping. 1) The plate sensitivity hypothesis posits that people are mindless about portion size and fill divided plates to capacity, drawing bigger overall meal sizes on larger divided plates with larger plates covered with more food than are smaller plates. 2) The meal norms hypothesis posits that people draw meals to conform to normative conceptions about how full a plate should be, filling divided plates to levels that seem appropriate to the plate size, with the same percentage of larger and smaller divided plates covered with food. 3) The meal composition hypothesis posits that plate size influences serving of different foods, with the type of food hypothesis proposing that bigger vegetable dishes will be drawn on larger divided plates and the food course hypothesis proposing that bigger main courses will be drawn on larger plates than smaller plates. 4) The gender moderation hypothesis posits that gender differences occur in plate size effects upon food choice, with men more sensitive to plate size than are women, and men drawing larger main courses on plates than women draw on plates.

2. Methods

Students attending one university course in 2011 and students attending the same course in 2012 taught by the same instructor were asked to participate in this study. In 2011 students were asked to draw on a large divided plate and in 2012 students drew on a small divided plate in this quasi-experimental design (Shadish, Cook, & Campbell, 2001). Each class got plates of only one size to avoid potential biases if students noticed that plate sizes differed among members of the class and discussed the size difference which would contaminate the plate size manipulation.

The large plate had a total outside diameter of 10.25″ and a depth of 1″, had a 1″ wide outer rim and the interior dividing ridges of the plate were .25″ wide, making the total usable food area of 52.5 in.^{2}, with 29.5 in.^{2} in the main compartment and 11.5 in.^{2} in each of the two symmetrical side compartments. The small plate had a total outside diameter of 9.5″ and a depth of .5″, had a 1″ wide outer rim and interior divisions of the plate were .25″ wide, making the total usable food area 43 in.^{2}, with 21.7 in.^{2} in the main compartment and 10.5 in.^{2} in each of the two symmetrical side compartments.

At the beginning of class, one paper plate and an attached questionnaire were given to each student as they entered the classroom. The questionnaire provided consent information plus demographic questions about age and gender. The instructions for the plate drawing asked students to "Please accurately draw and label the foods in a meal that you would enjoy eating for dinner tonight. Please be as realistic as possible with your drawings of the foods." No images of foods or examples of drawings were provided to avoid visual cues that could bias the food drawings (Tversky & Kahneman, 1974; Wadhera & Capaldi-Phillips, 2014). Each class received one size of plate that was from the same manufacturer (Chinet, De Soto, Kansas, USA) using the same material, design, and color to prevent potential biases if students had been given two different sizes or types of plates in the same classroom. Students were given class time to complete the plate drawing and questionnaire and turn in their materials. No compensation of course credit or other forms was given for participation. The University Institutional Review Board deemed this study exempt.

The researchers were not able to count the exact number of students attending each class session. The minimum estimated response rate was 76% in 2011 and 64% in 2012 based on the number of students officially registered for the class. Based on researcher observations that 0 unused plates in 2011 and 2 in 2012 were returned after class, the response rate was higher than this minimum. Of the 54 plates completed in 2011 and 53 in 2012, 98 (90%) were analyzed after excluding 4 plates in 2011 and 5 in 2012 that did not follow the written protocols. All participants were adults aged 18 or higher.

The completed plate maps were coded by manually measuring the circumference of each drawn food on the plate to calculate the size of each separate food portion, following the procedure of earlier plate mapping studies (Sharp & Sobal, 2012). Horizontal food area is an appropriate estimate of food item volume (Pratt, Croager, & Rosenberg, 2011). Coders were trained, monitored, and checked by double coding each plate. Sums of all the food portions on each plate were calculated to represent the total plate area covered to examine the plate sensitivity hypothesis. The proportion of plate coverage was calculated to examine the meal norms hypothesis. Food items were coded by food type into the categories of meat, cereal grain, vegetable, root vegetable and tuber, fruit, legume, dessert, and other to examine the meal composition hypothesis. Drawn foods that included more than one different food were classified as the type that included the most calories or took up the most space. Foods were also coded into categories by size ranging from the largest food in the meal to the fifth largest, which were used to represent the main course and side courses. The number of compartments in these plates containing food was also coded.

In this study the independent variable was plate size, and the dependent outcome variables were meal area, percent of plate covered, food type, and food item size. Gender was examined as a moderating variable and age was assessed to characterize the sample.

Analyses first produced descriptive statistics for all variables using percentages and means ± standard deviations. Next, bivariate comparisons of larger and smaller plates were made using chi-square and *t*-tests to examine the plate sensitivity, meal norms, and plate composition hypotheses. Finally, further bivariate comparisons between gender, plate size, and the plate drawing variables were performed to examine the gender moderation hypothesis.

3. Results

A total of 98 plates were included in the analysis. Men drew 32 (33%) plate maps and women drew 66 (67%) (Table 1). Similar numbers of larger plates ($n = 49$, 50%) and smaller plates ($n = 49$, 50%) were analyzed. The mean age of the sample was about 21 years.

All three compartments on the plates had food drawn in them on 84% (84) of all plates, 79% (42) among large plates and 79% (41)