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First come, first served. Does pouring sequence matter for consumption?

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ABSTRACT

Various environmental factors associated with eating and drinking affect people's food choice and food intake. Lately, the role of tableware has been studied in more detail. The aim of this study was to determine whether pouring sequence of food components affects portion size. Study 1 invited participants to pour a beverage containing both apple juice and sparkling water. Pouring apple juice first increased juice by almost 25% compared to pouring water first. Pouring water first increased water by almost 19% compared to pouring juice first confirming our hypothesis that pouring sequence affects the ratio poured. Study 2 asked participants to prepare themselves a snack containing cereals with milk. Within-subject comparisons revealed that pouring milk before cereals significantly increased both milk and cereal amounts resulting in larger overall portion size compared to pouring cereals before adding milk. Habitual tendencies for preparing foods causing a perception bias or a perception bias itself could be possible explanations for the divergent study findings. These findings show for the first time the influence of pouring and preparation sequence on portion size.

1. Introduction

Many environmental variables have been shown to influence our daily eating behavior (Stroebele & de Castro, 2004; Wansink, 2004a). Over the last two decades, research both in the real world as well as in experimental settings have found various ambient factors such as: plate shapes, package size, ambient lighting, décor coloring or convenience that appear to influence people's food choices and consumption (Wansink, 2004a, 2006). The impact of these factors seems to be mainly attributed to mindless eating (Wansink, 2006). Mindless eating describes the impact of environmental cues on people's daily eating behavior; which is often unknown to the consumer (Wansink, 2004b).

Wansink and his colleagues revealed an array of normative factors that impact our daily eating behavior in a rather subtle and unconscious matter. Besides the well-known portion size effect studied by many researchers (for a review see Hollands et al., 2015), research has also shown that the larger the plate, spoon, cup or bowl size, the more food or fluid is consumed irrespective of hunger (Wansink & van Ittersum, 2013; Wansink, van Ittersum, & Painter, 2006) or even taste (Wansink & Kim, 2005). Furthermore, short and wide glasses promote more drinking than high and narrow glasses (Wansink, van Ittersum, & Payne, 2014). Even the opening size of a beer bottle seems to influence how much a person drinks (Wansink, 1996). Differences in spoon material, for instance using either plastic or metal, influences taste perception and perception of food quality (Piqueras-Fiszman, Laughlin, Miodownik, & Spence, 2012). Moreover, spoons varying in weight also affect both taste and food quality perception (Harrar & Spence, 2012). In general, dishware and food color (Harrar, Piqueras-Fiszman, & Spence, 2011; Piqueras-Fiszman, Alcaide, Roura, & Spence, 2012; Spence, Levitan, Shankar, & Zampini, 2010), dishware material (Ariely, 2008; Piqueras-Fiszman & Spence, 2011; Spence, Harrar, & Piqueras-Fiszman, 2012) or plate rim widths and coloring (McClain et al., 2014) can affect food choice, palatability and intake.

Mindless consumption of food is affected by sensory cues such as hunger, palatability or scent; by emotional drivers including affect valence or stress; and by normative cues (Wansink & Chandon, 2014). Consumption norms often determine how much one should eat. People tend to rely on packages, portions and dinnerware as consumption norms without being aware of its influence. Even when made aware of it, people still served themselves more from larger packages and plates (Vartanian, Herman, & Wansink, 2008).

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Making changes to tableware that is associated with consumption norms and exposing people to convenient, attractive and new norms has already revealed promising results in regards to the consumption of healthier food choices (Wansink & Chandon, 2014; Wansink, 2015). These normative cues are starting to be of interest to public health professionals given that they are fairly easy to change in every day eating environments such as home, work or school (Wansink & Hanks, 2013; Wansink, Hanks, & Kaipainen, 2015).

However, a recent meta-analysis showed only marginal increases in food intake using large versus small dishware (Robinson et al., 2014) and the authors cautioned to make recommendations regarding dishware or plate size before its influence on food intake is better understood.

So far, to our knowledge, one aspect of the handling of food that has not yet been studied is the pouring sequence of different food components. Mindless eating starts with people's habits. One of those habits includes meal preparation and, more general, food and fluid preparation. In other words, how we prepare food is often habitual and unconscious, e.g. in which order we mix drinks or how we add fluids to solid foods. The aim of these two small-scale studies therefore was to examine whether changing the habitual pouring sequence of a beverage and the pouring sequence of a solid food with fluids would impact the amount poured. In a study by Wansink and Hanks (2013), the influence of two different food order arrangements in a buffet line was examined. The results showed that the order that food was presented to people influenced what foods were selected. The first foods a person encountered in the buffet line were significantly more likely to be selected than the foods encountered at the end of the buffet line. Thus, in our study it was hypothesized that the component poured first would be larger than the following component.

2. Materials and methods

2.1. Study 1

For the first study, conducted in the fall of 2015, participants were asked to pour themselves a popular German beverage containing both apple juice and sparkling water before taking part in an experimental feeding study not reported here. The participants were invited to consume the beverage during the experimental study but the main aim of this procedure was to examine and record their pouring behavior. When diluting juice, most people tend to start with the juice which is considered the main component of the mixed beverage. The tested hypothesis therefore was that participants would pour more juice when asked to pour juice first compared to pouring juice after pouring sparkling water.

2.1.1. Subjects

The participants were university students recruited via posted advertisements, flyers, a social networking site (Facebook) and the online newsletter of the University of Hohenheim, Germany. Criteria for inclusion in the study were being a student (either at the University of Hohenheim or at the University of Stuttgart), being 18–30 years old and speaking German. Students were not recruited if they had food allergies (i.e., intolerances towards foods offered in the feeding study) or studied nutritional sciences in order to avoid bias caused by their potential knowledge regarding mindful eating behavior.

Before starting the experiment, participants signed an informed consent and were entered in a raffle to win a semester train ticket as an incentive for their participation. The study protocol was approved by the University of Hohenheim ethical committee and agreed with the Helsinki Declaration.

2.1.2. Procedures

Before the beginning of the actual study, students were seated in a medium sized room set at a constant average temperature of 23 °C in one of six comfortable lounge chairs with an adjacent small table and asked to complete a demographic questionnaire including age, gender, self-reported height and weight. Afterwards, participants were instructed to pour themselves a popular German non-alcoholic beverage called "apple juice schorle" in a 250 ml glass out of carafes positioned on the small tables. The beverage was offered to be consumed during a video show (which was part of the other study) in the event they would become thirsty. The beverage consisted of a mixture of apple juice and sparkling water.

Participants were randomized into either starting with sparkling water or with juice which were made available in two separate carafes (500 ml) containing 430 ml apple juice and 430 ml sparkling water. No information in regards to pouring order was provided. Participants were told that due to "study procedures" they should pour the component already positioned on the coffee table first. After pouring the first component, research personnel replaced the first carafe with the second carafe (depending on randomization group) and carried the carafe with the remaining liquid out of the room. Both carafes were weighted before and after pouring and the amount poured was recorded.

2.1.3. Statistical analyses

Main outcomes of the study were the ratio and amount of poured apple juice and sparkling water. The grams of the consumed drinks where determined by subtracting pre- and post-consumption weight of the carafes.

The comparison of single components for the different pouring orders was made using independent t-tests. Due to the left-skewed distribution for analyzing the total amount of "schorle" in the two groups, a Mann-Whitney-U-Tests was conducted. Pearson's chi^2 and independent t-tests were used to compare the baseline characteristics of both groups. Means ± *SD* are presented in the text and tables. Statistical significance level was set at $p < 0.05$. Statistical tests were carried out using IBM Statistic SPSS for Windows, version 22.0.

2.1.4. Results

A total of 155 students (64.8% women and 35.2% men) participated in the study. Mean age was 22.03 ± 2.80 (range: 18–36 years) and mean BMI was 22.53 ± 3.31 (range: 16.85–37.50). Participants' characteristics did not differ between the two randomization groups.

There was no significant difference between the two groups in regard to the total amount of prepared "schorle" (264.32 g ± 24.20 vs. 260.83 g ± 24.90, $U = 5649.5$, $p = 0.319$). The overall mean ratio of apple juice and sparkling water for the group that poured apple juice first was 1:0.91 while the group pouring sparkling water first had a ratio of 1:1.35 which shows that pouring water first slightly increased total water amount. Table 1 presents amount poured under the two pouring sequence conditions. A significant pouring effect was revealed. Those pouring apple juice first poured significantly more apple juice (138.2 ± 36.3 g; 24.54% more) compared to subjects pouring apple juice as the second beverage component (111 ± 37.2 g, $t = 4.613$, $p < 0.001$). Similarly, subjects that poured sparkling water first poured 18.83% more sparkling water (149.9 ± 38.8 g) compared to subjects pouring sparkling water as the second beverage component (126.1 g ± 35.7 g, $t = -3.963$, $p < 0.001$).

2.2. Study 2

The second study, also conducted during the fall of 2015,