The Influence of Bite Size on Quantity of Food Consumed: A Field Study

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While research has extensively investigated how portion sizes can influence the quantity of food consumed, relatively little work has been done to explore how bite size influences overall consumption. This research seeks to address this concern. In a field study, we collected data in a restaurant and manipulated bite size by providing diners with small or large forks. We found that diners consumed more from smaller rather than larger forks. Utilizing motivation literature, which ties into the unique factors present in a restaurant consumption setting (e.g., diners have a well-defined goal of hunger satiation because they invest effort by visiting a specific restaurant, choose from a menu, and pay money for the meal), we present our rationale for the pattern of results. Moreover, in a controlled lab study we demonstrate that when these factors are absent, the pattern of results is reversed.

From simply being a source of sustenance, food consumption practices have become the cause of a health crisis (Chernev 2011). Overconsumption and obesity, and their related health problems, have made this the topic of much research. One stream of research has focused on how portion sizes can influence the quantity consumed. This research suggests that bigger portion sizes rather than smaller portions lead to higher consumption (Rolls et al. 2004; Schwartz and Byrd-Bredbenner 2006; Scott et al. 2008). For instance, people consume less soup overall from a smaller bowl rather than a larger one or eat more from large versus small packages (Wansink, Painter, and North 2005). The reason given behind such a pattern is that people use consumption norms and anchor on the given portion as the appropriate consumption amount.

However, one factor of the consumption setting has received relatively less attention—the bite size (the amount of food in each mouthful). It is worth noting that most of our consumption is in the form of meals that, unlike a one-time consumption, are composed of several bites of the food items. Even with the same portion size, people can consume different bite sizes. Hence, it is very important to understand how small versus large bite sizes in a meal would influence the overall quantity of food consumed. Would people still consume less with a smaller versus a larger bite size (in line with past work on portion size), or would this be reversed? Therefore, the aim of this research was to study the role of bite size on the quantity of food consumed.

In order to test this question, we collected data in a restaurant because several important situational factors that are difficult to mimic in a lab setting are uniquely present in a restaurant. For example, people visit the restaurant with a well-defined goal of satiating their hunger, and in this process they invest effort and resources (e.g., time, money, and choices of food and location) to satisfy their goal in the best possible manner. A meal in a restaurant entails a continuous consumption occasion, rather than a single helping of a food, which allows us to test the influence of bite sizes on overall consumption. Finally, a restaurant also offers the most commonly used consumption environment for meals outside of the home. Recent data indicate that 78% of adults in the United States like to eat in a restaurant and spend approx-

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imately $500 billion in a year on meals (National Restaurant Association 2010).

RESTAURANT STUDY

We conducted this study in a popular, locally owned Italian restaurant in the southwestern United States that has been in business for 40 years and offered a typical menu. Two sets of forks were used to manipulate the bite size. The larger fork held 20% more food and the smaller fork held 20% less food than the regular restaurant fork. A pretest revealed that both forks were not considered effortful for food consumption (see the appendix for details).

The study was conducted over 2 days, during two lunches and two dinners. One of the coauthors of the study and two research assistants served as waitstaff. For each meal, tables were assigned to be either "large fork" or "small fork" tables, and the fork assignments were rotated after every meal. During the study the servers took the customers' orders. After the food was prepared, it was placed on the kitchen counter, at which point the full plate of food was weighed (separate weighings of empty plates and bowls were also taken) on a sensitive food scale. A small sticky note was attached to the underside of each plate that noted the weight of the full plate in ounces, the menu item name, the table number, and the fork size at that table. This was done to reduce confusion when the plates were bought back in case the forks and plates were not together. The food was then taken to the diners. When the plate was brought back (either empty, with leftovers to be disposed of, or needing to be boxed to take home), it was again weighed, and the value was recorded on the sticky note. The sticky note was then removed and stored. The date, time, and price of the menu item were noted, as well as if an alcoholic drink was ordered.

Results

We assessed the influence of fork size on the weight of the food left on the plate (less food on the plate indicated more consumption) while controlling for the weight of the initial food served, food price, meal occasion (lunch vs. dinner), appetizer (yes vs. no) and alcohol consumption (yes vs. no). This ANCOVA showed that the use of the larger fork resulted in more food left on the plate (i.e., less quantity consumed) than the smaller fork ($M_{\text{large}} = 7.91$ ounces vs. $M_{\text{small}} = 4.43$ ounces; $F(1, 98) = 7.80$, $p < .01$, partial $\eta^2 = .07$).

Discussion

Therefore, we find that in a restaurant setting, diners consumed more food from a smaller rather than from a larger fork. This pattern appears opposite to what would be predicted for portion sizes—that is, people consume more from large rather than small portions. As we mentioned earlier, very little previous work has looked at the influence of bite size on quantity consumed. A possible exception is a study by Geier, Rozin, and Doros (2006). In that study, the authors found that participants picked fewer M&Ms with a small versus a large scoop when offered at the front desk of a concierge. In line with work on portion size, Geier et al. (2006) suggest that a unit or portion of consumption that has been predetermined (large vs. small scoop) allows people to anchor on it as the appropriate amount to be consumed. They cite social or cultural norms as factors that inhibit people from taking a second unit or helping (e.g., taking two scoops of M&Ms would be considered greedy). Hence, people choose less with the small scoop and more with the large scoop. However, one could argue that the main focus of their work was on portion size, and their study cannot be completely classified as considering bite size, since it did not involve actual consumption but whether people picked up more or fewer M&Ms from a small versus a large scoop. Nevertheless, these findings predict a pattern opposite to what we found.

Why do we find that diners in a restaurant consume more with small rather than with large bite sizes? We use findings in motivation research to propose an underlying process for the influence of bite size on quantity consumed.

THEORETICAL RATIONALE

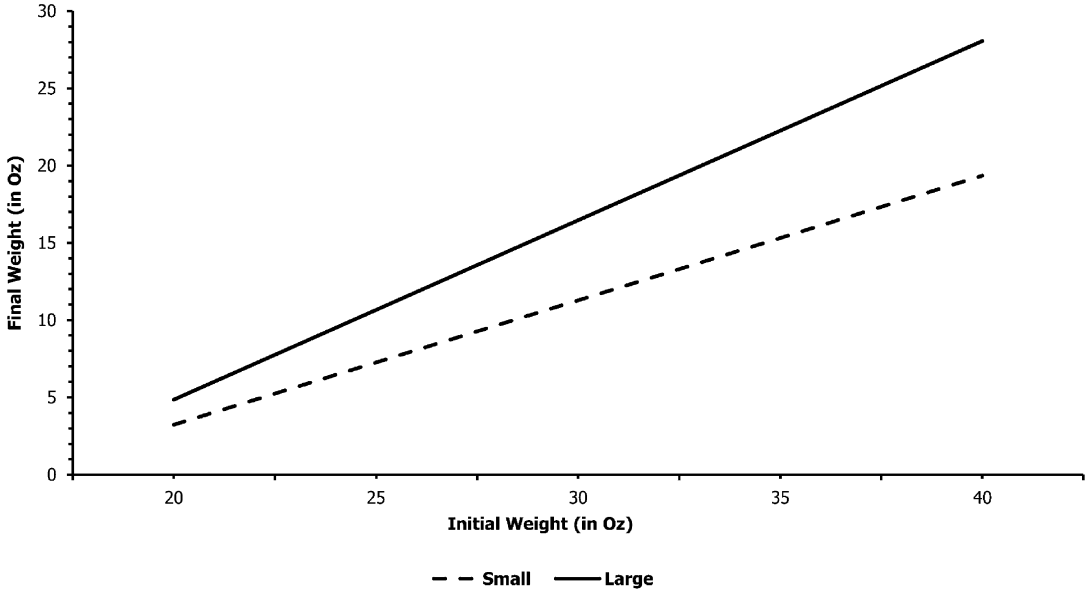
Research on motivation suggests that when people have a well-defined motive or goal, then the goal-effort link becomes very salient and easy to execute. People are willing to invest greater resources and effort to achieve the goal (Locke and Latham 2002), since the well-defined goal increases the incentive value of achieving it (Aarts, Gollwitzer, and Hassin 2004).

In our consumption context, we observe that diners visit the restaurant with a well-defined goal of satiating their hunger, and, because of this well-defined goal, they are willing to invest effort and resources to satiate their hunger. Since research has shown that free choice captures realistic behavior more accurately than forced choice situations (Dhar and Simonson 2003), a restaurant offers diners several methods to exercise free choice in satiating their hunger. For instance, diners select a restaurant of their choice, choose an entrée (or entrées) from the menu of offerings, pay for their food, and have the option to take home leftovers. Therefore, people invest effort in order to satiate their hunger.

We also know from past work that the medium plays a critical role in goal achievement (Hsee et al. 2003). In our research we suggest that bite size (operationalized through fork size in our study) becomes the medium with which one can facilitate (or not) the goal of hunger satiation. We suggest that fork size provides the diners with a means to observe their goal progress. The physiological feedback of feeling full, or the satiation signal, comes with a time lag (Carroll et al. 2007). Hence, in the absence of physiological feedback, diners focus on the visual cue of whether they are making any dent in the amount of food on their plates to assess goal progress. The smaller fork (compared to the larger fork) appears to provide less satisfactory goal progress; that is, diners feel they are not making much of a

FIGURE 1

THE INFLUENCE OF INITIAL QUANTITY SERVED AND FORK SIZE ON THE QUANTITY CONSUMED: RESTAURANT STUDY



dent in consuming their food and, hence, satisfying their hunger. This, in turn, focuses diners to put in more effort (e.g., more forkfuls) toward satiating their hunger. As a result, diners with smaller forks consume more food than those using larger forks.

In sum, unlike past work, the well-defined goal-effort link operating in a restaurant setting overrides anchoring on predetermined appropriate units (small vs. large fork). The overarching goal of hunger satiation influences diners to put in more mouthfuls of their preferred food with a small fork in order to satiate their hunger, and in this process they consume more. Therefore, there are two components to our goal-based explanation—a well-defined hunger satiation goal, which leads to subsequent efforts at goal satiation, and the role of the medium, fork size, in providing feedback on goal progress.

We tested for both of these components of the goal-based explanation. First, if it is true that a large fork appears to indicate better goal progress compared to a small fork, then we should find that the effect of fork size increases as the initial quantity of food served increases. That is, the difference in the quantity of food consumed with a small versus a large fork should be higher when the initial quantity served is more than when it is less. When the initial quantity of food served is more (a well-loaded plate), then the small fork should give even less of a feeling of goal progress, since diners feel that they are not making much of a dent in consuming their food. Visually, the food does not appear to be reducing after every mouthful. This would lead diners to consume even more food to feel that they are making goal progress. On the other hand, when the initial quantity served is small, then, even with the small fork, diners would feel that they are making satisfactory goal progress since the fork seems to be making some dent in the amount of food. Therefore, we would predict an interaction between fork size and the initial quantity of food served.

We tested this conjecture by running further analyses on the data from the restaurant study to examine the interactive influence of the initial quantity of food served and the fork size on the quantity of food consumed, while treating price paid, meal occasion, and appetizer and alcohol consumption as covariates. This regression analysis revealed a significant influence of fork size (as discussed earlier, $\beta = -.32$, $t(97) = -2.47$, $p < .05$) on initial quantity of food served, indicating that people who received bigger servings of food ate more ($\beta = .81$, $t(97) = 7.25$, $p < .01$), and an initial quantity served × fork-size interaction ($\beta = -.39$, $t(97) = -2.71$ $p < .01$). A spotlight analysis (following Aiken and West 1991; Fitzsimons 2008), at 1 standard deviation below the mean initial quantity served, showed that there was no significant difference between the quantity of food left on the plate across fork sizes ($\beta = .07$, $t(97) = .34$, $p = .73$). However, at 1 standard deviation above the mean initial quantity served, the diners consumed significantly more (i.e., left less on the plate) with a small rather than the large fork ($\beta = -.71$, $t(97) = -3.95$, $p < .01$). Moreover, no covariate (other than the initial quantity of food served) interacted with the fork size. For ease of exposition, this interaction is plotted in figure 1, where the *y*-axis indicates quantity left—more quantity left means less consumed. The results show a pattern consistent with the goal-

based explanation. When the initial quantity served is more, a small fork does not give a feeling to the diners that they are making much progress in satisfying their hunger, while a large fork gives them a feeling of goal progress. However, when the initial quantity served is less, then even the small fork is able to provide a feeling of satisfactory goal progress.

Next, we tested the second component of our goal-based explanation—the role of having a well-defined hunger satiation goal to satisfy and the resultant effort in achieving it. When factors such as a well-defined goal to satisfy hunger and the resultant effort investment to achieve the goal are absent from the consumption setting, then people would be more likely to allow a predetermined appropriate unit to guide their consumption and not override it. In this event, we should find that the influence of fork size on consumption disappears or even reverses. In order to test this theory, we conducted a study in a controlled lab setting.

Eighty-one participants took part in this study for partial course credit. They were told that this was a food consumption study, and each participant was taken to a separate table. They were then offered a preweighted bowl of pasta salad with either a small or a large fork and a bottle of water. The same forks from the restaurant study were used. A pasta salad was served, since several bites are required for consumption rather than a single forkful. Participants were left alone and allowed to consume as much as they wanted. When they indicated that they had enough to eat, they were taken to another room and debriefed. The pasta bowl was measured again to get the postmeal weight. Using ANCOVA, we assessed the influence of fork size on the weight of pasta left on the plate while controlling for the initial weight of the pasta served. The results showed that those assigned to the large fork condition left less pasta in the bowl (i.e., consumed more pasta) than those in the smaller fork condition ($M_{large} = 4.09$ ounces vs. $M_{small} = 5.19$ ounces; $F(1, 78) = 4.73$, $p < .03$, partial $\eta^2 = .05$). This pattern in the lab was the opposite of what we found in our restaurant study and consistent with portion size research and Geier et al. (2006).

CONCLUSION

In sum, we find that when people have a well-defined hunger goal to satisfy and put forth effort to reach the goal, they consume more from a small fork rather than from a large fork. The bite size becomes the medium that helps them satisfy their goal and also influences the quantity consumed. The small fork gives a feeling that they are not making much progress in satiating their hunger, which results in more consumption compared to when they have a large fork. The significant interaction between initial quantity served and fork size supports our goal-based explanation. We utilized a restaurant setting that allowed us to examine this goal-effort link and its subsequent influence on consumption in the most realistic manner. Moreover, we find that when there is no well-defined goal-effort link, as in the lab study, this effect reverses the pattern.

This research helps us to derive some of the following insights. First, in a consumption setting when people have a well-defined hunger satiation goal, then the feedback provided by the medium, fork size, on whether they are making goal progress influences the quantity of food consumed. Second, in the absence of a well-defined hunger satiation goal, people become more willing to anchor on the fork size as the appropriate bite size. Hence, they consume less with the small fork, as we find in the lab study. Third, as much past research has demonstrated in consumption settings, people do not have clear internal cues about the appropriate quantity to consume. They allow external cues, such as fork size in this study, to determine the amount of food they should consume.

Grandma's advice tells us to consume small bites, but remember, she also tells us to chew well so that our body has enough time to let us know that we are full. However, given people's busy lives and the growing trend of eating in restaurants, if we are not chewing longer, then consuming from a larger fork may actually be more helpful in controlling overconsumption. Therefore, we suggest that bite size is an important factor to be considered in the consumption setting because it becomes a critical medium that can influence the quantity of food consumed.

APPENDIX

PRETEST DESCRIPTION

Sixty participants took part in the pretest and were randomly assigned to the small or big fork conditions. We offered pasta with either a small or a large fork (these were the same forks that we later used in the restaurant study). After consuming pasta, the participants answered whether or not they found eating the pasta effortful on a 7-point scale (1 = not at all effortful to 7 = very effortful). The analysis showed that participants' effort ratings between the large and small fork conditions were not significantly different from each other, that is, the effort required was considered statistically the same with both types of forks ($M_{small} = 2.96$ vs. $M_{large} = 2.63$; $F(1, 58) = .58$, $p = .44$). Moreover, participants found that eating with either fork was not effortful since both ratings were significantly less than the scale midpoint (i.e., 4) toward the less effort direction ($M_{small} = 2.96$; $t(29) = -3.35$, $p < .01$, and $M_{large} = 2.63$; $t(29) = -4.43$, $p < .01$).

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