Ice Cream Illusions

Bowls, Spoons, and Self-Served Portion Sizes

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Background: Because people eat most of what they serve themselves, any contextual cues that lead them to over-serve should lead them to over-eat. In building on the size–contrast illusion, this research examines whether the size of a bowl or serving spoon unknowingly biases how much a person serves and eats.

Methods: The 2 × 2 between-subjects design involved 85 nutrition experts who were attending an ice cream social to celebrate the success of a colleague in 2002. They were randomly given either a smaller (17 oz) or a larger (34 oz) bowl and either a smaller (2 oz) or larger (3 oz) ice cream scoop. After serving themselves, they completed a brief survey as their ice cream was weighed. The analysis was conducted in 2003.

Results: Even when nutrition experts were given a larger bowl, they served themselves 31.0% more (6.25 vs 4.77 oz, $F(1, 80) = 8.05$, $p < 0.01$) without being aware of it. Their servings increased by 14.5% when they were given a larger serving spoon (5.77 vs 5.04 oz, $F(1, 80) = 2.70$, $p = 0.10$).

Conclusions: People could try using the size of their bowls and possibly serving spoons to help them better control how much they consume. Those interested in losing weight should use smaller bowls and spoons, while those needing to gain weight—such as the undernourished or aged—could be encouraged to use larger ones. Epidemiologic implications are discussed.

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Introduction

The weight of the average American consistently inched up over the last half of the twentieth century.[1] Part of this phenomenon has been blamed on increased portion sizes in away-from-home foods.[2] What has received less attention is the unknowing impact of one's more immediate, or self-controlled environment. Because it is estimated that people eat 92% of the food they serve themselves,[3] anything in their immediate environment that leads them to over-serve themselves should lead them to over-eat. This research examines whether the size of a bowl or serving spoon provides a visual bias that leads people—even nutrition experts—to over-serve and to over-eat in a natural environment.

Recent discoveries show that people pour more into short, wide glasses than into tall, narrow glasses, but they believe they have done the opposite. For example, teenagers at weight-loss camps poured 77% more juice into short wide glasses than into tall narrow glasses,[4] and Philadelphia bartenders poured 28% more liquor into tumblers than into "highball" glasses.[5] This has been attributed to the horizontal–vertical illusion.[6,7] This research examines a different illusion—the Ebbinghaus–Titchener size–contrast illusion—and suggests that it might similarly lead people to over-serve themselves depending on the size of the bowls or spoons they use.

Although deciding how much food to serve oneself requires cognitive effort, part is perceptually driven by environmental or contextual cues.[8] For instance, if a person decides to eat half a bowl of cereal, the size of the bowl acts as a contextual stimulus that may influence how much he or she serves and subsequently eats. Consider the top of Figure 1. The black center circle appears slightly larger when surrounded by smaller circles and slightly smaller when surrounded by larger circles.[9] As seen at the bottom of Figure 1, the size of the black circle on the right needs to increase in diameter by 20% before the two black circles appear to be of equal size in their different contexts.

Estimating size is often a relative judgment,[10] and one cannot help but to compare some items as smaller (or larger) when viewed in contrast with larger (or smaller) neighboring items.[11,12] Four ounces of ice cream in a small bowl may appear an appropriate

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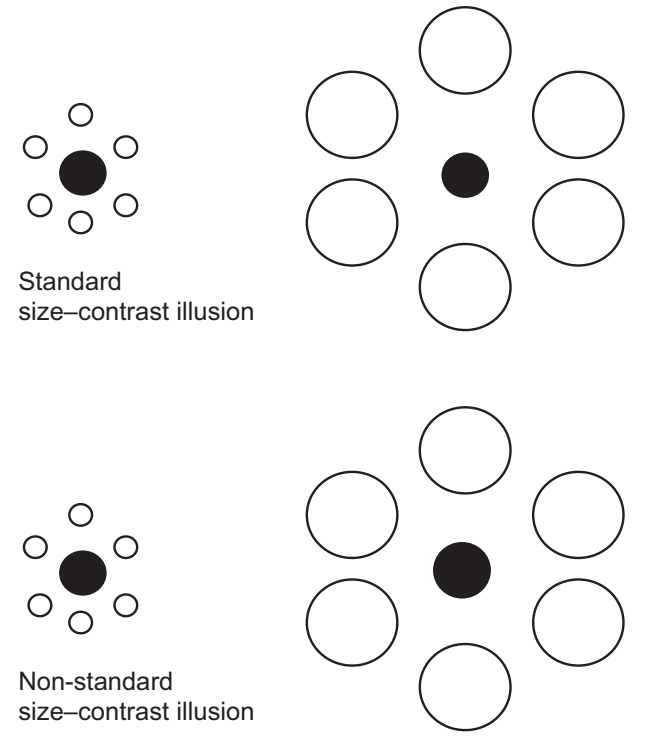

Figure 1. The Ebbinghaus–Titchener size–contrast illusion.

amount for a mid-afternoon snack, but the same amount in a larger bowl may appear insufficient, leading one to over-serve. These size–contrast effects suggest that people who receive a larger bowl will serve more than those who receive smaller bowls. This should also lead them to eat more because they are unlikely to be aware of this bias,[8] and people consume most of what they serve themselves.[3]

The same basic principle should operate with spoons. People who are given large serving spoons may tend to underestimate how much they are serving themselves relative to those given smaller serving spoons, and, as a result, the more they over-serve themselves with any given spoonful. While they may, in turn, serve themselves a greater number of servings from the smaller spoon, it is unclear whether these additional servings would fully compensate for the larger initial servings from the larger spoon.

Method

The study involved 85 faculty, graduate students, and staff members (27 male) of the Department of Food Science and Nutritional Science of a large Midwestern university. These nutrition experts received an e-mail invitation to attend an ice cream social to celebrate the success of a colleague (the third author) in 2002. Consistent with the University of Illinois at Urbana-Champaign's Institutional Review Board guidelines, when arriving at the reception, participants were made aware they were going to be asked questions at some point before they left.

The study involved a 2 × 2 between-subjects design. (This design enabled us to control for other factors that could influence how much ice cream a person took. Individuals with dieting issues would have been spread randomly over the four conditions, thereby minimizing any effect that they might otherwise have had.) Participants were blind to the conditions. Upon individually entering the ice cream line, the participants were randomly given either a smaller (17 oz) or a larger (34 oz) bowl. To avoid artificial ceiling effects, both sizes of bowls were large enough so that neither would be filled to capacity. In addition, participants were either given smaller (2 oz) or larger (3 oz) serving spoons with which to dish out their ice cream. Because participants individually helped themselves to the available ice cream in the cafeteria line, they were unaware that other participants had been given different-sized bowls and serving spoons.

On their way out of the line, participants were given a survey that asked them to estimate how much they believed they had served (in ounces and in calories), how many spoonfuls of ice cream they believed they took, and how full (0% to 100%) their bowl was (17 oz of ice cream would leave the bowl either 50% or 100% full, depending on the size of the bowl). They were also asked to indicate how much the size of the bowl and the spoon differed from what they normally use (1=smaller than normal, 9=larger than normal). While they completed the survey, their bowl of ice cream was weighed. Because nobody served themselves >10 oz of ice cream, it was concluded that the bowls were large enough to hold the volumes that they intended to serve. It was visually noted that all but three people finished their ice cream.

Based on previous findings regarding serving size,[3] a power analysis indicated a power of 0.91 for detecting a large effect size (0.50) at the 5% confidence level with a sample of 20 in each cell, and a power of 0.79 for detecting a medium effect size for the bowls (0.30). In 2003, the volume of ice cream served was analyzed with a two-way analysis of covariance with SPSS, version 11.0 (SPSS Inc., Chicago IL, 2001) that used bowl size and spoon size as between-subjects factors and used gender as a covariate.

Results

As Table 1 and Figure 2 show, the experts who received a larger bowl served and ate 31.0% more ice cream than those who received a smaller bowl (6.25 vs 4.77 oz, $F[1, 80]=8.05$, $p<0.01$). Even though they had served 31.0% more ounces, they did not perceive themselves as having served more (8.72 vs 8.40 oz, $F[1,80]=0.04$, not significant). Interestingly, the average person with a small bowl actually believed that she or he had served 3.8% more than those with big bowls, although this was not significant.

When the serving spoon size was increased 50%—from 2 to 3 oz—participants served and ate 14.5% more ice cream than those using 2-oz spoons, irrespective of the size of the bowl (Table 1, Figure 2). Although the main effect of the size of the spoon on the actual volume served was in the predicted direction (5.77 vs 5.04 oz, $F[1, 80]=2.70$, $p=0.10$), it was not statistically significant at the $p<0.05$ level. This may be explained

Table 1. How bowl and serving spoon size influence self-served portions

	Small bowl, 17 oz (SD)		Large bowl, 34 oz (SD)		F-test (p value)		
	Small spoon (*n*=20)	Large spoon (*n*=26)	Small spoon (*n*=17)	Large spoon (*n*=22)	Bowl size	Spoon size	Bowl size × spoon size
Ounces served							
Actual volume served (oz)	4.38 (2.05)	5.07 (1.84)	5.81 (2.26)	6.58 (2.91)	8.05 (**<0.01**)*	2.70 (0.10)	0.01 (0.91)
Perceived volume served (oz)	7.45 (4.92)	10.10 (7.12)	8.51 (4.11)	8.30 (4.56)	0.04 (0.84)	0.46 (0.50)	1.55 (0.22)
Spoonfuls served							
Number	2.22 (1.01)	1.90 (0.60)	2.94 (0.86)	2.09 (0.81)	6.28 (**<0.01**)*	9.45 (**<0.01**)*	2.20 (0.14)
Average ice cream per spoonful (oz)	2.00 (0.56)	2.79 (0.93)	2.04 (0.79)	3.35 (1.23)	1.86 (0.18)	28.51 (**<0.01**)*	1.87 (0.18)
Perceived fill level of bowl							
How full is your bowl? (%)	48.20% (25.00)	57.35% (20.10)	44.59% (18.82)	43.55% (19.33)	3.45 (0.07)	0.62 (0.43)	1.24 (0.27)
Bowl and spoon size perceptions							
How big was your bowl?[a] (too small/large)	5.37 (1.66)	5.77 (2.16)	6.06 (2.08)	7.64 (1.62)	11.30 (<0.01)*	2.85 (0.09)	1.75 (0.19)
How big was your serving spoon?[a] (too small/large)	4.47 (1.05)	5.88 (1.63)	3.71 (1.49)	6.36 (1.71)	0.13 (0.72)	32.19 (**<0.01**)*	3.36 (0.07)
My bowl is smaller/larger than normal[b]	6.11 (1.92)	5.73 (2.13)	6.82 (1.55)	7.59 (1.97)	10.40 (**<0.01**)*	0.00 (0.98)	1.61 (0.21)
The serving spoon was smaller/larger than normal	4.53 (0.99)	6.00 (1.60)	3.88 (1.54)	5.95 (1.96)	1.00 (0.32)	24.44 (**<0.01**)*	0.75 (0.39)

*$p<0.01$ (bolded).
[a]1=too small, 9=too large.
[b]1=smaller than normal, 9=larger than normal.
SD, standard deviation.

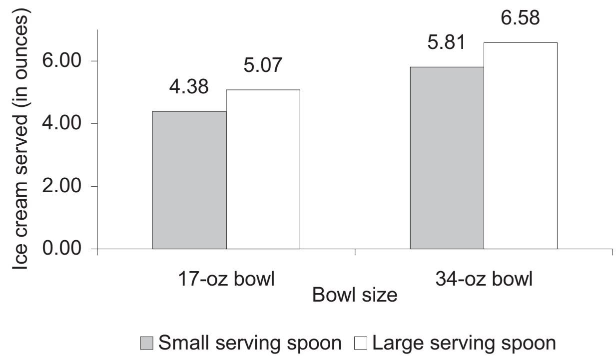

Figure 2. Bowl size and spoon size influence the ounces of ice cream served.

in part by the small 50% difference in size between the small and the large serving spoon. In most studies, the size of the manipulations vary by at least 100% in order to strengthen the effect and achieve $p<0.05$ levels of significance.

The influence of spoon size was most notable when combined with a large bowl. Planned contrasts indicated that participants who used a larger spoon to serve themselves ice cream into a larger bowl served and ate 56.8% more ice cream than those using a smaller spoon and a smaller bowl. These effects were additive, so the interaction between spoon size and bowl size was not significant ($F[1, 80]=0.01$, $p=0.91$).

Although people using smaller spoons may compensate by scooping out a greater number of servings, it was not known whether they would fully compensate. To determine this, the number of spoonfuls that they reported taking was divided by the total amount taken. It was discovered that people with larger spoons took more in each spoonful (3.04 vs 2.02 oz, $F[1, 80]=28.51$, $p<0.01$). Although those given smaller spoons took more spoonfuls (2.55 vs 1.99, $F[1, 80]=9.45$, $p<0.01$), this was not enough to compensate for the total amount taken.

Discussion

Small environmental factors can have a big impact on consumption. At this ice cream social, people given large bowls served themselves 31.0% more (127 calories), and increasing the size of their serving spoon by 50% increased the amount they served by 14.5%. When used in combination, a large bowl and a large serving spoon led people to serve themselves 56.8% more ice cream than those given a smaller bowl and a smaller serving spoon. What is critical to note, however, is that people—even these nutrition experts—are generally unaware of having served themselves more. This attests to the ubiquitous nature of these environmental cues.

The impact of bigger bowls and serving spoons was believed to be because of the larger consumption cue that they provided. Because the purpose of this study

was to investigate serving sizes in a natural environment, understanding the more detailed psychological processes will be best suited for future lab studies. Such studies would also help better assess estimates of how much food one has taken. Here, estimates were taken in terms of calories and ounces. While it is not clear how accurate people are in estimating ounces and calories, it was believed that this group would be most accurate given their expertise in nutrition.

Given the specific clinical concern about obese patients, future research could also examine how these environmental cues might affect those with different body mass index (BMI) levels. Although people with larger BMIs serve themselves more food, most studies show they are no more influenced by environmental cues than people of regular weight.[8]

From a clinical viewpoint, these findings might initially suggest that patients with weight concerns should be informed about this bias. The reality, however, is that knowledge of this bias seems to have little impact on behavior. With the studies involving drinking glasses, even after people are informed of the bias, given practice trials, and told to take their time when pouring, they still poured 20% more into short wide glasses than tall narrow ones.[5] These illusions are much more powerful than our vigilance.

It would simply be better to encourage a patient to re-engineer his or her immediate environment so that the larger bowls and the larger spoons were replaced by ones that did not necessitate vigilance. For instance, obese patients may want to use smaller bowls and spoons at home to reduce over-consumption. Preliminary studies have found that using smaller bowls also leads people to feel less like they are "sacrificing" or "on a diet."

In contrast, there are circumstances in which there is a desire to stimulate an increased intake of healthy foods, such as with the undernourished, young, and the aged. For instance, parents may want to encourage their children to eat more oatmeal, and a dietitian may want nursing home patients to eat more fruit in the cafeteria. In these cases, larger bowls and spoons would encourage more food intake than the smaller bowls and spoons that are often provided.

As clinicians, this bias could also unknowingly compromise our ability to analyze the food diary of a single patient as surely as it would bias an epidemiologic study of thousands. When a patient is serving himself or herself, the size of a bowl or serving spoon may lead to considerable variation in how much they would otherwise eat, and it would bias the serving estimates that they record. If accuracy is important, one solution would be to ask patients to record the size of the bowl, spoon, plate, or glass that they used when serving themselves. If greater precision or control is required, standard-sized bowls and spoons could be used when trying to establish benchmarks for longitudinal epidemiologic studies or when assessing behavior change in a single patient.

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