

Research finds pretzel size affects intake by governing how quickly a person eats and how big their bites are

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Researchers found that pretzel size affects the consumer's eating rate, with smaller sizes leading to a slower eating speed and smaller bites. Credit: Madeline Harper/Penn State, All Rights Reserved

The size of an individual snack piece not only influences how fast a person eats it, but also how much of it they eat, according to a new study led by researchers at Penn State. With nearly a quarter of daily calorie intake in the United States coming from snacks, these findings may have implications for helping people better understand how eating behavior impacts calorie and sodium intake.

The team of food scientists investigated how the size of pretzels influences eating behavior—overall intake, eating rate, bite size and snacking duration—and found that people eat larger pretzels quicker with larger bites. They also found that while people ate smaller pretzels slower and with smaller bites, and ate less overall, they still had higher intake of sodium. Their results are available online now and will be [published](#) in the June issue of *Appetite*.

Seventy-five adults participated in the study, eating snacks three different times in the Sensory Evaluation Center. The oversized snack was about 2.5 servings of one of three sizes of pretzel—small, medium or large. To calculate eating rate and bite size, the researchers video recorded each snacking session, noting how many minutes each participant spent snacking and the number of bites. They also measured how much each participant ate in both weight and calories.

When participants were given the same amount of food, how much they ate—in both snack weight and calories—depended on unit size, with study participants consuming 31% and 22% more of the large pretzels compared to the small and medium sized pretzels, respectively. Size of the pretzel also influenced eating rate and bite size, with the largest pretzel size yielding the fastest eating rate and largest mean bite size.

The researchers also reported that, after accounting for eating behavior, the pretzel size alone did not significantly affect how much a person ate, suggesting the eating behavior the different pretzel sizes prompted was

driving total intake. Their results suggest larger pretzel size induces a person to eat more quickly and take bigger bites.

Together, these findings indicate that unit size influences intake by affecting eating behavior and they show that food characteristics such as unit size can be leveraged to moderate snack intake, explained corresponding author John Hayes, professor of [food science](#) and director of the Penn State Sensory Evaluation Center.

"The study suggests that food structure—texture, size and shape—can be used to modulate eating behavior and food intake," he said. "Food geometry, specifically unit size, is of particular utility for [snack foods](#). We're interested in how the material properties of foods can be harnessed to help people eat less without impacting their enjoyment."

The relationship between pretzel size and [sodium intake](#) was obvious but previously overlooked, noted Madeline Harper, a graduate student in food science and lead author on the study. She explained that eating more smaller pretzels likely results in higher sodium consumption. The smaller size has more [surface area](#) for the same weight, so the researchers hypothesize that more total salt on the surface means that a snacker would consume more sodium eating them.

"So, we're suggesting that if you're trying to watch your calorie intake or are trying to reduce the amount that you're eating in a snack, then maybe a smaller pretzel would meet your needs better, because of the inherent way the size of the pretzel affects your eating rate," she said.

"But if you're more worried about hypertension or the amount of sodium you're consuming, the larger pretzel might be better for you, because you'll consume less sodium in that treatment, even though you might consume more grams of pretzel."

More information: Madeline M. Harper et al, Unit size influences ad libitum intake in a snacking context via eating rate, *Appetite* (2024).

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