New research finds brain activation in children viewing large portions of food

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Using functional magnetic resonance imaging to examine children's brains, researchers in the Department of Nutritional Sciences report that calorie content and portion size activate different brain regions in children. A total of 180 images of foods varying by portion size and calorie density were created and presented for this study. High energy-dense foods were presented along with low energy-dense foods. All foods were shown in large portion and small portion sizes. As a control, participants also viewed non-food images, such as furniture.

Credit: Dennis Maney

Viewing large portions of high-calorie food activates reward and sensory processing areas in children's brains, according to a Penn State study.

Using functional magnetic resonance imaging (fMRI) to examine children's brains, researchers in the Department of Nutritional Sciences at Penn State reported for the first time that calorie content and portion size activate different brain regions in children. While high calorie foods, like chocolate candies and pizza, activated an assortment of brain regions involved with taste and sensory processing, food portion size, independent of calorie content, activated brain regions involved with attention and self-control.

These findings are significant because they add to a growing platform of research that aims to further understand and predict future eating behavior and potential causes of overeating by investigating brain responsiveness to food cues.

"Our original motivation for this work was to understand why people overeat when given large portions of food," said senior author Kathleen L. Keller, Mark T. Greenberg Early Career Professor for Children's Health and Development. "Our results confirmed previous findings that food calorie content activates brain regions involved with taste, reward, and sensory processing. Additionally, for the first time, we show that food portion size activates brain regions implicated in self-control."

Previously, researchers had looked at select parts of these children's brains.

"There had been a lack of research regarding what happens in the brain

when viewing different sized portions of food," said the study's lead author, Laural English, a doctoral student in Keller's lab. "We previously tested a limited number of defined brain regions implicated in reward processing and decision making from this same group of children. However, we realized that there may be other brain regions that respond to food portion size and calorie content not previously tested in this previous approach. This study used a whole-brain approach to address that gap in knowledge."

The researchers published their results in The *American Journal of Clinical Nutrition* in November.

High energy-dense foods have more calories per bite, and may be higher in sugar and fat. Low energy-dense foods have fewer calories per bite, and are diluted by water and fiber, such as fruits and vegetables.

Subjects included 36 healthy-weight children who viewed food images differing in portion size and calorie density. Children were ages 7 to 10; half were girls and half boys. They were tested after a two-hour fast. Researchers took added steps to ensure the comfort among children during the fMRI scan, such as performing the "wiggle dance" prior to entering the scanner to help keep the children calm and still.

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Although the results of this study did not demonstrate a correlation between brain activity and actual eating behavior, the researchers said, they do show connections between brain regions and certain appetite traits that are associated with the development of obesity.

English and Keller worked with co-authors S. Nicole Fearnbach, Barbara Rolls and Jennifer S. Savage in the Department of Nutritional Sciences at Penn State; Stephen J. Wilson in the Department of Psychology at Penn State; and Jennifer O. Fisher in the Department of Behavioral and Social Sciences at Temple University.

"Further investigation is needed," English and Keller said. "But these findings may help researchers develop improved strategies to help some children moderate their intake when presented with 'supersize' portions."

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