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Study links overeating in obese mice to altered brain responses to food cues

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Obese mice are much more likely than lean mice to overeat in the presence of environmental cues, a behavior that could be related to changes in the brain, finds a new study by a Michigan State University neuroscientist. The study is to be presented this week at the Society for the Study of Ingestive Behavior, the foremost society for research into all aspects of eating and drinking behavior.

The findings offer clues in Alexander Johnson's quest to unpack the interconnected mechanisms of overeating and obesity. Obesity is an epidemic domestically—more than a third of Americans are considered to be obese—and a growing health problem in other parts of the world.

"In today's society we are bombarded with signals to eat, from fast-food commercials to the smell of barbecue and burgers, and this likely drives overeating behaviors," said Johnson, Assistant Professor of Psychology at Michigan State University. "Our study suggests both a psychological and neurobiological account for why obese individuals may be particularly vulnerable to these signals."

The study involved two groups of mice—one group that was fed a high-calorie diet until they became obese and a second group that was fed a regular lab chow diet so they stayed lean. Johnson then trained the mice with different auditory cues. Whenever they heard one cue, such as a tone, the mice received sugar reward; with a second cue, such as a white noise, they received no reward.

The mice were then given access to their assigned maintenance diet for three days so they were satiated (i.e., not hungry) for the final test phase of the study. In that test, the sugar solution was available to the mice at all times, to see what would trigger them to start eating. When no cue was given, and when the white-noise cue was given (which previously offered no reward), the lean mice and obese mice ate roughly the same amount. When the rewarding tone cue was given, however, the obese mice ate significantly more of the sugar solution compared to the lean mice.

"From a psychological perspective, this tells us that the obese mice are more vulnerable to the effects of environmental triggers on evoking overeating behavior," Johnson said. "Looking at it through a human lens, this suggests that obese individuals may be more sensitive to overeating food in the presence of say, the McDonald's Golden Arches."

But why? The final part of the study may offer an explanation.

Johnson also examined the mice's lateral hypothalamus, which is known as a key brain area in appetite and feeding behavior. Using a procedure called immunofluorescence to label neurons in this area of the brain, he found that neurons releasing a certain hormone- Melanin-Concentrating Hormone, or MCH—were more abundant in obese mice. But importantly, these MCH-releasing neurons were more active when the obese mice encountered the environmental reminders of sugar.

"In other words, if you become obese this leads to increases in MCH expression, which may make you more sensitive to this form of overeating," Johnson said.

The novel findings, he added, start to paint a picture of the relationship

between brain-behavior mechanisms that may underlie learned overeating in obese individuals.

"This could be one of perhaps many reasons why obese people may have the urge to eat more when presented with food cues."

More information: Dietary obesity leads to upregulation of feeding signals in lateral hypothalamus and an enhanced vulnerability to overeating in the presence of food cues, Society for the Study of Ingestive Behavior, 2016.

Provided by Society for the Study of Ingestive Behavior