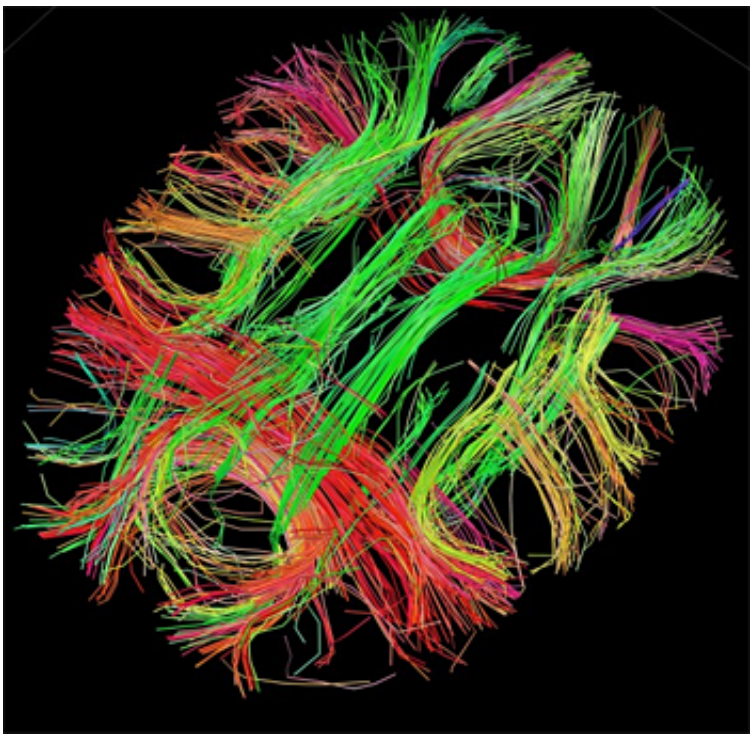
Researchers show brain activity can predict increased fat intake following sleep deprivation

February 12 2015, by Lee-Ann Donegan



White matter fiber architecture of the brain. Credit: Human Connectome Project.

Experts have warned for years that insufficient sleep can lead to weight gain. A new Penn Medicine study found that not only do we consume more food following a night of total sleep deprivation, but we also we consume more fat and less carbohydrates and a region of the brain

known as the salience network is what may lead us to eat more fat. The new findings are published in *Scientific Reports*.

Most research in this arena has focused on changes in metabolic hormones that lead to weight gain, while only a few have begun to examine how changes in brain activity may play a role. "We wanted to uncover whether changes in regional brain function had an impact on our eating behavior following sleep deprivation," says the study's senior author, Hengyi Rao, PhD, a research assistant professor of Cognitive Neuroimaging in Neurology and Psychiatry. "This work has implications for the approximately 15 million Americans who work the evening shift, night shift, rotating shifts, or other employer arranged irregular schedules."

The study took a unique approach and sequestered 34 sleep-deprived subjects and 12 controls in a sleep lab for five days and four nights for round-the-clock monitoring. All study subjects received one night of regular sleep and were then randomized to either total sleep deprivation or control for the remaining three nights. Baseline functional MRI (fMRI) to examine brain connectivity changes associated with macronutrient intake was conducted on all subjects the morning following the first night of sleep. Sleep-deprived subjects were matched to control subjects in age, body mass index (BMI), ethnicity or gender.

On the second night, sleep deprivation subjects were kept awake while the control subjects slept for eight hours. fMRI testing of both groups continued on days, two, three and four at the same time each day. All subjects had access to a variety of foods that they could consume as desired.

Sleep deprived subjects consumed close to 1,000 calories during overnight wakefulness. Despite this, they consumed a similar amount of calories the day following sleep deprivation as they did the day following

baseline sleep. However, when comparing the macronutrient intake between the two days, researchers found that healthy adults consumed a greater percentage of calories from fat and a lower percentage of calories from carbohydrates during the day following total sleep deprivation.

The Penn researchers also found that sleep deprived subjects displayed increased connectivity within the "salience network," which is thought to play a role in determining contextually dependent behavioral responses to stimuli that can be either internal or external, and is one of several key brain networks that carry out various aspects of brain function. Moreover, increased connectivity in the salience network correlated positively with the percentage of calories consumed from fat and negatively correlated with the percentage of carbohydrates after sleep deprivation. The salience network is located toward the front of the brain and consists of three sections, the dorsal anterior cingulate cortex, bilateral putamen, and bilateral anterior insula. Activity in these structures is linked to both emotion and bodily sensations, such as the heart racing, stomach churning, pain, thirst, embarrassment, and attempting mental challenges. Changes in caloric intake and content after sleep deprivation may therefore relate to changes in the "salience" of food, and in particular fatty food, in individuals who are sleep deprived.

"We believe this is the first study to examine the connection between brain network connectivity and actual macronutrient intake after baseline sleep and after total sleep deprivation," says Rao. Most similar studies rely on self-reported hunger levels of food cravings, or on brain responses to pictures of different types of foods. "Although this study examined the effects of acute total sleep deprivation, similar changes may occur in response to the chronic partial sleep restriction that is so prevalent in today's society."

More information: "Altered salience network connectivity predicts

macronutrient intake after sleep deprivation." *Scientific Reports* 5, Article number: 8215 DOI: 10.1038/srep08215