How genetics shape our addictions

News

Genes predict the brain's reaction to smoking

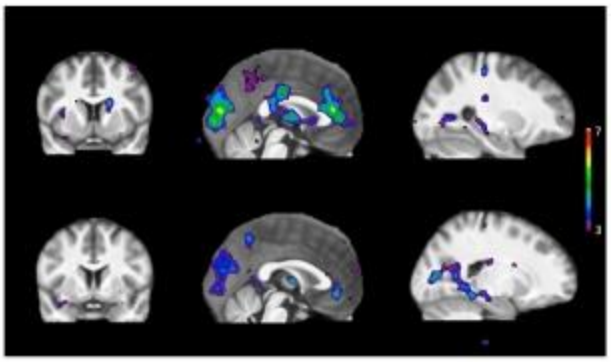

PHOTO: Scans show areas of brain activation in response to smoking cues in people with fast nicotine metabolism (upper row) and slow nicotine metabolism (bottom row). Brain regions are more activated in individuals with fast nicotine metabolism.

Have you ever wondered why some people find it so much easier to stop smoking than others? New research shows that vulnerability to smoking addiction is shaped by our genes. A study from the Montreal Neurological Institute and Hospital - The Neuro, McGill University shows that people with genetically fast nicotine metabolism have a significantly greater brain response to smoking cues than those with slow nicotine metabolism. Previous research shows that greater reactivity to smoking cues predicts decreased success at smoking cessation and that environmental cues promote increased nicotine intake in animals and humans. This new finding that nicotine metabolism rates affect the brain's response to smoking may lead the way for tailoring smoking cessation programs based on individual genetics.<!--break-->

Smoking cues, such as the sight of cigarettes or smokers, affect smoking behavior and are linked to relapse and cigarette use. Nicotine metabolism, by a liver enzyme, also influences smoking behavior. Variations in the gene that codes for this enzyme determine slow or fast rates of metabolism and therefore, the level of nicotine in the blood that reaches the brain. In the study smokers were screened for their nicotine metabolism rates and their enzyme genotype. Participants were aged 18 – 35 and smoked 5-25 cigarettes daily for a minimum of 2 years. People with the slowest and fastest metabolism had their brain response to visual smoking cues measured using functional MRI. Fast metabolizers had significantly greater response to visual cigarette cues than slow metabolizers in brain areas linked to memory, motivation and reward, namely the amygdala, hippocampus, striatum, insula, and cingulate cortex.

"The finding that nicotine metabolism rate has an impact on the brain's response to smoking cues supports our hypothesis that individuals with fast nicotine metabolism rates would have a greater brain response to smoking cues because of close coupling in everyday life between exposure to cigarettes and surges in blood nicotine concentration. In other words they learn to associate cigarette smoking with the nicotine surge," says clinician-scientist Dr. Alain Dagher, lead investigator at The Neuro. "In contrast, individuals with slow metabolism rates, who have relatively constant nicotine blood levels throughout the day, are less likely to develop conditioned responses to cues. For them, smoking is not associated with brief nicotine surges, so they are smoking for other reasons. Possibilities include maintenance of constant brain nicotine levels for cognitive enhancement (ie, improved attention, memory), or relief of stress or anxiety."

Future research could focus on improving smoking cessation methods by tailoring treatments for different types of smokers. One possibility is to measure the rate of nicotine metabolism as part of the therapeutic decision-making process. For example, targeting cue-induced relapse risk may not help those with slow nicotine metabolism, who are more likely to benefit from long-acting cholinergic drugs such as the nicotine patch, consistent with previous clinical trials. Conversely the use of non-nicotine based therapies aimed at reducing craving may help fast metabolizers, as demonstrated for buproprion, an anti-depressant that has been used for smoking cessation.

This research was supported by the Canadian Tobacco Control Research Initiative (AD), Fonds de Recherche en Santé du Québec (AD), and the Canadian Institutes of Health Research. About The NeuroThe Montreal Neurological Institute and Hospital — the Neuro, is a unique academic medical centre dedicated to neuroscience. Founded in 1934 by the renowned Dr. Wilder Penfield, the Neuro is recognized internationally for integrating research, compassionate patient care and advanced training, all key to advances in science and medicine. The Neuro is a research and teaching institute of McGill University and forms the basis for the Neuroscience Mission of the McGill University Health Centre. Neuro researchers are world leaders in cellular and molecular neuroscience, brain imaging, cognitive neuroscience and the study and treatment of epilepsy, multiple sclerosis and neuromuscular disorders. For more information, visit theneuro.com. Contact: Anita Kar, The Neuro, 514 398 3376, anita.kar@mcgill.ca

TASKS

1. Summarize the article using the SEE method (statement, example, explain).

2. Although smoking is linked to many different diseases, it is a voluntary act. Is it justifiable to spend large sums of money on scientific studies such as the one highlighted in this article? In your answer, consider the social, economic, environmental, scientific and/or political perspectives. Defend you answer with solid facts.

Opinion Paragraph				
	Poor 1 pts	**Fair 2 pts**	**Good 3 pts**	**Excellent 4 pts**
Topic Sentence	Topic/opinion is not stated.	Topic is not stated in a complete sentence, but does express an opinion.	Topic sentence is stated in a complete sentence and somewhat expresses an opinion about the topic.	Topic sentence is stated in a complete sentence and fully expresses an opinion about the topic.
Supporting Opinions and Reasons	Contains no supporting opinions and no specific reasons to support opinions.	Contains few supporting opinions and few specific reasons to support opinions.	Contains some supporting opinions and some specific reasons to support opinions.	Contains sufficient supporting opinions and specific reasons to support opinions.
Organization/ Structure	No discernible organization. Transitions are not present.	Organization is clear. Some transitions are present.	Logical progression of details. Transitions present, however do not enhance the overall effectiveness of the paragraph.	Logical progression of details. Transitions are appropriate and used effectively.
Mechanics	More than 5 errors in grammar or spelling that distract the reader from the content of the paragraph.	4-5 errors in grammar or spelling that distract the reader from the content of the paragraph.	3 errors in grammar or spelling.	1-2 errors in grammar or spelling.