Epigenomic boom over hyped?

It's unsurprising that many people find genetics too confusing to follow. First, we thought DNA was the last word. In the past 25 years, we discovered that factors from our environments interact with our genes, so the field of epigenetics was born. And now, some studies report that these epigenetic changes are passed down to our children and even grandchildren, causing geneticists to grapple with epigenetic inheritance.

But a recent review in Cell (via ScienceDirect) aims to slow down the epigenome's wild rise to celebrity. At heart is the issue of a plausible mechanism.

As Virginia Hughes writes in her great Nature investigation, Epigenetics: The sins of the father, covering an important study of epigenetic inheritance in mice:

> "Epidemiological studies are often messy, and it is impossible to rule out all confounding variables. In the past few years, however, several studies in rodents have supported these observations and begun to attribute the transmission of various traits to changes in sperm."

In that Nature Neuroscience study, Brian Dias and Kerry Ressler showed that exposing one generation of male rat to acetophenone, a chemical that smells like almonds, while giving them an electric shock made those males' children and their children's children more fearful of the smell. Those animals also had larger connections between acetophenone-sensitive neurons in their nose and neurons in their olfactory bulbs.

So how could this fear response get transmitted to a mouse's sperm and then to his son's? Well, there are a lot of options. From Hughes:

> "If the mechanism involves DNA methylation, histones or RNA, the field is likely to make great progress in the next few years, Rando predicts. 'But if it's something completely novel,' he says, 'Maybe it will take decades to Figure [sic] out.'"

And now to the dissenters, Edith Heard in the Mammalian Developmental Epigenetics Group at Institut Curie, Paris and Robert A. Martienssen at Howard Hughes Medical Institute. They argue:

> The environment can certainly influence gene expression and can lead to disease, but transgenerational consequences are another matter. Although the inheritance of epigenetic characters can certainly occur—particularly in plants—how much is due to the environment and the extent to which it happens in humans remain unclear.

They postulate alternative methods for the transmission of exposure-related information through mammalian generations just like those families of poor, marzipan-hating mice. Here's a summary thanks to Alex Berezow at Real Clear Science:

> The authors list four possibilities: Undetected mutations in the letters of the DNA sequence, behavioral changes (which themselves can trigger epigenetic tags), alterations in the microbiome, or transmission of metabolites from one generation to the next. The authors claim that most epigenetic research, particularly when it involves human health, fails to eliminate these possibilities.

So, we probably can't be sure about epigenetic effects, at least in humans, until we find some examples of what the proposed mechanisms of transmission could be.

Berezow sums it up:

> Be very skeptical of studies which claim to have detected health effects due to epigenetic inheritance. The hype may soon fade.

Additional Resources:

- Was Lamarck right? Epigenetic research suggests we might inherit learned traits. But how?, Genetic Literacy Project
- Can we inherit fear of a smell? The latest on transgenerational epigenetics, Genetic Literacy Project
- The "right time" to have children, Genetic Literacy Project