Epigenetics Around the Web: No, income inequality does not cause epigenetic changes, botching Lamarck, and more

This week's features: A psychology professor claims that income inequality is causing epigenetic changes and a Huffington Post article on climate change and wine grapes muddles the science of evolution. Plus, see what's trending on the Epigenetics Literacy Project.

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> University of Michigan psychology professor Dan Keating

Leave unsettled science out of politics

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Dan Keating

Income inequality was one of the many hot-button issues of the last election–and rightly so. The gap between the rich and the poor has increased drastically in the past few decades. In an April 2 story on CNN, University of Michigan psychology professor Dan Keating discussed what effects this may be having on human health, particularly stress:

> There is a clear line that connects increasing inequality in income and opportunities, to increases in stress and mortality that hits some groups earlier than others.

Keating's overall hypothesis is solid: Long-term stress can bring on physiological changes, particularly through the activation of cortisol-releasing cells. But his grasp of the science was tenuous beyond that. Keating claimed that income inequality causes stress that, in turn, induces life-long epigenetic changes:

> Slow-moving and cumulative social forces "get under the skin" early in life and can show up decades later in morbidity and mortality. The risk is magnified in light of very recent research showing that high levels of stress experienced by expectant mothers or by babies can make fundamental biological changes in infancy — through what are known as epigenetic changes, which alter how genes work — that can endure over a lifetime.

Income Inequality While there is some evidence that stress can induce epigenetic changes, most of it comes from studies of people who went through severe trauma or stress (like the Holocaust). It's also hard to understand how babies would be cognizant enough of their family's socioeconomic status to

experience stress-induced epigenetic changes. Such changes are also reversible and shift throughout a person's life. This means that an epigenetic modification linked to a disease (e.g. obesity or depression) that arises during childhood will not necessarily persist for a person's lifetime. Scientists are not clear under what conditions epigenetic tags persist or are removed. In a story posted on our site on April 5, cancer researcher Fabian V. Filipp of the University of California, Merced made the point that we don't yet have a good grasp on what a healthy epigenome (the collection of all the epigenetic tags on our DNA) looks like, which makes it difficult to ascertain how epigenetics can cause diseases.

So it is difficult to say with certainty that an epigenetic change uncovered in childhood would both stay throughout a person's lifetime and affect health decades down the road.

Keating has fallen into a frequent pitfall when nonexperts attempt to communicate about epigenetics: When you know a change in health has happened but you can't pinpoint its genetic, developmental or environmental trigger — blame it on epigenetics. As Sir Adrian Bird a geneticist at the University of Edinburgh famously said: "Epigenetics is a useful word if you don't know what's going on — if you do, you use something else."

Epigenetics is far from a settled field of science and really should be left out of discussions about poverty and economics. In reality, isn't the plight of the poor reason enough to help those who are worse off without having to drag unsettled science into the discussion?

Lamarck was wrong about giraffes and wine

"Lamarck said that as the giraffe's neck got longer, its offspring would also inherit a longer neck," Dr. Laura Catena said in a recent article written by former winemaker and journalist Christine Havens on the Huffington Post that discussed the former's work in studying *Vitis vinifera* (common wine vine) adaptation to climate change. Catena, a fourth generation vintner and Harvard-educated physician, is often called the 'face of Argentine wine.'

"It turns out that Lamarkian theory and transgenerational epigenetic inheritance holds true for *Vitis vinifera (winegrape)* as well," Havens wrote when describing Catena's work.

Some background: They are both referring to Jean-Baptiste Lamarck who was an 18th-century French biologist. He is widely known for his theories on species evolution which centered around the idea that characteristics and environmental adaptations acquired during an organism's lifetime could be passed down to the next generation. Here's a good example to illustrate his ideas from the University of California's Understanding Evolution website explains Lamarckianism:

> If a giraffe stretched its neck for leaves, for example, a "nervous fluid" would flow into its neck and make it longer. Its offspring would inherit the longer neck, and continued stretching would make it longer still over several generations. Meanwhile organs that organisms stopped using

> would shrink.

Lamarckianism has long been disproven–replaced by Darwinian evolution by natural selection. But the apparent inheritance of some environmentally-induced epigenetic changes (so-called transgenerational epigenetic changes) has caused some to recently rethink his theories. Stories that discuss epigenetics research often erroneously invoke Lamarck's theories, like Havens'.

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Image not found or type unknown
Dr. Laura Catena

The problem with these comments is two-fold. First, it misrepresents Lamarck. Lamarck rejected the notion that the environment would directly affect organismal traits. His point was that organisms responding to the environment led to adaptive changes that were passed on.

And on that second point, Lamarck was wrong. Giraffes and all living things don't evolve in this manner but through random mutations that lead to offsprings that are better adapted to survive and pass on their genetically-based characteristics. In other words, the two wine connoisseurs (and modern day Lamarckian advocates) are wrong about what he actually believed.

Transgenerational epigenetic inheritance is not the same as Lamarckianism. The term refers to the transmittance of information from one generation to the next (e.g., parent to child transmittance) without altering the primary DNA sequence.

Catena found that *Vitis vinifera* exposed to drought underwent epigenetic changes that are passed on to the subsequent generation. The process is still poorly understood in mammals, but scientific understanding of transgenerational epigenetic inheritance is further along in plants. Many experts believe that to deal with climate change, inducing transmittable epigenetic changes may be a key strategy for improving crops. In this aspect, Catena's work is both in-line with the modern understanding of epigenetics and vital to the future of wine.

But what she and Havens claim was not what Lamarck believed. He specifically rejected the notion that the environment directly influenced organisms:

> It is now necessary to explain what I mean by this statement: The environment affects the shape and organization of animals, that is to say that when the environment becomes very different, it produces in the course of time corresponding modifications in the shape and

> organization of animals. It is true, if this statement were to be taken literally, I should be convicted of an error; for, whatever the environment may do, it does not work any direct modification whatever in the shape and organization of animals. [Translated as in Kampourakis and Zogza (2007)]

Passing on a single acquired trait to the next generation is evolution. Most evidence about transgenerational epigenetic inheritance suggests it only penetrates a few generations. That's not enough to affect the entirety of a population or species, but it is enough to help build better crops.

Trending on the Epigenetics Literacy Project

Can epigenetics advance personalized cancer treatments? It's complicated
TPC

Image not found or type unknown Epigenomics has a lot of promise for cancer treatments, but there are still many more questions that we need to answer. What does the epigenome of a healthy person look like? And how does the epigenome change as we age? How does the epigenome of a sick person differ? In the future, these important questions will be addressed.

Janet Jackson gives birth at 50: Should aging moms and dads facing pregnancy worry?
JanetNewMain x

Image not found or type unknown Janet Jackson, age 50, and husband Wissam Al Mana, age 41, are part of a trend in which men and women are starting their families at an advanced age. Should they and other older parents be concerned? The science is less than settled.

Eating less linked to living long–but scientists are unsure why
fit

Image not found or type unknown The effects of reduced food consumption and lifespan extension have been observed in many species, including primates. But the biology behind how this is achieved is poorly understood.

For more epigenetics news—as well as news about the microbiome and endocrine disruptors—check out the Epigenetics Literacy Project, a sister-site to the GLP. Follow us on twitter and like our Facebook page.

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For more background on the Genetic Literacy Project, read GLP on Wikipedia