To arrive at the edge of the world's knowledge, seek out the most complex and sophisticated minds, put them in a room together, and have them ask each other the questions they are asking themselves.

https://www.edge.org/response-detail/25502
Printed On Sun June 10th 2018

2014 : WHAT SCIENTIFIC IDEA IS READY FOR RETIREMENT?

In the News [60]
|
Contributors [178] | View All Responses [185]

Athena Vouloumanos
Associate Professor of Psychology, Director, NYU Infant Cognition and Communication Lab, New York University

Natural Selection is the Only Engine of Evolution

In evolution classes, Lamarckism–the notion promoted by Lamarck that an organism could acquire a trait during its lifetime and pass that trait to its offspring–is usually briefly discussed and often ridiculed. Darwin's theory of natural selection is presented as the one true mechanism of evolutionary change.

In Lamarck's famous example, giraffes that ate leaves from higher branches could potentially grow longer necks than giraffes that ate from lower branches, and pass on their longer necks to their offspring. The inheritance of acquired characteristics was originally considered a legitimate theory of evolutionary change, with even Darwin proposing his own version of how organisms might inherit acquired characteristics.

Experimental hints of intergenerational transfer of acquired traits came in 1923 when Pavlov reported that while his first generation of white mice needed 300 trials to learn where he hid food, their offspring needed only 100, and their grandchildren only 30. But Pavlov's description didn't make clear whether the mice were all housed together allowing for some communication between mice or other kinds of learning. Still other early studies of potential intergenerational trait transfer in plants, insects, and fish also suffered from alternative interpretations or poorly controlled experiments. Lamarckism was dismissed.

But more recent studies–using modern reproduction techniques like in vitro fertilization and proper controls–can physically isolate generations from each other and rule out any kind of social transmission or learning. For example, mice that were fear-conditioned to an otherwise neutral odor produced baby mice that also feared that odor. Their grandbaby mice feared it too. But unlike in Pavlov's studies, communication couldn't be the explanation. Because the mice never fraternized, and cross-fostering experiments further ruled out social transmission, the newly acquired specific fear had to be encoded in their biological material. (Biochemical analysis showed that the relevant change was likely in the methylation of olfactory reception genes in the sperm of the parents and offspring. Methylation is one example of an epigenetic mechanism.) Natural selection is still the primary shaper of evolutionary change, but the inheritance of acquired traits might play an important role too.

These findings fit in a relatively new field of study called epigenetics. Epigenetic control of gene expression contributes to cells in a single organism (which share the same DNA sequence) developing differently into e.g. heart cells or neurons. But the last decade has shown actual evidence–and possible mechanisms–for how the environment and the organism's behavior in it might cause heritable changes in gene expression (with no change in the DNA sequence) that are passed onto offspring. In recent years, we have seen evidence of epigenetic inheritance across a wide range of morphological, metabolic, and even behavioral traits.

The intergenerational transmission of acquired traits is making a comeback as a potential mechanism of evolution. It also opens up the interesting possibility that better diet, exercise, and education which we thought couldn't affect the next generation–except with luck through good example–actually could.

Return to Table of Contents

2018 : **WHAT IS THE LAST QUESTION?**
2017 : **WHAT SCIENTIFIC TERM OR CONCEPT OUGHT TO BE MORE WIDELY KNOWN?**