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Q&A with Stanford's Marcus Feldman on the extension of biology through culture

Biology Professor Marcus Feldman is a pioneer in the field of cultural evolution and has worked on diverse topics, including fertility control in China, the evolution of language and Neanderthals' extinction. He discusses the importance of cultural evolution and its deep ties to biological evolution.

BY TAYLOR KUBOTA

In 1973, **Marcus Feldman (https://profiles.stanford.edu/marcus-feldman)**, professor of biology, and **L.L. Cavalli-Sforza (https://profiles.stanford.edu/luigi-cavalli-sforza)**, professor emeritus of genetics, published a **paper (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1762580/?page=1)** that went on to inspire an entire subdiscipline of cultural anthropology, which applies models inspired by ideas from population genetics to cultural change. In it, the Stanford professors originated a quantitative theory of cultural evolution that described how cultural traits of parents can get passed on to kids.

Biology Professor Marcus Feldman, director of the Morrison Institute for Population and Resource Studies, is a pioneer in the field of cultural evolution. *(Image credit: L.A. Cicero)*

“We draw analogies with biological evolution where things that happen in one part of the genome can often influence what’s happening in another part of the genome,” said Feldman. “In the same way, things that vary in one part of the culture-ome can influence or determine patterns of variation in other parts of the culture-ome.”

Last fall Feldman and colleagues from the University of St. Andrews (Scotland) and the University of California, Irvine, led a colloquium on current research in cultural evolution, how cultural evolution and biological evolution overlap, and why this is an important field. That colloquium resulted in several papers, **published (http://www.pnas.org/content/114/30/7775.full)** in the July 25 issue of *Proceedings of the National Academy of Sciences*. Feldman discussed these topics with Stanford News Service:

What is cultural evolution?

It’s the change over time in characteristics of human behavior that can be learned and transmitted from person to person. They can be behavioral traits such as attitudes or norms or ethics or values or use of implements. As in biological evolution, the prevalence of these characteristics can change over time, but unlike most genetic evolution, the rate of change can be very fast, even within a generation.

For example, following the implementation of the fertility control program in China, there was a rapid decline in the number of children that people had, but in early surveys the desired number of children was still about three. Now, the cultural environment has changed so that, for the majority of people, the desired number of children is two or less. It took maybe one generation for that to happen. At the same time, attitudes toward the desirability of having a son did not change and that’s why the sex ratio has been so extreme. There was a deeper cultural proclivity, related to carrying on the family name or who can perform rituals when you’re buried, and those norms have been much slower to change.

How is cultural evolution different from biological evolution?

The main places where it’s different is in the transmission mechanism. When Cavalli-Sforza and I wrote our **book (http://press.princeton.edu/titles/4409.html)** on cultural evolution 36 years ago, we distinguished three main modes of transmission. One is learning from your parents, which would be very conservative in terms of rates of change. Examples are religious attitudes and political preferences.

The second mode of transmission is what you might learn from your peers. This might be literature or entertainment preferences, attitudes toward food or clothing preferences.

And then we differentiated a third, which refers to those beliefs or behaviors or attitudes that are transmitted by non-parents who are members of an older generation; teachers, for instance.

Is there a clear distinction between what we would consider cultural versus biological evolution?

There was quite a bit of discussion in the meeting about this question. After centuries of asking questions about what is genetic and what is learned and what is imposed, the question is not fully resolved.

For example, one of the things we know is passed on culturally and does not get transmitted through the genes is language. But, it may be that the rapidity with which we learn it or the fluency which we eventually achieve has to do with some parts of our biological makeup.

I think there is no such thing as determination by nurture or nature. The analogy that I like to use is this: A trait is like the area of a rectangle and only knowing one side – only the genetics or only the culture – doesn't tell you very much about the area.

What has your research focused on?

Right now, we're working on figuring out what kinds of cultural advantage would have been necessary for the modern humans to replace Neanderthals. **Oren Kolodny (https://profiles.stanford.edu/oren-kolodny)**, a postdoctoral research fellow in my group, has been working on whether just the **migration alone (https://news.stanford.edu/2017/05/02/early-culture-shaped-by-migration/)** out of Africa would be enough. We also developed **models (http://www.pnas.org/content/113/8/2134.abstract?tab=author-info)** that frame the competition like you would between two species – only instead of the competition being based on some resource, like a food, it's based on culture. That kind of mathematical model of the spread of modern humans has a lot of similarities with questions that come up in the physics of spatial diffusion, and **William Gilpin (http://www.wgilpin.com/)**, a graduate student in applied physics, is collaborating on this together with some wonderful Japanese colleagues.

Other research with Nicole Creanza, a former postdoctoral research fellow of mine now on the faculty of Vanderbilt University, compared genomic variation around the world with phonemic variation around the world – the sounds that people make. We turned each language into a series of 1's and 0's based on whether or not they contained certain sounds; every language was a long string of 0's and 1's, and we looked for the patterns of similarities and differences between them. We came to the **conclusion (http://www.pnas.org/content/112/5/1265.full.pdf_1)** that you can't say one is the cause of the other but you could say the geography is the cause of both.

I've also worked with anthropologist **Melissa Brown (http://aparc.fsi.stanford.edu/people/melissa_j_brown)** to **study (http://www.pnas.org/content/106/52/22139.abstract)** marriage preferences in Taiwan and how they changed due to the prohibition by the Japanese in 1915 of foot binding. Before the ban, the Han Chinese did not want to marry into the aboriginal community because the aborigines didn't bind the feet of their women. We showed that there was a very rapid change in marriage customs following the ban on foot binding. One cultural change had a dramatic effect on another, apparently unrelated, aspect of culture.

Why is understanding cultural evolution important?

Worldwide, one of the important things that we can say is that making a cultural change in one area can have important cultural effects on other attitudes and behaviors. For example, prioritizing education for women in Kerala, India, led to them desiring fewer children and investing more effort in those children. Advertising the dangers of cigarettes led to a cultural shift in how people regard smoking.

I think one of the major reasons why China recently changed the fertility policy in the last couple years was that economic and sociocultural changes had reduced the desired number of children. It was also recognized that a pronounced shortage of women would affect the birth rate and population aging, thereby decreasing the available labor in 20 or 30 years. Those kinds of mathematical and statistical projections, if they're taken seriously by policymakers, can affect and potentially improve the human condition. I think that's one of the significant things we do.

In *PNAS*, there are several papers about whether animals have cultural transmission. What are people discussing on this topic?

Naturally, if you're an evolutionist, you would want to know: Is there some kind of continuity between animal "culture" through to what we think of as human culture?

It appears there is cultural transmission of some animal behaviors. Some traits, such as **whale (http://www.pnas.org/content/114/30/7822.full)** songs and certain feeding styles, are correlated between relatives and over geography. In the chimpanzee, there may be up to about **40 different traits (http://www.pnas.org/content/114/30/7790.full)** that have been identified as potentially being called "cultural," but the thing about them is that they don't appear to accumulate. Doubt also seems to exist as to whether they're actively being taught, whether young individuals are actually learning from their mothers and are then able to teach others.

The *PNAS* collection has an excellent **review (http://www.pnas.org/content/114/30.toc)** of anatomical and potentially cognitive evolution of cumulative culture from a neuroscience perspective. Another **paper (http://www.pnas.org/content/114/30/7830.full)** in the collection focuses on transmission of foraging techniques in songbirds. Even insects may have "cultural transmission": Some **bees (http://www.pnas.org/content/114/30/7838.full)** are apparently able to learn to do totally uncharacteristic tasks by watching other bees that can do these "unnatural" things.

Overall, there appears to be a marked gap between what the scholars believe is animal culture and what we know about human culture. The papers in this collection discuss this problem of accumulation and how one would recognize it.

Feldman is director of the Morrison Institute for Population and Resource Studies; co-director of the ***Stanford Center for Computational, Evolutionary and Human Genomics*** **(https://cehg.stanford.edu/)***; a member of* ***Stanford Bio-X*** **(http://biox.stanford.edu/)***, the* ***Stanford Cancer Institute*** **(http://cancer.stanford.edu/)** *and the* ***Stanford Neurosciences Institute*** **(https://neuroinstitute.stanford.edu/)***; and an affiliate of the* ***Stanford Woods Institute for the Environment*** **(http://woods.stanford.edu/)**.

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