Cultural adaptation study shows what's better for the individual isn't always better for the group

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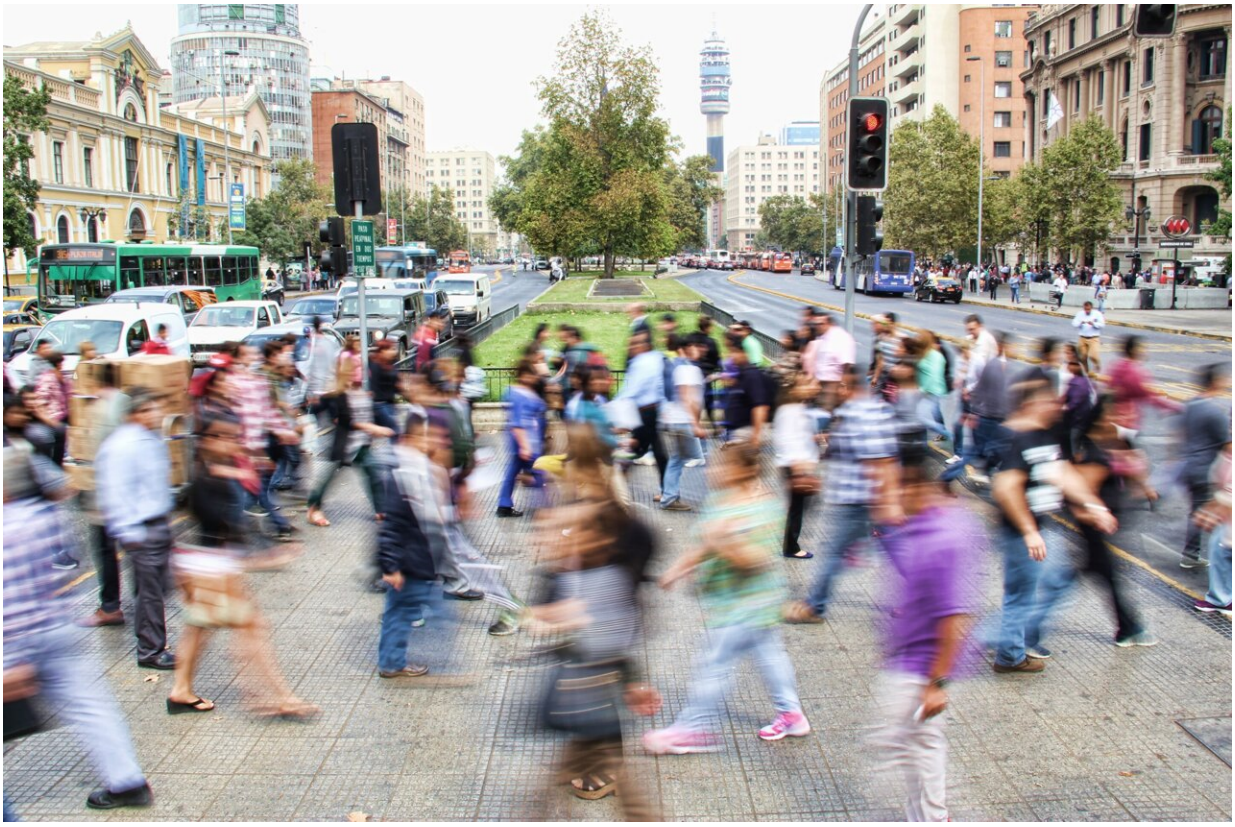

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Humans are arguably the most adaptable species on Earth. The species' enormous capacity to adapt and live in different environments is thanks

to cumulative culture, the transmission and continuous improvement of knowledge and technologies between individuals and generations.

Now, researchers from the School of Arts & Sciences have uncovered a source of inherent tension between individuals and the groups they live in. In a study published in *Evolutionary Human Sciences*, they show that individuals may be better off with fewer social connections, but groups do best when they consist of very dense social networks.

"Our capacity to accumulate cultural knowledge is part of what makes us human, and it's what has enabled us to settle and live all over the globe," says theoretical biologist Erol Akçay, an associate professor of biology. "In the real world, groups and individuals can benefit from either accumulating more traits or higher proficiency or both."

Akçay and evolutionary biologist Marco Smolla used a model to investigate the coevolution of social networks and cumulative culture. Specifically, they explored the relative benefits of specialist versus generalist cultures for individuals and groups.

Importantly, their model relied on the assumption that in order to learn socially an individual must be exposed to new skills or information multiple times.

"We were interested in complicated traits that a person would need to be exposed to multiple times in order to learn, for example, foraging tactics or making tools," says Smolla, who is a former postdoctoral fellow in Penn's Department of Biology and now a researcher at the Max Planck Institute for Evolutionary Anthropology.

The researchers found that groups benefit most when they have a specialist culture where everyone is highly connected. "Social learning is more effective, and more culture accumulates in these specialist cultures

where everyone becomes very proficient at the same handful of traits because there are no wasted learning opportunities," Akçay says. "But there's a conflict between individual-level incentives and what's best for the group."

The model showed that once groups are densely connected, there is an individual incentive to make fewer connections because it allows individuals to focus more and learn more effectively. The researchers also found that while individuals benefit from being innovative, too much innovation is disadvantageous for the group. This mismatch between individual and group interests eventually leads to the disintegration of specialist cultures which results in populations cycling between generalist and specialist cultures.

"Cumulative culture becomes a public good because to maintain it groups have to have this connected network structure, but maintaining that network is individually costly," Akçay says. "I do wonder if these cycling dynamics connect in some way to the archaeological phenomenon where you have a very vibrant culture that builds up and then suddenly collapses."

The researchers also explored how environmental stability might impact social learning and culture. They found that environmental stability promotes more specialized cultures, whereas highly variable environments favor generalist cultures. "Rapid environmental turnover favors disconnected groups because individuals are selected to increase their repertoire size in order to maximize the probability of learning at least some high-payoff traits," Smolla says.

The conflict between individuals and groups could also explain the cross-cultural ubiquity of social rituals that function to maintain social networks and the presence of social norms that enforce social learning at the expense of individual innovation.

"Our results provide a novel hypothesis for the evolution of rituals and social norms that promote social connections," Smolla says. "Such rituals can enforce connectivity and cultural convergence, which might give the group an advantage over competing groups."

More information: Marco Smolla et al, Pathways to cultural adaptation: the coevolution of cumulative culture and social networks, *Evolutionary Human Sciences* (2023). DOI: 10.1017/ehs.2023.21

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