Context on the study "Local convergence of behavior across species"

Reference
Local convergence of behavior across species, by Toman Barsbai, Dieter Lukas and Andreas Pondorfer, published in *Science* (15 Jan 2021), https://doi.org/10.1126/science.abb7481

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What is the question we are trying to address?

We humans exhibit an enormous diversity of behavior, which has allowed us to colonize essentially all terrestrial environments around the world. But nonhuman animals also occur in a large variety of behaviors and environments. Which role do local environments play in explaining this huge global variation in behavior? Does where one lives shape how one behaves and do the same environmental forces apply to both humans and nonhuman animals? In our study, we explore whether living in a specific local environment constrains the behavior of humans and other mammal and bird species who share the same environment in a similar way. If so, we should expect humans and nonhuman species who live in the same location to behave similarly. Differences in local environments would then explain part of the observed global variation in behavior across species.

What did we expect to find?

It was not clear to us what to expect as the theoretical prediction is ambiguous. On the one hand, species who live together in one place might specialize into different niches to reduce resource competition. In this case, we would expect behavioral diversity as different species would engage in different behaviors. On the other hand, local environmental conditions might only permit a certain range of behaviors. In this case, we would expect behavioral similarity as species with similar behaviors would tend to assemble in locations where these behaviors are most adaptive. It is even less clear what to expect for humans. There is evidence that cultural processes are responsible for the large variation in behavior observed across human societies and that we humans build our own ecological niche. At the same time, however, ecological constraints that shape behavior in other species might also apply to our own species. A priori, we thus did not have clear expectations about how these different forces play out in the real world.

How did we conduct our analysis?

We build our analysis around an ethnographic database that provides detailed information on the behavior of 339 human hunter-gatherer populations living in diverse environments around the world (Africa n=20, Asia n=28, Australia n=56, North America n=215, and South America n=20). The database was compiled by the archaeologist Lewis Binford and relies on

anthropological observations from the 19th and 20th centuries. Our focus is on small-scale, foraging human populations because they are generally tied to a specific location and acquire food from the available local resources. For each of the human populations, we first identified all mammal and bird species that lived in the same location (i.e., within a 25km radius around the centroid of each human population). We then identified 15 behavioral variables encoded in the human database for which closely comparative data exist for the nonhuman species. We assigned the typically observed behavior to each species and computed average mammal and bird behaviors at the different locations. We were thus able to analyze the association between human, mammal, and bird behaviors across locations.

Which behaviors did we look at?

We looked at a wide range of behaviors that reflect three broad behavioral domains: (i) foraging behavior (i.e., reliance on meat diet, reliance on fish diet, extent of food storage, day range, migratory distance, distribution range), (ii) reproductive behavior (i.e., age at first reproduction, extent of polygyny, existence of patrilocality, existence of exogamy, divorce), and (iii) social behavior (i.e., extent of paternal care, population density, group size, existence of social classes).

What do we find?

We find that *foraging* human populations and nonhuman mammal and bird species who live in the same location behave similarly. This local convergence of behavior applies to foraging, reproductive, and social behavior. In total, we found a systematic relationship for 14 out of the 15 behaviors we analyzed.

What are the implications of our findings?

Local environmental conditions appear to filter for which behaviors occur at a specific location. Only those behavior that are beneficial, or at least do not have a substantial cost, can be expressed. Most importantly, our findings show that these ecological filters operate similarly across species from very different taxonomic groups including our own species. We were surprised that local environmental conditions appear to select for similar variants of foraging, reproductive, and social behaviors in humans, mammals, and birds. Despite our behavioral flexibility that has allowed us to live in very diverse environments we humans thus rely on similar behavioral strategies as nonhuman animals in their respective local environments. Our findings offer new insights into why there is variation in behavior across environments and cultures.

How do we know that the observed relationships reflect ecological conditions?

First, the observed relationships in behavior across species weaken considerably when we account for variables that capture ecological conditions (i.e., biomes, latitude, altitude, and proximity to coast) in our statistical analysis. This is consistent with the idea that ecological conditions constrain behavior. Second, associations between the same ecological variables and the different behaviors are very similar across humans, mammals, and birds. This is consistent with the idea that specific ecological conditions consistently shape behavior across species. Third,

in line with this argument, human behavior from one location is similar to nonhuman behavior found at other locations with similar ecological conditions.

Do our findings mean that humans are just like other animals?
From an evolutionary perspective, humans are part of the animal lineage. Humans could thus be tied to the local environment in similar ways as other species. However, humans exhibit enormous variation in behavior and are the only mammal that occurs in essentially all terrestrial environments. Variation in behavior also exists in other species, but to a much lower extent than for humans. The flexibility that allows humans to adapt their behavior to local conditions and the extreme reliance on learning from others and building on this information over generations set humans apart.

Do our findings imply that human culture does not matter for how humans behave?
No. Our results only suggest that human culture *also* emerged out of adaptation to local ecological condition, in addition to independent non-ecological processes.

Are these foraging human populations simple because they behave like animals?
No, quite the opposite. While the behavior might superficially look the same, human foraging societies generally developed sophisticated techniques to deal with the challenges they encounter in their environments. For example, where humans and other mammals and birds rely more on fishing, human populations have acquired detailed knowledge and sophisticated technology on how to obtain fish. Foraging human populations persisted in their local environments precisely because they had identified the most appropriate set of behaviors to live in environments, where other societies, which we might erroneously consider more advanced, could not persist. In addition, many nonhuman animals are as well much more sophisticated than we usually acknowledge.

What do our findings tell us about industrial human societies?
Not much. On the one hand, agriculture, market integration, and technology might weaken the response of human behavior to local environmental conditions. On the other hand, there might be path dependencies (e.g., via cultural transmission of behavior across generations), which constrain the subsequent evolution of behaviors. In this case, the behavioral diversity of industrial human societies might still reflect past adaptations to the local environment. Our evidence on foraging human societies does not allow us to answer this question.

Do our findings reflect natural selection based on genes?
Our study cannot reveal what caused the differences in behavior, either across human populations or across other species. In general, the expression of any behavior is influenced by an interplay of a large number of genes, changes through development and flexibility, and experiences of diverse environmental factors. The exact genetic regions and environmental factors involved, and the interplay among them, are unknown for the behaviors we analyzed. It is unlikely that the differences in behavior we observe across human populations can be traced back to single regions within the genome. First, there are no clear genetic differences that

separate all individuals in one population from all individuals in another population. Second, for all the behaviors that we analyzed, individuals can change their behavior as soon as they move to a new society. This happens regularly among humans, e.g., to form marriages. Third, the rules that govern behavior often change quite rapidly, e.g., when societies adopt new religious traditions.

Do our findings imply that there is a single dominant behavior in a specific environment?
No. There might be multiple niches at a given locality and different ways to cope with ecological challenges. Indeed, there are multiple ways to behave in all environments we looked at. Instead, our findings suggest that local ecological constraints act like a filter making specific behaviors more likely to occur in those environments where they are adaptative or at least do not have a substantial cost (but without determining the outcome). For instance, food storage is more beneficial in environments with strong seasonality that makes it difficult to source food in winter. Food storage is hence relatively frequent there. But this does not imply that food storage is a must or is not found in other environments with a more stable food supply throughout the year. It is only less frequent in those environments.