Just How Special Are Humans?

with Eric Priest, Celia Deane-Drummond, Joseph Henrich, and Mary Meyers, "Introduction to Symposium on 'Just How Special Are Humans?'"; Eric Priest, "Human Uniqueness: Debates in Science and Theology"; Joseph Henrich, "How Culture Made Us Uniquely Human"; Agustín Fuentes, "Distinctively Human? Meaning-Making and World Shaping as Core Processes of the Human Niche"; Cristine Legare, "The Cumulative Quality of Culture Explains Human Uniqueness"; David Reich, "Human Uniqueness from a Biological Point of View"; Alan Mittleman, "'The Mystery of Human Uniqueness': Common Sense, Science, and Judaism"; Jan-Olav Henriksen, "Experiencing the World as the Evolved Image of God: Religion in the Context of Science"; Jennifer A. Herdt, "Responsible Agency: A Human Distinctive?"; Celia Deane-Drummond, "Tracing Distinctive Human Moral Emotions? The Contribution of a Theology of Gratitude"; and John Behr, "Nature Makes an Ascent from the Lower to the Higher: Gregory of Nyssa on Human Distinctiveness."

HOW CULTURE MADE US UNIQUELY HUMAN

by Joseph Henrich

Abstract. This article argues that understanding human uniqueness requires recognizing that we are a cultural species whose evolution has been driven by the interaction among genes and culture for over a million years. Here, I review the basic argument, incorporate recent findings, and highlight ongoing efforts to apply this approach to more deeply understand both the universal aspects of our cognition as well as the variation across societies. This article will cover (1) the origins and evolution of our capacities for culture, (2) examples of specialized mental abilities such as those related to mechanical causality, prestige, and cooperation, and (3) recent efforts to apprehend our capacities for abstraction. I close by discussing common canards that generate confusion in mapping what makes us human.

Keywords: cultural evolution; culture-gene coevolution; human evolution; human uniqueness; social norms

---

In 1854, while seeking to reconnoiter a canal route across the Isthmus of Darien in Panama, a small band of Americans led by Lieutenant Isaac Strain ignored advice from the indigenous Cuna and set off toward the Pacific. Despite being experienced frontiersmen, it was not long before the party of 27 men could not find food and slowed down to a crawl.

Joe Henrich is Ruth Moore Professor of Biological Anthropology and Professor of Human Evolutionary Biology at Harvard University, Cambridge, MA, USA; e-mail: joseph.henrich@gmail.com.

When their fishhook broke, they could not catch fish; they also failed at fashioning the kinds of spears, hooks, weirs, and canoes routinely used by the Cuna. At a crucial moment, they attempted to communicate between subgroups using gunshots into the air. These high-pitched signals went unheard, and disaster ensued. The Cuna, by contrast, use low-pitched signals, like drums, because such low-frequency vibrations carry more effectively through the forest. Attempting to survive as foragers, the team repeatedly made themselves sick by eating toxic plants and animals, including a deadly toad. Most of the men, including Strain himself, managed to stay alive by eating palm nuts. Sadly, however, the nuts' acid dissolved and damaged their teeth as well as giving them awful constipation. Six men died of starvation or poisoning. Weak and desperate, the remaining twenty-one Americans were luckily rescued by a British survey team, who arrived properly equipped with Cuna canoes and Cuna guides (Balf 2003).

Why couldn't this handpicked team of rugged outdoorsmen survive as foragers in the rainforests of central-south America? Prior to the Holocene, humans had lived as hunter-gatherers for roughly two million years. If there is anything we are evolved for, it should be surviving as foragers in tropical climates. Strain and his men had big brains, language, mentalizing abilities, and cooperative inclinations, but this could not save them. If they indeed had rationality and creativity, it did not produce fishhooks and canoes or locate fruits and seeds that were safe to eat. Of course, humans can do fine in this environment: the Cuna had been prospering in the Darien for centuries or millennia before Strain's arrival. Other primates also prospered, including both howler and spider monkeys—so these forests are "primate friendly."

So, why couldn't Strain and his men survive? The reason is that, unlike other species, humans are entirely addicted to culture for our survival, even our survival as hunter-gatherers. Moreover, the cultural products we depend on—our tools, technologies, and know-how—are not primarily the products of individual brain power. Strain's men arrived with ample supplies, were highly motivated and quite cooperative, but they could not master the most basic aspects of human foraging in this environment. In fact, in a game of survivor competing against small-brained monkey species not indigenous to the Darien, we humans would surely lose to our smaller-brained primate cousins.

Culture Drove Human Evolution

These cases of lost explorers highlight a central fact about humans (Boyd, Richerson and Henrich 2011): we are a cultural species. Not merely a species that is capable of social learning (a species with culture), but a creature that over hundreds of thousands or even millions of years of culture-gene coevolution, has become entirely reliant upon acquiring large bodies of accumulated knowledge, practices, heuristics, skills, emotions, and motivations for our survival. The key to understanding the origins of human uniqueness is to avoid focusing on specific attributes ("magic bullets"), like language, tools, cooperation, or rationality; but, instead to examine the underlying cultural and genetic evolutionary processes that produced these attributes and others (Henrich 2016; Laland 2017; Boyd 2018). The argument that my colleagues and I have made is that well over one million years ago a combination of factors, including cognitive, social, and ecological elements, led populations of human ancestors across an evolutionary fitness valley into a regime of cumulative cultural evolution (Boyd and Richerson 1996; Muthukrishna, Doebeli, Chudek et al. 2018). Cumulative cultural evolution is a process in which each generation selectively acquires a body of nongenetic information from the prior generation, augments it through a gradual process of recombination and filtering, and then bequeaths a larger and more adaptive body of information to the next generation. Over time, this process produces adaptive repertoires more complex and sophisticated than any individual could figure out in their lifetime. These processes occur often, or even predominately, outside of conscious awareness and variously harness, suppress or exploit innate aspects of human cognition. When necessary, this process can override many of our instincts—we have evolved to put our faith in culture, in the accumulated wisdom of prior generations (Henrich 2016).

Our species' social and cultural natures give rise to what my collaborators and I have called *Collective Brains*. In humans, larger and more interconnected populations generate faster cumulative cultural evolution and can sustain more complex technologies, languages, institutions and behavioral repertoires.[1] These products can, in turn, feedback to shape people's minds and brains, both genetically in the long run and ontogenetically over shorter time-scales.

This approach suggests the rapid expansion of our brains over the last 2 million years was driven by cumulative cultural evolution, by the need to acquire, store, organize, and retransmit the growing body of adaptive information created by cultural evolution and available in the minds and behaviors of others (Muthukrishna and Henrich 2016; Muthukrishna, Doebeli, Chudek et al. 2018). By this account, our mentalizing abilities evolved initially for learning from others (Baimel, Juda, Birch et al. 2021), not for Machiavellian trickery and outmaneuvering others—in fact, chimpanzees may be the true masters of Machiavellian intelligence (Henrich 2016: Chapter 2). Recent developmental evidence shows that when children could use their mentalizing abilities to either engage in more effective social learning or to manipulate a partner, they deploy it for learning even when this is costly to them. These findings support the view that children must first learn about their culturally constructed worlds from others using their mentalizing abilities, and only then, after mastering this, can they then use mentalizing to engage in Machiavellian trickery and deception—you cannot bend the rules until you know what they are and how others will judge you (Baimel, Juda, Birch et al. 2021).

This culture-driven process of genetic evolution was initiated, not by a genetic magic bullet such as is routinely proposed for various supposedly specialized human cognitive abilities (e.g., language or rationality), but by a shift in ecological conditions (anchored in current evidence from paleoclimatology) that opened the door to the emergence of cumulative cultural evolution in an ancestral primate species without any leading genetic modifications. Then, cumulative culture began to expand, sharpen, and hone our lineage's existing capacities for culture. Ultimately, our unique evolutionary trajectory lies in our cognitive adaptations for (1) putting faith in what we learn from others, often overruling our own intuitions and experience, (2) selectively learning from different people, and (3) greater sociality, all of which emerged through the interaction of genes and culture. Together, these contribute to creating relatively rapid cumulative cultural evolution under many circumstances (though not always, Henrich 2004). Cumulative cultural evolution, by dramatically shaping our environments and altering the driving selection pressures, generated the patterns and products that shaped our genes. Let us consider the products of this coevolutionary interplay.

Capacities for Culture

We take as our evolutionary starting point the cultural abilities of the great apes. A growing body of evidence suggests that apes do engage in social learning and all the great apes (Haun, Rekers and Tomasello 2012), to varying degrees, appear to possess cultural traditions (Tomasello 2019). Nevertheless, detailed studies of human children and comparisons with our fellow apes strongly suggest that we humans are much better at learning from others, more willing to rely on what we learn socially over our instincts and experience, and more motivated to use social learning across contexts and situations (Herrmann, Call, Victoria Hernández-Lloreda et al. 2007; Henrich and Tennie 2017).

With this as background, coevolutionary theorists have proposed that cultural learning should use cues of both *content* and *context* to figure out the who, what, and when of social learning (Henrich and McElreath 2003; Laland 2004). Content-based mechanisms gear learners' attention and inferences toward certain kinds of content domains, such as food, sex, animals, artifacts, reputational information (gossip), norms and social groups, permitting learners to efficiently and effectively acquire, organize and store relevant cultural information from these domains. A growing body of evidence supports the existence of such content-based mechanisms and their ability to speed learning (Medin and Atran 1999; Barrett and Broesch 2012; Broesch, Barrett and Henrich 2014; Henrich 2016).

Complementing these learning adaptations, context-based mechanisms use cues to figure out both which individuals to attend to for learning and how to integrate information from different people. A large body of research now reveals that infants, children and adults use cues related to success, skill, prestige, sex, age and ethnicity to pick out individuals likely to possess fitness enhancing information relevant to the learners themselves in their future contexts and social roles (Mesoudi 2009; Chudek, Brosseau, Birch et al. 2013; Jiménez and Mesoudi 2019). In addition to selecting preferred models, learners attend to the frequency of cultural traits in their communities, usually deploying conformist transmission, and to credibility enhancing displays, or CREDs, that indicate whether the models themselves truly believes in what they say or suggest (termed epistemic vigilance by Sperber et al. 2010)—the latter mechanism evolved to avoid manipulation (Morgan, Laland and Harris 2014; Muthukrishna, Morgan and Henrich 2016; Morgan, Rendell, Ehn et al. 2012; Nakahashi, Wakano and Henrich 2012; Muthukrishna, Morgan and Henrich 2016; Willard, Henrich and Norenzayan 2016; Willard and Cingl 2017).

Together, these cognitive adaptations for cultural learning foster adaptive cultural learning and the growing fit between people's repertoires and the socioecologies they confront. Of course, as cultural evolutionary modelers have long emphasized, even adaptive learning abilities favored by natural selection can produce all manner of maladaptive practices and the myriad puzzling patterns of culture (Boyd and Richerson 1985; Henrich 2009a; Vogt, Efferson and Fehr 2017).

Prestige Status

Cultural evolution accumulates a valuable body of skills, knowledge, practices, heuristics, and much more that end up distributed in various ways within populations. Confronting this recurrent situation, theorists have proposed that natural selection favored genes that lead learners to use a variety of cues to figure out who to learn from—whom to attend to (Henrich and Gil-White 2001). Of course, learners evolved to use cues of skill, success, and competence. But, we have also evolved to attend to *who others attend to and learn from*—a second order cue. If everyone is playing the same game, trying to figure out who to learn from, naïve individuals can take advantage of that fact to guide their attention, memory, and learning. This gives rise to prestige-biased transmission (Chudek, Heller, Birch et al. 2012; Jiménez and Mesoudi 2019).

Following the evolutionary logic presented by Henrich and Gil-White (2001), since many learners will want to access the best models—those they deem to have the best information—those individuals can exact a kind of social payment in the form of deference. Learners who are not sufficiently deferential will not get the most access to learning from a respected model, potentially leading them to learn less or miss key elements (Henrich and Gil-White 2001). The upshot of this evolutionary process is a second form of social status, *prestige*, which in humans operates along dominance status (inherited from our primate ancestors; Chen Zeng, Cheng and Henrich 2022). Unlike prestige, which is based on possessing (or being perceived to possess) valuable know-how, dominance is based on force and force threat.

This theoretical approach generates a broad array of predictions about the expected patterns of cultural learning, the use of prestige cues by learners, the ethological displays of both models and learners for dominance and prestige, and the role of the emotions of pride and shame. While more work is needed, the predictions have been tested and largely confirmed across a broad array of studies (Cheng, Tracy and Henrich 2010; Foulsham, Cheng, Tracy et al. 2010; Cheng, Tracy, Foulsham et al. 2013; Brosseau-Liard, Cassels and Birch 2014; Cheng, Tracy, Ho et al. 2016; Maner 2017; Redhead, Cheng, Driver et al. 2019; Jiménez and Mesoudi 2019; Witkower, Tracy, Cheng et al. 2020). Interestingly, preliminary evidence suggests that prestige, at least in a rudimentary form, may have also evolved in chimpanzees (Reddy et al., in prep).

Technologies, Toolkits, and Technical/Artifact Cognition

Cumulative cultural evolution, operating over generations, harnesses mistakes, lucky insights, chance recombinations and hard-won experience to gradually create and improve our tools, technologies, and know-how. Thus, effective technologies are not principally the product of individual creativity, heroic geniuses or causal reasoning (Henrich 2009a; Muthukrishna and Henrich 2016). Breakthroughs, for example, often appear roughly simultaneously in history because the key elements are already circulating at a particular time and within a social milieu (thus, double and triple inventions or discoveries, which, include the telephone, calculus, radio, and theory of natural selection, are common). Our causal understanding often follows, rather than preceding innovations, because novel technologies provide new windows on the world—early steam engines first taught us about thermodynamics, and only then could we apply this knowledge to further refine the technology. Detailed studies show that populations, from foragers to nuclear engineers, rely heavily on technologies that they do not fully understand. In fact, many populations rely on powerful technologies that they either misunderstand or do not even realize that they do anything at all (Henrich and Henrich 2010; Henrich 2021; Harris, Boyd, Wood et al. 2021). For example, traditional cooking recipes in the Americas call for the inclusion of wood ash into their corn meal mixes. This ash provides a source of alkali that chemically releases the otherwise unavailable niacin, thus preventing pellagra, a horrible disease resulting from a niacin deficiency. When interviewed, people explained that the inclusion of ash was just their "custom" and was not necessary.

Our long and growing reliance on cultural products over the course of our species' evolutionary history has driven many aspects of our genetic evolution. For example, the cultural evolution of fire and cooking shifted the selection pressures on our digestive physiology, leading to our short colons, small stomachs, weak jaws, and diminutive teeth. Similarly, the cultural evolution of water containers and tracking knowledge opened the door for the genetic evolution of our many adaptations for long-distance running, which run from the nuchal ligaments that allow our heads to turn independent of our torsos to the springy arches in our feet that store and release energy as we run.

Cognitively, selective pressures for dealing with increasingly complex tools and other artifacts may have led to some specialized aspects of cognition for both learning about and improving our tools (Henrich 2016: Chapter 5; Osiurak, Lesourd, Navarro et al. 2020)—for thinking mechanically. Of course, one might argue that this "technition" could have evolved regardless of cumulative cultural evolution. Two types of evidence suggest this is unlikely. First, nonhumans do not appear to have sophisticated technition, but do use tools in a manner that indicates they could benefit from better cognitive abilities for making and using tools. Second, developmental research suggests that children readily activate their causal modelbuilding abilities for tools during social learning but not when the nonsocial world presents them with precisely the same stimuli (Henrich 2016: Chapter 7). Such findings suggest that technition evolved in the service of using and improving the products of cumulative cultural evolution.

Language and Communication

Cumulative cultural evolution generates increasingly complex tools, practices and norms for communication. This process has yielded not only an incredibly diverse array of spoken languages, which variously use tones and clicks as well as vowels and consonants, but also many hunter-gatherer societies have had full sign languages and there are whistle-based languages around the world. Children, if anything, learn sign-based languages more rapidly than sound-based languages. Further, its increasingly clear languages are culturally adapted to environments and contexts that people confront. For example, linguistic sound systems appear adapted to the acoustics of where they evolved, with tonal languages in the tropics and vowel-rich languages in warm places where people have to communicate outdoors (Henrich 2106: Chapter 12). In one fascinating study, researchers showed that the toughness of diets in moving from primarily foraging to primarily agriculture resulted in a shift in our bite—we agriculturalists effectively have overbites (Blasi, Moran, Moisik et al. 2019). The anatomical shifts in the relative positioning of people's teeth—due to ontogenetic changes—led to systematic changes in the phonemes found in the languages of those groups. Furthermore, like human technological repertoires, languages vary in their complexity across societies in ways consistent with the effects of population size and interconnectedness. Larger populations have more words, more phonemes and a broader range of grammatical tools.

The cultural evolution of increasingly complex communicative systems based on vocalizations may have led to some adaptations for spoken language. One possibility is that the cultural evolution of languages may have created the conditions for the genetic evolution of some specialized aspects of cognition for learning grammar. However, this remains an area of great controversy, where confusion abounds. Crucially, most cultural evolutionists agree that language is shaped by innate features of the human mind, and in fact, languages have evolved culturally to exploit those features to make languages more learnable, often by children. So, innate cognitive structure matters. The question is whether any of these cognitive features evolved *for* learning languages specifically or are they innate features that exist in support of something else. The challenge is, in light of the immense diversity of human languages, what are those reliable features? I have not seen a persuasive proposal. Grammar may represent a "hard target" for natural selection (Christiansen and Chater 2008; Evans and Levinson 2009; Chater, Reali and Christiansen 2009); or, we scientists may have been insufficiently creative to have figured out how natural selection might have accomplish this.

Grammar aside, there are several distinctively human features that appear to be genetic adaptations for our system of culturally evolved linguistic communication (Bickerton 2009; Tomasello 2010; Henrich 2016). First, compared with other primates, the anatomy of human throats—our vocal tract—has changed to permit the creation of a broader range of sounds. Second, natural selection also appears to have formed direct neural connections from our neocortices deep into our spines, improving the dexterity and control of our hands and tongues. Greater manual dexterity would have improved both our tool using, driven by the process described above, and our capacity for sign languages (Hecht, Gutman, Khreisheh et al. 2014). Third, and perhaps due in part to these changes, humans have an unusual capacity for vocal mimicry, an ability seen in birds but not our fellow primates. Finally, unlike other primates, humans have genetically evolved white sclera in our eyes (Tomasello, Hare, Lehmann et al. 2007), which reveals to others where we are looking. This provides a ready way for cooperative communicators to share attention, though it makes deception more difficult.

Overall, the evolution of languages, whether via cultural evolution or culture-gene coevolution, demands greater cooperative inclinations for sociality than we have observed in most species, including most primates. Now, we turn to human cooperation, which necessarily coevolved with language.

Ultrasociality and Cooperation

Evolutionary researchers are fond of pointing out how cooperative humans are and then endeavoring to explain why . However, there are at least four additional puzzles associated with human cooperation that should be considered alongside our general sociality (Chudek and Henrich 2010; Henrich and Muthukrishna 2021).

(1) *Scale and intensity variation*: Why does the scale and intensity of cooperation vary so substantially across societies, from populations where the scale of cooperation is limited to small communities or extended families (Henrich 2020; Johnson 2003) to modern nation-states that routinely cooperate on the order of thousands or even millions of people? Explaining human cooperation requires accounting for why some communities do NOT cooperate nearly as much as others, despite life and death demands for cooperation (Tuzin 2001; Handley and Mathew 2020)?

(2) *Domain variation*: Why do the domains of cooperation vary so much from community to community? Comparative ethnography suggests that different social groups inhabiting the same or similar ecologies cooperate in different behavioral domains. Some cooperate only in fishing and war, while others, just downstream, cooperate only in rituals and house construction (Curry, Mullins and Whitehouse 2019; Handley and Mathew 2020).

(3) *Rapid growth*: Over the last 12 millennia, how and why have some human societies scaled up from relatively small-scale communities to vast states (Turchin 2015)? Theories of human cooperation need to explain this rapid process, and why it proceeded at different rates in different populations and on different continents.

(4) *Noncooperative or maladaptive practices*: Why do the sanctioning, reputational, and other incentivizing mechanisms that support cooperation, such as those based on reputation, signaling, and punishment, also enforce actions that are unrelated to cooperation, such as those related to ritual, taboos, and clothing? Why do these mechanisms sometimes even sustain maladaptive customs, like the consumption of dead kinfolk (spreading prion diseases), footbinding, or clitoral

infibulation (Durham 1991; Mackie 1996; Vogt, Efferson and Fehr 2017)?

Explaining these patterns requires recognizing that much of our behavior is guided by social norms. Norms emerge naturally once individuals rely sufficiently strongly on cultural learning, such that they acquire both a behavior, like not eating pigs, and the standards for judging those who do not enact the behavior or follow the rule ("pig eaters are disgusting and should be avoided"). Norms can be sustained by a wide variety of social mechanisms, including punishment (Henrich and Boyd 2001; Mathew 2017), reputation, indirect reciprocity (Panchanathan and Boyd 2004; Bhui, Chudek and Henrich 2019), and signaling (Gintis, Smith and Bowles 2001; Jordan, Hoffman, Bloom et al. 2016), among others (Henrich 2009b). Cultural evolutionary models of norms based on any of these social mechanisms can address the above puzzles.

In response to the growing importance of norms and the proliferation of prosocial or cooperative norms via intergroup competition and other mechanisms (Zefferman and Mathew 2015), my colleagues and I have argued that this resulted in three kinds of genetically evolved social adaptations:

(1) *Norm psychology*: The proliferation of increasingly important social norms fostered a psychology for learning and navigating a world structured by social norms (Chudek and Henrich 2010). From a young age, humans assume the existence of social norms, readily infer specific norms based on limited information, and anticipate social sanctions for violations (Schmidt, Rakoczy and Tomasello 2011). People also internalize social norms as motivations or heuristics that help guide them through social life (Rand, Peysakhovich, Kraft-Todd et al. 2014). By this account, an important source of our altruism toward strangers arises from the internalization of norms, such as those for charitable giving (Henrich and Muthukrishna 2021).

(2) *Self-domestication*: The sanctions for norm violations drove a process of self-domestication (Hare 2017; Wrangham 2019) that reduced our species' inclination for reactive aggression while increasing our docility and tolerance for greater sociality. Wrangham effectively makes the case for the power of this selection by looking at what happens when individuals in hunter-gather bands violate norms regarding aggression and harming others. The self-domestication process neatly opens the door for cultural evolution to extend the power of negative indirect reciprocity to cooperation in other contexts (Bhui, Chudek and Henrich 2019).

(3) *Interdependence psychology*: Because many social norms fostered group-level sharing, the fitnesses of individuals within small groups

became increasingly interdependent (Henrich 2020; Henrich and Muthukrishna 2021). If you and I share all the food we each acquire via hunting or gathering, our fitnesses are effectively tied together, and I consequently need to worry about your health and welfare (as well as those who help you) and vice versa. This created a selection pressure for an interdependence psychology, which helps account for our cooperative inclinations toward nonkin within our networks of interdependence. Sharing food together is one example of a cue that sparks up this psychological mechanism—unconsciously making people feel more interdependent, thus favoring greater cooperation.

Competition among social groups has driven cultural evolution to construct "social technologies" that harness various aspects of our minds to expand the sphere of cooperation and trustworthy social interactions. For example, driven by intergroup competition, cultural evolution has shaped both religions and rituals to expand the sphere of human sociality and extend human cooperation to larger groups (Norenzayan, Shariff, Gervais et al. 2016; Purzycki, Henrich, Apicella et al. 2017). While the gods found in the smallest scale human societies are often morally ambiguous, like many humans, they sometimes enforce cooperative behavior but only within a limited scope. For example, among the Mentawai horticulturalists on the isle of Siberut (Indonesia), the Crocodile Spirit punishes people for not sharing properly with members of their clans, and people seem genuinely concerned about these sanctions, conducting expensive rituals to appease the spirit (Singh, Kaptchuk and Henrich 2021). Crucially, though, the domain and scope of the Spirit is limited to "food sharing within clans." As societies expanded, supernatural beings became increasingly concerned about people's behavior within large groups and in more domains, including theft, murder, violence, and adultery. These gods or cosmic forces evolved greater powers to punish transgressions, eventually gaining control of the afterlife. Some gods became not only omnipresent—the ultimate social monitor—but also omniscient, gaining the power to access people's minds and see into their hearts. A growing body of recent work suggests that the more strongly people believe in the willingness of their god to monitor and punish transgressions, the more prosocial they are toward distant strangers—and the more they treat them like members of their own community (Shariff, Willard, Andersen et al. 2016; Purzycki, Apicella, Atkinson et al. 2016; Lang, Purzycki, Apicella et al. 2019).

Abstraction and Causal Model Building

Humans are clearly cable of a level of abstract thought that has not been observed in other species. In cognitive science, researchers have modeled and explained many aspects of human learning and the process of abstraction using hierarchical Bayesian models (Tenenbaum, Griffiths and Kemp 2006; Tenenbaum, Kemp, Griffiths et al. 2011). A simple example is the creation of folk biological taxonomies and the use of category-based induction, where learners infer that a novel species they had encountered—for example, a house sparrow—has hollow bones because it is a type of bird. While this approach has proved productive in explaining both adaptive learning from sparse data and the presence of irrational decision-making biases in humans (Gershman 2021), few have sought to explain why this system would be hypertrophied. To address this, Zeng and colleagues (in prep) has suggested that greater social learning, by effectively providing more training data in the form of other people's experiences, opened the door to more levels in the Bayesian hierarchy, effectively fostering greater abstraction and generalization. One key to understanding the evolution of human brains and cognition is to recognize how cultural learning dramatically augments the availability of "cheap data," patterned in a manner suitable for the kind of structured learning facilitated by hierarchical Bayesian learning. By this account, it as the accumulation of cultural information that created the conditions favorable to an expansion of the Bayesian hierarchy and thereby, our capacities for abstraction and generalization.

Decoys and Cognitive Mosaics

Many of the features of supposedly "human cognition" that have so impressed the many philosophers and others who have pondered the question of human uniqueness turn out to be heavily influenced by cultural evolution.

Thinking Tools

Cultural evolution will hone any aspects of our cognition that aid us in navigating our institutional, technological, and linguistic worlds. Thus, our cognition is heavily supported by, and often trained up using, the products of cultural evolution. For example, most societies probably counted something like 1, 2, 3 then many, though some societies may have had no such number concepts at all (Dehaene 1997). In the modern world, we all (culturally) inherit a fully formed system of user-friendly numerals that permit us to count without bound. Using this system, it is trivial to distinguish a pile of 35 cherries from one with 36; moreover, psychological research indicates that learning such a system influences how we intuitively think about numbers and solve problems (Gordon 2005; Butterworth, Reeve, Reynolds et al. 2008).

Similarly, training with culturally honed tools like the abacus can lead to extraordinary mental abilities (Frank and Barner 2012; Miller and Stigler

2013). Here, children first use a real abacus but then eventually put the physical object away and simply imagine an abacus, which uses beads and visual spacing in ways that are custom fitted to human cognition. Adepts can then rapidly perform complex calculations in their heads faster than calculator users.

Finally, derived from an obsessive focus on gambling games, the modern concept of probability, which pervades modern thought and decision-making, may have emerged only in the latter part of the seventeenth century (Hacking 2006).

Rationality

Did humans evolve to be rational? Well, first, many complex human behaviors look rational—in the sense of providing functional adaptations to the environment—but do not arise from individuals weighing the costs and benefits of alternatives (Henrich 2002). When people preferentially copy the behavior or strategies of particularly successful individuals, an entire population can eventually come to perform a full repertoire of adaptive behaviors, strategies or heuristics without analyzing costs and benefits. Cultural evolution can generate rational-looking behavior without any rationality or rational decision-making.

Nevertheless, people do sometimes analyze costs and benefits, and weigh evidence, though many people underestimate how much culture is part of this analysis. For example, both our epistemologies and ontologies evolve culturally. Populations, for example, vary in how much people weight dreams as a source of evidence, and of course, these are embedded in norms, so they also judge other people according to their use of dreams (Hong 2021). Dreams have played a prominent role in statecraft in many civilizations, but in others, they are thought to be of little value—and a politician using his dreams to make decisions would suffer. Populations also vary in what constitutes a "good reason" or persuasive argument. In some places, great weight is placed on the wisdom of elders or ancient sages (Silverman and Maxwell 1978; Saenger n.d.). In other places, people ignore all other epistemic sources and try to rely only on empirical evidence (Strevens 2020; Henrich 2020). A growing body of scholarship suggests that modern "rationality" is an assembled patchwork of epistemic norms (e.g., dreams are not good evidence) and ontological commitments (e.g., mathematical realism: the laws of physics can be represented with mathematics) assembled by cultural evolution over time to make knowledge-generating institutions (Renn 2020; Gal 2021).

Creativity

Discussions of "creativity" often begin when some scholar casually points so our species' fancy stone tools, cave art, and other later cultural products.

This maneuver covertly assumes that creative products arise from individually creative minds. But, remember our lost Americans in the Darian: to save their lives, these supposedly creative individuals could not figure out how to find food, make tools, fashion water craft, communicate in the forest or avoid dissolving their teeth. Where is all the creativity?

Strain's men failed because creativity is an emergent product of collective minds operating over time, not a manifestation of individual cognitive prowess. Creative products, which are often merely recombinations of ideas already circulating within some cultural milieu, arise from the interactions of individuals over time (Johnson 2011; Ridley 2020). Small insights, lucky accidents, and fortuitous combinations aggregate and accumulate over time to yield the cultural products that we deem creative (Muthukrishna and Henrich 2016).

The view of creativity and innovation, rooted in the Collective Brain, is supported by a large body of evidence (Page 2007; Bettencourt, Lobo, Helbing et al. 2007; Lobo and Strumsky 2008; Derex, Beugin, Godelle et al. 2013; Muthukrishna, Shulman, Vasilescu et al. 2014; Kempe and Mesoudi 2014; Derex and Boyd 2015; Muthukrishna and Henrich 2016; Winkler, Schulz and Henrich n.d.). First, larger and denser populations tend to be associated with more innovation, usually measured using patent data. Complementing such observational evidence, experimental studies reveal that interaction and learning in larger populations fosters the emergence of more sophisticated cultural products. Second, both experimental and observational evidence indicate that more interconnected populations innovate more rapidly, leading to faster cumulative cultural evolution. Finally, more cognitively diverse communities tend to generate faster innovation.

The impact of the collective brain can also be seen at the individual level. First, studies of innovators reveal that while they do not have the highest IQ, they do tend to have diverse friends and other social contacts that place them in bridging roles between intellectual communities—thus, they represent a nexus where diverse ideas can meet (Johnson 2011). Second, the great feats produced by those celebrated as geniuses, generally represent recombinations of ideas or concepts already circulating within their communities or networks. For this reason, the production of the same or similar inventions or discoveries often occurs independently at the same time. Of course, there is little doubt that some individuals are more creative than others, but most of the heavy lifting done to produce any particular cultural product comes from the collective, not the individual.

Conclusion

Most scholars who have tackled the question of human uniqueness are WEIRD (Henrich, Heine and Norenzayan 2010), meaning they come from populations that are Western, Educated, Industrialized, Rich, and Democratic. A large and growing body of research suggests that people from these societies are psychologically peculiar, particularly in their focus on individuals, their reliance on dispositional attributes for inferences, and their use of distinct categories (analytical thinking) for explanation (Henrich 2020; Apicella, Norenzayan and Henrich 2020). These psychological inclinations appear clearly when we look at how scholars choose to tackle the question of human uniqueness. To distinguish humans, scholars have tended to look for dispositional traits, like cooperativeness, linguistic abilities, or foresight, and then distinguish humans by placing them in separate and distinct categories. This "feels" like the right approach for a psychological WEIRDo. Such approaches are only ever "evolutionary" in the sense that some authors try to cook up post-hoc stories about where these special, distinguishing features came from. Rarely do these accounts explain why such traits do not appear in other species, where they vary across societies (and they often do) or why they emerged when and where they did.

However, a fully evolutionary perspective suggests a different approach. Understanding our species' uniqueness lies not in isolating particular uniquely human features, like language, abstract thought or cooperation, but in illuminating the dynamic and ongoing processes that drove human evolution, since we split from the lineages leading to chimpanzees and bonobos. Here, I have argued that cumulative cultural evolution, which can emerge without any genetic changes or with only quantitative shifts, has driven much of our species genetic evolution for over two million years. Our cognitive features have emerged from existing primate abilities in response to, and then coevolution with, various features of cumulative cultural evolution. To illustrate, I have discussed aspects of human psychology related to using tools, thinking abstractly communicating with language and cooperating with nonrelatives and well as aspects of rationality, reasoning and creativity. Progress in seating humans within the natural world, while recognizing our uniqueness, hinges on understanding dynamic evolutionary processes and our heritage as an ape, not on casting about for proposals of how we are special.

Note

1. Technically, there is an optimal degree of interconnectedness for a population, so it is possible to be too interconnected. However, under most circumstances over human evolutionary history, this concern was only theoretical since most populations remained insufficiently interconnected to maximize the rate of cumulative cultural evolution. Many social processes tear populations down and pull them apart.

References

Apicella, Coren, Ara Norenzayan, and Joseph Henrich. 2020. "Beyond WEIRD: A Review of the Last Decade and a Look Ahead to the Global Laboratory of the Future." *Evolution and Human Behavior* 41 (5): 319–29.

Baimel, Adam, Myriam Juda, Susan Birch, et al. 2021. "Machiavellian Strategist or Cultural Learner? Mentalizing and Learning over Development in a Resource-Sharing Game." *Evolutionary Human Sciences* 3:e14.

Balf, T. 2003. *The Darkest Jungle: The True Story of the Darien Expedition and America's Ill-Fated Race to Connect the Seas*. New York: Crown Publishers.

Barrett, H. C., and J. Broesch. 2012. "Prepared Social Learning about Dangerous Animals in Children." *Evolution and Human Behavior* 33 (5): 499–508.

Bettencourt, L. M. A., J. Lobo, D. Helbing, et al. 2007. "Growth, Innovation, Scaling, and the Pace of Life in Cities." *Proceedings of the National Academy of Sciences of the United States of America* 104 (17): 7301–6.

Bhui, Rahul, Maciej Chudek, and Joseph Henrich. 2019. "How Exploitation Launched Human Cooperation." *Behavioral Ecology and Sociobiology* 73 (6): 78.

Bickerton, Derek. 2009. *Adam's Tongue: How Humans Made Language, How Language Made Humans*. 1st ed. New York: Hill and Wang.

Blasi, D. E., S. Moran, S. R. Moisik, et al. 2019. "Human Sound Systems Are Shaped by Post-Neolithic Changes in Bite Configuration." *Science* 363 (6432): eaav3218.

Boyd, R., and P. J. Richerson. 1996. "Why Culture Is Common But Cultural Evolution Is Rare." *Proceedings of the British Academy* 88:77–93.

Boyd, Robert. 2018. *A Different Kind of Animal*. Princeton, NJ: Princeton University Press.

Boyd, Robert, P. J. Richerson, and J. Henrich. 2011. "The Cultural Niche: Why Social Learning Is Essential for Human Adaptation." *Proceedings of the National Academy of Sciences* 108 (2): 10918–25.

Boyd, Robert, and Peter J. Richerson. 1985. *Culture and the Evolutionary Process*. Chicago: University of Chicago Press.

Broesch, J., H. C. Barrett, and Joseph Henrich. 2014. "Adaptive Content Biases in Learning about Animals across the Lifecourse." *Human Nature* 25 (2): 181–99.

Brosseau-Liard, Patricia, Tracy Cassels, and Susan Birch. 2014. "You Seem Certain But You Were Wrong Before: Developmental Change in Preschoolers' Relative Trust in Accurate versus Confident Speakers." *PLoS ONE* 9 (9): e108308.

Butterworth, Brian, Robert Reeve, Fiona Reynolds, et al. 2008. "Numerical Thought with and without Words: Evidence from Indigenous Australian Children." *Proceedings of the National Academy of Sciences of the United States of America* 105 (35): 13179–84.

Chater, Nick, Florencia Reali, and Morten H. Christiansen. 2009. "Restrictions on Biological Adaptation in Language Evolution." *Proceedings of the National Academy of Sciences of the United States of America* 106 (4): 1015–20.

Chen Zeng, Tian, Joey T. Cheng, and Joseph Henrich. 2022. "Dominance in Humans." *Philosophical Transactions of the Royal Society B: Biological Sciences* 377 (1845): 20200451.

Cheng, J. T., J. L. Tracy, and J. Henrich. 2010. "Pride, Personality, and the Evolutionary Foundations of Human Social Status." *Evolution and Human Behavior* 31 (5): 334–47.

Cheng, J. T., Jessica Tracy, Thomas Foulsham, et al. 2013. "Dual Paths to Power: Evidence That Dominance and Prestige Are Distinct yet Viable Avenue to Social Status." *Journal of Personality and Social Psychology* 104:103–25.

Cheng, Joey T., J. L. Tracy, S. Ho, et al. 2016. "Listen, Follow Me: Dynamic Vocal Signals of Dominance Predict Emergent Social Rank in Humans." *Journal of Experimental Psychology-General* 145 (5): 536–47.

Christiansen, M. H., and N. Chater. 2008. "Brains, Genes, and Language Evolution: A New Synthesis." *Behavioral and Brain Sciences* 31 (5): 537–58.

Chudek, M., Patricia Brosseau, Susan Birch, et al. 2013. "Culture-Gene Coevolutionary Theory and Children's Selective Social Learning." In *The Development of Social Cognition*, edited by M. Banaji and S. Gelman. New York: Oxford.

Chudek, M., and Joseph Henrich. 2010. "Culture-Gene Coevolution, Norm-Psychology, and the Emergence of Human Prosociality." *Trends in Cognitive Sciences* 15 (5): 218–26.

Chudek, Maciej, S. Heller, S. Birch, et al. 2012. "Prestige-Biased Cultural Learning: Bystander's Differential Attention to Potential Models Influences Children's Learning." *Evolution and Human Behavior* 33 (1): 46–56.

Curry, Oliver Scott, Daniel Austin Mullins, and Harvey Whitehouse. 2019. "Is It Good to Cooperate? Testing the Theory of Morality-as-Cooperation in 60 Societies." *Current Anthropology* 60 (1): 47–69.

Dehaene, Stanislas. 1997. *The Number Sense: How the Mind Creates Mathematics*. New York: Oxford University Press.

Derex, Maxime, Marie Pauline Beugin, Bernard Godelle, et al. 2013. "Experimental Evidence for the Influence of Group Size on Cultural Complexity." *Nature* 503 (7476): 389–91.

Derex, Maxime, and Robert Boyd. 2015. "The Foundations of the Human Cultural Niche." *Nature Communications* 6 (1): 8398.

Durham, William H. 1991. *Coevolution: Genes, Culture, and Human Diversity*. Stanford, C: Stanford University Press.

Evans, Nicholas, and Stephen C. Levinson. 2009. "The Myth of Language Universals: Language Diversity and Its Importance for Cognitive Science." *The Behavioral and Brain Sciences* 32 (5): 429–48; discussion 448–94.

Foulsham, T., J. T. Cheng, J. L. Tracy, et al. 2010. "Gaze Allocation in a Dynamic Situation: Effects of Social Status and Speaking." *Cognition* 117 (3): 319–31.

Frank, M. C., and D. Barner. 2012. "Representing Exact Number Visually Using Mental Abacus." *Journal of Experimental Psychology-General* 141 (1): 134–49.

Gal, O. 2021. *The Origins of Modern Science: From Antiquity to the Scientific Revolution*. Cambridge: Cambridge University Press.

Gershman, S. 2021. *What Makes Us Smart: The Computational Logic of Human Cognition*. Princeton, NJ: Princeton University Press.

Gintis, H., E. A. Smith, and S. Bowles. 2001. "Costly Signaling and Cooperation." *Journal of Theoretical Biology* 213 (1): 103–19.

Gordon, Peter. 2005. "Numerical Cognition Without Words: Evidence from Amazonia." *Science* 306:496–99.

Hacking, I. 2006. *The Emergence of Probability: A Philosophical Study of Early Ideas about Probability, Induction and Statistical Inference*. Cambridge Series on Statistical And Probabilistic Mathematics. Cambridge: Cambridge University Press.

Handley, Carla, and Sarah Mathew. 2020. "Human Large-Scale Cooperation as a Product of Competition between Cultural Groups." *Nature Communications* 11 (1): 702.

Hare, Brian. 2017. "Survival of the Friendliest: *Homo Sapiens* Evolved via Selection for Prosociality." *Annual Review of Psychology* 68 (1): 155–86.

Harris, Jacob A., Robert Boyd, and Brian M. Wood. 2021. "The Role of Causal Knowledge in the Evolution of Traditional Technology." *Current Biology* 31 (8): 1798–803.

Haun, Daniel B. M., Yvonne Rekers, and M. Tomasello. 2012. "Majority-Biased Transmission in Chimpanzees and Human Children, but Not Orangutans." *Current Biology* 22 (8): 727–31.

Hecht, E. E., D. A. Gutman, N. Khreisheh, et al. 2014. "Acquisition of Paleolithic Toolmaking Abilities Involves Structural Remodeling to Inferior Frontoparietal Regions." *Brain Structure & Function* 220:2315–31.

Henrich, Joseph. 2002. "Decision-Making, Cultural Transmission and Adaptation in Economic Anthropology." In *Theory in Economic Anthropology*, edited by Jean Ensminger, 251–95. Walnut Creek, CA: AltaMira Press.

———. 2004. "Demography and Cultural Evolution: How Adaptive Cultural Processes Can Produce Maladaptive Losses: The Tasmanian Case." *American Antiquity* 69 (2): 197–214.

———. 2009a. "The Evolution of Innovation-Enhancing Institutions." In *Innovation in Cultural Systems: Contributions in Evolutionary Anthropology*, edited by Stephen J Shennan and Michael J O'Brien, 99–120. Cambridge: MIT.

———. 2009b. "The Evolution of Costly Displays, Cooperation and Religion: Credibility Enhancing Displays and Their Implications for Cultural Evolution." *Evolution and Human Behavior* 30 (4): 244–60.

———. 2016. *The Secret of Our Success: How Culture Is Driving Human Evolution, Domesticating Our Species, and Making Us Smarter*. Princeton, NJ: Princeton University Press.

———. 2020. *The WEIRDest People in the World: How the West Became Psychologically Peculiar and Particularly Prosperous*. New York: Farrar, Straus and Giroux.
———. 2021. "Cultural Evolution: Is Causal Inference the Secret of Our Success?" *Current Biology* 31 (8): R381–83.
Henrich, Joseph., and R. Boyd. 2001. "Why People Punish Defectors: Weak Conformist Transmission Can Stabilize Costly Enforcement of Norms in Cooperative Dilemmas." *Journal of Theoretical Biology* 208 (1): 79–89.
Henrich, Joseph, and Francisco J. Gil-White. 2001. "The Evolution of Prestige: Freely Conferred Deference as a Mechanism for Enhancing the Benefits of Cultural Transmission." *Evolution and Human Behavior* 22 (3): 165–96.
Henrich, Joseph, Steven J. Heine, and Ara Norenzayan. 2010. "The Weirdest People in the World?" *Behavioral and Brain Sciences* 33 (2–3): 61–83.
Henrich, Joseph, and Natalie Henrich. 2010. "The Evolution of Cultural Adaptations: Fijian Food Taboos Protect against Dangerous Marine Toxins." *Proceedings of the Royal Society B: Biological Sciences* 277 (1701): 3715–24.
Henrich, Joseph, and R. McElreath. 2003. "The Evolution of Cultural Evolution." *Evolutionary Anthropology* 12 (3): 123–35.
Henrich, Joseph, and Michael Muthukrishna. 2021. "The Origins and Psychology of Human Cooperation." *Annual Review of Psychology* 72 (1): 207–40.
Henrich, Joseph, and C. Tennie. 2017. "Cultural Evolution in Chimpanzees and Humans." In *Chimpanzees and Human Evolution*, edited by Martin Muller, R. Wrangham, and D Pilbream. Cambridge, MA: Harvard University Press.
Herrmann, Esther, Josep Call, María Victoria Hernández-Lloreda, et al. 2007. "Humans Have Evolved Specialized Skills of Social Cognition: The Cultural Intelligence Hypothesis." *Science* 317 (5843): 1360–66.
Hong, Ze. 2021. "Dream Interpretation from a Cognitive and Cultural Evolutionary Perspective: The Case of Oneiromancy in Traditional China." *PsyArXiv* April, https://doi.org/10.31234/osf.io/kfzxs.
Jiménez, Ángel V., and Alex Mesoudi. 2019. "Prestige-Biased Social Learning: Current Evidence and Outstanding Questions." *Palgrave Communications* 5 (1): 20.
Johnson, Allen. 2003. *Families of the Forest: Matsigenka Indians of the Peruvian Amazon*. Berkeley, CA: University of California.
Johnson, S. 2011. *Where Good Ideas Come From: The Natural History of Innovation*. New York: Penguin Publishing Group.
Jordan, J. J., M. Hoffman, P Bloom, et al. 2016. "Third-Party Punishment as a Costly Signal of Trustworthiness." *Nature* 530 (7591): 473–76.
Kempe, M., and A. Mesoudi. 2014. "Experimental and Theoretical Models of Human Cultural Evolution." *Wiley Interdisciplinary Reviews-Cognitive Science* 5 (3): 317–26.
Laland, Kevin N. 2004. "Social Learning Strategies." *Animal Learning & Behavior* 32 (1): 4–14.
———. 2017. *Darwin's Unfinished Symphony: How Culture Made the Human Mind*. Princeton, NJ: Princeton University Press.
Lang, Martin, Benjamin G. Purzycki, Coren L. Apicella, et al. 2019. "Moralizing Gods, Impartiality and Religious Parochialism across 15 Societies." *Proceedings of the Royal Society B: Biological Sciences* 286 (1898): 20190202.
Lobo, José, and Deborah Strumsky. 2008. "Metropolitan Patenting, Inventor Agglomeration and Social Networks: A Tale of Two Effects." *Journal of Urban Economics* 63 (3): 871–84.
Mackie, Gerry. 1996. "Ending Footbinding and Infibulation: A Convention Account." *American Sociological Review* 61 (6): 999–1017.
Maner, Jon K. 2017. "Dominance and Prestige: A Tale of Two Hierarchies." *Current Directions in Psychological Science* 26 (6): 526–31096372141771432.
Mathew, Sarah. 2017. "How the Second-Order Free Rider Problem Is Solved in a Small-Scale Society." *American Economic Review* 107 (5): 578–81.
Medin, D. L., and S. Atran. 1999. *Folkbiology*. Cambridge, MA: MIT Press.
Mesoudi, A. 2009. "How Cultural Evolutionary Theory Can Inform Social Psychology and Vice Versa." *Psychological Review* 116 (4): 929–52.
Miller, Kevin F., and James W. Stigler. 2013. "Meanings of Skill : Effects of Abacus Expertise on Number Representation" *Cognition and Instruction* 8 (1): 29–67.

Morgan, T. J. H., L. E. Rendell, Micael Ehn, et al. 2012. "The Evolutionary Basis of Human Social Learning." *Proceedings of the Royal Society B: Biological Sciences* 279 (1729): 653–62.

Morgan, Thomas J. H., Kevin N. Laland, and Paul L. Harris. 2014. "The Development of Adaptive Conformity in Young Children: Effects of Uncertainty and Consensus." *Developmental Science* 18 (4): 511–24.

Muthukrishna, M., Ben W. Shulman, Vlad Vasilescu, et al. 2014. "Sociality Influences Cultural Complexity." *Proceedings of the Royal Society B: Biological Sciences* 281:20132511.

Muthukrishna, Michael, Michael Doebeli, Maciej Chudek, et al. 2018. "The Cultural Brain Hypothesis: How Culture Drives Brain Expansion, Sociality, and Life History." Edited by Corina E Tarnita. *PLOS Computational Biology* 14 (11): e1006504.

Muthukrishna, Michael, and Joseph Henrich. 2016. "Innovation in the Collective Brain." *Philosophical Transactions of the Royal Society B: Biological Sciences* 371 (1690): 1–14.

Muthukrishna, Michael, Thomas J. H. Morgan, and Joseph Henrich. 2016. "The When and Who of Social Learning and Conformist Transmission." *Evolution and Human Behavior* 37 (1): 10–20.

Nakahashi, W., J. Y. Wakano, and J. Henrich. 2012. "Adaptive Social Learning Strategies in Temporally and Spatially Varying Environments How Temporal vs. Spatial Variation, Number of Cultural Traits, and Costs of Learning Influence the Evolution of Conformist-Biased Transmission, Payoff-Biased Transmission, and Individual Learning." *Human Nature-an Interdisciplinary Biosocial Perspective* 23 (4): 386–418.

Norenzayan, Ara, Azim F. Shariff, Will M. Gervais, et al. 2016. "The Cultural Evolution of Prosocial Religions." *Behavioral and Brain Sciences* 39:1–86.

Osiurak, François, Mathieu Lesourd, Jordan Navarro, et al. 2020. "Technition: When Tools Come Out of the Closet." *Perspectives on Psychological Science* 15 (4): 880–97.

Page, Scott E. 2007. "Making the Difference: Applying a Logic of Diversity." *Academy of Management Perspectives* 21 (4): 6–20.

Panchanathan, Karthic, and Robert Boyd. 2004. "Indirect Reciprocity Can Stabilize Cooperation without the Second-Order Free Rider Problem." *Nature* 432:499–502.

Purzycki, Benjamin Grant, Coren L. Apicella, Quentin D. Atkinson, et al. 2016. "Moralistic Gods, Supernatural Punishment and the Expansion of Human Sociality." *Nature* 530 (7590): 327–30.

Purzycki, Benjamin Grant, Joseph Henrich, Coren L. Apicella, et al. 2017. "The Evolution of Religion and Morality: A Synthesis of Ethnographic and Experimental Evidence from Eight Societies." *Religion, Brain & Behavior* 8 (2): 101–32.

Rand, David G., Alexander Peysakhovich, Gordon T. Kraft-Todd, et al. 2014. "Social Heuristics Shape Intuitive Cooperation." *Nature Communications* 5: 3677).

Redhead, Daniel, Joey T. Cheng, Charles Driver, et al. 2019. "On the Dynamics of Social Hierarchy: A Longitudinal Investigation of the Rise and Fall of Prestige, Dominance, and Social Rank in Naturalistic Task Groups." *Evolution and Human Behavior* 40 (2): 222–34.

Renn, J. 2020. *The Evolution of Knowledge: Rethinking Science for the Anthropocene*. Princeton, NJ: Princeton University Press.

Ridley, Matt. 2020. *How Innovation Works: And Why It Flourishes in Freedom*. London: Harper.

Saenger, Leo. n.d. "Respect Your Elders? The Economic Origins and Political Consequences of Attitudes Toward the Aged. "

Schmidt, M. F. H., H. Rakoczy, and M. Tomasello. 2011. "Young Children Attribute Normativity to Novel Actions without Pedagogy or Normative Language." *Developmental Science* 14 (3): 530–39.

Shariff, Azim F., Aiyana K. Willard, Teresa Andersen, et al. 2016. "Religious Priming: A Meta-Analysis with a Focus on Prosociality." *Personality and Social Psychology Review* 20 (1): 27–48.

Silverman, P., and R. J. Maxwell. 1978. "How Do I Respect Thee? Let Me Count the Ways: Deference Towards Elderly Men and Women." *Behavior Science Research* 13 (2): 91–108.

Singh, Manvir, Ted J. Kaptchuk, and Joseph Henrich. 2021. "Small Gods, Rituals, and Cooperation: The Mentawai Water Spirit Sikameinan." *Evolution and Human Behavior* 42 (1): 61–72.

Sperber, D., F. Clement, C. Heintz, O. Mascaro, H. Mercier, G. Origgi, and D. Wilson. 2010. "Epistemic Vigilance." *Mind & Language* 25 (4): 359–93.
Strevens, M. 2020. *The Knowledge Machine: How an Unreasonable Idea Created Modern Science*. London: Penguin Books Limited.
Tenenbaum, Joshua B., Thomas L. Griffiths, and Charles Kemp. 2006. "Theory-Based Bayesian Models of Inductive Learning and Reasoning." *Trends in Cognitive Sciences* 10 (7): 309–18.
Tenenbaum, Joshua B., Charles Kemp, Thomas L. Griffiths, et al. 2011. "How to Grow a Mind: Statistics, Structure, and Abstraction." *Science* 331 (6022): 1279–85.
Tomasello, M. 2019. *Becoming Human: A Theory of Ontogeny*. Cambridge, MA:Harvard University Press.
Tomasello, M., B. Hare, H. Lehmann, et al. 2007. "Reliance on Head versus Eyes in the Gaze Following of Great Apes and Human Infants: The Cooperative Eye Hypothesis." *Journal of Human Evolution* 52 (3): 314–20.
Tomasello, Michael. 2010. *Origins of Human Communication.*Cambridge, MA: MIT Press.
Turchin, Peter. 2015. *Ultrasociety: How 10,000 Years of War Made Humans the Greatest Cooperators on Earth*. Connecticut: Beresta Books.
Tuzin, Donald. 2001. *Social Complexity in the Making: A Case Study among the Arapesh of New Guinea*. London: Routledge.
Vogt, Sonja, Charles Efferson, and Ernst Fehr. 2017. "The Risk of Female Genital Cutting in Europe: Comparing Immigrant Attitudes toward Uncut Girls with Attitudes in a Practicing Country." *SSM - Population Health* 3 (December): 283–93.
Willard, Aiyana K., and Lubomír Cingl. 2017. "Testing Theories of Secularization and Religious Belief in the Czech Republic and Slovakia." *Evolution and Human Behavior* 38 (5): 604–15.
Willard, Aiyana K., J. Henrich, and Ara Norenzayan. 2016. "The Role of Memory, Belief, and Familiarity in the Transmission of Counterintuitive Content." *Human Nature* 27 (3): 221–43.
Winkler, Max, Jonathan Schulz, and Joseph Henrich. n.d. "Sociocultural Diversity, Surnames and Innovation." 69.
Witkower, Zachary, Jessica L. Tracy, Joey T. Cheng, et al. 2020. "Two Signals of Social Rank: Prestige and Dominance Are Associated With Distinct Nonverbal Displays." *Journal of Personality and Social Psychology* 118 (1): 89–120.
Wrangham, R. 2019. *The Goodness Paradox: The Strange Relationship Between Virtue and Violence in Human Evolution*. New York: Pantheon Books.
Zefferman, Matthew R., and Sarah Mathew. 2015. "An Evolutionary Theory of Large-Scale Human Warfare : Group-Structured Cultural Selection" *Evolutionary Anthropology* 61:50–61.