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CECILIA HEYES, *Cognitive Gadgets: The Cultural Evolution of Thinking*, Cambridge, Massachusetts: The Belknap Press of Harvard University Press, 2018, ix + 292 pp., \$31.50 / £25.95 / €28.50

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Heyes' book is an essential addition to the literature on human uniqueness. Her main claim is that the key human cognitive capacities are products of cultural rather than genetic evolution. Among these distinctively human capacities are causal understanding, episodic memory, imitation, mindreading, and normative thinking. According to Heyes, they emerged not by genetic mutation but by innovations in cognitive development. She calls these mechanisms 'cognitive gadgets.'

The book is organized into nine chapters. The first four chapters are dedicated to laying out the theoretical foundations of the book as well as clarifying its scope and objectives. Chapter 1 introduces the cognitive gadgets theory. Chapter 2 argues for a teleosemantic conception of information that helps us to disentangle the differential contributions of genetic, environmental, and cultural factors. Chapter 3 focuses on human-unique cognitive traits that have been shaped primarily by genetic information. Chapter 4 examines the nature of cultural learning that enables cultural inheritance. The next four chapters focus on the evolution of some core adaptations for cultural learning from the perspective of the cognitive gadgets theory. Chapter 5 discusses selective social learning. Chapter 6 examines imitation. Chapter 7 addresses human mindreading capacities. Chapter 8 gives an overview of the current debate about the origins of language. Finally, in Chapter 9, Heyes offers an overview of what the framework of cultural evolutionary psychology implies about human nature.

In this review, I will focus on some of the key theoretical aspects of Heyes' approach. She starts from the intuition that one of the most prominent distinctive features of our species lies in our capacity to produce culture. The cognitive gadget theory maintains that the origins of many of the distinctive features of human cognition that support the acquisition of cultural information are explained through cultural evolution. Cultural evolution has significantly transformed how we think, by building upon a rather minimal set of genetically inherited differences in the way we process information when compared to other species. Heyes draws upon insights from evolutionary psychology and cultural evolutionary theory, but unlike these approaches, the cognitive gadget theory maintains that distinctively human cognitive mechanisms have been built by cultural evolution itself. This idea is both challenging and interesting. Although arguments for human uniqueness are common in the literature, they often premise on the assumption that humans have always been unique. On Heyes' view, human uniqueness is mostly the result of cultural innovations that shape cognitive development but never reach the point of genetic assimilation.

Throughout the book, Heyes uses the terms 'cognitive gadget theory' and 'cultural evolutionary psychology' more or less interchangeably. Yet, I find it useful to think about the former as the narrow hypothesis that cultural inheritance has played a dominant role in shaping

most (if not all) of our distinctively human cognitive mechanisms, while using the latter to refer to the broader framework (or research program) that recognizes the differential influence of genetic, environmental, and cultural information. I agree with the general strokes of her framework. Cognitive research should indeed pay attention to the extent to which a given cognitive trait evolved by modifying genetic, cultural, and environmental causal processes during development. Development itself is a dynamic, multifactorial process that can change at the population level within an evolutionary timescale. Heyes frames this idea in terms of inherited information. However, I am much more cautious about the literal use of the term ‘information’ throughout the book. I think this use should be metaphorical at best.

Heyes claims, however, that the relative contributions of these factors to a given cognitive trait can be identified using a teleosemantic conception of information (or perhaps another competing theory), and empirical data about the covariation of cognitive abilities and genetic, environmental, and cultural factors that serve as developmental inputs. This is a question about what kind of information structures the developmental trajectories we see in human cognitive development. The more the development of a cognitive trait depends on culturally inherited information, the more its evolutionary trajectory will rely on cultural evolution.

This makes Heyes’ narrower hypothesis incredibly bold. One reason is that it relies on a single, unified view of information that makes sense of the differential contribution of these information channels. Also, if the evolution of a cognitive trait depends on changing developmental pathways, it must also modify developmental dynamics. As a result, claims about the relative influence of one source of information over another should take into account the diachronic interactions that occur at different timescales between the different components of a given developmental system and their non-linear interactions. Causal interactions unfold over time. The more non-linear interactions are involved in a developmental process, the more difficult it is to infer system dynamics from the informational resources that the system’s components supply. Certainly, Heyes could eventually be proven right. But this will require moving forward in theoretical debates that currently remain unsettled.

Heyes believes that only a few human-unique cognitive traits have been shaped primarily by genetic information. These traits include mechanisms for increased social tolerance and enhanced social motivation that make social interaction especially rewarding. These motivational and affective mechanisms go hand in hand with attention biases toward social cues (e.g., faces and voices) which we find intrinsically rewarding. Heyes also speculates that humans might have an enhanced capacity for associative learning (i.e., learning in which an excitatory or inhibitory link is formed between representations of events) when compared to other apes (e.g., humans create associations faster, learn more of them in parallel, or attach associations more readily to specific contexts). Moreover, the human executive function seems also different in humans when compared to other apes, as inhibitory control, working memory, and cognitive flexibility (three core components of executive function) seem to develop at a slower pace and improve more easily with training. Taken together, these mechanisms constitute what Heyes calls the ‘starter kit’ of our distinctively human cognitive capacities.

Talking about human-unique traits is often considered controversial. But a claim in the vicinity of it must be true to make sense of differences between taxa. Trying to pin down these differences to differences at a level of information that maps into a basic, starter kit of human cognition is yet far more ambitious. To say that the above differences have been primarily shaped by genetic information may oversimplify the dynamics of the processes that regulate

human development as well as the relevance of non-genetic variables for shaping them. The structure of these regulatory systems changes during development via inductive signaling and environmental cues. If there is genetic information being transmitted, its transmission crucially depends on non-genetic parameters that constantly re-write the basic information package. Genes and their interactions are not the only major causes of development, so even Heyes' starter kit is at risk of taking too seriously the metaphor of a genetic program.

According to Heyes, this starter kit facilitated cultural evolution in our lineage, but the kit itself is not adaptations for acquiring or transmitting cultural information. Heyes does not talk about cultural evolution loosely. Humans and other species can learn from the environment. But this information often does not come from other individuals, and when it does, it does not rely on cognitive adaptations for cultural inheritance. Learning that is built upon socially acquired information can indeed be considered culturally inherited. But cultural evolution relies on special adaptations for cultural inheritance. In this vein, Heyes argues that selective social learning, imitation, mindreading, and language are some of the core adaptations for cultural learning. But the evolution and development of these adaptations mostly depends on culturally inherited information.

Each of these mechanisms is discussed in the subsequent chapters. In them, Heyes offers evidence on a case-to-case basis to show that these mechanisms are culturally inherited. I find this evidence compelling. But showing that information inherited by social and cultural learning has played a key role in human evolution is one thing. Showing that one channel of information does most of the work in evolution and/or development is another. The available empirical evidence might just not be sufficient to determine if such a claim is true.

In the final chapter, Heyes offers a clever rebuttal to this line of argument. She emphasizes that these mechanisms for cultural inheritance are not prone to genetic assimilation because they do not perform specific tasks that continue to be worth doing in spite of changes in human environments. This is consistent with archeological evidence about behavioral modernity. Behavioral modernity required a major cognitive upgrade, but this seems to have occurred long after we had become genetically and anatomically modern. This suggests that we have somewhat traded cognitive plasticity for stability. We transformed cognitive development through learning and education, but many destabilizing factors (e.g., war and epidemics) can take us back to ground zero. This also suggests that research on the development and evolution of human cognition should be informed not only by biological theory but also by other historical disciplines that can provide useful information about the change of human culture over time.

This collaboration between biological theory and historical disciplines is welcome. Nevertheless, the claim that selective social learning, imitation, mindreading, or language are mostly the result of cultural inheritance again weighs too much on the evolutionary role of a single channel of information. Gene-culture coevolutionary claims, for instance, are appealing because the channels of biological and cultural information are only partially independent of each other, so selection on one of them should partially depend on selection on the other. One should then expect some kind of mutual adjustment of different selective demands on different channels of information. This is not a debate about which channel funnels the most information or the most important information. The central claim is that if there is such a thing like cultural and biological information, such mutual adjustments are necessary for its stable and faithful transmission.

Admittedly, gene-culture coevolutionary models are themselves simplifications and abstractions of a more complex evolutionary dynamic. Even if behavioral modernity occurred long after the emergence of genetic and anatomical modernity, this disparity could be explained by demographic conditions that generate tipping points. Size, density, and connectivity are well-known population-level parameters that influence the direction and pace of evolutionary change. Moreover, culture can coevolve with biological variables other than the gene. One example is niche construction, which shows how the modification of several aspects of our physical environment not only change selective regimes but also buffer development against environmental variation. In this way, cultural practices such as storing seasonal surplus, agriculture, and modern food production affect phenotypic traits such as body size, cognitive development, and gut bacteria over generations without a major genetic overhaul. These changes, in turn, generate different dietary and nutritional demands that change those cultural practices themselves.

Overall, in *Cognitive Gadgets*, Heyes makes a strong case for the idea that cultural evolution has played a key role in the emergence of several distinctive features of human cognition. Reading it is an intellectually rewarding experience. Even if, like me, the reader does not agree with all the details of Heyes' account, her book brilliantly challenges many of the core assumptions of contemporary evolutionary psychology in a way that is insightful, cohesive, detailed, and carefully written. This is perhaps one of the best and most comprehensive views of human cognitive evolution advanced in the recent years.