CHAPTER 48

COGNITIVE ARCHAEOLOGY MEETS CULTURAL EVOLUTIONARY PSYCHOLOGY

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Introduction: Cognitive Archaeology Meets Philosophy

What can philosophy offer the discipline of cognitive archaeology? One answer to this question is: analysis. Philosophers do not have to coordinate excavations, collate findings, or build data sets. Most of our time is spent reading, writing, and thinking. But what should philosophers of cognitive archaeology think about? Luckily, there is no shortage of topics apt for analysis.

One popular topic is methodology. Recently philosophers have become particularly interested in analyzing the way archaeologists generate evidence and how they use evidence to produce inferences (Chapman & Wylie, 2016; Currie, 2018; Currie & Killin, 2019; Killin & Pain, 2021; Pain, 2019; Wylie, 2002). Such questions are particularly pressing in the case of cognitive archaeology. As Hawkes (1954) taught us, it is one thing to try to reconstruct the behaviors involved in producing an artifact; it is another thing entirely to try to reconstruct the cognitive and social processes driving those behaviors.

Another popular topic is the nature of cognition. Debates over the representational theory of mind have been a mainstay in the philosophy of cognitive science, particularly in the last 30 years. In a nutshell, this debate concerns the claim that the brain is analogous to a computer. Some people think the analogy is a good one, others less so.[1] This split is also found in cognitive archaeology. Some researchers work in a representational paradigm (e.g., Cole, 2016; Hiscock, 2014; Shipton et al., 2019; Toth & Schick, 1994; Wynn, 1989, 1993, 2000), while others are influenced by embodied, enactive, extended, and embedded (4E) frameworks (Ingold, 2013; Noble & Davidson, 1996; Malafouris, 2013, 2016; Tomlinson, 2015). So there is plenty of scope for philosophical analysis here also.

However, in this chapter I want to do something a bit different. The focus is more on synthesis, less on analysis. Specifically, I am interested in theoretical and methodological integration. This task represents an acute challenge for cognitive archaeology. As Wynn notes: "Unfortunately, the disciplines of archaeology and psychology have never shared much in the way of theory and methodology"; as such, "it is very unlikely that variables taken directly from the psychological literature could be applied to archaeological remains" (Wynn, 2002, p. 390). Moreover, "the traditional categories of archaeology are inappropriate" insofar as "none . . . has ever been defined with cognition in mind, and it would be misleading to use them as such" (p. 390). So, the success of cognitive archaeology depends on integrating two disciplines with very little crossover in terms of either methodology or foundational categories, and this is no small task.

As a brief illustration of the depth of this challenge, consider the divergence between cognitive psychology and archaeology on the class of capacities considered "distinctively human." A cognitive psychologist's list might include metacognition, mental mapping, and episodic memory. Meanwhile, an archaeologist's list would typically ~~list~~ capacities such as symbolic cognition, abstract reasoning, and imagination. There are of course some overlaps—language and theory of mind, for instance—but we should certainly hope for more consensus than that. And the reasons for this divergence are precisely those that Wynn (2002) identifies: Archaeologists are trying to explain transitions in the archaeological record (in the case of "distinctively human," traditionally the European Upper Palaeolithic), whereas cognitive psychologists are often trying to identify those capacities that distinguish human from nonhuman animals and develop mechanistic hypotheses to explain those capacities.

Addressing such problems requires synthesis, and this is an area where philosophers can help. How exactly do we apply conceptual frameworks from the psychological sciences to the archaeological record? How do we integrate the methods and categories from psychology and archaeology to produce a unified discipline? And how do we do all this in a way that ~~produces~~ reliable inferences to the past? Here I aim to make some headway on these questions.

The particular psychological framework I am interested in is Cecilia Heyes' (2018, 2019) cultural evolutionary psychology. According to Heyes, many distinctively human cognitive capacities are transmitted via cultural evolution rather than via biological evolution. Her claim is that cultural processes facilitate not only the intergenerational transmission of information processed *by* cognitive mechanisms, but also the development *of* cognitive mechanisms. Prima facie support for this view comes from recent work on adaptive neuroplasticity and neural reuse (e.g., Anderson, 2010, 2014; Anderson & Finlay, 2014). Heyes builds on this by outlining evidence suggesting that the cognitive capacities involved in cultural learning are themselves culturally inherited.[2] She argues that selective social learning, imitation, theory of mind, and language are built during development via processes of cultural inheritance. In labeling these cognitive capacities "cognitive gadgets," Heyes draws a direct analogy with the culturally transmitted material artifacts studied by archaeologists. When considered in the context of cognitive archaeology, cultural evolutionary psychology yields a striking conclusion: Stone tools and cognitive mechanisms are more similar than we have traditionally thought, insofar as both are built via cultural forces. As she puts the point: "Distinctively human ways of thinking are products of the same process—cultural evolution—as machines in the outside world; they are pieces of technology embodied in the brain" (Heyes, 2018, p. 2).

Heyes' theory is bold and novel and, if true, has far-reaching implications for the way we think about the evolution of human cognition. Yet so far there have been relatively few interactions between cognitive archaeology and cultural evolutionary psychology. As Heyes notes, bringing the two research programs together is important work: "[C]onnecting the cognitive gadgets theory to key events in human evolution, using the archaeological record, is a priority for future research" (Heyes, 2018, p. 210). Here I set myself two general tasks. First, I address the question of how cognitive archaeology might be conducted within a cultural evolutionary psychology framework. I take up Wynn's methodological challenge and look briefly at debates about behavioral modernity through the cognitive gadgets lens. Second, I assess how cognitive archaeology might inform research in cultural evolutionary psychology. Here I use recent work in the evolution of language as a case study.

Before I begin, there is a brief caveat: My aims here are modest. I merely want to take some preliminary steps toward the larger project of bringing together the cognitive gadgets framework and cognitive archaeology. My goal is to think through some ways in which the two frameworks might be usefully combined, identify some key problems, and point toward directions for future research. The interaction between cultural evolutionary psychology and cognitive archaeology will hopefully be a long and fruitful one; in what follows, I simply aim to help get the conversation started.

The chapter proceeds as follows. The next section provides a brief overview of cultural evolutionary psychology. The following sections explore the implications of practicing cognitive archaeology in a cultural evolutionary psychology framework, and how research in cognitive archaeology can inform cultural evolutionary psychology. The final section summarizes the chapter discussion.

What Is Cultural Evolutionary Psychology?

Cultural evolutionary psychology offers a new answer to an old question: What explains the capacities that set humans apart from nonhuman animals? Heyes' answer to it is: cognitive gadgets.

Cognitive gadgets are unique in the logical geography of human evolutionary theory. This is because they are a novel combination of two otherwise familiar ideas. First, cognitive gadgets are *mechanisms* of thought. They are hence not the outputs of mental processes (e.g., behaviors or cultural artifacts), but mental processes themselves. Second, cognitive gadgets are produced during ontogeny via cultural learning and not via genetic inheritance.

These commitments set cultural evolutionary psychology apart from two main theoretical alternatives: *evolutionary psychology* and *cultural evolutionary theory*. Like Heyes, proponents of evolutionary psychology argue that understanding distinctively human mechanisms of thought is central to explaining the evolution of human behavior and culture. However, contra Heyes, evolutionary psychologists maintain that these mechanisms of thought are genetically inherited (e.g., Barkow et al., 1995; Pinker, 1995). Cultural evolutionary theorists, on the other hand, agree with Heyes that cultural evolution is the most important inheritance mechanism producing distinctively human behavior and culture; hence, both reject the emphasis evolutionary psychology places on genetic inheritance. Yet contra Heyes (and evolutionary psychology), cultural evolutionary theorists typically downplay, or at least bracket off, the role of the mind in accounting for human distinctiveness (e.g., Boyd, 2017; Richerson & Boyd, 2008).

So, Heyes unites the cognition-focused accounts favored by evolutionary psychology with the emphasis cultural evolutionary theory places on processes of cultural inheritance. A cognitive gadget, then, is a mechanism of thought that is built during ontogeny through cultural forces. But what exactly does a cognitive gadget look like?

Heyes' proof of principle for a cognitive gadget is literacy (Heyes, 2018, p. 19–22). On one hand, we know that learning to read changes the neural configuration of our brains. In turn, this allows people to access large stores of intergenerationally transmitted information. Literacy is thus a cognitive mechanism that is also involved in processes of cultural learning. On the other hand, writing has only been a feature of human lives for some 5,000 to 6,000 years, too short for literacy to have been assimilated genetically. Literacy is thus a culturally inherited cognitive mechanism. Heyes' central argument is that other cognitive mechanisms involved in cultural learning—selective social learning, imitation, theory of mind, and language—should be understood in the same way we understand literacy.[3]

In sum, cultural evolutionary psychology prioritizes both cognition and culture in explaining human evolution. Although Heyes is careful to stipulate that there are important genetically acquired prosocial and attentional capacities that allow for the development of cognitive gadgets—the genetic "starter kit" (Heyes, 2018, Chapter 3)—these are "small ordinary" attributes and contrast with the "big special" cognitive mechanisms (e.g., theory of mind, language, causal understanding, etc.) that have reached such a high level of sophistication in humans. So, for Heyes, while the development of human behavioral and cognitive traits is always the product of complicated interactions between biological, environmental, and cultural processes, it is cultural processes that are key.

Gadgets and Artifacts: Doing Cognitive Archaeology in a Cultural Evolutionary Psychology Framework

Let's suppose that Heyes is right. What does cognitive archaeology look like when practiced in a cultural evolutionary framework? In this section, I explore some of the implications and challenges of interpreting the archaeological record using cognitive gadgets.

On Categories and Methodology

It is important to note that cultural evolutionary psychology is not first and foremost a theory *of* cognitive capacities; rather, it is a theory of how some familiar capacities *get built*.[4] Often, cognitive archaeologists operate using the former type of theory. The general strategy is to take a psychological model of some mechanism and then trace the evolution of that mechanism by analyzing the record using the model. For instance, Wynn and Coolidge (Wynn & Coolidge, 2004; also see Coolidge & Wynn, 2018) use Ericsson's (Ericsson & Delaney, 1999; Ericsson & Kintsch, 1995) model of long-term working memory and expert performance; Noble and Davidson (1996) use J. J. Gibson's (1979) theory of affordances; and Cole (2016) uses Premack and Woodruff's (1978) model for theory of mind. Heyes' theory proposes nothing new about the structure and operations of, say, our language-processing capacities. Rather, it proposes something new about the ontogenetic and phylogenetic development of those capacities. Applying the framework to the archaeological record thus raises a different set of questions.

Recall Wynn's point that none of the traditional categories in archaeology have "ever been defined with cognition in mind, and it would be misleading to use them as such" (Wynn, 2002, p. 390). Rather, archaeological categories tend to be based on presumed properties like artifact function or social complexity or else-according to more practical concerns, such as usefulness of temporal ordering. Wynn's point is that, in approaching the record with, say, Ericsson's model of long-term working memory, categories like "Middle Stone Age" or "classic period" are not necessarily useful. Instead, we must reimagine the record in cognitive terms.

Interestingly, the nature of cultural evolutionary psychology goes some way to resolving this categorical gap, in the following sense. We do not have to reimagine the categories of archaeology in psychological terms because Heyes has, to some extent, *reimagined psychology in archaeological terms*. This is because she defines psychological categories with technology in mind; as we have seen, for Heyes', capacities like language and theory of mind are "pieces of technology embodied in the brain" (Heyes, 2018, p. 2). Accordingly, the phenomena studied by archaeology and psychology turn out to be more similar than we have traditionally thought.

Now, it is important to reiterate that, for the most part, we are still dealing with the same old neurally realized capacities of more traditional theories. What has changed is how they are built. So, there is a broad sense in which the categories of the two disciplines have been brought together: The classic methodological challenge of cognitive archaeology has been to theoretically align a biological category (cognitive mechanisms) with a cultural category—the archaeological record; on Heyes' account however, we are attempting to align two types of culturally produced phenomena.

Coming to grips with the implications of this move is a complicated task. Here is one line of thought that might seem initially attractive. The central inferential problem that faces cognitive archaeology is as follows: How do we produce reliable inferences from the record to the cognitive capacities of past populations? One might think that adopting Heyes' framework goes some way to bridging the epistemological gap between artifacts and minds, for the following reason. On more traditional views of the evolution of human cognition, the challenge is to understand causal relationships between a genetically transmitted capacity and a culturally transmitted artifact. In Heyes' view, both capacity and artifact have their origins in cultural learning. So one might think that, as they are products of the same inheritance mechanism, the epistemic gap between artifacts and cognition is reduced. In other words, the inferential route from artifact to gadget is more straightforward than the route from artifact to instinct.

This move—shifting the traditional categories we use to understand cognition and material culture—has been employed in cognitive archaeology in a different context.

Lambros Malafouris (2013, 2016) has argued that expanding the ontology of mind beyond the brain can likewise help address the inferential challenge. According to Material Engagement Theory, artifacts are more "minded" than we have traditionally taken them to be. Consequently, there is less of an epistemological gap between material culture and the mind than traditional, representational theories of mind would have us believe.

In the case of cultural evolutionary psychology, I do not think this strategy works. Take Heyes' proof of principle for cognitive gadgets: literacy. Suppose we are tasked with trying to identify the cognitive mechanisms governing the production of early writing systems. Suppose also that we are working on the assumption that those mechanisms were built by biology. This task would not get any easier were we to suddenly discover that they were instead built by culture. Likewise, finding out that theory of mind is culturally inherited would not make it any easier to attribute third-order intentionality capacities to the makers of Middle Stone Age handaxes (Cole, 2016, 2019). In each case, we still need to go through the process of applying a cognitive model to the record and running an inference to the cognitive capacities of past individuals; knowing that both capacity and artifact were built by the same inheritance mechanism doesn't make that process any less daunting.

This point can be made sharper in the following way: Cultural evolution is typically "messier" than biological evolution. This is because cultural evolution relies on fleeting and unstable mechanisms like convention, social norms, and habits. Cultural evolution also involves vertical, oblique, and horizontal lines of inheritance: I can learn from my parents, my aunts and uncles, or my own peer group. In contrast, biological evolution relies on genetic mechanisms—and so is more stable—and typically involves only vertical lines of inheritance. This last fact is thought to mean biological evolution operates on slower timescales than cultural evolution (e.g., Ram et al., 2018). So on the traditional view, cognitive archaeologists were trying to infer capacities generated by slow, stable processes from artifacts generated by fast, unstable processes. On the cognitive gadgets view, we are trying to infer capacities generated by fast, unstable processes from artifacts generated by fast, unstable processes. And the latter project looks just as inferentially challenging as the former. Indeed, one might even think it looks more challenging.

This provides some illumination regarding the terms of Wynn's categorical challenge. Successful cognitive archaeology does not require an equivalence relation between archaeological categories and psychological categories; rather, it requires an explication relation. And the former does not guarantee the latter. We appeal to theories in the cognitive sciences in order to *explain* patterns in the record; however, the record gives us a bound on what people can do, and what people can do is only partly determined by what they can think. So doing cognitive archaeology in a cultural evolutionary framework goes some way to addressing the methodological challenge identified by Wynn—there is a sense in which Heyes has defined the variables of cognitive science with artifacts in mind, and this brings the two disciplines closer together. However, this does not in itself make cognitive archaeology more inferentially robust.

This conclusion might sound a bit pessimistic. There are, after all, some important methodological upshots to the idea that cognitive mechanisms and material artifacts share a common mode of inheritance. The most important of these, in my opinion, is that the archaeological record gives us an independent window into the extent and fidelity of cultural transmission in a lineage over a given period. In the next section, I expand on this idea.

Force Theories and Narrative Theories

So—what does practicing cognitive archaeology in a cultural evolutionary framework actually look like? Answering this question involves tackling the following question: How do we interpret the archaeological record using the cognitive gadgets hypothesis?

Heyes (2018, pp. 12–13, 210) stresses the importance of this task via a distinction between two strategies employed by human evolutionary theorists. *Force theories* emphasize the processes involved in producing some phenomena, such as the role cultural forces play in shaping the human mind. *Narrative theories*, on the other hand, are more interested in chronology. They attempt to outline the series of events leading up to, for instance, the development of language. Theories in cognitive archaeology are typically more narrative in flavor. The great promise of the discipline is that the archaeological record might be used to provide a lineage of the evolution of human cognition. However, as Heyes notes, an ideal theory would combine both of these virtues; it would "use chronology as evidence of forces, and forces to explain chronology" (2018, p. 210). In the remainder of this section, I engage with the latter project. In the following section I engage with the former.

The force/narrative distinction resembles a well-known distinction in the philosophy of science between *robust process explanations* and *actual sequence explanations* (Sterelny, 1996; also see Jackson, 1992; Jackson & Pettit, 1990; and Sober, 1983 for precursors to the distinction). Robust process explanations posit high-level causes for an outcome. For instance, we might say that the First World War was caused by an arms race between European powers. On the other hand, actual sequence explanations focus on the particular series of events leading up to some outcome. For instance, we might say that the First World War was caused by the assassination of Archduke Franz Ferdinand. Robust process explanations are to some extent encapsulated from the contingencies of actual sequence explanations. If a European arms race was the overriding cause of the war, then the conflict would have begun regardless of Ferdinand's assassination.

In this example, we can see that the "arms race" hypothesis can be used to explain the series of events coming after Ferdinand's assassination leading to war. How would we go about using the cognitive gadgets theory to explain sequences we find in the archaeological record? Heyes (2018, pp. 210–213) makes a start on this task. Here I build on her observations, outline some criticisms, and suggest some future lines of inquiry.

Cognition, Demography, and Transitions

Heyes' focus is on the European Upper Palaeolithic and the African Middle Stone Age and their association with behavioral modernity. She notes that influential work by McBrearty and Brooks (2000) suggests a much more graded and geographically dispersed account of the development of behavioral modernity, which challenges models that appeal to random, one-off genetic events (e.g., Coolidge & Wynn, 2018; Mellars, 2005; Mellars & Stringer, 1989). In place of genetic accounts, cultural evolutionary theorists have proposed the *collective intelligence hypothesis* (Boyd, 2017; Henrich, 2015; Muthukrishna & Henrich, 2016; Richerson & Boyd, 2008, 2013). The idea here is that the changes we see in the European Upper Palaeolithic and the African Middle Stone Age are the product of changes in demography, not genetics. Humans thus had all the biological traits required for behavioral modernity perhaps as far back as *Homo heidelbergensis*, but such behaviors could only be generated once human groups reached a sufficient size and/or were sufficiently interconnected.

Powell et al. (2009) makes a similar point. According to the *social-scale hypothesis*, the complexity of material culture that a population can maintain is a function of its size. Powell et al.'s modeling begins with the assumption that skill levels act as a constraint on technological complexity. In turn, skill levels are constrained by cultural learning. Effective cultural learning depends on two factors: (a) how noisy the information flow from expert to novice is and (b) the spread of aptitude among experts and novices. As the spread of aptitude among experts and novices emerges from normal variation within a population, aptitude is sensitive to social scale. Consequently, so is technological complexity. So for Powell et al., the European Upper Palaeolithic is a signal of changing demographic patterns, not upgrades in cognition.

Heyes' take on this debate is to maintain the emphasis on cognition stressed by genetic accounts, but swap in cultural rather than biological inheritance mechanisms. In other words, the collective intelligence and social-scale hypotheses hold that all the necessary cognitive mechanisms required for behavioral modernity were in place well before the European Upper Palaeolithic or African Middle Stone Age. What was missing were the necessary social structures required to generate more complex outputs from those structures. Heyes, in contrast, argues that the necessary cognitive mechanisms were *not* in place before these demographic changes. Rather, all that was in place were the "small ordinary" components of the genetic starter kit (see previous section). The demographic changes leading up to the European Upper Palaeolithic and African Middle Stone Age allowed distinctively human cognitive mechanisms to be built by creating the conditions required for the more high-fidelity transmission of cultural capital. So, for cultural evolutionary theorists, the onset of behavioral modernity was a transition in *what* people thought about, whereas for Heyes it was also a transition in *how* people thought.

I believe there are significant concerns with this line of thought. Here Heyes asks us to buy in to a "major transition" account of both the record and human cognitive evolution. She indicates that stone tool technologies prior to the European Upper Palaeolithic and the African Middle Stone Age were produced in the absence of cognitive gadgets:

> The Small Ordinary components of the genetic starter kit . . . were already in place and had been supporting cooperation and simple stone technologies for millions of years. Demographic changes allowed the Small Ordinary components to be elaborated by cultural group selection into the mechanisms that we now identify as, for example, causal understanding, episodic memory, imitation, theory of mind and full-blown language.
>
> (Heyes, 2018, p. 213)

But can the components of the genetic starter kit—increased prosocial tendencies, information-processing capacities, and attentional biases—really support, say, late Acheulean or prepared-core technologies? There is evidence from cognitive archaeology that suggests otherwise. I argue that the record supports a graded account of capacities like theory of mind and language. In turn, this indicates that cognitive gadgets have a much older and more gradual evolutionary history.

Let's begin with theory of mind. This refers to our ability to infer, or understand, the mental states of another individual. For instance, I might infer from yawns in the audience that participants in my lecture are bored. Our theory of mind capacities are embedded in a broader framework of orders of intentionality. These orders begin with the awareness of my own mental states and progress from there. For instance, I intend (a); that my audience understand (b); that Heyes believed (c); that Boyd disagreed (d); with Mellars' commitment to genetic models of behavioral modernity (e); and so on. Theory of mind is thus located in the second order of intentionality. Recently, Cole (e.g., 2016, 2019) has produced a range of studies attempting to correlate theory of mind capacities and orders of intentionality with the lithic record. His results suggest that our ability to interpret other people's mental states long pre-date the African Middle Stone Age. On his reading, early *Homo* variants and even late *Australopithecine* possessed second-order intentionality and hence theory of mind capacities. *Homo erectus* and the appearance of the Acheulean signal third-order intentionality, and fourth-order intentionality arrives with *H. heidelbergensis* and prepared-core technologies. This reading contrasts starkly with Heyes' proposal, in which theory of mind capacities only emerge as a result of demographic transitions during the African Middle Stone Age.

Recent work on the evolution of language likewise suggests a deeper evolutionary history than Heyes proposes. Studies from the emerging field of neuroarchaeology indicate that many of the mechanisms required for language production may well have been in place by the Late Acheulean (Putt, 2019; Putt et al., 2017; Stout & Chaminade, 2012; Stout et al., 2008). Theoretical work also bolsters this conclusion. For instance, Planer (2017b) makes a case that hominins of the early Pleistocene were equipped with a protolanguage. Indeed, Planer and Sterelny (2021) see evidence for the type of hierarchical cognition needed to support language in the behavior of the great apes. This work is the focus of the following section, so I do not dwell on it here; suffice to say that plenty of thinking in cognitive archaeology supports the conclusion that the origins of language long pre-date the demographic events singled out by proponents of the collective intelligence hypothesis. This work adopts a more graded account of the development of complexity in technology, which in turn supports a more graded account of the capacities driving that development.

What might a cognitive gadgets theorist say in response to this evidence? There are various alternatives available. For instance, note that there is no requirement that the entire suite of capacities ~~required~~ for cultural learning should all have the same evolutionary trajectory. So maybe proposing a staggered account is the right move. For instance, we might accept that language and theory of mind have much older origins, but hold that imitation and selective social learning are newer innovations. And the latter were necessary for the transitions we see in the African Middle Stone Age and European Upper Palaeolithic. However, recent work suggests that cumulative technological culture had its origins in the Acheulean and perhaps even the Oldowan (de la Torre et al., 2003; Stout, 2011; Stout et al., 2010, 2019). Typically, imitation and selective social learning are thought to play a role in supporting cumulative technological culture. If so, this would count against a staggered account.

A different—and to my mind more promising—solution is to develop a graded account of the evolution of cognitive gadgets. This approach would understand the cultural evolutionary process in terms of small, incremental changes over a long period of time and reject any appeal to large, sudden changes. The notion that there were major transitions in hominin cognitive/behavioral evolution is one that is tied to the notion that there are major technological transitions signaled by the archaeological record. Yet there is active debate concerning both the extent and the significance of such transitions (e.g., Clark, 2009; Clark & Riel-Salvatore, 2006; Shea, 2011; Straus, 2009). And a more graded account of the record suggests a more graded account of the cognitive capacities involved in its production. Consequently, we need a graded account of the cultural evolution of selective social learning, imitation, theory of mind, and language. However, while there is no reason in principle why this would not be possible, such an account must address important questions. The piecemeal evolution of cognitive mechanisms over millions of years requires explanation in the cultural case: What factors impede the normally fast processes involved? How do these factors impact the construction of mechanisms? This is less so in the biological case—slow and steady is the standard modus operandi in biology. Working out the details of a gradualist account of cognitive gadgets is an important line of future inquiry for cultural evolutionary psychology.

Heyes notes that her proposal is "a start" for which she uses a "broad brush" (Heyes, 2018, p. 210), and the comments I offer here are an attempt to develop and refine that proposal.[5] I engage with these themes in more detail in the next section, but the general point is this: Theories of human cognitive evolution are well advised to adopt gradualism, and cultural evolutionary psychology is no different.

Is Language a Cognitive Gadget?

In the previous section, we saw how we might use cultural evolutionary psychology to interpret the archaeological record. In other words, we used forces to explain chronology. In this section, chronology is used as evidence of forces. To return to our First World War analogy, we can see that the series of events coming after Ferdinand's assassination and leading to war provide evidence for the "arms race" hypothesis. So, how can the archaeological record be used to provide evidence for Heyes' theory?

One of Heyes' most contentious claims is that language is plausibly a cognitive gadget. Under the influence of Chomsky, the thought that humans possess innate, language-specific cognitive mechanisms has dominated linguistics.[6] Contrary to this, Heyes argues that there is increasing evidence for the view that language is produced by domain-general mechanisms that are built by cultural processes (Heyes, 2018, pp. 183–189). The cognitive gadgets hypothesis is thus a viable alternative to nativist accounts of language (see also Christiansen & Chater, 2016).

The evidence Heyes offers—from research on the neural distribution of language processing, on the role of domain-general sequence learning in speech production and comprehension, and on how social shaping affects the way children use language—addresses ontogeny. Cognitive archaeology offers cultural evolutionary psychologists something further: a line of evidence to the phylogenetic evolution of language. Here I provide an overview of recent work on tool–language coevolutionary hypotheses and argue that such work lends support to the claim that language is a cognitive gadget.

The Evidence from Neuroarchaeology

Over the last 40 years there has been growing interest in the idea that language and tools coevolved (Greenfield, 1991; Isaac, 1976; Kimura, 1993; Montagu, 1976; Planer 2017b; Planer

& Sterelny, 2021; Reynolds, 1976, 1993; Sterelny, 2012). Traditionally, cognitive archaeologists have contributed to this research by applying models from the cognitive and language sciences to various tool industries (Gibson & Ingold, 1993; Mithen, 1996; Noble & Davidson, 1996; Toth & Schick, 1994). Adopting this inferential strategy requires addressing a number of methodological problems, from Wynn's (2002) concerns regarding the integration of archaeological and psychological categories, to more recent concerns regarding heuristics for theory choice and issues with cross-cultural sample diversity (Killin & Pain, 2021, 2022). More recently, cognitive archaeologists have adopted a different inferential strategy. Experimental neuroarchaeology takes modern human subjects and uses neuroimaging techniques to investigate their brain activity during knapping tasks. In the area of language evolution, attention has focused on assessing neural overlap between toolmaking and language (e.g., Putt, 2019; Putt et al., 2017; Stout et al., 2008; Stout & Chaminade, 2007, 2012). If such overlap is found—so the thought goes—then we have evidence for the claim that emerging language capacities were able to co-opt preexisting capacities that had evolved for toolmaking. Neuroarchaeology inherits a different inferential problem: Modern humans are not, for instance, *H. erectus*, so the argument produced is one by homology. The strength of the inference thus relies on the level of neural similarity between the two species, and that ratio is notoriously difficult to gauge.

Here I put such concerns aside. I take it that demonstrating neural overlap between toolmaking and language production in modern humans lends some evidential weight to tool–language coevolutionary hypotheses. The case I want to make is that this is good news for cultural evolutionary accounts of language. However, our first question is: Does such an overlap exist?

In their 2008 study, Dietrich Stout and colleagues took three expert Early Stone Age knappers and used fluorodeoxyglucose positron emission tomography to assess the areas of the brain co-opted by both Oldowan and Late Acheulean tasks (Stout et al., 2008). They found that Late Acheulean toolmaking produced increased activity in areas associated with language production as compared with Oldowan toolmaking. Of particular interest is the activation of inferior frontal gyrus. This area is already associated with language production and is increasingly thought to play the computational role of a more general-purpose supramodal processor of hierarchically sequenced information (e.g., Fadiga et al., 2009; Koechlin & Jubault, 2006; Poldrack, 2006). Also of interest is the activation of the right and left dorsal portions of inferior frontal gyrus *pars triangularis*. The former is thought to play a role in syntactic/semantic integration and in processing high-level motor representation and hierarchical action sequences more generally. The latter is associated with working memory and sentence processing (Elmer, 2016; Makuuchi et al., 2009; Matchin, 2018).

More recently, Shelby Putt and colleagues expanded the scope of this work using functional near-infrared spectroscopy (Putt, 2019; Putt et al., 2017). Putt and colleagues were particularly interested in investigating whether the mode of learning—either verbal or nonverbal—had any effect on the brain regions co-opted by Oldowan and Late Acheulean tasks. Participants in the experiment were taught to knap using either spoken language and visual aids or using visual aids alone. Their results showed increased activity in ventral precentral gyrus (associated with the guidance of visual working memory) and the temporal cortex (associated with the integration of visual, auditory, and sensorimotor information). Importantly, they found that only participants who had learned to knap verbally showed any activation in pars triangularis in the right hemisphere. This suggests that the activity Stout and colleagues observed in that region may be a product of the way their subjects were taught to knap rather than an indication of a coevolutionary relationship between toolmaking and language. The increased reliance on sensorimotor control via working memory and reduced activity in inferior frontal gyrus found by Putt and colleagues suggests a more motor-based account of Acheulean toolmaking than is suggested by Stout and colleagues' results. However, activation in inferior frontal gyrus still lends weight to tool–language coevolutionary hypotheses (Putt, 2019, p. 313).

In summary, this work supports the idea that an emerging behavioral phenotype—language—was able to co-opt existing neural substrates that had evolved to support an older behavioral phenotype: toolmaking. But why is this important?

On the Evolution of Language

To see this, it is necessary to situate the neuroarchaeological evidence within the broader logical geography of theoretical work on language evolution. I characterize this work according to three central (and importantly related) debates: (a) saltationism versus selectionism; (b) domain-specific versus domain-general mechanisms; and (c) cultural evolution versus gene–culture coevolution. This demonstrates that neural overlap in toolmaking and language lends support to the claim that language is a gadget.

Saltationism Versus Selectionism

A central debate in the field is between those who argue that language evolved in incremental stages and those who hold that it appeared suddenly. The latter position—*saltationism*—is typified by Berwick and Chomsky (2016; see also Hauser et al., 2002). In their view, the evolution of language required a random genetic mutation that resulted in a neural "rewiring." This morphological change produced the computational mechanism ("merge") required for syntax, which in turn is a necessary condition for language. This purported event happened comparatively recently—some 80,000 to 120, 000 years ago. On the other hand, *selectionists* (also called "gradualists" or "neo-Darwinians") hold that language emerged piecemeal via incremental steps (Culicover & Jackendoff, 2005; Pinker, 1995; Pinker & Bloom, 1990). This thought is captured by the notion of a "lineage explanation" (Calcott, 2009). Lineage explanations must satisfy two constraints. First, the path through phenotypic space from one trait to another must proceed via steps that vary only in minor ways. Second, none of those steps can be blocked by selection. The challenge for selectionists is to show how this is possible in the case of language. More recently, the scope of selectionism has been expanded—by differing degrees—to encompass the role of culture (e.g., Christiansen & Chater, 2016; Planer & Sterelny, 2021; Tomasello, 2005, 2009, 2010, 2014).

Saltationism is particular to genetic accounts of language evolution; all cultural evolutionary accounts of language are selectionist accounts. It follows that evidence counting against saltationism counts against one of the two alternatives to cognitive gadgets theory. And the neuroarchaeology we have just reviewed offers evidence of this kind. The reason for this should be clear. If language were able to co-opt preexisting capacities, then we do not have to posit the sudden appearance of language-specific mechanisms. Saltationism about the evolution of language thus looks unnecessary.

And, more broadly speaking, this is good news. In evolutionary biology there are reasons to doubt the plausibility of an account that requires the undirected, de novo generation of a domain-specific cognitive mechanism (Fisher & Bennett, 1999). Moreover, this general line of critique has been applied specifically in the case of Berwick and Chomsky's work (Planer, 2017a). The neuroarchaeological evidence points us toward a selectionist account of language evolution that avoids these problems.

Domain-Specific Versus Domain-General Mechanisms

Moreover, the neuroarchaeological evidence offers reasons to doubt not only the saltationist position, but also the genetic selectionist account. This is because it points the way to an understanding of language evolution that requires only domain-general mechanisms and hence jettisons the need to posit any language-specific capacities.

Theorists of all stripes can agree that language production utilizes many capacities that play a broader role within cognitive systems (i.e., memory, executive control, and theory of mind). However, these capacities are not thought to be language specific; that is, they are not dedicated solely to language production. Strictly genetic accounts of language evolution typically commit themselves to an additional claim: The ontogeny of language is guided by innate psychological processes that *are* dedicated solely to language. These domain-specific mechanisms explain how children begin speaking despite the apparent lack of information in the social environment required to learn the specific languages they learn—the "poverty of the stimulus" argument. Mechanisms dedicated to syntax production are a key (for some, *the* key) innate language-specific capacity that is required to overcome poverty of the stimulus concerns (Hauser et al., 2002). Consequently, evidence that the evolution of syntax did not require domain-specific mechanisms undermines genetic accounts of both the saltationist and selectionist variety.

And neuroarchaeology provides such evidence. As we have seen, late Acheulean toolmaking triggers activation in inferior frontal gyrus, an area already associated with language production and increasingly thought to play the role of a more general-purpose supramodal processor of hierarchically sequenced information (e.g., Fadiga et al., 2009; Koechlin & Jubault, 2006; Poldrack, 2006). Taken together, this evidence suggests that Broca's area—traditionally thought to be the "language" part of the brain—is in fact co-opted by a range of different goal-oriented tasks.

Furthermore, attempts have been made to draw a more concrete link between the hierarchical action processes involved in Acheulean toolmaking and those found in syntax (e.g., Planer & Sterelny, 2021; Stout & Chaminade, 2012). This adds extra detail to the tool–language co-evolutionary picture. The idea here is that the sophisticated action hierarchies evidenced by the late Acheulean indicate that its makers had the cognitive mechanisms required to produce sophisticated action hierarchies. If we then think of speech production in terms of sophisticated action hierarchies—that is, if we think in terms of linguistic pragmatics—then we have the building blocks of an account of syntax. This is an account that relies only on domain-general mechanisms, namely, those co-opted by any complex hierarchical action sequence.

This removes an important cornerstone of genetic accounts of language evolution insofar as we have a way of explaining syntax without appealing to language-specific processes. And this is good news for the cognitive gadgets account.

Cultural Evolution Versus Gene–Culture Coevolution

I have so far talked in terms of language behaviors co-opting toolmaking behaviors. However, a properly *co*evolutionary account of toolmaking and language acknowledges that the causal arrows go both ways. That is, making tools may have produced the cognitive mechanisms required for the emergence of language, but the emergence and spread of language also enhanced the cognitive mechanisms required to make tools. Moreover, as populations of hominins adapted to an increasingly language-rich cultural environment, increasingly language-specific and genetically transmitted cognitive mechanisms may have evolved.

There is a family of views that emphasize this scenario. Proponents of these views might agree with all that has been said so far, yet will nonetheless reject the cognitive gadgets account of language. I want to finish by distinguishing these two positions.

Recently, Planer and Sterelny (2021) have developed a selectionist view of the kind just described. Importantly, they maintain that the hierarchical cognitive capacities required to make use of rudimentary syntax long pre-date the appearance of modern humans. They argue that those capacities were likely present, in rudimentary forms, in the last common ancestor with the chimpanzee. Consequently, they reject the claim that explaining the early evolutionary stages of language requires positing the emergence of syntax-specific capacities. But this does not rule out, of course, the scenario in which genetically endowed language-specific capacities evolve in response to the new cultural niche, namely, language. So Planer and Sterelny can agree with Heyes can agree on the early stages of the story, but will disagree with her on the later stages; they can agree on the phylogeny but will disagree on the ontogeny. Each will emphasize the importance of culture and the need for only domain-general mechanisms in the early evolution of language, yet will diverge on whether we find genetically inherited, language-specific mechanisms in the development of language in modern-day human children.

How do we decide between these two accounts? The question here is a broader one that faces the cognitive gadgets theory. If a cognitive gadget is successful, and if it aids the reproductive fitness of its bearer, then why wouldn't cognitive gadgets be genetically assimilated (Henrich, 2015)? Cognitive gadgets are dependent on experience for development, but if selection were to favor mutations that reduce that dependence, then presumably those gadgets would become instincts. Heyes finds little evidence for genetic assimilation and suggests this may be because the regularities in cultural environments that cognitive gadgets track move too fast for gadgets to be assimilated (Heyes, 2018, pp. 207–210; see also Heyes, Chater, et al., 2020). The idea here is that gadgets have to be "nimble," such that they can adjust to shifting social conventions and technological complexes. Given this, the environment that gadgets need to track is never stable enough for them be assimilated.

Picking between cultural evolutionary and gene–culture coevolutionary accounts of language will require answering complicated questions regarding how nimble the language instinct is and assessing whether conventions in linguistic environments are in fact as variable as Heyes suggests (see Brown, 2021 for a general critique of the claim that gadgets are nimble). This will be an important focus of future research.

In sum, work in experimental neuroarchaeology provides a plausible line of evidence to the phylogenetic development of language. For the most part, the implications of this evidence align well with the commitments of the cognitive gadgets account of language. Specifically, neural overlap between toolmaking and language supports both a commitment to the importance of the cultural environment in producing the cognitive prerequisites for language and a commitment to the idea that the early evolution of language was the product of domain-general processes. Choosing between cultural evolution accounts and gene–culture coevolution accounts is trickier and hinges on Heyes' claim that cultural environments are too unstable for cognitive gadgets to be genetically assimilated. More work is needed to assess whether this claim holds up.

Closing Remarks

I have surveyed some general considerations regarding how to interpret the record using the cognitive gadgets theory and conversely how the record might be used to provide evidential support for cognitive gadgets. This follows Heyes' prescription that good human evolutionary theory should use forces to explain chronology and chronology as evidence of forces. I want to finish by proposing a line of thought in the latter vein, but on a much broader scale.

The record potentially provides testable evidence for the cognitive gadgets hypothesis in the following way: In the traditional view, we have mechanisms produced by slow, stable processes (biological evolution) generating artifacts via fast, unstable processes (cultural evolution). In the cognitive gadgets view, we have mechanisms produced by fast, unstable processes (cultural evolution) generating artifacts via fast, unstable processes (cultural evolution). Should we expect the record to look different according to these two hypotheses? If so, then broad patterns in the archaeological record itself might help decide between the two alternatives.

Here is one line of thought. The slow, stable processes of biological evolution would produce slow, stable patterns in the record. On the other hand, the faster, more unstable processes that underpin the cognitive gadgets view would produce faster, more erratic patterns in the record. So, we potentially have testable predictions between the two hypotheses. Now, as we have seen, there is active debate concerning what patterns there are in the record, regardless of these predictions. Assessing cultural evolutionary psychology in this way is thus no simple task. However, as a preliminary step it would be interesting to see what modeling the two alternatives predicts of the record.

My overall goal in this chapter has been to progress the conversation between cognitive archaeology and cultural evolutionary psychology. The cognitive gadgets hypothesis is poised to become a key player in debates about human evolution; it is thus important that cognitive archaeologists engage with the framework. I hope to have shown that, although there are methodological hurdles to be negotiated, there is a bright future for collaborations between the two disciplines.

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Notes

1. I use very broad brushstrokes here. There are in fact important differences between representational theories of mind and computational theories of mind.
2. I will not attempt to defend the cognitive gadgets hypothesis in any detail here—I take the position to be prima facie plausible, and proceed from there. But this is not to say that the view does not face very serious challenges. Some of the most pressing of these, to my mind, are outlined in Roige and Carruthers (2019), Turner and Walmsley (2020), and Brown (2021).
3. More recently, Heyes has expanded this list to include metacognition (Heyes, Bang, et al., 2020) and moral thinking (Heyes, 2021).
4. Imitation is something of an exception here, as the gadgets account of imitation leans quite heavily on Heyes' associationist framework.
5. Moreover, there are aspects of the cognitive gadgets framework that make it uniquely interesting from a cognitive archaeological perspective. One of these is that Heyes offers a specific account of how new mechanisms (gadgets) are built from older, and more phylogenetically diverse, mechanisms (the genetic starter kit). Rival coevolutionary accounts are often less specific regarding these mechanisms (though see Planer & Sterelny, 2021). As such, Heyes' framework offers cognitive archaeology important resources for understanding the transition from predominantly biological cognition to more culturally scaffolded cognition. This also is an important avenue for further research.
6. For reasons of space, I use broad brushstrokes here. However, it is worth noting that the term "language" means different things to different people in this debate. For Chomsky, language meant the ability to combine meaningful units into hierarchically ordered strings of meaningful units (i.e., words into sentences), and the primary function of this ability is the organization of thought, not communication. Others (including Heyes) use language in the more standard sense.

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