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INTRODUCTION

COGNITIVE ARCHAEOLOGY AT THE CROSSROADS

Karenleigh A. Overmann and Frederick L. Coolidge

Sometime in the fall of 1974, a graduate student named Thomas Wynn walked across the campus of the University of Illinois at Champaign-Urbana, deep in thought as he mulled over potential projects for his doctoral research in Early Stone Age/Lower Paleolithic archaeology. Suddenly, the research possibility that popped into his mind quite literally stopped him in his tracks, mid-quad. Months earlier, in the spring semester, his doctoral supervisor, anthropologist Charles Keller, had given him the name of psychologist Jean Piaget and tasked him with assessing whether Piaget's ideas about cognitive development in children were of any use to an archaeologist. At the time, Wynn had concluded that there was no way to apply psychological theory to the archaeological record. But now, he was powerfully struck by the thought that Piaget's ideas on the ontogenetic development of cognitive abilities might explain how human cognition had evolved, as discerned through change in the forms of stone tools.

The idea that human cognitive evolution could be understood from stone tools—the only things that remain over the millions of years separating us from our earliest tool-using ancestors, apart from a few bones, either theirs or ones they modified—was perhaps something of a *Zeitgeist* in the 1970s, a reaction to the rigid materialism that characterized the “processual archaeology” advocated by the “new archaeologists” a decade earlier. Certainly, floating around the University of Illinois campus were ideas by Lewis Binford (1962, 1972; Binford & Binford, 1968) and pro-structuralist concepts of culture and science from Claude Lévi-Strauss (1962) and Edmund Leach (1973). In fact, similar ideas were emerging on both sides of the Atlantic, not only in the work of Wynn but also that of his contemporaries, scholars like archaeologists Glynn Isaac, Colin Renfrew, John Gowlett, and Iain Davidson, psychologist William Noble, evolutionary primatologist William McGrew, biological anthropologist Sue Taylor Parker, and evolutionary neurobiologist Kathleen Gibson.

The central challenge then, as it remains today, for an archaeology interested in cognition was this: How might every last bit of data be squeezed from the archaeological record and used to understand evolutionary change in human cognition, with the daunting goal of resolving the ages-old mystery, how did we become human? The inquiry is particularly challenging, not merely because of the vagaries that perplex any archaeological interpretation, but because those interpretations necessarily involve theoretical frameworks, definitions, assumptions, methods, and models that come from outside archaeology. Cognitive abilities had to be understood in

psychological terms in order to operationalize them as behaviors whose traces might be archaeologically detectible. As a result, cognitive archaeology was no relatively straightforward matter of discovery and description, but an interdisciplinary endeavor that increasingly needed to know and apply things about how psychological constructs might be operationalized so that they could be detected as change in material forms. Included in this endeavor was examination of the ways in which neuroanatomy and neurofunctionality change over ontogenetic and evolutionary spans of time and how this relates to material change, and philosophical speculations about the nature of cognition, concepts, and symbols and the possible role of materiality in such phenomena.

Cognitive archaeology might be called the not-so-simple art of squeezing minds from stones—not coincidentally the title we have chosen for this volume. To introduce it, we first look briefly at the work of some of the pioneers of cognitive archaeology, and use it to demonstrate how, some four decades later, many of the same concerns and challenges still remain, though new theoretical frameworks and methodological techniques have been adopted to address them. Then we outline the book's contributions, which we have divided into four parts: general cognitive evolution, stone tools and the mind, social cognition, and more recent cognition (things like numbers, weapons, and trapping). Our contributors include many of the scholars who helped establish cognitive archaeology as a research inquiry, as well as some emerging scholars. This range reflects change in the discipline itself, which is still pondering unresolved questions like language origins, incorporating approaches such as neuroimaging, and broadening demographics such as gender (more women) and specialty (primate archaeology and modern art). We conclude the volume with the thoughts of one of the pioneers, Thomas Wynn, on the future of cognitive archaeology.

THE BEGINNINGS OF COGNITIVE ARCHAEOLOGY: A REACTION TO PROCESSUALISM

Processual archaeology demanded that interpretation be guided by theory, something that remains a continuing mandate. Yet it also provided something to react against, its insistence that the past be interpreted strictly according to the material evidence. As Leach (1973) expressed it, archaeology was ill-equipped to study ancient *peoples*: “. . . all the ingenuity in the world will not replace the evidence that is lost and gone for ever,” and “. . . you should recognize your guesses for what they are” (p. 768). Nonetheless, processualism had also opened up the possibility that the archaeological record could be informative not just about the artifacts themselves, the discover-and-describe mandate of earlier schools of archaeological thought, but also regarding the lifestyles of those who made and used them. As Renfrew (1982) would later note, “inferring intelligent behavior from its material relics” was something only archaeology could do (p. 4). Admittedly, these were matters requiring new approaches and theoretical frameworks, longer chains of inference, and, occasionally, bigger leaps of faith than might fit comfortably with the injunction for a no-nonsense scientism. Binford (2001), for example, had introduced the idea that the archaeological record could be understood by gaining insights from contemporary hunter-gatherer societies. Such ethnic explanations would quickly be criticized (if not rejected outright) because

modern traditional societies are hardly prehistoric—as Smith (1955) expressed it, such comparisons demonstrated only “what an incredible variety of codes of behaviour in fact actuate human conduct” (p. 5)—and therefore do not provide valid comparisons to societies that were, either in form or dignity. One of Binford’s contemporaries, anthropologist Ralph Holloway (1969), was grappling with the similarly difficult and still unresolved question of between-species comparability: How special is humanity in comparison to non-human species? How might concepts like culture and cultural transmission be defined? And should such definitions be broad enough to show continuities between humans and non-human species or so narrowly construed that discontinuities emphasized human uniqueness?

In responding to the whiff of revolution in the air while expanding on some of these processual ideas, Thomas Wynn focused his doctoral research on change in lithic technologies—the Oldowan, Acheulean, and Levallois industries—over a span of about two million years, published as “The Intelligence of Later Acheulean Hominids” in *Man* (1979), and later as *The Evolution of Spatial Competence* (1989). Wynn used Piagetian developmental theory as his framework for explaining how changes in material form revealed evolutionary change in hominin spatial cognition and intelligence. The evidentiary, theoretical, and investigative scopes were narrowly drawn: They included lithic change, Piaget’s developmental framework, human capacities for spatiality and intelligence, and little else. Essentially, increasing complexity in material form was an index for the emergence of new and increasingly complex psychological capabilities, a spectrum of evolutionary change that originated in continuity (an endpoint that was decidedly ape-like) and reached discontinuity (an endpoint anchored in the unique cognitive complexity of modern humans). Wynn would later team up with evolutionary primatologist William McGrew (Wynn & McGrew, 1989) to explore further the idea that human discontinuity had originated in an ape-like continuity. They compared the Oldowan industry to tool use by modern apes (especially chimpanzees), arguing that the capabilities required for the former fell within the range demonstrated by the latter, with the possible exceptions of carrying objects for longer distances and competing for food with large carnivores. Here they addressed the *minimum necessary competence*, the idea that as tools reflect only the lower boundary of the capabilities required for their production and use, they are likely to underestimate either the actual or potential cognitive abilities of their makers. This concept would become a mantra for Wynn, one he has passed on to his collaborators and students: Make no more assumptions than necessary for explaining a phenomenon.

Also working in North America but independently from Wynn, Sue Taylor Parker and Kathleen Gibson (1979) were attacking the problem from a slightly different angle. Rather than operationalizing a cognitive ability like spatial cognition and then looking for its traces in material change, they examined the origins of intelligence and language through ontogenetic development in cognition and evolutionary change in brain size. While thoroughly Piagetian in their orientation toward ontogenetic development, they nonetheless held the phylogenetic part of Piaget’s theory at arm’s length, calling his evolutionary model “Lamarckian and vitalistic” (p. 400). Their attempted compromise was comparing and finding parallels between four stages in the evolution of intellectual abilities for human children (Piaget’s ontogenetic theory) and various primate groups—prosimians, Old World monkeys, great apes, and hominids—species whose differentiation was apparently based on non-Piagetian evolutionary

criteria.¹ Positing tool use as the *sine non qua* of hominid intelligence, they included a panoramic number of contributing factors in their model of how tool use developed, including cooperation, shared attention, diet, hunting, sociality and social structures, food sharing and transportation, shelter construction and use, climate, and available environmental resources. Individuals able to acquire more resources through cognitive advantages in domains such as planning were thought to have been favored by both natural and social selection: more likely to survive, acquire mates, and perpetuate their advantageous behavioral skills and cognitive traits through cultural and genetic mechanisms.

At about the same time but halfway across the globe in East Africa, Glynn Isaac (1976) was analyzing material complexity in the archaeological record and deriving conclusions about human evolution. He identified early tools and some dependence on their use for subsistence as falling outside the range of modern apes. Like Wynn, he stuck close to artifacts and their properties, but where Wynn had construed cognitive change from morphological change, Isaac focused on what morphological properties might indicate about the transport of raw materials, modification and use of finished tools, and cultural differences between groups. Isaac incorporated evidence on fossils and diet, types of interdisciplinary data whose inclusion has since become fairly common in cognitive archaeology. Also unlike Wynn (at least at this period), Isaac was willing to speculate about language, a topic as controversial and undecided then as it is today. He took the economic behaviors and adaptive patterns associated with tool use (e.g., modes of subsistence that included preying on local fauna and establishing a home base from which to scavenge, things that suggested groups were cooperating to obtain and share food resources like meat) to be windows on information exchange and the emergence of language (Isaac & Isaac, 1975).

In Australia, Iain Davidson and William Noble (1989) were also taking up the challenge of language, further helping to resurrect language origins as an archaeological inquiry. Recognizing the need to find ways of detecting traces of language origins and development in the archaeological record, they hypothesized that language had originated in depictive images that had themselves originated in gesture. During the Upper Paleolithic, gestures recreating the shapes of objects like bison had yielded parietal art that represented bison, which in turn had yielded reflexivity on the meaning of bison, and such reflexivity to words for them. Basically, language required understanding an object's meaning, a mental leap from depiction to reference that assumed significant discontinuity in the way humans and non-human species construct, understand, and share social meanings. This approach differed from that being followed

¹ Whether Parker and Gibson (1979) were completely successful in rejecting Piaget's phylogenetic theory is debatable, given that their compromise ended up comparing evolutionary change in primates with Piaget's ontogenetic stages of cognitive development. The parallels the authors inferred between Piaget's *sensorimotor period* (birth to 2 years), *preoperations period* (2–7 years), *concrete operations period* (7–12 years), and *formal operations period* (12 years and thereafter) and what they called a *prosimian stage*, *Old-World monkey stage*, *great ape stage*, and *hominid stage* still equated prosimians with human infants, monkeys with human toddlers, and so on, characterizations that, while perhaps not as disparaging as similar parallels drawn to human societies by nineteenth-century theorists, remain inaccurate nonetheless.

in two related avenues of language origins research: the idea that language originated in gesture (the gestural origins hypothesis; Corballis, 1999; Gentilucci & Corballis, 2006), not as a transition to reference, as Davidson and Noble had argued, but as a communicative modality in itself, and the idea that language originated in tool use (Bradshaw & Nettleton, 1982; Higuchi, Chaminade, Imamizu, & Kawato, 2009), which recognized the neural and combinatorial similarities of language and the motor movements associated with tool behaviors. Davidson and Noble also doubted that culture could exist without language, a question that in recent decades has been answered with a resounding *yes*, since socially learned behaviors have also been demonstrated by non-human primates and cetaceans, species that presumably lack communication capabilities on par with human speech (Laland & Janik, 2006). Davidson and Noble also claimed that handaxes were the unintended results of repetitive behaviors rather than the deliberate imposition of shape enabled by increasingly complex spatial abilities, as had been argued by Wynn.

Davidson and Noble's (1989) idea that inchoate concepts were given form as material substances were manipulated and were recognized perhaps only after the formative act complemented the philosophical turn developing in Britain, where Colin Renfrew (1982) was working to create a "cognitive processualism." Renfrew disagreed that hominid cognitive evolution could be understood through Piagetian theory, the "old and dangerous principle that ontogeny follows phylogeny" (p. 14) and its converse, that phylogeny follows ontogeny. He also rejected processual elements such as the insistence that "an explanation can only be decently 'scientific' if expressed in the form of a universal law" (p. 10), while continuing the processual tradition of prioritizing objectivity and elaborating the processual idea that material forms were informative of how their makers had lived, to examine *how*—and perhaps even *what*—they had thought. In an archaeology of the mind, intelligent behavior could be recognized in the material forms found archaeologically, since material culture had an active role in constituting cultural reality. Archaeologists were being set free to interpret artifacts like stone cubes from Mohenjo-daro, a site of the Indus Valley civilization, as weights that implied both a system of conceptual mapping and the social conditions associated with it (Renfrew, 1982). Renfrew also noted that a cognitive archaeology would necessarily overlap with other disciplines—human psychology and neurophysiology, social and physical anthropology, comparative studies with other species, and even artificial intelligence, and needed coherent theory and sound analytical procedures to guide its inferences. Further, he recognized that the Cartesian distinction between mind and matter was problematic, an idea that would later inspire the even more philosophically oriented material engagement theory of cognitive archaeologist Lambros Malafouris (2013), which incorporates concepts from philosophy of mind.

Also in Britain, and sticking very close to the artifacts themselves as Wynn was doing, John Gowlett (1979, 1984) was focusing on the evolution of design form in lithic technologies. He suggested that analyzing a skill such as stone knapping (as reflected in finished artifacts) might be a fruitful way to approach cognitive evolution. Accordingly, he outlined biface manufacture as a complex process that included not only the series of strike decisions and strikes, but the selection and transport of raw material and the use of the tool as well. Gowlett agreed that handaxes showed an increase in cognitive complexity but argued, against Wynn, that it was a matter of standardization, not one of coordinating multiple visuospatial perspectives. He

proposed the end-to-end process to be so complex that it exceeded the capacity of modern non-human primates, even as early as the Oldowan (something Wynn and colleague William McGrew would argue against in 1989). Gowlett further suggested that handaxes and cleavers reflected concepts in the minds of their makers, some kind of mental template that guided the imposition of form, which was at odds with the idea of concepts becoming tangible and appreciable in new ways through material engagement (Malafouris, 2010b, 2013). Gowlett also noted that human cognition was likely not understood well enough in ways that would enable characterization of the continuities and discontinuities with other species, particularly the hominid adaptation to the intergenerational accumulation and transmission of experience (in other words, culture).

In this volume, the 22 chapters from our contributors develop many of the same themes raised in the formative decade of cognitive archaeology: the validity and use of ethnoarchaeological and experimental methods; the question of continuities and discontinuities between humans and non-human species; the selection and application of theoretical frameworks, including the displacement of Piagetian theory by contemporary psychological and neuroscientific approaches to brain function and form; the incorporation of interdisciplinary data; the origin of language; the ability of construing intentionality from artifactual form; the philosophical turn in cognitive archaeology; and the riddle of intergenerational accumulation and transmission. And, of course, still with us is the desire to wring every last bit of possible data out of stone tools, as well as more recent technologies like bows and arrows or traps and snares.

FORTY YEARS AFTER: CONTEMPORARY COGNITIVE ARCHAEOLOGY

Despite the rejection of Binford's hunter-gatherer comparisons, today ethnoarchaeological and experimental approaches remain vibrant modes of understanding traditional and ancient technologies and the cognitive processes they involve, as extrapolated from the behaviors and brains of modern humans and non-human species. For example, in Chapter 18 in this volume, Sophie de Beaune uses ethnographic data from contemporary hunter-gatherers in Australia, Africa, and the Arctic. She does not equate their gendered division of labor to that construed for prehistoric peoples but, rather, uses it to demonstrate that archaeological analyses of gender are often skewed by researchers' own cultural expectations. This has since been exemplified by the surprise greeting of last year's announcement that a Viking grave, identified as that of a warrior because it contained weapons and horse bones, belonged in fact to a female and not a man, whose sex was recently identified through DNA analysis of her remains (Hedenstierna-Jonson et al., 2017). And as an example of the experimental approach, Mark Moore applies his personal wealth of flintknapping experience to the problem of construing intent in lithic remains: What does a modified stone tell us—if anything—about what its ancient maker intended when he or she knocked rocks together to produce flakes and perhaps refine them? How much of a goal is involved in making an artifact like a handaxe: Does it require a mental template that guides production by visualizing the end product, or is it simply the unintended consequence of exhausting a core, much as Davidson and Noble argued in the 1980s? And what light, if any, can experiments performed by modern stone-knappers shed on ancient intent

to realize artifactual form? Shelby Putt's contribution on language (discussed later) also falls into the experimental category.

Holloway's concern with between-species comparability foreshadowed what is now a substantial interest in comparative analyses, particularly with non-human primates and especially in regard to their tool use and the transmission and reproduction of learned behaviors. William McGrew, Tiago Falótico, Michael Gumert, and Eduardo Ottoni extend this line of inquiry by reviewing a wide range of studies in primate archaeology, now a distinct subdiscipline of archaeology (Haslam et al., 2009, 2017). Unlike experiments with captive apes (e.g., Kanzi; Savage-Rumbaugh, Toth, & Schick, 2007), primate archaeology focuses on tool use in natural situations, conditions more directly comparable to those of early hominids. These authors compare the tools produced by apes and Old and New World monkeys to early lithic technologies like the Oldowan industry, further updating work by Wynn and McGrew (Wynn, Hernandez-Aguilar, Marchant, & McGrew, 2011; Wynn & McGrew, 1989). One key difference in tool-use behaviors is the degree to which tools are reused. Non-human primates often make new tools whenever one is needed (e.g., chimpanzee termite-fishing probes), and when they reuse tools like anvils for cracking open foods like shellfish and nuts, they do so one at a time. These behaviors have several effects. First, tools are not used by more than one individual at a time, limiting potential opportunities for engaging cognitive processes like joint attention, something Rex Welshon explores in his chapter. Second, the tools do not accumulate modifications, either because they are created to fulfill a need and discarded once they have been used to satisfy it or because, like an anvil, their form does not become refined and hence does not act to accumulate social knowledge. The question of what it takes to accumulate and transmit culture between generations is addressed by Stephen Lycett and Miriam Noël Haidle in their respective chapters.

For its part, Piagetian theory has fallen out of fashion, particularly in the phylogenetic aspects presciently rejected by Parker and Gibson. If Piagetian phylogenesis was "Lamarckian and vitalistic" (Parker & Gibson, 1979, p. 400), his ontogenetic theory applied to archaic, traditional, and industrialized societies had the effect of dividing them into adults and children (Piaget, 1928), characterizations as unpalatable as they are inaccurate. More current theoretical frameworks on psychological capabilities have been adopted in cognitive archaeology. An example is the working memory model of Baddeley and Hitch (1974), brought to his decades-long collaboration with Thomas Wynn by Frederick Coolidge and recapped in his contribution to this volume. Consistent with the turn toward contemporary psychological theory, Thomas Wynn and Tony Berlant explore the neuroaesthetics of art, something that can be seen developing in the increasing incorporation of symmetric forms in lithic technologies. The chapter by Wynn and Berlant recounts "the great handaxe junket," their five-year mission to seek the world's most compelling handaxes, as judged by their respective archaeological and artistic sensibilities; the exhibit opened in January 2018 at the Nasher Sculpture Center in Dallas (Farago, 2018). Derek Hodgson examines developments in spatial cognition, as discerned from change in the form of stone tools, using insights from the neuroscience of visuospatial memory, visuomotor control, attention, and planning. James Cole offers a similar examination of change in lithic form, arguing that it illuminates developments in the construct known as theory of mind, the ability to know that others have minds whose content can differ from one's own.

Modeling the mind and its evolutionary development continue to pose a challenge, especially as interdisciplinary data are brought to bear on the question. Philip Barnard looks at behaviors like tool use and their effects on mental and neural systems, differentiated in humans and non-human primates by developments in abilities like propositional meaning that underlie mental states, perception, and bodily control. He reviews the interacting cognitive subsystems (ICS) model, which enables mental capabilities to be analyzed and compared across extant species and the evolutionary development of human cognition. Dietrich Stout focuses on the continued incorporation of theory and methods capable of analyzing how organisms interact with their environments over time: Darwinian and neo-Darwinian evolutionary theory, Dunbar's social brain hypothesis, technical intelligence hypothesis, niche construction theory, phenotypic accommodation, and gene-culture co-evolution. With a more personal retrospective, Iain Davidson looks back at how cognitive archaeologists approached stone tools during the formative decade, finding pre-processual influences from as early as the nineteenth century. He uses *chaîne opératoire* analysis, comparisons with non-human primate tool use, and Barnard's cognitive subsystem model to argue for newer, more productive methods. One such method is the Budapest model of evolving cognitive systems (ECS), which seeks to understand ancestral cognitive states through comparative studies; the goal is to avoid modeling ancestral cognition as incomplete or deficient (e.g., as lacking language, which modern cognition includes), much as extant species are assumed competent (though alinguistic).

Language origins remains a topic of significant interest. Shelby Putt applies another experimental approach, the use of neuroimaging to see what parts of the brain are activate when someone flintknaps. Her focus is not how much intent is needed to realize form but rather to understand whether and to what extent the motor movements involved in flintknapping might overlap that of language. She notes Wynn's (1991) reminder that attempts to find the origins of language in tool behaviors must be justified theoretically and, to the extent practicable, empirically if they are to be plausible and persuasive. Putt notes that in modern knappers, instruction by means of language rather than silent imitation affects which parts of the brain become active in replicating early stone tools. The idea is that specific overlaps between the neural activation patterns for language and stone knapping is taken as supporting the hypothesis of common origin. In comparison, Cory Stade and Clive Gamble approach the question of language origins through theory of mind. Their hypothesis is that somewhere during the long prehistory of stone tool production, silent imitation alone became insufficient for reproducing artifacts with the complexity of the prepared core techniques; language instruction would have been needed for its transmission. These authors analyze the tool as a "third partner" that enables joint attention and shared understanding on the part of both teacher and student, a critical development in cognition (see Rex Welshon's chapter) and cumulative culture (see the chapters by Stephen Lycett and Miriam Noël Haidle).

The philosophical turn is represented here by several scholars. Karenleigh Overmann analyzes prehistoric numerical cognition. After reviewing the evolution of contributing abilities like quantity perception, she examines the archaeological record of Mesopotamia for the first unambiguous numbers, the role of material forms for counting in them, and what change in such material forms might suggest about possible archaeological signs and timelines for even earlier periods. This discussion

is underpinned by material engagement theory (MET), the theoretical framework of cognitive archaeologist Lambros Malafouris (2010a, 2013; Malafouris & Renfrew, 2010). MET views the mind as not just *embodied* and *embedded* (cognition is affected by being in a body and situated in an environment) but also *extended* (material forms are not just causally linked to cognition but a constitutive component of it), *enacted* (cognition is the interaction of brains, bodies, and behaviors), and *evolving* (humans have by no means reached a terminal cognitive state). Overmann takes Malafouris' idea that "tools make minds" to suggest that change in material forms indexes change in behaviors and psychological processes. Marlize Lombard similarly looks at how tools co-create and transform behaviors, bodies, and brains. Mark Moore emphasizes the embodied and enactive aspects of stone knapping: The "decision about where to place the next blow, and how much force to use, is not taken by the knapper in isolation; it is not even processed internally. The flaking intention is constituted, at least partially, by the stone itself . . . [which], like the knapper's body, is an integral and complementary part of the intention to knap" (Malafouris, 2010b, p. 17). And Rex Welshon brings analytic philosophy to bear on key attributes of joint attention, such as its reflexivity, symmetry, and transitivity.

While all the contributions in this volume use the archaeological record to illuminate the ancient mind, some adhere more closely to stone tools, the material form with the greatest longevity and hence the best potential for illuminating the deepest prehistory of human cognitive evolution. In this vein is the contribution by Adam Brumm, Matt Pope, Mathieu Leroyer, and Kate Emery. These authors analyze scavenging and reuse in Lower Paleolithic stone tools, as demonstrated through their analysis of weathering and patina effects. Natalie Uomini and Lana Ruck compare and contrast three hypotheses on why the human species is so strongly right-handed—matters of social learning, fighting, or task complexity that might intensify right-handedness or maintain a minority of left-handers. These authors then speculate on how the various hypotheses might be examined and substantiated through archaeological analyses. Gonen Sharon examines the independent development of giant core techniques by distinct Acheulean populations separated by most of the African continent. He proposes their similarities as an instance of convergent evolution, with different groups converging on similar solutions to questions of technology and design in response to identical social needs and purposes. Ceri Shipton looks at what stone tools reveal about over-imitation, the tendency to recreate actions when knapping stone, whether those actions are causally efficacious or not. He then analyzes this evidence for what it can tell us about social transmission and the necessity for some of the instruction to take the form of language.

Finally, what complex technologies can reveal about cognitive change concerns the last two chapters of the volume. In her contribution, Marlize Lombard focuses on compound technologies like the bow and arrow as an index for change in cognitive plasticity, which she defines as human abilities for teaching and learning from one another, innovating both behaviorally and technologically, and responding flexibly and creatively when novel or complex situations are encountered. Lyn Wadley offers a similar analysis of snares and traps, which require and therefore imply cognitive abilities like planning and inhibition (i.e., delayed gratification). This illuminates the need for inferential argumentation posed by the lack of direct archaeological evidence. Traps and snares are not archaeologically attested, presumably because they were

made of perishable materials. Rather, they are suggested by demographic differences in faunal remains (e.g., more bones than expected from species difficult to hunt because of size, speed, and habits). Such indirect evidence requires the use of so-called bridging arguments, statements that link archaeological findings to the conditions producing them, especially as understood through ethnoarchaeological comparisons and experimental data.

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