

STONE TOOLS IN HUMAN EVOLUTION: BEHAVIORAL DIFFERENCES  
AMONG TECHNOLOGICAL PRIMATES

In *Stone Tools in Human Evolution* John Shea argues that over the past three million years hominins' technological strategies shifted from occasional tool use, much like that seen among living non-human primates, to a uniquely human pattern of obligatory tool use. Examining how the lithic archaeological record changed over the course of human evolution, he compares tool use by living humans and non-human primates, and predicts how the archaeological stone tool evidence should have changed as distinctively human behaviors evolved. Those behaviors include using cutting tools, logistical mobility (carrying things), language and symbolic artifacts, geographic dispersal and diaspora, and residential sedentism (living in the same place for prolonged periods). Shea then tests those predictions by analyzing the archaeological lithic record from 6500 years ago to 3.5 million years ago.

John J. Shea is Professor of Anthropology at Stony Brook University. He is the author of *Stone Tools in the Paleolithic and Neolithic Near East: A Guide* (2013), and co-editor of *Out of Africa 1: The First Hominin Colonization of Eurasia* (2010). Shea is also an expert flintknapper whose demonstrations of stone tool production and other “ancestral technology” skills appear in numerous television documentaries and in the United States National Museum of Natural History in Washington, D.C., as well as in the American Museum of Natural History in New York City.

STONE TOOLS IN HUMAN  
EVOLUTION

Behavioral Differences among Technological Primates

JOHN J. SHEA

*Anthropology Department  
Stony Brook University*

Cambridge University Press & Assessment  
978-1-107-12309-0 — Stone Tools in Human Evolution  
Behavioral Differences among Technological Primates  
John J. Shea  
Frontmatter  
[More Information](#)



Shaftesbury Road, Cambridge CB2 8EA, United Kingdom  
One Liberty Plaza, 20th Floor, New York, NY 10006, USA  
477 Williamstown Road, Port Melbourne, VIC 3207, Australia  
314-321, 3rd Floor, Plot 3, Splendor Forum, Jasola District Centre, New Delhi – 110025, India  
103 Penang Road, #05-06/07, Visioncrest Commercial, Singapore 238467

Cambridge University Press is part of Cambridge University Press & Assessment,  
a department of the University of Cambridge.

We share the University's mission to contribute to society through the pursuit of  
education, learning and research at the highest international levels of excellence.

[www.cambridge.org](http://www.cambridge.org)

Information on this title: [www.cambridge.org/9781107123090](http://www.cambridge.org/9781107123090)

© John Shea 2017

This publication is in copyright. Subject to statutory exception and to the provisions  
of relevant collective licensing agreements, no reproduction of any part may take  
place without the written permission of Cambridge University Press & Assessment.

First published 2017

*A catalogue record for this publication is available from the British Library*

*Library of Congress Cataloging-in-Publication data*

Shea, John J. (John Joseph) author.

Stone tools in human evolution : behavioral differences among technological primates / John J. Shea,  
Anthropology Department, Stony Brook University.

Cambridge, United Kingdom : Cambridge University Press is part of the University of Cambridge,  
[2017] | Includes bibliographical references and index.

LCCN 2016028973 | ISBN 9781107123090 | ISBN 9781107554931 (paperback)

LCSH: Tools, Prehistoric. | Stone implements. | Human evolution. | Social evolution.

LCC GN799.T6 S54 2017 | DDC 930.1/2—dc23

LC record available at <https://lcn.loc.gov/2016028973>

ISBN 978-1-107-12309-0 Hardback

ISBN 978-1-107-55493-1 Paperback

Cambridge University Press & Assessment has no responsibility for the persistence  
or accuracy of URLs for external or third-party internet websites referred to in this  
publication and does not guarantee that any content on such websites is, or will  
remain, accurate or appropriate.

Cambridge University Press & Assessment  
978-1-107-12309-0 — Stone Tools in Human Evolution  
Behavioral Differences among Technological Primates  
John J. Shea  
Frontmatter  
[More Information](#)

---

*For Pat, Bianca, and Boudicca*

## CONTENTS

|  |                |
|--|----------------|
| <i>List of Figures</i>   | <i>page</i> ix |
| <i>List of Tables</i>  | xi             |
| <i>List of Boxes</i>   | xiii           |
| <i>Preface</i>   | xv             |
| <i>Acknowledgments</i>   | xix            |
| <b>1 Introduction</b> . . . . .  | <b>I</b>       |
| Little Questions vs. Big Questions                                     | I              |
| Why Archaeologists Misunderstand Stone Tools                           | 5              |
| <b>2 How We Know What We Think We Know About Stone Tools</b> . . . . . | <b>10</b>      |
| Sources of Information about Lithic Technology                         | 10             |
| A Pre-industrial Model of Lithic Technology                            | 13             |
| Non-human Primate Stone Tool Use                                       | 17             |
| <b>3 Describing Stone Tools</b> . . . . .                              | <b>20</b>      |
| Essential Terms and Concepts   | 20             |
| Inessential Terms and Concepts   | 25             |
| A New Descriptive Framework  | 29             |
| <b>4 Stone Cutting Tools</b> . . . . .                                 | <b>39</b>      |
| Stone Tools as Artificial Teeth/Nails                                  | 39             |
| The Plio-Pleistocene Evidence  | 44             |
| Stone Cutting Tools: Predictions Evaluated                             | 52             |
| <b>5 Logistical Mobility</b> . . . . .                                 | <b>56</b>      |
| Residential vs. Logistical Mobility                                    | 56             |
| Early-Middle Pleistocene Evidence                                      | 62             |
| Logistical Mobility and Stone Tools: Predictions Evaluated             | 74             |
| <b>6 Language and Symbolic Artifacts</b> . . . . .                     | <b>84</b>      |
| Language vs. Non-human Primate Communication                           | 84             |
| The Middle-Late Pleistocene Evidence                                   | 90             |
| Language and Symbolic Artifacts: Predictions Evaluated                 | 101            |

|          |   |     |
|----------|---|-----|
| <b>7</b> | <b>Dispersal and Diaspora</b> . . . . .   | 110 |
|          | Diaspora vs. Endemism   | 110 |
|          | The Late Pleistocene and Early Holocene Evidence                                | 117 |
|          | Diaspora and Stone Tools: Predictions Evaluated                                 | 133 |
| <b>8</b> | <b>Residential Sedentism</b> . . . . .  | 146 |
|          | Sedentism vs. Mobility  | 146 |
|          | The Southern Levant in the Late Pleistocene and Early Holocene:<br>A Case Study | 153 |
|          | Residential Sedentism in the Levant: Predictions Evaluated                      | 165 |
| <b>9</b> | <b>Conclusion</b> . . . . .   | 179 |
|          | Overview  | 179 |
|          | Strategic Changes in Hominin Stone Tool Use                                     | 183 |
|          | Concluding Thoughts   | 191 |
|          | <i>Appendix Traditional Archaeological Age-stages and Industries</i>            | 194 |
|          | <i>Glossary</i>   | 198 |
|          | <i>Bibliography</i>   | 205 |
|          | <i>Index</i>  | 232 |

## FIGURES

|  |               |
|--|---------------|
| 1.1 Industrial vs. pre-industrial and non-human primate models of stone tool use.                    | <i>page</i> 6 |
| 2.1 Chimpanzee stone tool use. (Photo by Tetsuro Matsuzawa, Kyoto University, used with permission.) | 18            |
| 3.1 Basic terms for lithic artifacts and lithic artifact production.                                 | 22            |
| 3.2 Index fossils, age-stages, industries, and technocomplexes.                                      | 26            |
| 3.3 Modes A–E.   | 30            |
| 3.4 Modes F–I.   | 31            |
| 3.5 Illustration conventions used in this book.  | 36            |
| 4.1 Contrasts in male human vs. chimpanzee teeth.  | 41            |
| 4.2 Human vs. bonobo hands shown with fingers extended and gripping a stone percussor.               | 42            |
| 4.3 Locations of important Plio-Pleistocene sites.   | 45            |
| 4.4 Plio-Pleistocene hominin fossil crania.  | 48            |
| 4.5 Plio-Pleistocene stone tools.  | 51            |
| 4.6 Stone tools made by a bonobo.  | 55            |
| 5.1 Locations of Early-Middle Pleistocene sites.   | 62            |
| 5.2 Crania of Early-Middle Pleistocene <i>Homo</i> .   | 64            |
| 5.3 Early-Middle Pleistocene long core-tools.  | 69            |
| 5.4 Early-Middle Pleistocene large flake cores and long core-tools made on flakes.                   | 70            |
| 5.5 Early-Middle Pleistocene bifacial hierarchical core technology.                                  | 71            |
| 5.6 Early-Middle Pleistocene blade cores, blades, and retouched blades.                              | 73            |
| 5.7 Strategic Cache and Routed Foraging Models for Early-Middle Pleistocene site formation.          | 77            |
| 5.8 A variety of handaxes from Pleistocene contexts.   | 81            |
| 6.1 Locations of Middle-Late Pleistocene sites.  | 91            |
| 6.2 Middle-Late Pleistocene hominin crania.  | 92            |
| 6.3 Middle-Late Pleistocene retouched tools and unretouched flakes from hierarchical cores.          | 97            |
| 6.4 Elongated bifaces from Middle-Late Pleistocene contexts in Eurasia and Africa.                   | 99            |
| 6.5 Middle-Late Pleistocene hierarchical cores and flakes.   | 100           |

|      |   |     |
|------|---|-----|
| 6.6  | Middle-Late Pleistocene flakes and retouched pieces.  | 103 |
| 6.7  | Conjectural hafting arrangements for Middle-Late Pleistocene artifacts.   | 104 |
| 6.8  | Behavioral modernity vs. behavioral variability.  | 108 |
| 7.1  | Population movements: Migration and dispersal.  | 111 |
| 7.2  | Late Pleistocene/Early Holocene human dispersals.   | 118 |
| 7.3  | Locations of early Sahulian archaeological sites.   | 119 |
| 7.4  | Stone tools associated with human dispersal to Sahul.   | 120 |
| 7.5  | Geographic groups of northern Eurasian Late Pleistocene archaeological sites included in this study.  | 123 |
| 7.6  | Stone tools associated with human dispersal to northern Eurasia.  | 125 |
| 7.7  | Locations of Beringian and early American archaeological sites.   | 129 |
| 7.8  | Stone tools associated with human dispersal to the Americas.  | 130 |
| 7.9  | Pressure-flaked artifacts.  | 140 |
| 7.10 | Artifacts from Early Holocene Europe, Late Pleistocene/Early Holocene Southwest Asia, and Holocene South Africa generally accepted as microliths. | 141 |
| 7.11 | Small artifacts from Europe >17 Ka and Africa >40 Ka not generally accepted as microliths.  | 142 |
| 7.12 | Stone tools from Liang Bua and Mata Menge, Indonesia.   | 144 |
| 8.1  | Locations of Levantine Terminal Pleistocene archaeological sites.   | 154 |
| 8.2  | Locations of Levantine Early Holocene archaeological sites.   | 155 |
| 8.3  | Representative Levantine Terminal Pleistocene stone tools.  | 158 |
| 8.4  | Representative Levantine Early Holocene stone tools.  | 159 |
| 8.5  | Levantine Terminal Pleistocene/Early Holocene groundstone tools.  | 164 |
| 8.6  | Levantine Terminal Pleistocene and Early Holocene lithic projectile armatures with conjectural hafting arrangements.                              | 167 |
| 8.7  | Levantine Terminal Pleistocene/Early Holocene celts, conjectural hafting of axes, adzes, and the use of a chisel.                                 | 169 |
| 8.8  | Functional specialization among sickle inserts, perforators, and seed-grinding equipment.   | 170 |
| 8.9  | “Simple” and “overdesigned” stone points, knives, sickle inserts, celts, and vessels.   | 172 |
| 8.10 | Prehistoric examples of extreme flintknapping.  | 176 |



## TABLES

|  |                |
|--|----------------|
| 2.1 Industrial, pre-industrial, and non-human primate models of stone tool use.  | <i>page</i> 14 |
| 3.1 Lithic raw materials commonly used to make stone tools.  | 21             |
| 3.2 Modes A–I, and terms for their products.   | 32             |
| 4.1 Differences in non-human primate vs. human stone tool use.   | 43             |
| 4.2 Plio-Pleistocene hominins.   | 47             |
| 4.3 Representation of Modes A–I among chimpanzee nut-cracking sites and Plio-Pleistocene lithic assemblages.                     | 49             |
| 4.4 Occurrence of Modes A–I in recent chimpanzee vs. Plio-Pleistocene contexts.  | 52             |
| 5.1 Differences in non-human primate vs. human stone tool use related to logistical mobility.                                    | 60             |
| 5.2 Early-Middle Pleistocene hominins.   | 64             |
| 5.3 Representation of Modes A–I among Early-Middle Pleistocene lithic assemblages.   | 66             |
| 5.4 Occurrence of Modes A–I among Plio-Pleistocene and Early-Middle Pleistocene lithic assemblages.                              | 74             |
| 6.1 Differences in non-human primate vs. human stone tool use related to language and symbolic artifacts.                        | 88             |
| 6.2 Middle-Late Pleistocene hominins.  | 93             |
| 6.3 Representation of Modes A–I among Middle-Late Pleistocene lithic assemblages.  | 95             |
| 6.4 Occurrence of Modes A–I among Early-Middle Pleistocene and Middle-Late Pleistocene lithic assemblages.                       | 101            |
| 7.1 Differences in non-human primate vs. human stone tool use related to dispersal.  | 113            |
| 7.2 Representation of Modes A–I among Late Pleistocene and Early Holocene stone tool assemblages from Sahul.                     | 121            |
| 7.3 Representation of Modes A–I among Late Pleistocene and Early Holocene stone tool assemblages from northern Eurasia.          | 126            |
| 7.4 Representation of Modes A–I among Late Pleistocene and Early Holocene stone tool assemblages from Beringia and the Americas. | 131            |

|     |  |     |
|-----|--|-----|
| 7.5 | Occurrence of Modes A–I among Middle-Late Pleistocene and Early Holocene lithic assemblages and lithic assemblages associated with human dispersal to Sahul, northern Eurasia, and the Americas. | 134 |
| 8.1 | Differences among stone tools used by residentially mobile and sedentary humans.   | 149 |
| 8.2 | Representation of Modes A–I in Levantine Terminal Pleistocene and Early Holocene assemblages.  | 160 |
| 8.3 | Occurrence of Modes A–I among Levantine Terminal Pleistocene and Early Holocene lithic assemblages.  | 165 |
| 8.4 | Numbers of Levantine Terminal Pleistocene and Early Holocene assemblages in which various kinds of groundstone tools occur.  | 166 |
| 9.1 | Summary of predictions about stone tool variation.   | 180 |
| 9.2 | Characteristics of occasional, habitual, and obligatory stone tool use.  | 184 |

## BOXES

|   |  |                |
|---|--|----------------|
| 1 | Lithic Artifact Illustration.  | <i>page</i> 36 |
| 2 | Bonobo Flintknapping.  | 55             |
| 3 | Arguments about Handaxes.  | 81             |
| 4 | Behavioral Modernity and Behavioral Variability.                             | 108            |
| 5 | Pressure Flaking and Lithic Miniaturization.                                 | 139            |
| 6 | What Does <i>Homo floresiensis</i> Tell Us about Brain Size and Stone Tools? | 144            |
| 7 | Extreme Flintknapping.   | 176            |

## PREFACE

Stone tools are potentially rich sources of information about the evolution of human behavior, but archaeologists squander that potential. Countless books and papers try to convince other paleoanthropologists of stone tools' relevance to major issues in human evolution, but time and again when archaeologists read papers about stone tools at scientific meetings, their colleagues check email, peruse the meeting program, or head for the restrooms or the bar. College textbooks on human evolution barely mention the lithic (stone tool) evidence. In my own archaeology classes, I spend less and less time lecturing about stone tools each year.

This is a shame. No other line of evidence has such a wide perspective on the evolution of human behavior. Our ancestors and other hominins left stone tools everywhere they lived. Because non-human primates also use stone tools, stone tool use is a logical focal point for comparisons of human vs. non-human primate behavior. Behavior varies, and human behavior varies more than that of any other animal. Stone tools outnumber hominin fossils by multiple orders of magnitude. Each fossil preserves time-averaged evidence for lifetime behavior. Each stone artifact is a snapshot of human behavior at one moment. Stone tools' durability and widespread occurrence make them almost uniquely well suited for research on the evolution of human behavioral variability.

I decided to write this book while I was attending a scientific meeting about European and Asian stone tools dating to around 30,000–40,000 years ago. Earlier archaeologists had grouped these tools together into a single “Aurignacian Industry.” My colleagues were debating whether regional differences among these tools were sufficient to justify calling them different names. For archaeologists, calling groups of stone tools by different names implies that they represent different groups of people. Archaeologists had long linked the Aurignacian Industry to *Homo sapiens*' dispersal into Europe; so, knowing whether it represented one, two, or even more distinct groups of people could shed light on how humans dispersed from Africa into Eurasia.

The meeting had been going on for hours when I realized we were wasting our time. We were treating stone tools as if they were emblems of prehistoric social identities, like the plastic name tags we were wearing. Hypotheses about those identities can only be proven wrong by interviewing extinct humans themselves. Stone tools are not people; they are residues of behavior. Their variation and their variability arise from differences in humans' and ancestral hominins' strategies for solving problems requiring sharp cutting edges, piercing tools, abrasive surfaces, and rigid percussors. Anything more than this, any claim to greater knowledge based on the stone tool evidence, requires theoretical justification. The most credible such "middle-range" theoretical justifications are hypotheses grounded in observations of contemporary human and non-human primate behavior. This approach to explaining the past, "uniformitarianism," originated in geology, but it is now a guiding principle in all historical sciences. The least credible hypotheses are those derived from the archaeological record itself. One cannot use the same evidence to test an hypothesis as that which inspired the hypothesis in the first place. All too often, however, and with the Aurignacian in particular, the archaeological record is both wellspring and proving ground for hypotheses about stone tool variation. In a word, archaeologists err by equating the patterning of the stone tool evidence with the processes that created it.

It would be convenient if the Aurignacian and other named stone tool industries corresponded to social and cultural differences among prehistoric humans; but there is no reason to assume they do and compelling reasons to think they do not. The word "Aurignacian" first appears in the archaeological literature more than a century ago. Archaeologists applied this term and others like it to stone tools excavated from caves, rockshelters, and other sites throughout western Eurasia. In deciding how to organize these artifacts into higher-order groupings, such as artifact-types and industries, early archaeologists relied on their intuition. This intuitive approach created many problems, if only because intuition varies. Comparisons of stone tools from the same levels of sites collected decades apart routinely reveal variation due to differences in earlier archaeologists' intuitive choices about which artifacts were important enough to keep. Worse still, efforts to investigate older collections with newly developed analytical methods often fail to take such "selective curation" into account. Debates about the nature of particular artifact-types and stone tool industries, exhortations to recognize new ones, and attempts to redefine established ones, swell the archaeological literature of all continents from the oldest phases of prehistory to recent times.

In theory, these lithic "systematics" help archaeologists explain human biological and cultural evolution using concepts analogous to those used to explain historical events. In practice, they do no such thing. "Anthropogenic" narratives (hypotheses about human evolution presented as narratives) and

“prehistory” can be satisfying explanations of the facts we know at any given moment. But inductively generated explanations lack predictive power. Every new discovery comes as a surprise, a “game changer” in the argot of “press-release science.” Consequently, archaeologists constantly tinker with these narratives and their component elements in order to accommodate newly discovered evidence. Such constant tinkering makes these narratives ever more complex and less comprehensible to non-archaeologists.

Discontent with traditional archaeological approaches to stone tool analysis runs deep, but there is also a lot of complacency, even a bit of fatalism, about prospects for change. Invoking Gabriel de Mortillet, the French researcher who identified many of the stone tool industries we still recognize today, archaeologist Lawrence Straus recently despaired, “We are all prisoners of de Mortillet!” But does this make any sense? Is there any other science whose ways of organizing evidence have remained fundamentally the same for more than a century? Do physical anthropologists analyze DNA in order to redefine human races? Are cultural anthropologists still searching for primitive cultures? Archaeologists revere the past, but we misplace our reverence when we apply it to concepts developed in the infancy of prehistoric research. All prisoners want to be free.

Told that I was writing a book about stone tools’ role in human evolution, a colleague remarked, “If anyone can write that book, you can; after all, you’re a flintknapper.” I was flattered. I do make and use stone tools and practice other ancestral skills. But, the questions this book asks and the hypotheses it proposes do not arise from my making and using stone tools. I wrote this book as a paleoanthropologist who uses archaeological methods to answer evolutionary questions. Stone tools, properly studied, have tremendous potential to change our views about human evolution. Traditional archaeological approaches to the lithic evidence prevent us from realizing that potential.

Archaeologists need to see alternative paths for connecting the stone tool evidence to major issues in human evolution. Physical anthropologists and geneticists need to see these other paths too. Many of them think narrative prehistory is all stone tool analysis has to offer human origins research. *Stone Tools in Human Evolution* explores a new path. It uses a comparative analytical approach to assess how the evolution of behavioral differences between humans and non-human primates influenced the stone tool evidence at various inflection points over the last 3.5 million years. *Stone Tools in Human Evolution* develops an hypothesis about how hominin strategies for making and using stone tools changed from an ancestral pattern of occasional stone tool use, one much like that seen among living non-human primates, to a situationally variable mixture of occasional, habitual, and obligatory stone tool use, a condition in which all humans lived until recently.

Students, physical anthropologists, and archaeologists will each get something different from this book. *Stone Tools in Human Evolution* will help students

identify and understand the “big questions,” the questions all of us involved in human origins research care about. Physical anthropologists will find in it a possible path to “consilience,” that rare occasion when research in separate fields leads to new integrative syntheses that are more than the sum of their parts. How better to test hypotheses about the origins of behavioral differences between humans and non-human primates originating from analyses of genes, fossils, and behavior than with a virtually indestructible archaeological lithic record? Archaeologists will be surprised that *Stone Tools in Human Evolution* does not use age-stages or named stone tool industries, and uses only a handful of named lithic artifact-types. I do this to make an important point. These terms and concepts are so deeply embedded in archaeological method and theory that the impossibility of reforming them is itself a major barrier to more anthropologically engaged stone tool analysis. *Stone Tools in Human Evolution* shows not only that we do not need these things, but also that paleoanthropology is better off without them.

## ACKNOWLEDGMENTS

This book profited from discussions with many colleagues, including John Fleagle, Philip Lieberman, Ian Wallace, and Daniel Lieberman. For helping me fill the gaps in my knowledge about the archaeological evidence from various regions and time periods, I thank Dan Adler, Ofer Bar-Yosef, Nicholas Conard, Metin Eren, Peter Hiscock, John Hoffecker, David Meltzer, Alan Simmons, Nicola Stern, Lawrence Straus, Gil Tostevin, Katheryn Twiss, and Evan Wilson. For the photograph in Figure 2.1, I thank Tetsuro Matsuzawa of the Kyoto University Primate Research Institute. For procuring publications I needed for my research, I thank Stony Brook University's Interlibrary Loan staff, Donna Sammis, Jay Levenson, Diane Englot, and Hanne Tracey. For reading the proposal for this book, I thank Grant McCall, Gil Tostevin, and two anonymous reviewers. I thank Asya Graf and Beatrice Rehl of Cambridge University Press for their editorial guidance and Christina Sarigiannidou and Julene Knox for assistance in production. For support and encouragement during the writing, I thank Nancy Franklin and my wife, Patricia Crawford. I alone am responsible for opinions expressed and any errors.